FACTORS INFLUENCING SUSTAINABILITY OF SMALL SCALE FISH FARMING PROJECTS IN KENYA: THE CASE OF SOUTH IMENTI SUB-COUNTY, MERU COUNTY

GATONYE, MARGARET WANJIRU

A Research Project Report Submitted in Partial Fulfillment of the Requirements for the Award of Degree of Masters of Art in Project Planning and Management of the University of Nairobi

2017

DECLARATION

This research project report is my original work and has not been submitted and/or presented for academic award in any other University

Signature _____ Date _____

GATONYE, MARGARET WANJIRU

L50/84473/2016

This research project report has been submitted for examination with my approval as the University Supervisor

Signature _____ Date _____

PROF. CHRISTOPHER GAKUU

OPEN AND DISTANCE EDUCATION LEARNING (ODEL)

UNIVERSITY OF NAIROBI

DEDICATION

This research project report document is dedicated to my parents Joseph Gatonye and Judith Njeri Gatonye, my brother Antony Ngugi and my sister Mary Mukami and my extended family for their continued encouragement during this entire period of my study.

ACKNOWLEDGEMENT

I acknowledge Professor Christopher Gakuu, my supervisor for his expertise, guidance and in-depth evaluation of this work. I wish to recognize my lecturers, extra mural department staff as well as the Jomo Kenyatta Memorial librarians who played a key role and contributed immensely to the successful completion of my course work and research project report. I also wish to thank the Proposal and final defense examiners for their comments and additions to my research project. I appreciate my friends Dennis Kikete, Dr. Fred Jonyo, Joseph Rarama, Domiciano Maingi, Patrick Kiara, Stanley Mworia, Mr. Patrick Mbaabu, Fisheries Director, Meru County and South Imenti Fisheries Officer Mr. Ngetich for their help and motivation through this process and all those who helped in one way or the other. To all weekend students of 2016 Masters of Arts Degree in Project Planning and Management Class of Extra Mural Center main campus Nairobi, thank you for the team work, encouragement, and motivation.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS AND ACRONYMS

