FACTORS INFLUENCING CROP PRODUCTION IN IRRIGATION SCHEMES IN THE ARID AND SEMI ARID LANDS OF KENYA: THE CASE OF HOLA IRRIGATION SCHEME, TANA RIVER COUNTY, KENYA

BY

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DECLARATION

This research Project Report is my original work and has not been presented for any academic award in any other university.

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This Research Project Report is dedicated to my loving and caring family Ng'ethe, Mugera, Wawira, Wambui, Wangeci.

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I would like to thank God for giving me the opportunity to undertake this course and for the grace that enabled this project to come to a completion. Special thanks to Dr. Ndunge N. Kyalo, my Supervisor, for her guidance and positive criticism through the research process.

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TABLE OF CONTENTS

DECLARATION..... i

DEDICATION..... ii

ACKNOWLEDGEMENT..... iii

TABLE OF CONTENTS iv

LIST OF TABLES viii

LIST OF FIGURES ix

ABBREVIATIONS AND ACRONYMS..... x

ABSTRACT..... xi

CHAPTER ONE: **INTRODUCTION** 1

1.1 Background to the Study..... 1

1.2 Statement of the Problem..... 3

1.3 Purpose of the Study 3

1.4 Objectives of the Study..... 4

1.5 Research Questions..... 4

1.6 Significance of the Study 4

1.7 Delimitation of the Study..... 5

1.8 Limitation to the Study 5

1.9 Assumptions of the Study 6

1.10 Definition of Significant Terms 6

1.11 Organization of the Study 7

CHAPTER TWO: LITERATURE REVIEW..... 8

2.1 Introduction..... 8

2.2 Concept of Crop production in Irrigation Schemes Kenya..... 8

2.3 The Cost of Crop Production in Irrigation Schemes 11
2.4 Role of Culture in a Society 11
2.5 Availability of Labour Crop Production 13
2.6 Availability of Agricultural Support Services in Irrigation Schemes 13
2.7 Theoretical Framework 14
2.7.1 Social and Culture Theories 14
2.7.2 Theory of Demand 15
2.8 Conceptual Framework 15
2.9 Knowledge Gap 17
2.8 Summary of Literature Review 18
CHAPTER THREE: RESEARCH METHODOLOGY 19
3.1 Introduction 19
3.2 Research Design 19
3.3 Target Population 19
3.4 Sampling Design 20
3.5 Data Collection Instruments 21
3.5.1 Questionnaires 21
3.5.2 Piloting the Instrument 21
3.5.3 Validity of Research Instrument 21
3.5.4 Reliability of Research Instrument 22
3.6 Data Collection Procedure 22
3.7 Data Analysis 22
3.8 Operational Definition of Variables 23
3.9 Ethical Consideration 25
CHAPTER FOUR: DATA ANALYSIS, PRESENTATIONS, INTERPRETATIONS AND DISCUSSIONS 26

4.1 Introduction 26
4.2 Questionnaire Return Rate 26
4.3 Demographic characteristics of respondents 26
4.3.1 Gender of respondents from the study 26
4.3.2 Age of Respondents 27
4.4 Costs of crop production in Hola Irrigation Scheme 29
4.4.1 The variable costs per acre per season 29
4.5 Culture of the community living in Hola Irrigation Scheme 30
4.5.1 Main Economic activities before introduction or revival of irrigation in Hola Scheme 30
4.5.2 Current main Economic activities 31
4.5.3 Perception of irrigated agriculture in Hola Irrigation Scheme 32
4.6 Availability of labour in Hola Irrigation Scheme 32
4.6.1 Size of a household in Hola Irrigation Scheme 33
4.6.2 Composition of a household and number of labour days provided by each household member in Hola Irrigation Scheme 33
4.7 Availability of Agricultural support services in Hola Irrigation Scheme 34
4.7.1 Training on farming activities in Hola Irrigation Scheme 35
4.7.2 Access to loans for farming activities in Hola Irrigation Scheme 35
4.8 Gross margins analysis for crop production in Hola Irrigation Scheme 36
4.8.1 The number of cropping seasons in HIS for one year 36
4.8.2 The number of acres cropped per farmer per season 37
4.8.3 The crops grown per farmer per season 37
4.8.4 The number of bags harvested per acre 38
4.8.5 The cost of seed maize per 90 kg bag 38
4.8.6 Expected income from sale of produce 39

CHAPTER FIVE: SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS 40

5.1 Introduction 40

5.2 Summary of findings 40

5.3 Conclusions of the study 42

5.4 Recommendations of the study 43

5.5 Suggestions for Further Study 45

REFERENCES 46

APPENDICES 49

APPENDIX I: LETTER OF TRANSMITTAL 49

APPENDIX II: QUESTIONNAIRES 50

APPENDIX III: NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY AUTHORIZATION PERMIT LETTER 54

APPENDIX VI: RESEARCH PERMIT 55

LIST OF TABLES

Table 2.1: Summary of knowledge gaps……17

Table 3.1: Components of the target population……..……20

Table 3.2: Sampling technique and Sample size 20

Table 3.3: Operationalization table..... 24

Table 4.1: Distribution of respondents by Gender..... 27

Table 4.2: Distribution of respondents by Age..... 27

Table 4.3: Distribution of respondents by Marital Status..... 28

Table 4.4: Distribution of respondents by level of education..... 28

Table 4.5: Variable costs per acre..... 29

Table 4.6: Distribution of respondents by main economic activities..... 30

Table 4.7: Distribution of respondents by current economic activities 31

Table 4.8: Distribution of respondents by perception of irrigated agriculture 32

Table 4.9: Size of household in HIS 33

Table 4.10: Household Composition in HIS..... 33

Table 4.11: Distribution of respondent's trained areas on farming activities..... 35

Table 4.12: Distribution of institutions offering loans to respondents 36

Table 4.13: Number of cropping seasons in HIS..... 36

Table 4.14: Number of acres cropped per season..... 37

Table 4.15: Type of crops grown in HIS by farmers..... 37

Table 4.16: Average number of bags of produce harvested per acre..... 38

Table 4.17: Expected income from sale of produce 39

Table 4.18: Gross margins per acre 39

LIST OF FIGURES

Figure 1: Conceptual framework 16

ABBREVIATIONS AND ACRONYMS

Abbreviations	Description
AFC	Advanced Financing Company
ASALs	Arid and Semi-Arid Lands
FAO	Food and Agriculture Organization
GoK	Government of Kenya
HIS	Hola Irrigation Scheme
IWUA	Irrigation Water User Association
KALRO	Kenya Agricultural and Livestock Research Organization
Km	Kilometer
MoA	Ministry of Agriculture
MFI	Micro Financing Institution
NIB	National Irrigation Board
O&M	Operation and Maintenance

ABSTRACT

The Arid and Semi-Arid Lands (ASALs) of the world make up over 40% of the earth's surface and are however home to the world's poorest and most marginalized people. In Kenya, the ASALs occupy over 80% of the country areas and have the lowest development indicators and the highest incidence of poverty.

The ASALs sit on vast idle virgin lands as their potential is untapped. In the attempt to address this problem, one of the suggested solutions has been to introduce irrigated agriculture in these areas. The Kenyan Government has set aside resources into installation of irrigation infrastructure in ASALs in the effort to address food insecurity and eradicate poverty. This intervention is however not yielding bounties as anticipated. This study therefore sought to understand the factors influencing crop production in irrigation schemes in the ASALs of Kenya focusing on costs of crop production, culture of the community, availability of labour and agricultural support services. The study covered HIS in Tana River County located in an ASAL region. Descriptive and quantitative research designs were used for this study on a target population of 1040 members of Hola Irrigation Scheme (HIS). A sample of 121 members was selected. Questionnaires were used as data collection tools. Upon approval of the proposal, a research permit was acquired and consequently, the data collection process was conducted within a period two months. The findings indicated that majority of the participants ranged between the age of 40 and above and there were low education levels in the community. The average number of acres cropped per farmer per season was two (2) acres with an average of two cropping seasons. The most cropped produce was maize (seed maize) which was produced under contractual arrangements with Kenya Seed Company at a buying price Kshs. 68 per kg. The costs of inputs were high with the costs of pesticides and fertilizer being the highest. The average gross margins per acre per year were calculated to be kshs. 109,980.00.. The study on influence of the culture of the community living in Hola Irrigation Scheme established that, 98 (85%) practiced pastoralism prior to irrigated agriculture, a clear indication that the community had minimal experience as far as farming was concerned. Moreover, the farmers were not able to provide enough labour for their farms to operate the scheme successfully based on the labour requirements for the scheme. The study on the availability of agricultural support services in Hola Irrigation Scheme, established that the farmer trainings were not adequate. Further, the credit facilities were already available according to the survey conducted but were very limited. This therefore contributed to the low gross margins in Hola Irrigation Scheme. It was concluded that women in the ASALS had remained behind the scenes as far decision making was concerned but participated actively in the irrigation farming activities which had resulted in them being over-burdened, low education levels for majority of the respondents were interpreted to be a major challenge that affected the decision making in farming processes, the high costs of production reduced the farmers' gross margins, the labour within the scheme was insufficient for all the irrigation activities and the project area lacked an agriculture training facility to support the project through training. All these factors influenced crop production in irrigation schemes as the gross margins for the farmers were greatly reduced. The attitude of the community living in HIS towards farming was positive and therefore did not contribute to the low yields from their farms. The study thereafter recommended further studies to be carried out on the support to agricultural production and establishment of market linkages through value chain approach, Feasibility Studies on establishment of high value crops and integration of pastoralism into the irrigation schemes for the ASALs of Kenya.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The Arid and Semi-Arid Lands (ASALs) of the world make up over 40% of the earth's surface on which over one billion people depend for their livelihoods. ASALs are home to the world's poorest and most marginalized people. Arid and semi-arid or sub humid zones are characterized by low erratic rainfall of up to 700mm per annum, periodic droughts and different associations of vegetative cover and soils. Inter-annual rainfall varies from 50-100% in the arid zones of the world with averages of up to 350 mm. In the semi-arid zones, inter-annual rainfall varies from 20-50% with averages of up to 700 mm. Regarding livelihoods systems, in general, light pastoral use is possible in arid areas and rain fed agriculture is usually not possible. In the semi-arid areas agricultural harvests are likely to be irregular (Goodin & Northington,1985).

Majority of the population of arid and semi-arid lands depend on agriculture and pastoralism for subsistence. These zones exhibit ecological constraints which set limits to nomadic pastoralism and settled agriculture. These constraints include; Rainfall patterns that are inherently erratic, rains which fall mostly as heavy showers and are lost to run-off, a high rate of potential evapotranspiration further reducing yields, weeds growing more vigorously than cultivated crops and competing for scarce reserves of moisture, low organic matter levels, except for short periods after harvesting or manure applications and highly variable responses to fertilizer (Salih & Ahmed, 1993).

In Kenya, the ASALs occupy over 80% of the country and host about 10 million people (Blank, Mutero, & Murray-Rust, 2002). These areas however, have the lowest development indicators and the highest incidence of poverty. Over 60% of ASAL inhabitants live below the poverty line. The ASALs sit on vast idle virgin lands which present a lot of potential for endless possibilities. Instead, droughts, conflicts and household food insecurity are the most common features. Currently, ASALs cannot sustain themselves and do not contribute substantially to the national economy regardless of how much potential they hold. In the attempt to address this problem, one of the suggested solutions has been to introduce farming in these areas. Rain-fed agriculture has however failed Kenya miserably and the only hope to achieving food security lies in irrigated agriculture. Irrigation provides an attractive option for stabilizing agricultural production and by

extension Kenya's economic growth. By optimally utilizing national irrigation potential, there is a high possibility that the country can attain food self-sufficiency and security, income generation for communities in the rural areas will improve and employment and wealth creation opportunities will be expanded to the majority of Kenya's people (NIB, 2014).

ASALs offer the best sites for irrigation development in Kenya due to their vast unutilized acreage. In this regard, the Kenyan Government has set aside resources into installation of irrigation infrastructure in ASALs in the effort to address food insecurity and eradicate poverty. Nevertheless, with all the struggle and resilience, the yields being realized from the irrigated schemes are very low in regards to expected production under irrigation (Blank, Mutero, & Murray-Rust, 2001). This therefore puts in question the sustainability of the schemes and the high capital investment in developing these schemes (Ngigi S. N., 2001). The irrigation Schemes in ASALs have realized low yields over the years and do not contribute substantially to the national economy. A very important point to note here is that an equal investment in non-ASALs has better returns (NIB, 2014).

Sustainable production increase can be achieved by two ways in irrigated agriculture. Either new irrigation projects can be developed or existing schemes can be evaluated and their performance can be improved. Improving irrigation systems performance is more preferable than developing new irrigation areas due to the fact that investment in irrigation has failed to produce the expected result in many countries (Şener, Yüksel, & Konukcu, 2007).

This case was worth investigating because there is a strong synergetic relationship between the economies of the ASALs and those of the other parts of the country (GoK, 2013). It is impossible to achieve effective economic growth in the rest of the country if ASALs are not integrated into the national development agenda.

The study area was Hola Irrigation Scheme located on the Western bank of River Tana, about 490 Km East of Nairobi through Garissa and Bura within the Tana River District. The inhabitants of the project area were from mixed communities including the Orma, Pokomo and Somali (Luke, Hatfield, & Cunneyworth, 2005). The area was selected as the scheme is located in an ASAL region which is always prone to drought and hunger. The area is generally hot with low annual rainfalls, poor vegetation and soils which cannot support plant growth without being irrigated. The GoK has thereby installed irrigation infrastructure in the area as an intervention measure to improve the economic status of the area.

1.2 Statement of the Problem

It is agreeable that ASALs have a high irrigation potential. Some efforts through irrigated agriculture have been made to harness ASALs resources not only to sustain themselves but also to contribute to national economic development (Africa, 2014). This intervention is however not yielding bounties as anticipated (Torori & Mumma, 1995). Plenty of money is being pumped to run these irrigation systems with pitiable outputs being achieved. The investment costs for irrigation projects in Kenya range from US$50 000 to about US$300 million. The yields realized from the irrigation schemes are sometimes as low as 6 bags per acre in the case of maize (NIB, 2014).

It is of great importance that public irrigation schemes on implementation, be handed over to the respective communities for operation and maintenance purposes. This way, the communities can own the projects, run them of their own and thereby reduce over dependence on the Government. For this to happen, the irrigation scheme's yields must surpass the inputs. While other irrigation schemes in non-ASALs have proved to be very productive over the years, the opposite is true for ASALs (NIB, 2014).

There is a clear indication that something must have gone wrong along the way in the development of irrigation schemes in ASALs of Kenya. This therefore calls for the need to evaluate the genesis of the current situation with a view of identifying successes, failures, challenges, opportunities and constraints. The evaluation needs to point out what went wrong and formulate possible remedies and future strategies (Ngigi S. N., 1999).

This study therefore sought to investigate the factors influencing crop production in irrigation schemes in the ASALs of Kenya. With the findings and mitigation measures in place, irrigation schemes will be successfully used as a tool to achieve sectoral and national objectives such as food self-sufficiency, alleviation of poverty and stimulation of economic growth in the Country.

1.3 Purpose of the Study

The study intended to investigate the factors influencing crop production in irrigation schemes in the ASALs of Kenya.

1.4 Objectives of the Study

The study was guided by the following objectives:

1. To evaluate the influence of the costs of production on crop production in irrigation schemes in the ASALs of Kenya.
2. To investigate the influence of the culture of community living in ASALs of Kenya on crop production in the irrigation schemes.
3. To assess the influence of availability of labour on crop production in irrigation schemes in the ASALs of Kenya.
4. To determine the influence of availability of agricultural support services on crop production in irrigation schemes in the ASALs of Kenya.

1.5 Research Questions

The research intended to answer the following questions:

1. To what extent does the cost of production influence crop production in irrigation schemes in the ASALs of Kenya?
2. How does the culture of the community living in ASALs of Kenya influence crop production in the irrigation schemes?
3. To what extent does the availability of labour influence crop production in irrigation schemes in the ASALs of Kenya?
4. In what ways does the availability of agricultural support services influence crop production in irrigation schemes in the ASALs of Kenya?

1.6 Significance of the Study

This study sought to investigate why the pilot irrigation investments in ASALs had failed to achieve high yields. The findings and recommendations of this study were then expected to help all implementing agencies to develop sustainable irrigation schemes in ASALs of Kenya.

Furthermore, they were hoped to offer practical importance for the stakeholders of the irrigation schemes in ASALs. The communities living in these areas were to achieve food self-sufficiency and security, generate income and create employment opportunities thus improving their living standards.

The research study was also to provide a base for further research on crop production in irrigation schemes in ASALs.

The research was also aimed at documenting social and economic factors that influenced crop production in irrigation schemes in ASALs for planners and implementers so that food security in Kenya could be achieved.

1.7 Delimitation of the Study

This study covered Hola Irrigation Scheme in Tana River County. HIS was located on the Western bank of River Tana, about 490 Km East of Nairobi through Garissa and Bura within the Tana River District. The inhabitants of the project area were from mixed communities including the Orma, Pokomo and Somali (Luke, Hatfield, & Cunneyworth, 2005). The area was selected as the scheme was located in an ASAL region which was always prone to drought and hunger. The area was generally hot with low annual rainfalls, poor vegetation and soils which could not support plant growth without being irrigated. The GoK had thereby installed irrigation infrastructure in the area as an intervention measure to improve the economic status of the area.

The study focused on the influence of the culture of the community living and availability of labour within the scheme on crop production in the irrigation scheme. Analysis of all costs of production and agricultural support services analysis was done to investigate their influence on crop production in the irrigation scheme. The study was carried from April to May 2015.

Research data was collected from the stakeholders of HIS since they were the people on the ground and had key information on the factors influencing the scheme's implementation. Semi-structured questionnaires were used in the data collection for the study.

1.8 Limitation to the Study

One of the limiting factors was insecurity. The study area was an insecurity prone area as it had seasonal conflicts between livestock keepers and farmers during the dry season. To avoid being caught up in the clashes, the research was carried out during the drought free season. Security personnel were also hired during the research period.

There was a possibility of encountering uncooperative respondents who were not willing to answer the questionnaires or give reliable information concerning the study. This may have limited the accessibility of vital information for the study. To overcome this, the researcher

sought permission from NIB to access Hola irrigation scheme reports and other relevant documents to back up the gathered information.

1.9 Assumptions of the Study

It was assumed that at the period of the study, respondents were available to answer the research questions. Moreover, the study was to be completed within the scheduled time without major external influences.

1.10 Definition of Significant Terms

The significant terms in the study included:

Agriculture Support Services: These were a range of services aimed at making crop production efficient, sufficient, profitable and sustainable. These services included among others the following: Provision of training on better farming practices and credit availability.

Costs of Production: These were variable costs included in crop production such as: Land preparation (hired labour or equipment), planting material (for example seed), fertilizers, chemicals (pesticides, insecticides, and herbicides), operation and maintenance fees.

Crop Production: In the study, these were the yields realized from growing of crops through irrigation so as to stabilize food supply through optimum utilization of available land and water resources.

Culture of a Community: These were the characteristics of a particular group of people, defined by strong or weak work ethics and literacy levels.

Irrigation Scheme: This entailed irrigation and drainage infrastructure used to provide water for farming with an aim of achieving food security, improving livelihoods and economic growth in Kenya.

Irrigation Water User's Association*:* These were Irrigation farmers' institutions charged with the responsibility of acquiring land and water rights, collection of O&M fees, to ensure efficient water use and distribution, resolving conflicts and undertaking operation and maintenance.

Labour: This was the aggregate of all human physical and mental effort used for crop production through irrigation.

Operation and Maintenance fee: These were the charges payable to whoever supplied the irrigation water by the users. This money went into maintenance of the irrigation infrastructure to ensure that the system operated efficiently.

1.11 Organization of the Study

The study is organized systematically. The next chapters are as follows; In Chapter Two, the available literature on the study is reviewed so as to widen knowledge on the study area as well as establish the existing gaps that were tackled during current study. Theories that guided the study and the conceptual framework behind it are also discussed. Chapter Three covers the research design, target population, sample and sampling procedures, data collection, analysis methods and ethical considerations of the study. Chapter four looks at data analysis, presentation, interpretation and discussion. Lastly, Chapter five gives a detailed summary of study findings, conclusions and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In this chapter, some of the literature done on the study topic was looked at. The section analyzed literature on culture of the community living within the ASALs. Literature on costs of production, availability of labour and agricultural support services in ASALs was reviewed. The chapter concluded by describing the theoretical and conceptual frameworks that guided the study.

2.2 Concept of Crop production in Irrigation Schemes Kenya

The Government stressed on the importance of promoting irrigation development in the 9th National Development Plan for the period 2002-2008 (Kenya, 2002) so as to improve and stabilize food supply through optimum utilization of available land and water resources.

It identifies over-reliance on rain-fed agriculture as one of the contributors to frequent food shortages and insecurity in the country. Therefore, in order to overcome food shortage and achieve food security, the Government intends to increase funding of irrigation related development activities so as to carry out the following.

(i) Rehabilitate and extend existing large and small scale irrigation schemes,

(ii) Develop new irrigation schemes through optimum utilization of available resources,

(iii) Develop water storage facilities so as to harness excess rain water thereby reducing negative impacts related to floods.

Kenya's Vision 2030 (Kenya, 2007) emphasizes on utilization of a million hectares of currently uncultivated land, and new cultivation of up to 1.2 million hectares of newly-opened lands. It further highlights on increasing productivity of crops in Kenya through introduction of new land use policies through: better utilization of high and medium potential lands by her farmers, preparation of new land for cultivation by strategically developing more irrigable areas in arid and semi-arid lands for both crops and livestock.