AAK: Aquacultural Association of Kenya

AUIBAR: African Union –InterAfrica Bureau Animal Resources

ESP: Economic Stimulus Programme

EU: European Union

FAO: Food and Agricultural Organization

HLPE: High Level Panel of Experts

IFAD: International Fisheries and Aquaculture Develeoment

IOC: Indian Ocean Commission

KEPSA: Kenya Private Sector Alliance

KMFRI: Kenya Marine and Fisheries Reserch Instituite

LVFO: Lake voctoria Fisheries Organisation

MOALF: Ministry of Agriculture Livestock and Fisheries

MOFD: Ministry of Fisheries Development

MDGs: Medium Development Goals

MT: Metric Tonnes

NARDTC: National Aquaculture Research Development and Training Center

ABSTRACT

Aquaculture is recognized as one of the fastest growing subsector in the world for sustainability of fisheries sector especially in developing countries like Kenya where capture fisheries is dwindling in Lake Victoria due to over fishing. Consequently, the Kenyan Government is keen to promoting small scale fish farming projects through initiatives such as the Economic Stimulus Program in 2009. However, most small-scale fish farming projects are either dormant, have collapsed or are still operating under recurrent expenditure hence become unsustainable. The purpose of this study therefore was to identify factors influencing sustainability of small scale fish farming projects. Specifically, it sought to determine the influences of cost of inputs, provision of extension services, accessibility to market and use of technology as the main factors of sustainability in small scale fish farming projects. The study was guided by the Diffusion of Innovation Theory (DOI) and Theory of Production. Mixed Method research design was used, targeting small-scale fish farmers in South Imenti Sub-county, Meru County. To collect both qualitative and quantitative data cluster sampling was used. Yamane formula was used to obtain the sample size of 148 respondents. Questionnaire, interview schedules and focus groups were used as data collecting instruments. Of 150 questionnaires distributed 109 were filled and returned. Descriptive statistics (Mean, standard deviation, frequencies, and percentages) and inferential statistics (correlation) were adopted to measure relationships and give meanings. The study established that small scale fish farming projects are greatly influenced by provision of extension services ($r = 0.521$) indicating that an improvement of the services to the farmers results to higher and better yields which in turn result to sustainability. Access to market ($r = 0.411$) also influenced sustainability, this indicates accessing broader markets would consequently make fish farming sustainable. Use of technology ($r = 0.301$), proved to have an influence on sustainability implying that adoption and use of technology significantly influences the production positively hence making the projects sustainable. Lastly, cost of inputs ($r = 0.013$), the low value can be explained as the variable having dual impact on the respondents, while to some farmers high cost means less production there were others that high cost meant good quality hence high production. The study recommends that the government gives subsidies to farmers hence lowering the cost of inputs, employ more extension officers and provide resources for ease of access to the farmers; farmer organizations should lobby the government to provide subsided and lower taxes on farm inputs and finally farmers should be advised to form production and marketing groups so as to easily meet the market demands.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The global fishery has declined tremendously over the years due to increased catches. This has seen aquaculture become the fastest growing food producing sectors in the world (FAO, 2012). According to HLPE, (2014) aquaculture has led to an increase in availability of fish and significantly contributes to the consumption of fish products worldwide. Globally, aquaculture has significantly grown over the past half century to around 52.2 million tonnes in 2008 worth US$ 98.5 billion and in turn representing about half of the world's fish food supply (John Bostock, 2010). According to FAO, (2014), food fish supply has been increasing in the last five years at an annual average rate of 3.2 per cent, surpassing the world population growth of 1.6 per cent.

Small scale fish farming in sub-Saharan Africa is a recent activity (FAO, 2004). However, aquaculture in Africa continues to steadily grow with millions of poor people relying heavily on fishing and farming to earn their livelihood and feed their families. Africa relies heavily on fish as an important source of animal protein (FAO, 2004). These has led to aquaculture played a key role in food production, economic development and food security therefore meeting the rising demand for fish in Africa, Asia and whole world. Despite the 126 million metric tonnes (MT) of fish available for consumption in 2009, Africa had the lowest consumption (9.1 million MT with 9.1 kg per capita), Asia consumed two-thirds of total consumption with 85.4 million MT (20.7 kg per capita) of which 42.8 million MT was consumed outside China (15.4 kg per capita) (FAO, 2012). Presently, the contribution of the African aquaculture sector to the

global production stands at less than 1 per cent, with significant production in Egypt, Ghana, Nigeria and Zimbabwe. (Randall, 2008).

According to Eyster, (2014), Aquaculture in East Africa countries is still a new industry and with the current growth can barely meet the increasing need for fish and its products. The European Union through different development partners; Food and Agriculture Organization Indian Ocean Commission-Smart-fish(IOC-SmartFish), African Union-InterAfrica Bureau Animal Resource(AUIBAR), Lake Victoria Fisheries Organization(LVFO) among others have made tremendous strides in the promotion of the development of fisheries and aquaculture in the East Africa countries. The relationship between fish and aquaculture across the East Africa has been analyzed showing the biggest fish consumers being Uganda, followed by Tanzania and lastly Kenya to a low extent. (Arjo Rothuis, 2014).

Fish farming in Kenya goes back to the early 20th century, when trouts were introduced as a sport fishing activity (E. Okemwa, 1996). It later evolved to water pond culture of Tilapia Common carp (Cyprinus carpio) and African catfish (Clarias gariepinus) were introduced. Research by Charles (2007) indicates that just like many African countries characterized by small ponds, low production and low-level management until the mid-90s, the Kenyan case has not been any different. Farmed fish is believed to be of commercial value. According to Mwangi, (2008) aquaculture is the only viable alternative sources of fish especially due to the diminishing stocks of capture fisheries. In 1999, fish production from Lake Victoria was 200,000 MT eight years later in 2007 the production had dropped with 70,000 MT with very limited chances of recovery of the sector soon. According to FAO, (2016), in 2009 Kenya had 6328 fish farmers with on 9116 earthed ponds covering 275.37 hectares (ha). This figure

showed a marginal increase from the total of 4742 farmed with 7530 ponds covering 227.79 ha in 2008. Based on FAOs reports a total of 4890 MT was recorded in 2009.