A study done on Land, Agriculture in Kenya (Gachimbi, 2010), illustrates that Irrigation particularly in the high- and medium-potential agricultural areas and ASALs should be substantially scaled up by developing the largely untapped potential of the Tana and Athi river basins and the country's 253 km Lake Victoria shoreline. It further recommends that policies

geared towards efficient and effective natural resource management in the ASALs needs to be promoted as the communities are at risk of becoming trapped in a downward poverty spiral and that unless this is urgently instituted, this may force them to eventually migrate out of these marginal areas to other already densely populated rural and urban areas, increasing the pressure on these.

According to FAO (FAO, 2006), the irrigation potential of Kenya has been estimated at 353,060 ha and is distributed over the basins as follows:

- 180 000 ha in the Nile (Lake Victoria) basin;
- 52 500 ha in the Kerio Valley (Rift Valley) basin;
- 111 100 ha in the East Coast basin (including the Tana and Athi basins);
- 9 460 ha in the Ewaso Ngiro (Shebelle-Juba) basin.

Further it explains how the funding of irrigation development is in transition as the emphasis has shifted from government-led development to participatory and community-driven development. As a result of the change of approach and policy, irrigation development has been categorized so that schemes in the arid and semi-arid lands (ASAL) have to be developed through grants, with the beneficiaries providing contribution in terms of unskilled labour and local materials. Community-based market-oriented irrigation schemes are currently developed through cost-sharing rather than full cost recovery on infrastructure. Full cost recovery approach has been discontinued because it has been found to be a hindrance to irrigation development especially where major infrastructure is involved. In both cases operation and maintenance are the responsibility of the community.

Basing its findings on land suitability classification, the National Water Master Plan of 1992 (JICA, 1992) estimated that 1.3 million hectares could be irrigated. Irrigated agriculture currently accounts for only 1.5% of the total land under agricultural production. The few studies conducted in the Irrigation & Drainage sector have reported various findings. (Mati, 2008) reports experiences on capacity development for irrigation in Kenya from a study of seven smallholder irrigation schemes, namely: New Mutaro, Emening, Mitunguu, Ng'uuru Gakirwe, Lari, Mukuria-Kyambogo and Isiolo River Water Users Association. These schemes were selected for their apparent success in irrigation management, sustainability and poverty reduction among the

beneficiaries. Although the seven schemes had diverse innovations and enterprises, common drivers of success were identified as: Introduction of new knowledge/technology, availability of markets, good governance structures, funding for infrastructure development, and targeted capacity development. It was also found that initial investment costs for smallholder irrigation schemes ranged from about US $198 to $1744 per ha, which is much lower than reported for large public schemes (Ragwa, Kamau, & and Mbatia, 1998). Generally, all the schemes had recorded improved food security and incomes, with net earnings ranging from US $200 to $1200 per month for single-crop enterprises. Capacity development had played a major role in the positive performance of the schemes. However, the respective schemes had experienced different modes of capacity building, which included government extension services, NGOs, private sector, research institutes, out-grower support schemes and farmer-to-farmer learning.

According to (FAO, 2002), the basis for estimating the total income earnings from production are the harvests (equal to yield multiplied by area) and the unit price that farmers are likely to obtain, taking into account the season and the local market conditions. Multiplying the harvest and the estimated unit price gives the estimated gross income. The most commonly used indicator of economic performance in irrigation schemes is the gross margin per hectare of irrigated area (Averbeke, 2012). This information can easily be augmented to indicate which factors of production are effectively used and which are not. It is not a precondition of success that irrigation is of prime importance to each farmer. There are, however, a number of common important factors, such as water, labour and inputs, for which performance can be monitored through use of indicators.

Many formal irrigation schemes are performing inefficiently for a number of reasons, among which the poor performance of irrigation institutions is one. It is this realization that prompted the World Bank to initiate, among others, action on "Reforming Irrigation Institutions". The objective of this initiative is "to improve the performance of irrigation management in projects by increasing the efficiency, transparency and accountability of the organizations in charge of providing irrigation services and increase the participation of users and the private sector". (Malan & Burton, 2001)

This study however focused on the costs of crop production in ASALs, the culture of beneficiaries of ASALs, availability of labour and agricultural support services and infrastructure in ASALs. These factors were elaborated below:

2.3 The Cost of Crop Production in Irrigation Schemes

(FAO, 2002) describes the variable costs included in crop production as: Land preparation (hired labour or equipment), planting material (for example seed), fertilizers (both organic and inorganic), chemicals (pesticides, insecticides, herbicides), transport of inputs, interest on seasonal loan if money for inputs is borrowed, casual labour for weeding, harvesting, packing material, transport of outputs, marketing costs.

A study done by (Consultants A. &., 2013) on HIS found the following as the inputs required for crop production in the irrigation scheme; Land preparation, Planting, Weeding, Application of farm inputs and Water management in irrigated fields. Land preparation in schemes is done mechanically (Ruigu, 1987). It involves clearing bushes and readying the land for planting. Most farmers plough once, others plough twice while a few farmers harrow their land. Land preparation activities start at least a month before the onset of rains and tractor use is common. Planting is mainly done by hand for cereals, pulses and roots crops. Most of the horticultural crops and fruit crops are first grown in the nursery after which they are transplanted to the fields. Weeding is done by hand using hoes and there are usually two weeding exercises per cropping season. First weeding is 2-3 weeks after germination and the second weeding is before flowering. However, depending on weed intensity, three or more weedings can be done. Application of farm inputs include; fertilizers (planting and top-dressing fertilizers), Certified seeds (especially for horticultural crops), Pesticides (applied mostly on horticultural crops). Water management involves application of water at predetermined intervals per crop. Number of irrigation days normally varies with the kind of crop being irrigated. Regular irrigation is required for shallow rooted crops and those grown in shallow and light soils. Long period interval for irrigation is required for the deep rooted crops and in moderate to loamy sands.

In Kenya, most farmers lack information on the right type of farm inputs to use and the appropriate time of application of the same. The cost of key inputs such as seed, pesticides, fertilizer, drugs and vaccines is high for resource-poor farmers. Most farmers therefore do not use them. This greatly reduces the yield that the farmers get. (Kibet, 2011)

2.4 Role of Culture and its influence in economic growth in a Society

Gregory Clark (Clark, 2007) explored inequality of cultures. He clearly stipulated that some ethnic groups seemed to be far more successful in business than others. He focused on the Industrial Revolution in Great Britain which he argued that institutions of themselves did not

generate economic progress. Stable political institutions, a reliable legal system, predictable land values and functioning markets were the necessary but not sufficient conditions for the economy to take off. Why this is the reason, he explained is due to deep cultural changes, especially a sense of competitiveness and a strong work ethic, that was required if sudden technological breakthroughs were to have any real impact on the society. The data that the researcher presented to us offered a picture of a society that was losing its taste for violence even as its homicide rate was dropping, a society with high population growth among the well-to-do, one in which people had to work hard and long to gain a competitive advantage over their peers, a society that was increasingly literate and patient. These traits served people so well in Britain.

A research done by (Francis X. Hezel, 2009) strived to explain why some countries do very well, while others fail to develop, even when all the requisite economic factors are in place. How to explain the repeated failure of African nations, even when aid is given in great supply, to develop their economy? Why countries like Indonesia and the Philippines, even with a strong resource base and a well-educated population, are so resistant to development? For that matter, what is there to explain the slow economic growth rates of the Pacific nations? He investigated why some cultural groups seemed to do better than others, what would explain the differences?

He researched on Micronesia and in his findings, it become clear that Micronesia simply did not enjoy the same cultural advantages that led Britain to prosperity after the Industrial Revolution or which have given Chinese and Lebanese entrepreneurs the competitive edge they enjoy even after leaving their own country to settle in another.

He concluded that it would take improved education for the population, an infusion of investment capital, an import of the latest technology, dependable political and economic institutions and most importantly, a constellation of cultural values suited for modern business as a critical ingredient for economic development to kick off.

Moreover, (Landes, 1999) concluded that the success of national economies is driven by cultural factors more than anything else. Thrift, hard work, tenacity, honesty and tolerance are the cultural factors that make all the difference, he suggested. In his view, Max Weber was right after all in suggesting that social attitudes and values have the decisive say on what economies would succeed and which would fail.

2.5 Availability of Labour in Crop Production

According to (FAO, 2002) in most countries in Southern Africa, rain fed crop production utilizes family labour for about five months of the year. However, irrigated crop production is a year round labour demanding enterprise. Hence, the issue of the labour demand of a particular irrigation activity is very important (Arifullah, Chishti, Jama, & Yasmeen, 2008). Farmers normally have on-farm and off-farm activities prior to irrigation development. Irrigation will therefore introduce extra demands on the people's labour. It is therefore necessary, during scheme planning, to evaluate the labour requirements of the planned irrigation design alternatives versus the estimated available labour in order to determine when and where shortages may occur.

According to (Chancellor, 1996), some countries in sub-Saharan Africa experience labour shortages due to use of labour intensive technologies and the migration of male labour to urban centres. Consequently, women make up the bulk of labour for agricultural activities which result in them being over-burdened.

2.6 Availability of Agricultural Support Services in Irrigation Schemes

A study conducted by a team of international and Kenyan professionals on Irrigation and Drainage Sector Institutional Reform support services, (Consultants, 2009) defined "support services" as including all those activities related directly to the irrigated agriculture production systems. These included: Physical services, e.g., construction and repair of irrigation facilities;

Agricultural services, e.g., land development, provision of agricultural inputs (seeds, fertilizers, pesticides, herbicides etc.); Institutional services, which includes agricultural extension, irrigation management extension, financing, marketing, training, regulating and auditing, water rights, and conflict resolution; and Provision of equipment and services, for example pumps, drip irrigation systems, greenhouses, etc.

Further, they explained that the provision of such support services was essential for developing a prosperous, efficient and sustainable irrigated agricultural sector; and their provision should be the core business of specific institutions (Commission, 2001). Support services related to irrigated agriculture production therefore included rehabilitation/ improvement of systems and some assistance for their operation and maintenance (Aagaard, 2005).

This study also noted that other agricultural production-related services such as supply and marketing facilities, cooperatives for purchasing inputs, and marketing outputs were not well-coordinated among the related agencies. Institutional support for either strengthening existing organizations or providing foundations for the establishment of new organizations was also limited (Poulton & Kanyinga, 2013). The Consultant acknowledged a Kenyan use of the term "support services" to refer to the necessary infrastructure such as roads, cold chain facilities, and communication and market infrastructure. The Consultant considered these as necessary conditions for a prosperous market-oriented agriculture, whether irrigated or not, and that these conditions were absolutely essential.

An important gap related to irrigation management extension i.e. including irrigation agronomy (advice on water management techniques for specific crops), management of water deliveries to farmers on irrigation schemes, achieving high crop productivity and profitability per unit of water and integration of crop production with livestock and fish production were identified in this study. The MoALF extension staff that should offer advice on crop management were often absent from irrigation schemes. MoALF still had extension staff members with irrigation agronomy training who worked largely on farm-level rainwater harvesting; but they often did not have specialized training for irrigation water management. The Consultant therefore established that provision of effective extension services on irrigation schemes was currently a serious gap.

2.7 Theoretical Framework

The study was based on the following theoretical framework.