Aquaculture in Kenya has massive potential (currently contributing 2.5 per cent to our fishery while it can potentially contribute as much as 50 per cent to the Kenyan fishery output), it requires massive investment in modern technology for its maximum output. (Kagiri, 2016). Aquaculture is very important to fishing community; it earns people a living by providing income, creating jobs, and improving their health. The sector supports approximately 80,000 Kenyans directly and another 800,000 indirectly. (Mwangi, 2008). Through the Kenyan government interventions to promote aquaculture development by 2015, several achievements had been realized, this included development of fish breeding structure with holding capacity of 200,000 brood-stock; procurement of 54 feed pelleting machines and distributed to clusters of fish farmers, 286 fisheries extension officers recruited; the national aquaculture production increased from 1,047 MT tin 2005 to 24,096 MT in 2014 which has a farm gate value of Kshs 5.6 billion compared to 23,501 MT valued at Kshs 5.5 billion in 2013 (MOALF, 2015). Like most other high potential counties in the country aquaculture in Meru is growing at a tremendous rate. Fish farming in Meru is mainly done by small scale fish farmers. There are about 2500 fish farmers in the county who own 2000 fish ponds. The major types of fish cultured in Meru are tilapia, African Catfish (mud fish) and trout (CIDP, 2013).

1.2 Statement of the Problem

This study investigated the factors influencing sustainability of small scale fish farming projects in South Imenti Sub-county, Meru county Kenya. Fish farming in Kenya is mainly done by small scale fish farmers who do subsistence farming under semi intensive type farming. This type of farmers are scattered all over the country making it hard to reach them. In

2009 the government of Kenya through the then Ministry of Fisheries Development implemented the Fish Farming Economic Stimulus Programme (ESP) whose main aim was to promote fish farming in the country. Through the programme, 200 earthen ponds were constructed where some of the beneficiaries included institutions, primary and secondary schools and small-scale farmers from 140 constituencies. Meru county and more particularly South Imenti Sub-county was among the beneficiaries of this programme. In 2014, Meru County had a total of 3,250 pond that were both ESP and non ESP occupying an average pond area of 926,250 M^2, the total production that year was 2,037,750 kgs valued at 610.9 Million; South Imenti, Sub-County had 418 ponds occupying an average pond area of 12,400M^2, the total production that year was 275,880kgs valued at Kshs86.4 Million (SDF,2014).

However, despite the government initiatives to promote fish production, create job opportunities for young people, generate income and promote food security, the sustainability of small scale fish farming projects has been very low. Most of the fish farming activities have either collapsed, stalled, or/and continue to run under recurring expenditure due to high cost of inputs (fish feed and seed) leading to low productivity from aquaculture, inadequate extension services and trainings, lack of access to markets and marketing and low adoption of new technologies. These problems have made it difficult for small scale fish farmers to make money from fish farming and sustain the fish farming as a profitable enterprise.

It was on this background that the research was premised, it aimed at identifying factors influencing sustainability of small scale fish farming projects in Meru County, South Imenti Sub-county.

1.3 Purpose of Study

The purpose of this study was to identify factors influencing sustainability of small scale fish farming in Kenya focusing on South Imenti, Meru County.

1.4 Objectives of the Study

i. To assess how cost of inputs influence sustainability of small scale fish farming projects in South Imenti sub-county Meru County Kenya.
ii. To establish how provision of extension services influence sustainability of small scale fish farming projects in South Imenti sub-county Meru County Kenya.
iii. To assess how accessibility to market influence sustainability of small scale fish farming projects in South Imenti sub-county Meru County Kenya.
iv. To establish the influence of new technology on sustainability of small scale fish farming projects in South Imenti sub-county Meru County Kenya.

1.5 Research Questions

This research aimed to answer the following question:

i. How does cost of inputs influence sustainability of small scale fish farming projects in South Imenti sub-county Meru County Kenya?
ii. How does provision of extension services influence sustainability of small scale fish farming projects in South Imenti sub-county Meru County Kenya?
iii. How does accessibility to market influence sustainability of small scale fish farming in South Imenti sub-county Meru County Kenya?
iv. In what way does use of new technologies influence sustainability of small scale fish farming in South Imenti sub-county Meru County Kenya?

1.6 Significance of the Study

The government of Kenya through the State Department of Fisheries and the Blue Economy has tried to address the declining production of capture fisheries through promoting aquaculture development in the country (MOALF-SDF, 2013). One such initiative is the Fish Farming Economic Stimulus Programme in 2009 that completely transformed fish farming in the country by promoting fish production and consumption. The National Aquaculture Strategy and Development Plan 2010-2015 MOFD (2010), proposed the need to address critrical issues relating to aquaculture development that is, input supply, access to extension services and markets. Fish farming in Kenya is mainly done by small scale fish farmers who are scattered in different parts of the country.

In 2011, the government launched the National aquaculture policy that was aimed at guiding the sustainable development of the aquaculture subsector in an effective and coordinated manner (MOFD, National aquaculture Policy (2011): Ministry of Fisheries Developemt , 2011). However, despite the government support, high cost of inputs such as fish feed and seed, inadequate extension services and training, lack of access to markets and low use of modern technology contributes greatly to slow growth of the aquaculture sector and this has contributed to the sector accounting for only 1% of the total national fish production MOFD (2009) despite the existing aquaculture potential in the country.

Currently, the government continues to actively promote small scale fish farming by encouraging small scale fish farmers transform from subsistence fish farming to commercial fish farming through reinvesting in their business. There is therefore need for information on the factors influencing sustainability of small scale fish farming in the country and particularly

Meru County. An analysis of profitability and projects cost of inputs will therefore help to evaluate viability of the investment and efficiency of government resource allocation.

This study adds to the existing knowledge on factors affecting sustainability of small scale fish farming projects in Kenya; help scholars explore more on the gaps in small scale fish farming and aquaculture sector in general; benefit the small-scale fish farmers who will be able to understand the factors that affect sustainability of their industry; act as an eye opener to many as well as enable the fish farmers to counter the challenges faced in the sector. The study is also useful to the National government, County government and policy makers as it will provide insight on what affects sustainability of small scale fish farming projects and also offer guidelines for policy formulation and inform decision making, and by so doing clearly identifying the gap areas that need more resources to revamp the sector.

1.7 Basic Assumptions of the Study

According to Simon, (2011), assumptions are items out of the researcher's control, but if allowed to disappear the study would not make much sense. They show whether the limiting factors may or may not affect the study outcome. 2017 being an election year in Kenya, it is assumed that during this study political instability will not affect data collection. According to Alberto, (1996) "political instability" is the propensity of a government collapse.

The researcher assumed that the sample population involved in the study was voluntarily willing to participate and respond to questions truthfully. The researcher also assumes that the respondents understood the questions in the questionnaire and interview schedule and responded objectively that the respondents were conversant with challenges in small scale fish farming.

1.8 Limitations of the Study

The study projected the following limitations; time given to the study was likely to hinder the researcher from interviewing all the small-scale fish farmers in South Imenti. It is based on this that the researcher drew a sample of the population and generalized the findings as representative of the same. Lack of co-operation from the respondents, the researcher expected some respondents not be cooperative. This would have hindered the researcher from getting the required information. This was mitigated by the researcher familiarizing herself with the community, respondents and the fish farmers and signed a confidential consent with the respondent. Other respondents may withhold crucial information being sought by the researcher especially information that touched on money issues. This was because they feared being exposed to authorities like Kenya Revenue Authority. This was mitigated by assuring the respondents that their information would be solely used for study purposes only and that it would not be disclosed to anybody without their consent.