2.7.1 Social and Culture Theories

Social and Cultural theories strived to explain how people relate to each other and/or the surrounding environment. Reference was made to these theories by the Scottish Government while doing a research on Agriculture and Climate Change specifically on factors influencing farmer behaviours. The following was noted: In learned behavior, people look to those around them for guidance on how to behave when faced with choice and uncertainty. Actions taken by others can boost the perception that a request is legitimate and justified; Personal and societal influence to what people value is partly prescribed by their wider culture. This shapes the values which they consciously pursue, as well as their subconscious behaviours; In-group dynamics, people's behaviour as consumers is dictated by the social connotations they associate with certain

products and activities; and Social commitment which requires people to stand by agreements and fulfil their obligations. Once a belief or commitment has been expressed publicly, the individual exhibits a strong tendency to act in a way that is consistent with the commitment.

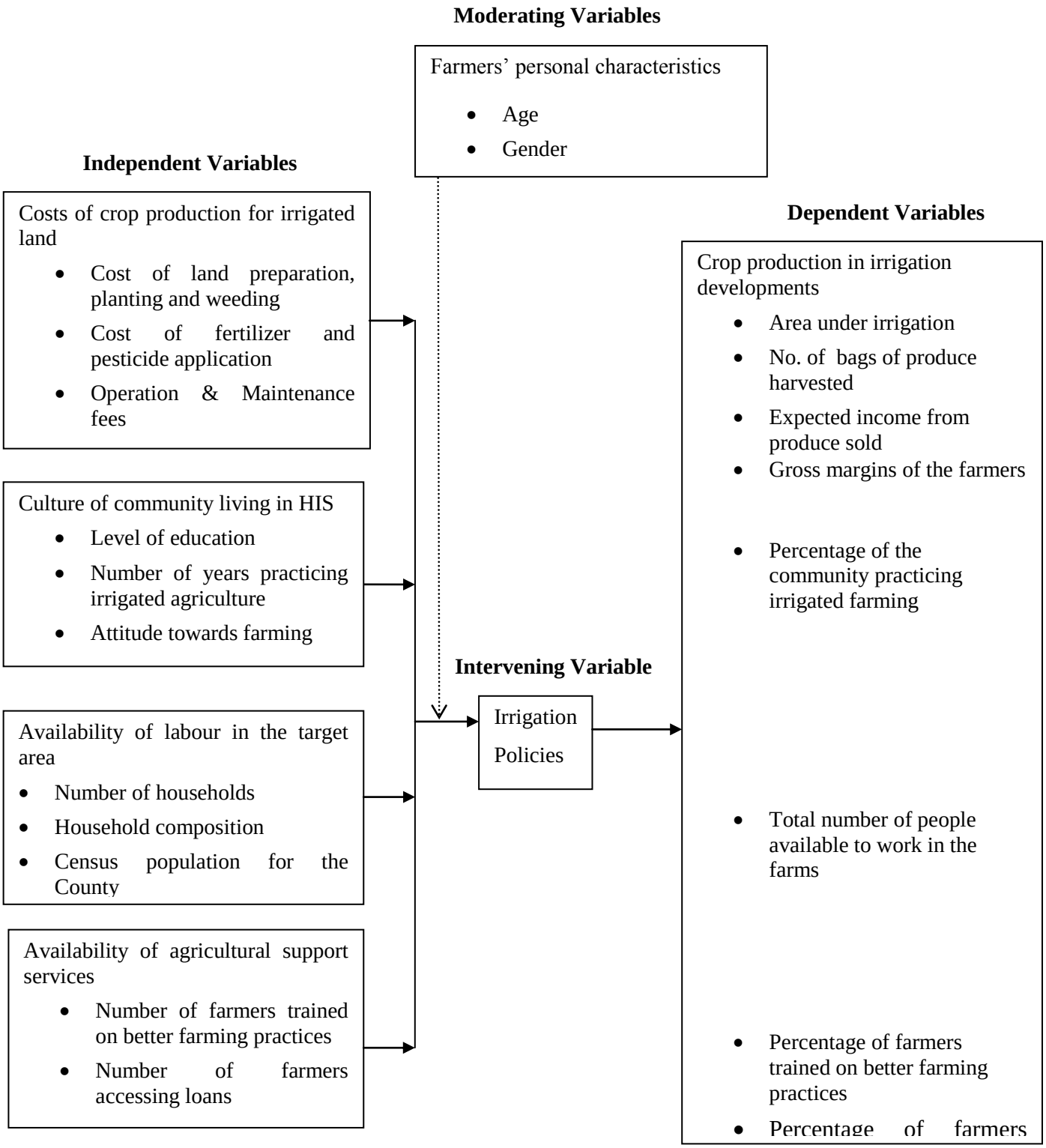
2.7.2 Theory of Demand

This conceptual framework according to (Barbara Tocco, 2013) formed the basis of devising the theoretical model and methodology for the empirical estimation of the derived demand for labour. It explains that the demand for all factors of production, including labour, is a derived demand, as the demand for the factors of production is dependent on the demand for the outputs that they produce. Secondly, the empirical analysis of labour demand in agriculture requires a careful analysis of the drivers which affect the demand for the different factors, and the impact of policy on those decisions. A brief summary of the variables which affect the production process and need to be taken into account can be summarized in the following points: The relative price of inputs, which does play a significant role in the determination of the demand for the individual factors of production; The factors influencing the relative price of inputs, which have an influence upon the factor mix in production; Input market imperfections, which are expected to drive a wedge between efficient and observed factor prices; Other input market interventions; The factors influencing the output level and its composition, which have an indirect effect upon factor prices and resource allocation; Output market imperfections; Policy and biased technical progress, as public policy could alter the relative marginal products of different factors of production, i.e. biased technical progress, which would also affect relative demand, and in the long-run relative factor prices and earnings.

2.8 Conceptual Framework

The figure 2.1 offers the Conceptual framework on which the study was based. The factors under study include: the costs of crop production, the culture of community living in ASALs, availability of labour and agricultural support services with their respective indicators. The intervening variables that influence crop production in irrigation developments in ASALs were also illustrated. The moderating variables included: farmers' personal characteristics such as age and gender. The intervening variables included: irrigation and agriculture policies (Annor-Frempong, 2013).

Figure 2.1: Conceptual framework



2.9 Knowledge Gap

For large public irrigation schemes, it was clear that there is not enough systematic information on the performance of existing schemes, trends in that performance and very important, the factors leading to their success or under performance. The study therefore sought to investigate these factors influencing performance of the irrigation schemes with emphasis on those in the ASALs of Kenya. It further recommended that such information would be central to a management information system to support investment planning.

Table 2.1: Summary of knowledge gaps

Variable	Author	Findings	Knowledge gap
Cost of crop production for irrigated land	(FAO, Water and Agriculture, 2006)	The inputs required for crop production in the irrigation scheme included Land preparation, Planting, Weeding, Application of farm inputs and Water management in irrigated fields.	The application methodology of inputs for the various crops needs to be well documented so as to adequately guide the farmers on the irrigated farming procedures.
Culture of community living in Hola Irrigation Scheme	(Gregory Clark, 2007)	This study explored inequality of cultures where social attitudes and values have the decisive say on what economies would succeed and which would fail.	The culture of a community can be integrated into the proposed economic activity development as opposed to bringing total change to a community of interest.
Availability of labour in the target area	(FAO, Financial and Economic Appraisal of Irrigation Projects, 2002) (Chancellor, 1996)	The study emphasized that irrigated crop production is a year round labour demanding enterprise.	There is a need to establish the proportion of the families that may meet the labour requirements since the labour in irrigated agriculture is a family affair.
Availability of agricultural support services	(Consultants E. M., 2009)	The study elaborated on provision of such support services as essential for developing a prosperous, efficient and sustainable irrigated agricultural sector. Moreover, it also noted that other agricultural production-related services such as supply and marketing facilities, cooperatives for purchasing inputs, and marketing outputs were not well-coordinated among the related agencies.	The methodology of how the agricultural services can be availed to the farmers to give them the support they need in irrigation should be proposed. The key players in availing the agriculture support need to be identified and engaged.

2.8 Summary of Literature Review

This section detailed literature on crop production in irrigation developments.

It analyzed literature on agriculture sector in Kenya, irrigation and drainage sector, factors that influence crop production in irrigation developments such as costs of production, culture of the community living in ASALs, availability of labour and agricultural support services in ASALs.

The chapter concluded by describing the theoretical and conceptual framework that guided the study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

In this chapter, the subtopics covered included: The research design, target population, sample size and sampling techniques, data collection procedures and the instruments used. Validity and reliability of these instruments was included as well as data analysis and presentation procedures.

3.2 Research Design

The research design used in the study was both descriptive and quantitative research design.

Descriptive research design was used in order to gain a rich and complex understanding of people's experience. It was considered to be best as it was suited for explaining human behaviour, especially areas such as attitudes and other emotions that could not be investigated by direct observation.

Quantitative research design involved collecting and converting data into numerical form so that statistical calculations could be made and conclusions drawn.

This design was appropriate for the study as it enabled data collection from the sample and facilitated the researcher to summarize the findings in an appropriate way for carrying out a holistic, in depth and comprehensive investigation on factors influencing crop production in Hola Irrigation Scheme.

3.3 Target Population

The target population in the study was 1040 members of HIS comprising of ten (10) staff members, thirty (30) Irrigation Water Users Associations (IWUA's) committee and a thousand (1000) farmers (Consultants A. &., 2013).

The respective groups engaged in the study during the month on April and May 2015 was summarized in Table 3.1:

Table 3.1: Components of the target population

Component of the population	Target population	Percentage
Hola Irrigation Scheme staff members	10	1.0
Irrigation Water Users Associations (IWUA's)	30	2.9
Farmers	1000	96.1
Total	**1040**	**100**

3.4 Sampling Design

The representative sample size was determined using the sampling frame.

The sample size selection on HIS staff members was done using purposive sampling technique. It's a sample which was selected by the researcher subjectively as the focus was on specific staff members who had knowledge on the study area. The HIS staff members included: (1) Manager (2) Irrigation Engineers, (2) Water technicians, (1) Agronomist, (1) Accountant and (1) Secretary. The sample was therefore comprised of: (1) Manager (2) Irrigation Engineers, (2) Water technicians, (1) Agronomist.

The sample size selection on Irrigation Water Users Associations (IWUA's) committee and farmers was done using systematic sampling technique. The first sample unit was selected at random and the remaining units were automatically selected in a definite sequence at equal spacing from one another. This sampling technique was recommended as there was a complete and up to date list of the sampling units and that the units were arranged in alphabetic order.

The calculated sample size and corresponding sampling techniques used in the study were summarized in Table 3.2

Table 3.2: Sampling technique and Sample size

Component of the population	Target	Sampling	Sample
Hola Irrigation Scheme staff	10	Purposive	6
Irrigation Water Users	30	Systematic	15
Farmers	1000	Systematic	100
Total	**1040**		**121**

3.5 Data Collection Instruments

These are the tools used in the collection of data on the phenomenon of the study (Creswel, 2013). Questionnaires were the tools used for the study.