1.9 Delimitation of the Study

This study focused on small scale fish farming projects in South Imenti, Meru County and explores the factors affecting its sustainability. It was conducted to cover all the six wards within South Imenti Subcounty namely; Nkuene, Abogati West, Abogati East, Igoji East. Igoji West and Mitunguu. The study was concerned with the factors influencing sustainability of small scale fish farming projects in South Imenti, Meru County

1.10 Definition of Significant Terms Used in the Study

Access to information: ability to gather, share and disseminate information to farmers in a timely manner and through effective and efficient channels of communication.

Accessibility to market: means the ability of a fish producer to sell fish and fish products within and beyond boarders to make profit

Cost of inputs: refers to cost of farm inputs used in fish farming this include cost of seed(fingerlings), feeds, pond liners, nets, and all other equipment's

Fish farming: refers to growing of fish and aquatic plants in a controlled environment eg ponds, cages, race ways

Provision of extension services: refers to the act of applying new knowledge/skills and scientific research to agricultural practices through farmer training or education. The content of this study also included trainings.

Use of new technology: is the acceptance of new technologies available and use of these technologies to improve production and productivity of fish farming projects

Sustainability in fish farming: refers to fish farming for today and the future**.**

Small scale fish farming projects: refers to fish farming with low investment. The term is also interchangeably used with subsistence fish farming.

Small scale fish farmer: refers to a farmer with one to five ponds.

1.11 Organization of the Study

This research study was arranged in chapters one to five. Chapter one introduced the study by looking at the background of the study, the statement of the problem, the purpose, objectives and research questions, significance, limitation and delimitation of the study, basic assumption, definition of significant terms used in the study and organization of the study. Chapter two reviewed the available literature on the factors influencing sustainability of small scale fish

farming projects in Kenya. This was derived from scholars who had studied subjects in other small sac le fish farming contexts. The chapter provided the theoretical framework that identified two theories that used be in the study and the conceptual framework that outlined the relationships between the dependent, moderating and independent variables identified in the subject of study. Chapter three looked at the research methodology that highlighted the research design, target and sample populations of the study. It further broke down the instruments used to collect, analyze the data and also the data analysis techniques used. In details it explained the sampling procedure used to determine how data was collected as well as the validity, reliability and ethical awareness of the research study. Chapter four gave the results findings of the data analysis presentation in frequency table and interpretations. Chapter five gave the summary of the findings, discussions of the finding, conclusions and recommendations made on each of the research objectives.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter gives a review of the existing related literature. It critically analyzes and presents the theoretical discussion while explaining the conceptual framework, relationships on sustainability of small scale fish farming projects; cost of inputs, provision of extension services; accessibility of market and use of technology while spotting the gaps that are addressed later in the study.

2.2 Sustainability of small scale fish farming projects

Sustainability is without doubt one of the most important challenges in today's time and immediate future. This is because most donors funded projects die as soon as the donor pulls out. According to WCED, (1987), sustainability as a concept of development is one that meets the need of the present without compromising on the future generation to meet their needs. Sustainability is very crucial and must be addressed as a requirement in any projects during its planning and design stages (Reza, 2012). Sustainability involves balancing or harmonizing social, environmental, and economic interests considering the full life cycle of any project. Economic sustainability has been defined as effectively and efficiently using available resources to ensure that the business continues return profit over several years. According to Foy, (1990) there are many ways to look at economic sustainability nevertheless: Economic sustainability needs current economic activities which do not jeopardies or burden the finances of the future generation.

For small scale fish farming projects to be economically sustainable, fish and fisheries products needs to be produced at a competitive cost with other animal-protein sources and sold at a

reasonable profit. Other sustainability factors include participation and inclusion of small scale fish farmers and farmers associations in the planning and implementation of projects. Constant interaction between the beneficiaries/ target groups and projects is needed. Sustainability of agricultural projects is assessed in terms of viable production system and the satisfaction of basic social and economic needs (IFAD, 2009). According to Garling, (2009) economic considerations can be divided into investment, finance, production and marketing. Net present value (NPV) is one of the popular methods for analyzing profitability of an investment project (Howard, 1993). NPV gives an indication of the present value of future earnings. If the NPV of a project is positive, the project is profitable and if the project is negative it should be abandoned (Sobo, 2014). The higher the NPV value the more profitable the business/investment is.

In his article "sustainable aquaculture" Aquasol, (2003) gives three main economical areas that fish farming can be of help. The areas include growth, trade as well as standards of living. However his article does no elaborate as to how aquaculture has done this or would do this. Further, it also does not comment on whether fish farming has offered any benefits and who the benefits have gone to. Lastly, looking into the future the aricle does not comment on who this benefits will go to. According to Bernard, (2016) the final product quality and the individual task times are the major components of sustainability

2.3 Cost of inputs and sustainability of small scale fish farming

Literature highlights many problems with today's fish farming as it affects other problems activities and natural environment. According to Rahman, (2015) profitable pond fish production depends on the application of its inputs management and technology.

According to KEPSA, (2013), the cost of input like seed, pesticide, feed and vaccine is very high, leading to adulteration of inputs. Based on AAK, (2015) report cost of feed in Kenya accounts to about 60 per cent of the total fish production. This is because most of the fish feed found in Kenya is imported therefore very expensive and the locally made feed is adulterared leading to low protein content. One of the biggest constraints to aquaculture development in Kenya has been lack of quality fish seed (Mary *et.al*, 2017). According to NARDTC G. a., (2014) seed production plays a key role in fish farming and its important for fish farmers to use good quality seed. Quality seed guarantees fastgrowth, high yields and good survial rate. Prior years provision and distribiution of fingerlings depended on government, this did not help the farmers as expected due to poor infrastructure and low production level. However the governemnet initited two natioanl fish selctive breeding programs for Nile tilapia and African Catfish at the National Aquaculture Research Development and Training Center together with Kenya Marine and Fishereies Research Institute in Sagana in collaboratiuon with other development partners, to develop national breeding nuclei with multiplication centers and hatcheries to distribute quality broodstock to hatcheries (NARDTC, 2013).

This has seen the upcome of privately owned hatcheries authenticated by government ensure quality fingerlings production and also bridge the gap of inadequate fingerlings produced by governement and supply to farmers. The KMFRI, (2017) have tried to increase fish production in fish farming by promoting fish seed production through genetic improvement and hormonal manipulation to produce appropriate fish seed/ fingerling (monosex) that is resiliance to the kenya climatic conditions. Production of monosex tilapia fingerlings should enure that a minimum of 95 per cent are male (NARDTC G. a., 2014). Despite all this efforts to promote production of quality fingerlings some farmers still fill that the cost of monosex fish

seed is still very high. Others lack that knowledge of where to get this qulity fingerlings and end up buy mixed sex that does not give them maximum output.

Research done by Harrison *et. al*, (2017), shows that profitability of commercial fish farming operation is of paramount importance to all fish farmers. And to achieve this, farmers must have access to well balanced and cost-effective feeds coupled with optimal on- farm feed management practice. In Kenya, most fish farming relies heavily on natural foods in the pond system with some supplement feed to increase fish yield (KEMFRI, 2013). This is because most fish feed found in Kenya are imported and usually sold at very high prices due to high taxation and VAT. Some are adulterated tampering with the quality of the feed and later sold to farmers at cheap prices.