3.5.1 Questionnaires

Self-constructed questionnaires were used to collect primary data from the HIS staff members, IWUAs and farmers and to gain an in-depth understanding of the study area. This involved use of both open-ended and closed-ended questions which were completed by all the respondents. Open ended questions focused on answers which were not known to the researcher while closed-ended questions were used to keep the respondents on tract. This method was selected as its administration was comparatively inexpensive and easy when gathering data from large numbers of people spread over wide geographic area.

The questionnaire had five parts; the first part had questions on the general information about the respondent. The second, third, fourth and fifth parts had the factors influencing crop production in Hola Irrigation Scheme i.e. costs of crop production, culture of the community living there, the availability of labour and agricultural support services in Hola Irrigation Scheme. The researcher made a follow-up in order to ensure that the respondents returned all the questionnaires in time.

3.5.2 Piloting the Instrument

(Mugenda, 2003) suggest that pre-testing allows ascertaining the suitability of the tool before the actual administration. The research instrument was pre-tested to increase the validity and reliability of the response. Pre-testing was done by administering the questionnaire to 10% of the total respondents. Based on the observations during the pre-test, the questions were revised to make them more objective and aligned to the research objectives.

3.5.3 Validity of Research Instrument

Validity is defined as the appropriateness, correctness, and meaningfulness of the specific inferences which are selected on research results (Frankel & Wallen, 2004). The focus for this study was content validity. This ensured that the instruments covered the subject matter of the study as intended by the researcher.

The researcher therefore closely consulted with the Supervisor, Research experts and also the Irrigation experts. The Supervisor and Research experts assisted in assessing the variables to be

measured by the instruments, while the irrigation experts helped in determining whether the set of items were accurately representing the variables under study.

3.5.4 Reliability of Research Instrument

Reliability is the consistency with which the measuring instrument performs, such that apart from delivering accurate results, the measuring instrument must deliver similar results consistently after repeated trials (Leedy & J.E., 2000).

The reliability of the instruments was estimated through the split-half method. To do this, Spearman-Brown prophecy formula was used to obtain the said reliability: This was obtained as shown below:

Pxx" = 2Pxx'/1+Pxx'

Where:

Pxx" is the reliability coefficient for the whole test

Pxx' is the split-half correlation

A correlation coefficient of 0.73 was obtained indicating that the instrument had an internal consistency. Mbwesa (2006) indicated that if the correlation coefficient of the instruments falls above +0.6, the instrument is taken as reliable and fit for data collection.

3.6 Data Collection Procedure

The proposal was presented before the University of Nairobi examination panel for defence. Upon approval of the proposal, the researcher obtained a letter of introduction from the University of Nairobi and a research permit from the National Commission for Science, Technology and Innovation as authorization for data collection. Once the authorization was granted, the researcher visited the study area and consequently carried out the data collection process. The data collection was carried out for two months in the month of April and May 2015.

3.7 Data Analysis

According to (Kothari, 2004) data analysis implies examining the collected data and making discussions, inferences and conclusions. This study used the quantitative and qualitative statistical methods to analyze the collected data. Qualitative data gathered from respondents using open-ended questions was analyzed using qualitative methods which involved establishing the categories and themes, patterns and conclusions in line with the study objectives. Since the questionnaires used had several closed ended questions with appropriate rating scales then,

Computer Software Microscoft Excel was used to analyze all the quantitative data collected. Frequencies and percentages were generated for all quantitative data, and results presented using frequency distribution tables to discuss data and information on various issues addressed by the study objectives.

3.8 Operational Definition of Variables

The operational definition of study variables were undertaken as shown on Table 3.3.

Table 3.3: Operationalization table

Variable	Indicators	Measurement Scale	Analysis Tool
Independent Variables Cost of crop production for irrigated land	• Cost of land preparation, planting and weeding • Cost of fertilizer and pesticide application • Operation & Maintenance fees	Ratio Ratio Ratio	Mean, Percentage, Frequencies, Mode, Correlation analysis, Mathematical modelling
Culture of community living in Hola Irrigation Scheme	• Level of education • Number of years practicing irrigated agriculture • Attitude towards farming	Ordinal Ratio Ordinal	Mean, Percentage, Frequencies, Mode, Mathematical modelling
Availability of labour in the target area	• Number of households • Household composition • Total population for the County	Ratio Ordinal Ratio	Mean, Percentage, Frequencies, Mode, Mathematical modelling
Availability of agricultural support services	• Number of farmers trained on better farming practices • Number of farmers accessing loans	Ratio Ratio	Mean, Percentage, Frequencies, Mode, Mathematical modelling
Intervening Variable Irrigation Policies	• Existing irrigation policies	Nominal	Mean, Percentage, Frequencies, Mode, Mathematical modelling
Dependent Variable Crop production in irrigation schemes	• Area under irrigation • No. of bags of produce harvested • No. of bags of produce sold • Percentage of the community practicing irrigated farming • Total number of people available to work in the farms • Percentage of farmers trained on better farming practices • Percentage of farmers with access to loans	Ratio	Mean, Percentage, Frequencies, Mode, Mathematical modelling
Moderating Variables	• Age • Gender	Ordinal Nominal	Mean, Percentage, Frequencies, Mode

3.9 Ethical Consideration

Caution was observed while administering the data collection instruments to the respondents to ensure their rights and privacy are respected. Before the administration of the instruments, the purpose of the study was explained to the respondents.

No respondents were forced into the exercise of the study. To ensure confidentiality, the questionnaires were given numerical codes instead of names. The study findings were then presented without any manipulation of data by the researcher.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATIONS, INTERPRETATIONS AND DISCUSSIONS

4.1 Introduction

This chapter provides an analysis, presentation, interpretation and discussion of the data collected from the study respondents on the HIS. The information obtained was on the demographic characteristics of HIS staff members, IWUAs and farmers that covered gender, age, marital status and level of education; costs of crop production, availability of labour, culture of the community living within the scheme and agricultural support services within the scheme and their influence on crop production in the irrigation scheme.

4.2 Questionnaire Return Rate

The study sample was 121 subjects, 6 HIS staff members, 14 IWUA members and 100 farmers. During the study, 6 questionnaires were administered to HIS staff members, 14 questionnaires to IWUA members and 95 questionnaires to farmers. The study sample size of 121 respondents was not realized. The response rate was therefore 95.87% which was considered adequate for analysis and conclusion.

According to (Frankel & Wallen, 2004) a response rate of above 95% of the respondent can adequately represent the study sample and offer adequate information for the study analysis and consequently give good conclusions and recommendations. Different HIS groups were met through prior arrangements which enabled the researcher to effectively collect data from the sampled respondents.

4.3 Demographic characteristics of respondents

The study obtained the respondents responses on gender, age, marital status and level of education.

4.3.1 Gender of respondents from the study

One of the demographic characteristic that the study investigated on was gender distribution among the members of HIS. To fulfill this, the researcher asked the respondents to indicate their gender and the results were presented in Table 4.1.

Table 4.1: Distribution of respondents by Gender

Gender	Frequency	Percentage
Male	102	88
Female	14	12
Total	**116**	**100**

The findings indicated that 102 (88%) of the respondents were male and 14 (12%) were female. This implied that major decisions within the study area were still a reserve of men.

A study done by (Chancellor, 1996), established that some countries in sub-Saharan Africa, women make up the bulk of labour for agricultural activities which result in them being over-burdened. This could not be far from the truth. The families in HIS were male headed which may be the reason why most of the respondents were male. The women were however the ones who did the major work at the farms.

4.3.2 Age of Respondents

Age was a demographic characteristic whose influence on crop production in irrigation schemes was investigated. To determine this influence, the study respondents were asked to indicate their age bracket for the study analysis.

The findings obtained are presented in Table 4.2.

Table 4.2: Distribution of respondents by Age

Age distribution	Frequency	Percentage
20 years and below	6	5
21-30	15	13
31-40	30	26
40 and above	65	56
Total	**116**	**100**

The findings showed that 65 (56%) of the Scheme's participants were in the range of 40 years and above, 30 (26%) were between 31-40 years, 15 (13%) were between 21-30 years, 6 (5%) of the Scheme's participants were below the age of 20. Most of the community members aged below 20 years were not involved in the Scheme's activities despite the fact they are the most populated and vibrant age group within the society. The majority of the participants ranged between the age of 40 and above.

The study results agree with Kipserem (2011) who found out that in Keiyo district, the average age of farmers in the study area was above 45 years and concluded that youth tend to shun projects that are agriculture-related and those of low monetary profits.

4.3.3 Marital Status of the Respondents

Marital status of the respondents was likely to have influence on crop production in the irrigation scheme. In order to establish this influence, the study respondents were asked to state the marital status they belonged to and the findings were analyzed and presented in Table 4.3.

Table 4.3: Distribution of respondents by Marital Status

Marital status	Frequency	Percentage
Single	5	4
Married	91	79
Widowed	20	17
Total	**116**	**100**

Survey indicated that 91 (79%) of the respondents were married, 20 (17%) were widowed and 5 (4%) were single. The married respondents were more involved in the irrigated farming because they maybe had more responsibilities in fending for their families.

4.3.4 Level of education of the Respondents

The level of education of the respondents was likely to have influence on crop production in the irrigation scheme. In order to answer the study question on this influence, the study respondents were asked to indicate their education levels which were analyzed and presented in Table 4.4.

Table 4.4: Distribution of respondents' level of education

Level of education	Frequency	Percentage
Primary level	60	52
Secondary level	30	26
College level	12	10
University level	0	0
Never attended any school	14	12
Total	**116**	**100**

Survey findings indicated that 60 (52%) had primary education, 30 (26%) had secondary education, 14 (12%) had never attended any school, while only 12 (10%) had attained tertiary education. Low education levels for majority of the respondents are expected to be a major challenge as this affected the decision making processes particularly for uptake of technologies as well as influence on proper farming methods in the scheme. According to (Francis X. Hezel, 2009), a society that was increasingly literate will more easily embrace economic activities and perhaps pursue other indirect benefits that come with irrigated agriculture.

4.4 Costs of crop production in Hola Irrigation Scheme

Costs of crop production were examined in an attempt to answer the study question on influence of crop production in irrigation schemes. The study therefore investigated on the variable costs per season per acre.

4.4.1 The variable costs per acre per season

The variable costs per acre per season were important in examining how much a farmer spent in an acre for crop production. The analyzed costs of inputs included: Costs of seeds, cost of land preparation, labour costs incurred during planting, labour costs of weeding, costs of fertilizer, costs of pesticides and operations & maintenance fees. The results were analyzed and presented in Table 4.5.