This has led some farmers to using supplements using locally available raw materials for example Ochonga, cassava leaves, sun flower, and white bran among others to feed their fish. These has further lead to farmers developing feeding strategies such as spreading feed at fixed points at same time daily, bag and restrict feeding techniques, break feeding schedules and promote natural pond productivity (Jonathan et al, 2014). The governemnt through the ESP programme promoted cottage industry through provision of fish feed pelleting machines, this pelleting machine produced bad quality pellets (sinking pellets). In 2015 the State Department of Fishreies through the Fish Quality Assurance Department developed a Manual of Standards Operatiing Procedures and the Residue Monitoring Plan to help ensure standards within the aquaculture sector. The lack of feed testing facility ie proximate analysis, Feed Conversion Ratio in kenya is still a major problem in trying to ensure production of quality fish feed.

2.4 Provision of Extension services and sustainability of small scale fish farming

Providing extension services to rural communities to improve their fish farming skills and capacity to increase their farming efficiency is very important in any project. by providing this services to the farmers it provides them with information on production, value addition, access to finance, marketing etc. Therefore provision of extension services play an important role in the development of aquaculture (Christian, 2016). According FAO reports aquaculture extension services have played an important role in the development of aquaculture nevertheless more is expected in the future. At grass root level efficient extension services are required to promote the existing farmers and potential farmers for effective promotion of equitable and sustainable development of aquaculture sector. In Kenya fish farming was popularized in the 1960s by the government through targeted "Eat More Fish" campaigns to promote consumption especially in the eastern and central parts of the country (Charles, 2007). Similary, to promote fish production and consumption in the country the governmnet initiated an ESP programme in 2009 (GOK, 2009). A report by KEPSA, (2013), indicates that in Kenya the effectiveness of extension services has declined over the last two decades due to a sharp reduction in operational budgets and human resource in the sector ministries. According to (FAO, 2004) one of the key problem in extension services is low level of support to field technician, those front line staff in direct contact with farmers.

Further Charlse and Manyala, (2004), in their study on Aquaculture extension services in Kenya shows extension services to be one of the major problems facing aquaculture sector development in the country mainly due to inadequate extension officers provided by the department of fisheries. A report by Sharma, (2004), indicates that government need to provide support services tailored to enable small scale farmers take up commercial farming through

sustainable practices. In his research Bernard, (2016) also emphasised on the need to radically restructure extension services to make technology dissemination responsive to small farmers. Bethwell, (2007) stated that capacity building and skills training determine the success of agricultural developemnt to realize a projects objectives and for this to be fulluy achieved the guidline for life of thr project must be strongly implemented. Research conducted by Hope (2009) found that to be engage in a sustaiablle manner to develop posiitively and reduce poverty as well as meet all the MDGs, extension should be regareded as the key ehnancement of competency of farmers and local communities.

Based on research conducted by FAO, (2004) Aquaculture extension in sub-Saharan Africa, extension agents gain important training in both technology and participation. However, one of the lessons learnt from this study was that "quality extension" does not simply mean that technicians have adequate technical training. In Kenya, aquaculture systems are characterised by high cost of inputs, inadequate extension services and lack of markets all leading to low fish production in the country. Despite the National and County government being aware of the inadequate extension services in the counties, a lot of government and donor funded projects are being implemented before addressing the issue of indequate and trained extension workers.

An assessment done by Kato *et al* (2000), in Asia attempting to provide a sustainable flat-form for future growth in Cambodia's future growth, international development agencies have adopted an interlinked approach showing the critical role for growth on the local level, bottem up growth initivie predominantly in rural societies that remain largely organised around rural-urban weak link and surounding villages.

In conclusion, prior years aquaculture extension services have been seen to target commercial fish farmers. This has slowly changes and studies show that small scale fish farming can also

contribute to poverty reduction provided the extension approaches are appropriate and flexible. Extension approaches that are currently being used in aquaculture and agriculture in general are considered inappropriate for majority of small scale fish farmers. The existing aqauculture extension services are under-resourced hence seen to suffer many of the commercial/large extension problems. To be able to have a more approriate extension approach that will develop small scale fish farming a participatory extension approach would be appropriate. Fish farmers and extension workers need to be equal partners in the development process.