Table 4.5: Variable costs per acre

S. No	Inputs	Average cost of production per	Percentage
1	Cost of seeds	1,200.00	3
2	Cost of land preparation	3,800.00	10
3	Cost of planting	2,500.00	7
4	Cost of weeding	4,360.00	12
5	Cost of fertilizer	10,200.00	28
6	Cost of pesticides	11,350.00	31
7	Operation &	3,400.00	9
	Total	**36,810.00**	**100**

The findings indicated that the farmers spent on average Kshs. 36,810 per acre as crop production costs. Kshs. 11,350 (31%) was spent on pesticides, kshs.10, 200 (28%) on fertilizer, kshs. 4,360 (12%) on weed removal, kshs. 3,800 (10%) on land preparation, kshs. 3,400 (9%) on operation & maintenance costs, kshs. 2,500 (7%) on planting labour costs and kshs.1, 200 (3%)

on seeds. The costs of pesticides and fertilizer were the highest. This was due to the probable fact that there were very few retailers who offered a relatively narrow range of products including pesticides and fertilizers an indication that the farmer's purchasing power was low. The remoteness of the study area and poor infrastructure could also be a contributing factor to the high prices. Further, the relationship between the variable costs and gross margins was investigated. A strong negative correlation coefficient of -0.968 was found which meant that an increase in the variable costs resulted to a decrease in the farmers' gross margins. It may be concluded that, in an effort to save costs and increase their gross margins, some farmers used these inputs sparingly leading to lower yields. Irrigated farming is specialized, it is of importance that the inputs application, water application, weed removal among others are done at the right time and in required quantities so as to optimize on yields (FAO, 2002).

4.5 Culture of the community living in Hola Irrigation Scheme

Culture of the community living in Hola Irrigation Scheme was examined in an attempt to answer the study question on influence of crop production in irrigation schemes. The study therefore investigated on the economic activities the respondents practiced before irrigated agriculture was introduced or revived to their community, their current major economic activities and their perception of irrigated agriculture.

4.5.1 Main Economic activities before introduction or revival of irrigation in Hola Scheme

The main economic activities practiced by the respondents before irrigated agriculture was introduced or revived in HIS were important to understand the history and experience as far as irrigated agriculture was concerned in the community.

The results were analyzed and presented in Table 4.6.

Table 4.6: Distribution of respondents by main economic activities

Economic activity before introduction or revival of irrigation in HIS	Frequency	Percentage
Pastoralism	98	85
Business	1	1
Salaried employment	6	5
Casual labour	5	4
Farming	6	5
Total	**116**	**100**

The findings indicated that 98 (85%) practiced pastoralism as an economic activity, 6 (5%) had salaried employment, 6 (5%) practiced farming, 5 (4%) were casual labourers and only 1(1%) had a business running. This was a clear indication that the community had minimal experience as far as farming was concerned.

Irrigation in the scheme was done on a rotational basis. There were various blocks on which the water was delivered to at specific days. On these days, the farmer was required to apply just the right amount of water to the plants for a period of time. The application would vary depending at what stage of growth the plant was in. The weeding, fertilizer and pesticide application was done on scheduled dates. Moreover, for the seed maize the harvesting was specialized. Experience and skills were required in all these areas. That notwithstanding a lot of training on these farming activities was therefore paramount for the scheme to realize optimum yields (Consultants E. M., 2009).

4.5.2 Current main Economic activities

The current main economic activities practiced by the respondents in HIS were investigated to understand the career change brought about by introduction of irrigated agriculture. The reason for this was to find out if the community had other major economic activities as sources of income besides irrigated agriculture.

The results were analyzed and presented in Table 4.7.

Table 4.7: Distribution of respondents by current economic activities

Current economic activity	Frequency	Percentage
Pastoralism	_	_
Business	_	_
Salaried employment	6	5
Casual labour	_	_
Farming	110	95
Total	**116**	**100**

The findings provided a clear indication of a major shift as far as economic activities in the community living in HIS. Most the respondents indicated that farming through irrigation was their major economic activity. This emphasized on the importance of boosting the yields from the farming as this was the only opportunity the community had to improve their livelihood. This meant that if the farming yields improved, the farmers would make more sales and get more

money for running their lives and thus eradication of poverty in the community. This study however found out that, adaptation of irrigation by majority of the community members did not have much influence on the improvement of yields within the Scheme.

The findings agreed with a study done the United Nations (Commission, 2001) that, embracing irrigated agriculture was a step forward to boosting food security in the ASALs region of Africa. This would then contribute to the economic growth in these regions and eventually eradicate poverty.

4.5.3 Perception of irrigated agriculture in Hola Irrigation Scheme

The perception of irrigated agriculture by the respondents in HIS was important to investigate their attitude towards irrigated agriculture as an economic activity. This played a key role in assessing the acceptability levels of irrigated farming in the scheme.

The results were analyzed and presented in Table 4.8.

Table 4.8: Distribution of respondents by perception of irrigated agriculture

Perception	Frequency	Percentage
Largely valued	97	84
Moderately valued	15	13
Not largely valued	4	3
Total	**116**	**100**

Findings indicated that 97 (84%) largely valued irrigated agriculture, 15 (13%) moderately valued it and 4 (3%) did not largely value it. These results portrayed irrigation agriculture to be largely valued and majority of the farmers felt that the Irrigation Scheme had improved their livelihood in one way or another.

According to (FAO, 2002) if the acceptability level towards farming were low, then lower production levels are expected. In this case, the findings contradicted this research as the acceptability levels of the irrigated farming in HIS were significantly high. This meant that, the perception of irrigated agriculture in Hola Irrigation Scheme did not contribute to the low gross margins in HIS.

4.6 Availability of labour in Hola Irrigation Scheme

Availability of labour in the irrigation scheme was a factor that was examined in an attempt to answer the study question on influence of crop production in irrigation schemes. The study

therefore estimated the available labour in order to determine whether there were shortages or surplus of labour within the scheme. The parameters investigated included; the size of a household and the household composition of the community living HIS.

4.6.1 Size of a household in Hola Irrigation Scheme

The size of a household in HIS was important in the calculation of the number of people available within the Scheme to provide labour for the farms.

The results were analyzed and presented in Table 4.9.

Table 4.9: Size of household in HIS

Size of a household	Frequency	Percentage
1-5	18	16
6-10	85	73
11 and above	13	11
Total	**116**	**100**

The findings indicated that all households were headed by men. Moreover, 85 (73%) of the households had 6-10 members, 18 (16%) had 1-5 members and 13(11%) had 11 & above members. The average household size was therefore found to have 6-10 member. According to the study done on Kenya population situation analysis (GoK, 2013), the average household size in Kenya is 5. The study average household size area is therefore higher perhaps due low family planning adoption.

4.6.2 Composition of a household and number of labour days provided by each household member in Hola Irrigation Scheme

The composition of a household in HIS was important in the identification of the number of people within the family unit that had the strength and capability to work in the farms and the number of labour days they each provided.

The results were presented in Table 4.10.

Table 4.10: Household composition in HIS

Composition of a household	Average number	Number of labour days provided
Adults (Above 18 years)	3	20 days per month
School going children (9-18 years)	3	20 days during school holidays
Small children (less than 9 years)	4	None
Total	**10**	

The findings indicated that there were 20 labour days per month provided by 3 adults (Above 18 years), 20 labour days by 3 school going children (9-18 years) during school holidays and no labour days were provided by the 4 small children (less than 9 years).

From HIS cropping calendar (NIB, 2014), the cropping was done within the school days. The harvesting of the seed maize for the first and second season was June and January respectively. These did not coincide with the school holidays and therefore the labour days from the school going children in this study were considered negligible. The labour days available for analysis were therefore 20 days per month provided by the 3 adults in a household.

According to (FAO, 2002), the labour requirement for seed maize for an irrigated area of two acres is 27.4 labour days per month.

The amount of additional labour required in HIS was therefore calculated as (27.4-20) =7.4 labour days. It may therefore be noted that the farmers are not able to provide enough labour for their farms to operate the scheme successfully.

A study done in HIS (Consultants A. &., 2013) identified the number of households of the community living in HIS to be 1,779 spread throughout an area of 3,037.5 Km^2.

On multiplying the number of households with the average household size (10), the total population of the beneficiaries of HIS was estimated at 17, 779.

The population density was thereafter calculated as:

Population density = (Total population of HIS ÷ Area)

$$= (17{,}779 \div 3037.5) = 5.9 \text{ approximately } 6 \text{ people/km}^2$$

This was considered to be lower than the national population density of 401.1 people per km^2 (KIRA, 2014). Moreover, this was an indication that there was limited labour available to be hired to make up for the shortfall in the Scheme.

Irrigated crop production is a labour demanding enterprise. Hence, the issue of the labour demand of a particular irrigation activity is very important to realize better yields (FAO, 2006). The unavailability of labour in Hola Irrigation Scheme has therefore, without a doubt contributed to the low yields in HIS.

4.7 Availability of Agricultural support services in Hola Irrigation Scheme

Availability of agricultural support services in the irrigation scheme was a factor that was examined in an attempt to answer the study question on influence of crop production in irrigation

schemes. The study therefore investigated the farming practices that the farmers had been trained on and their access to loans for farming activities.

4.7.1 Training on farming activities in Hola Irrigation Scheme

The training on farming activities in HIS was important in the identification of the farming areas in which the farmers had been trained on in HIS.

The results were analyzed and presented in Table 4.11.

Table 4.11: Distribution of respondent's trained areas on farming activities

Trained areas	Total of farmers trained out of the 116 respondents	Percentage trained	Adequacy of the training
Land preparation for seed maize	13	11	Not adequate
Crop establishment of seed maize	40	34	Not adequate
Crop management of seed maize	31	27	Not adequate
Harvesting and post-harvest	23	20	Not adequate

The finding indicated that 40 (34%) of the respondents had been trained on crop establishment of seed maize, 31(27%) on crop management of seed maize, 23(20%) on harvesting & post-harvest handling of seed maize and 13 (11%) on land preparation for seed maize. All the respondents indicated that the trainings were not adequate. The percentages of those trained in the various areas were very low considering the fact that most of them had no prior experience as far as farming was considered.

Irrigation was specialized process that requires knowledge in land preparation, crop establishment, water application, weed removal, pest control and harvesting. The farmers in HIS require thorough training as far as all the irrigation components are concerned in order to increase their production (FAO, 2002). Training of farmers on irrigated agriculture was at minimal in HIS, this therefore contributed to the low yields in HIS.

4.7.2 Access to loans for farming activities in Hola Irrigation Scheme

Access to loans for farming activities in HIS was important in the identification of the number of farmers with access to loans in HIS.

The results were analyzed and presented in Table 4.12.

Table 4.12: Distribution of institutions offering loans to respondents

Institutions offering loans	Frequency	Percentage
Kenya Women Finance Trust (KWFT)	14	12
Equity Bank of Kenya	65	56
Kenya Commercial Bank	37	32
Total	**116**	**100**

The credit facilities were already available according to the survey conducted. Availability of credit facilities was however limited in the project area where 65 (56%) received their credit from Equity Bank, 37 (32%) from Kenya Commercial Bank and 14 (12%) from KWFT.

The availability of credit facilities for farmers in Hola Irrigation Scheme was limited. The farmers' options were few with high interest rates. Failure to pay the debt owed to the credit facilities for one season meant no cropping for the farmers in the next season. This therefore contributed to the low yields in HIS. Irrigated crop production is a high-input high-output system. Farmers therefore need to procure seeds, fertilizers and chemicals in order to optimize their production system. However, the poor cash flow from conventional rain fed farming or other sources is too low for such an investment. Consequently, the need for credit is great indeed (NIB, 2014).

4.8 Gross margins analysis for crop production in Hola Irrigation Scheme

The gross margins for crop production in HIS were analyzed in an attempt to determine the Scheme's performance. The study investigated on cropping seasons in the year, the number of acres cropped per season, the type of crops grown in the season and estimates of income from the produce per farmer.

4.8.1 The number of cropping seasons in HIS for one year

The cropping seasons were important in calculating the scheme's yields for one year. The results were analyzed and presented in Table 4.13.

Table 4.13: Number of cropping seasons in HIS

Number of cropping seasons in a year	Frequency	Percentage
One	6	5
Two	100	86
Three	10	9
Total	**116**	**100**

The findings indicated that, 100 farmers (86%) cropped for two seasons and 10 (9%) cropped for three seasons and 6(5%) cropped for one season. The majority of the farmers cropped for two seasons. The optimum cropping seasons for HIS is three (Consultants A. &., 2013). Most of the farmers were therefore operating below minimum. Some farmers cropped for one season for lack of debt payment from their creditors.

4.8.2 The number of acres cropped per farmer per season

The number of acres cropped per farmer per season was important in calculating the scheme's yields for one year. The results were analyzed and presented in Table 4.14.

Table 4.14: Number of acres cropped per season

Number of acres cropped per season per farmer in a year	Frequency	Percentage
One (1)	4	3
Two (2)	80	69
Three (3)	20	17
Four (4)	12	11
Total	**116**	**100**

The findings indicated that 80 farmers (69%) cropped in two acres in a season, 20 (17%) cropped in three acres in a season, 12 (11%) cropped in four acres in a season and 4 (3%) cropped in one acre in a season. The average number of acres cropped per farmer per season was therefore two (2 acres).

The land allocated to farmers by the Government was not adequate in increase the farmer's profits margins. According to a study done by (Averbeke, 2012) on wheat growing in Kenya, good profits from this produce have been achieved through large scale farming. The same is true for all farming activities embarked on for profit purposes.

4.8.3 The crops grown per farmer per season

The crops grown per farmer per season were important in calculating the scheme's yields for one year. The results were analyzed and presented in Table 4.15.

Table 4.15: Type of crops grown in HIS by farmers

Crops grown per farmer per season in a year	Frequency	Percentage
Maize (seed maize)	116	100

The findings indicated that 116 farmers (100%) cropped maize (seed maize) which is produced under contractual arrangements with Kenya Seed Company.

The farmers face a problem of marketing their produce, therefore the contract with Kenya Seed provided a ready market for them. The seed maize however, is not a high value crop and the selling price is low. The farmers henceforth do not enjoy the high profit margins.

This therefore agrees with the study on Contract farming in Africa that identified the constraints of contract farming on as exploitation because of the unequal relationship between farmers and large agribusiness firms and it also excludes small farmers as buyers prefer to work with medium and large farmers (Minot, 2011).

4.8.4 The number of bags harvested per acre

The number of bags of maize seed harvested for an acre was important in calculating the yields for the HIS. The results were analyzed and presented in Table 4.16.

Table 4.16: Average number of bags of produce harvested per acre

Average number of bags harvested per acre (90kg)	Frequency	Percentage
5-10	5	4
10-15	22	19
15-20	86	74
20-25	3	3
Total	**116**	**100**

The findings indicated that the majority of the farmers, 86 (74%) harvested between 15-20 bags of seed maize. The least number of bags harvested was 20-25 bags at 3%. The optimum number of bags to be harvested in an acre is 25 bags for the seed maize (Consultants A. &., 2013). The majority of the farmers were operating below minimum.

4.8.5 The cost of seed maize per 90 kg bag

The findings indicated that the farmers in HIS were contracted by Kenya Seed to grow seed maize. The price of sale for the seed maize was the same for all farmers at **Kshs. 68** per kg.

This buying price by Kenya seed is very low. The sale of seed maize from other parts of Kenya is at least Kshs.200 per kg. The lack of competition by buyers has led to this atrocious pricing for the farmers' seed maize (FAO, 2014).

4.8.6 Expected income from sale of produce

The expected income from sale of produce for an acre was important in calculating the gross margins for the HIS. The findings were analyzed as shown in Table 4.17.

Table 4.17: Expected income from sale of produce

Average number of 90kg bags harvested per acre per season	Cost of 90kg bag of seed maize (Kshs. (68 x 90))	Expected income per acre per season (Kshs.)
5-10	6,120.00	45,900.00
10-15	6,120.00	76,500.00
15-20	6,120.00	107,100.00
20-25	6,120.00	137,700.00
Average	**6,120.00**	**91,800.00**

The findings indicated that the average expected income per acre per season was kshs. 91,800.00.

The gross margins per acre for HIS were then calculated by subtracting the total variable costs from average expected income. The findings were analyzed as shown in Table 4.18.

Table 4.18: Gross margins per acre

Crop	Average variable costs per acre per season (Kshs.) *(As calculated at section 4.4.1)*	Average expected income per acre per season (Kshs.)	Average gross margins per acre per season (Kshs.)	Average gross margins per acre per year (Kshs.) (Two seasons)
Seed Maize	36,810.00	91,800.00	54,990.00	109,980.00

Findings indicated that the average gross margins per farmer per acre per year were kshs. 109,980.00.

This means an average monthly earning of **kshs. 9,165.00** Per farmer**.** This is quite low. The low annual gross margins are an obvious demotivating factor as far as farming is concerned.

According to the Kenya wage bill 2015, (Mbuthia, 2015) the gazetted monthly average ranges between kshs. 12,136.00 and kshs.15,357.00 excluding housing allowance. It is concluded that the farmers in the study area are therefore earning far below the minimum threshold.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This section presents the study's summary of findings, conclusion and recommendations in line with the research questions. The summary of the analysis of each research indicator is featured and from this study analysis, associated recommendations for improvement of crop production in irrigation schemes in ASALs of Kenya and suggestions for further research were given.

5.2 Summary of findings

The study sought to investigate factors influencing crop production in irrigations schemes in the ASALs of Kenya with an aim of proposing measures and strategies that could improve crop production through irrigated agriculture in these areas. The study engaged all participants of HIS namely; HIS staff members, IWUA members and farmers. As far as demographic characteristics were concerned, 102 (88%) of the respondents were male and 14 (12%) were female, a clear indication that men were the decision makers. However, women participated actively in the irrigation farming activities which resulted in them being over-burdened. As for age, 65 (56%) of the Scheme's participants were in the range of 40 years and above, 30 (26%) were between 31-40 years, 15 (13%) were between 21-30 years, 6 (5%) of the Scheme's participants were below the age of 20. This was an indication that majority of the participants ranged between the age of 40 and above and the young shunned from the farming activities.

The respondents were from different marital status where 91 (79%) of the respondents were married, 20 (17%) were widowed and 5 (4%) were single. The married group participated more in the Scheme's farming activities.

For the education levels, 60 (52%) had primary education, 30 (26%) had secondary education, 14 (12%) had never attended any school, while only 12 (10%) had attained tertiary education. Low education levels for majority of the respondents were expected to be a major challenge in adoption of new farming methods.

While investigating the gross margins in HIS, the study established that the irrigation scheme had an average of two cropping seasons. The average number of acres cropped per farmer per season was two (2) acres. 116 farmers (100%) cropped maize (seed maize) which was produced under contractual arrangements with Kenya Seed Company. The farmers spent on average Kshs.

36,810 per acre as crop production costs; Kshs. 11,350 (31%) was spent on pesticides, kshs.10, 200 (28%) on fertilizer, kshs. 4,360 (12%) on weed removal, kshs. 3,800 (10%) on land preparation, kshs. 3,400 (9%) on operation & maintenance costs, kshs. 2,500 (7%) on planting labour costs and kshs.1, 200 (3%) on seeds.

The costs of pesticides and fertilizer were the highest. Majority of the farmers, 86 (74%) harvested between 15-20 bags of seed maize. The price of sale for the seed maize was the same for all farmers at Kshs. 68 per kg. The average expected income per acre per season was kshs. 91,800.The average gross margins per acre per year were calculated to be kshs. 109,980.00 which meant that the farmers earned an average of kshs. 9,165.00 on a monthly basis which was quite low.

While investigating the influence of the culture of the community living in HIS, the study established that, 98 (85%) practiced pastoralism as an economic activity, 6 (5%) had salaried employment, 6 (5%) practiced farming, 5 (4%) were casual labourers and only 1(1%) had a business running. This was a clear indication that the community had minimal experience as far as farming was concerned. On revival of irrigation in the scheme, there was a major shift as far as economic activities in the community living in HIS were concerned. All the respondents indicated that farming through irrigation was their current major economic activity. The findings portrayed irrigation agriculture to be largely valued and majority of the farmers felt that the Irrigation Scheme had improved their livelihood in one way or another. This meant that, the perception of irrigated agriculture in HIS did not contribute to the low gross margins in HIS.

While investigating the influence of availability of labour in HIS on crop production, the study established that, the average household size was therefore found to have 6-10 members.

There were 20 labour days per month provided by 3 adults (Above 18 years), 20 labour days by 3 school going children (9-18 years) during school holidays and no labour days were provided by small children (less than 9 years). It may therefore be noted that the farmers were not able to provide enough labour for their farms to operate the scheme successfully based on the labour requirements for the scheme. Moreover, the population density was too low (6 people per km^2) thus providing limited labour to be hired to make up for the shortfall in the Scheme. The unavailability of labour in Hola Irrigation Scheme has therefore contributed to the low gross margins in HIS.

While investigating the availability of agricultural support services in HIS, the study established that, 40 (34%) of the respondents had been trained on crop establishment of seed maize, 31(27%) on crop management of seed maize, 23(20%) on harvesting & post-harvest handling of seed maize and 13 (11%) on land preparation for seed maize. These trainings were not adequate.

The credit facilities were already available according to the survey conducted and were limited to 65 (56%) received from Equity Bank, 37 (32%) from Kenya Commercial Bank and 14 (12%) from KWFT. The high interest rates led to failure in payment credit which meant no cropping for the defaulters in the next season. This therefore contributed to the low crop production in HIS.

5.3 Conclusions of the study

The study focused on factors influencing crop production in HIS, Tana River County. The demographic characteristics of the community living within the study area were also investigated. The study therefore concludes that demographic characteristics and especially gender imbalance plays a large role in development projects in HIS. Women in the ASALS have remained behind the scenes as far decision making is concerned. They however, participate actively in the irrigation farming activities which have resulted in them being over-burdened

Low education levels for majority of the respondents are interpreted to be a major challenge as this affects the decision making processes particularly for uptake of technologies as well as influence on livelihood change.

The variable costs for irrigation are quite high and this increases the farmers' costs of production thus reducing their gross margins.

The main economic activity for the community before irrigated agriculture was pastoralism. The farmers had no prior experience in farming and this contributed greatly to low yields encountered in the Scheme as the training on better farming practices was inadequate. The attitude of the community living in HIS towards farming was positive. They had however not embraced the hardworking culture in them which may explain the low yields from their farms.

The available labour was estimated as an average figure, based on the assumptions on household composition. This however ignored the variation that existed between farms. The labour within the scheme was insufficient for all the irrigation activities. Accordingly, there may be a need to estimate the proportion of the families that are not able to meet the labour requirements.

The project area lacked an agriculture training facility to support the project through training and demonstration plots. The farmers in HIS therefore had very little training in irrigated agriculture. The training of farmers and the adoption of new farming practices was the mandate of the country's extension services. However, most extension agents in sub-Saharan Africa are not familiar with irrigated crop production. Hence the need to assess the level of extension know-how and provide for the training needs of the extension staff. While the success of achieving the desirable results will greatly depend on the adaptability of farmers, no effort should be spared in developing and implementing the appropriate training for the farmers.

Irrigated crop production is a high-input high-output system. Farmers therefore need to procure seeds, fertilizers and chemicals in order to optimize their production system. The need for credit is therefore very important.

5.4 Recommendations of the study

In order to ensure sustainable crop production in Irrigation Schemes in ASALs of Kenya, the study recommends the following:

1. The Kenya Constitution proscribes discrimination on the basis of gender among other factors. The stakeholders support the idea of applying affirmative action to engender the project by ensuring that integration of youth and women into the project both at production and management levels. In this regard registered youth and women groups should be allocated irrigation plots upon application in the section earmarked for commercial irrigation. This will contribute to equitable access to productive resources as well as economic empowerment of women and youth through earnings from farming and employment creation. In addition, the affirmative action principle will give the women and youth a voice in the management and governance of the project.
2. The level of education is perhaps the single most important factor in development. No society in the history of humankind has progressed without a strong educational foundation. The free primary education policy that is currently being implemented in Kenya is a step in the right direction. There is therefore need for concerted efforts between the government, civil society and religious organizations to double their efforts in ensuring that the current boundaries and reaches of education are expanded through a deliberate and systematic strategy of allocating sufficient resources to build additional

schools, expand existing ones and equip these schools with the basic equipment and necessary personnel in the ASALs.

3. Extension and training should be conducted through linkages with NIB staff, Ministry of Agriculture, Research institutions like KALRO, Universities and International bodies with expectations of providing training through research and demonstration farms.
4. Private firms should be engaged to provide credit in terms of working capital. The National Irrigation Board is expected to play a major role in credit recovery process from the farmers. This can also be achieved by collaborating with lending institutions (such as MFI's, AFC), and private stockists which supply inputs in advance. The necessary legal and contractual requirements are also expected to be put in place.
5. Research and farmers training institution should be considered with the following facilities: Applied Research plots, crop demonstration plots, offices, tuition facilities, boarding facilities and transport facilities. The institution should have the following staff: Manager; crop subject matter specialists (SMSs); technicians, administration and support staff. The institution should be managed under the National Irrigation Board structure like the Mwea Irrigation Agriculture Development centre (MIAD).
6. It is advisable to look for a less labour intensive cropping pattern or perhaps put forward some conditions concerning the size of families selected for Irrigation Schemes or ensure that the cash income generated from irrigation is large enough to hire the extra labour. If the calculation shows that there is need for hired labour during certain months, some thought should be given as to whether this labour will be available.
7. The pastoralist community should be integrated into Irrigation Schemes in order to accord all the ethnic communities an opportunity to participate in the management and governance of the scheme.

5.5 Suggestions for Further Study

The focus of this study was to investigate on factors influencing crop production in irrigation schemes in the ASALs of Kenya. From the findings of this study, it is suggested that further research be carried out on the support to agricultural production and establishment of market linkages through value chain approach for the ASALs of Kenya as far as irrigated agriculture is concerned.

Moreover, Feasibility Studies on establishment of high value crops in the irrigation schemes in ASALs of Kenya should be undertaken.

Studies on integration of pastoralism into the irrigation schemes as opposed to eliminating it have been recommended.

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APPENDICES

APPENDIX I: LETTER OF TRANSMITTAL

WINNIE MUGERA
P.O BOX 14572-00100
NAIROBI

Dear, Sir/Madam,

RE: FACTORS INFLUENCING CROP PRODUCTION IN IRRIGATION DEVELOPMENTS IN ASALS OF KENYA

I am a Master of Arts student at the University of Nairobi- Extra-Mural Centre (Reg No. L50/62004/2013). I am undertaking a study that seeks to examine factors affecting crop production in irrigation developments in ASALs of Kenya as a partial fulfillment for the requirement for an award of a Masters in Arts degree in Project Planning and Management.

You have been randomly selected to provide information on the above factors through the issued questionnaire. This is a request for your participation in responding to the attached questionnaire. Your honest response will help facilitate this study.

Please be assured that any personal information given will be treated with utmost confidentiality and will be purposely used for this study.

Thank you for your participation.

Yours Faithfully,

Winnie Mugera

APPENDIX II: QUESTIONNAIRES

The Questionnaire seeks to gather information about Hola Irrigation Scheme. It is sub- divided into six sections. The first part contains the respondent's general information and the other five address the study variables. The identity of all the respondents will be confidential. Kindly do not include your name in the questionnaire. Participation of the survey will be voluntary and all the information given will be used only for the research purpose.

Date: ……

PART A: General Information

Please put a tick where appropriate.

1. What is your gender (i) Male [ ] (ii) Female [ ]

2. Age bracket in years (i) 20 years and below [ ] (ii) 21 -30 [ ]
(iii) 31 -40 [ ] (iv) 41 and above [ ]

3. Marital Status: (i) Single [ ] (ii) Married [ ] (iii) Widowed [ ]

4. Level of your education?
(i) Primary level [ ] (ii) College level [ ] (iii) Secondary level [ ]
(iv) University level [ ] (iv) Never attended any school [ ]

PART B: Costs of Inputs in Crop Production

5. Indicate the costs incurred for each of the following farming activities per season per acre.

S.No	**Activity**	**Cost per acre (Kshs)**
1.	Cost of seeds	
1.	Cost of land preparation	
2.	Cost of planting	
3.	Cost of weeding	
4.	Cost of fertilizer	
5.	Cost of pesticides	
6.	Operation & Maintenance fees	

PART C: Culture of the Community in Hola Irrigation Scheme

6. Which economic activity did you practice before irrigation agriculture was revived in Hola Irrigatio Scheme?

(i) Pastoralism [ ] (ii) Business [ ] (iii) Salaried employment [ ] (iv) Casual labour [ ] (v)Farming [ ]

7. What is your current major economic activity?

(i) Pastoralism [ ] (ii) business [ ]

(iii) Salaried employment [ ] (iv) Casual labour [ ] (v) Farming [ ]

8. What is your perception of irrigated agriculture?

(i) Largely valued [ ] (ii) Moderately valued [ ]

(iii) Not largely valued [ ]

PART D: Availability of Labour in Hola Irrigation Scheme

9. Size of household (i) 1- 5 [ ] (ii) 6- 10 [ ] (iii) 11 and above [ ]

Whose head of the family is (i) Father [ ] (ii) Mother [ ] (iii) Child [ ]

10. Household composition and number of labour days provided by each member (tick where appropriate)

S. No	Household Composition	No.	Number of labour days provided
1.	Adults (Above 18 years)		
2.	School going children (9-18 years)		
3.	Small children (less than 9 years)		

PART E: Availability of Agricultural Support Services in Hola Irrigation Scheme

11. Have you been trained on any of the following farming practices?

Trained areas	**Yes/No**	**Adequacy of the training***(please tick where appropriate)*
Land preparation for seed maize		Adequate [ ] Not adequate [ ]
Crop establishment of seed maize		Adequate [ ] Not adequate [ ]
Crop management of seed maize		Adequate [ ] Not adequate [ ]
Harvesting and post-harvest handling of seed maize		Adequate [ ] Not adequate [ ]

12. Do you have access to loans from the following institutions?

Institutions offering loans	**Yes/No**
Kenya Women Finance Trust (KWFT)	
Equity Bank of Kenya	
Kenya Commercial Bank	

PART F: Gross margins analysis for crop production in Hola Irrigation Scheme

13. How many cropping seasons are there in a year in the scheme? .....

14. How many acres of land are cropped per season?

(i) One [ ] (ii) Two [ ] (iii) Three [ ] (iv) Four and above [ ] (iv) None [ ]

15. Which crops are commonly grown in a season? …….

16. How many bags of produce are harvested per acre (please tick where appropriate)

Average number of bags harvested per acre (90kg)	**No.**
5-10	
10-15	
15-20	
20-25	

17. Estimate the income from sale of produce (Kshs. per kg)……

18. State the buyer of your produce……..

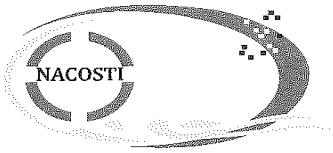
FOR OFFICIAL USE ONLY

This survey was carried out by: ……

Signature: ……..…. Date……

Mobile Phone Number: ……

APPENDIX III: NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY AUTHORIZATION PERMIT LETTER



NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471,
2241349, 310571, 2219420
Fax: +254-20-318245, 318249
Email: secretary@nacosti.go.ke
Website: www.nacosti.go.ke
When replying please quote

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

Ref: No.

Date:

30th June, 2015

NACOSTI/P/15/5255/6810

Winnie Nyaguthii Mugera
University of Nairobi
P.O. Box 30197-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Factors influencing crop production in irrigation schemes in the Arid and Semi Arid Lands of Kenya. The case of Hola Irrigation Scheme, Tana River County"*** I am pleased to inform you that you have been authorized to undertake research in **Tana River County** for a period ending **30th September, 2015.**

You are advised to report to **the County Commissioner and the County Director of Education, Tana River 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. M. K. RUGUTT, PhD, HSC.
DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Tana River County.

The County Director of Education
Tana River County.

APPENDIX VI: RESEARCH PERMIT

THIS IS TO CERTIFY THAT:
MISS. WINNIE NYAGUTHII MUGERA
of UNIVERSITY OF NAIROBI, 0-100 Nairobi,has been permitted to conduct research in *Tanariver County*
on the topic: *FACTORS INFLUENCING CROP PRODUCTION IN IRRIGATION SCHEMES IN THE ARID AND SEMI ARID LANDS OF KENYA. THE CASE OF HOLA IRRIGATION SCHEME, TANA RIVER COUNTY*
for the period ending:
30th September,2015

Permit No : NACOSTI/P/15/5255/6810
Date Of Issue : 30th June,2015
Fee Recieved :Ksh 1,000

.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation

CONDITIONS

1. **You must report to the County Commissioner and the County Education Officer of the area before embarking on your research. Failure to do that may lead to the cancellation of your permit**
2. **Government Officers will not be interviewed without prior appointment.**
3. **No questionnaire will be used unless it has been approved.**
4. **Excavation, filming and collection of biological specimens are subject to further permission from the relevant Government Ministries.**
5. **You are required to submit at least two(2) hard copies and one(1) soft copy of your final report.**
6. **The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice**

REPUBLIC OF KENYA

NACOSTI

National Commission for Science, Technology and Innovation

RESEARCH CLEARANCE PERMIT

Serial No. A 5522

CONDITIONS: see back page