2.5 Accessibility of market and sustainability of small scale fish farming

In Kenya, development of aquaculture has been occurring in recent years and marketing of aquaculture products has been an area of concern with many farmers desiring to attract international and regional markets (Mary. *et al*, 2017). According to KEPSA (2013) report on 'The Kenya National Business Agenda II 2013-2018' states that while Kenya's agriculture is better developed than that of most countries in sub-Saharan Africa, the domestic market is too poorly organized to take advantage of the regional market. Further report by FAO (2016) indicated that fish market in Kenya is classified according to target markets: local and international market where local fish is largely sold fresh while external market involves high quality standards during handling, processing and storage. Unpublished reports by AAK, (2015), indicated that supermarkets, hotels, schools, fish outlet center (establish through the Kenya productivity and agribusiness programme) are some of the main markets where small scale farmers sell their fish. In 30th July 2015 Kenya was listed to export farmed fish to the EU markets EU, (2015) this has opened up more market opportunities of fish and fisheries products to the European countries.

According to Heinemann (2002), farmers in the rural areas in Africa highlight access to market as one of the greatest challenge why they cannot improve their living standards. That notwithstanding, accessibility of fish Markets in Kenya has been a teething problem due to low production. Daniel *et. al* (2015) in his fish farmers training manual advised fish farmers to embrase cluster production and marketing approaches through cooperative societies to benefit from economics of scale. Daniel et al continue to state that fish production should be linked to market demand and fish farmers must ensure that they produce products demanded by the market. Several interventions have been made by development partners to promote competitiveness and access to market of farmed fish and fisheries products (Lucy *et. al,* 2015).

More literature review on small scale agriculture marketing done by Killick *et. at* (2000), Freeman and Silim (2001), IFAD (2003), Dorward *et.al*.(1998) found that there are many challenges linked to access to market such as price risk and uncertinity, lack of organised small scale producers which increases the cost of putting together sparsly dispersed quantities of produce and also lack of meeting the required market standards. In Kenya for example small scale fish farmers are geographycally dipersely, raods inpersible, and farmers not able to produce enough to meet the market demand. AAK (2014) confirm this stating that in the previous years marketing of fish for small scale fish farming was a major challenge due to farmers dispersly placed and not well organised.

In South Africa Senyolo & Chaminuka (2009), study showed that most emergeing farmers emenate from groups of smallholder farmers who were previously excluded from mainstream economy however, accessibility and use of market by the group are two main factors that determine the development of this groups of farmers. According to IITA (2001), to solve these problems farmers have formed cooperatives and collective maketing associations to increase

their burganing power in the market. AAK (2016) report say that fish in Kenya have formed cooperatives to help them market their fish. commercial fish farmers in kenya have also been keen to forming mutually beneficial alliance with the small scale farmers to supply marketable products at an agreed price (AAK 2016).

According to Pinstrup-Anderson and Shimolwawa (2006) lack of good infrustructure leads to poor domestic markets with little or no room for spacial or temporal integration, low prices and weak international competitiveness. In Vietnam poor road condition, high transport and market distance has been identifies as factors that hinder imporved market access for aquaculture farmers which has also contriubuted to failing inpu market Van & Tran (2016).

2.6 Use of new technology and sustainability of small scale fish farming

Technologies are increasingly being developed in a global market, for farm level application with an impact on the sustainability beyond the farm. Adoption and use of technology for sustainable fish farming systems is a multi-disciplinary approach taking into account a wide range of objective geared towards sustainable aquaculture.

According to FAO, (2017) over the last five years the system and technology used in aquaculture has developed rapidly. Similary, research by (El-Gayar, 1997) showed that recent advances in information technology have had profound impact on all walks of life and aquaculture is noexception. He continues to state that the growing importance of aquaculture as an alternative source for food protein has further emphasised the need to adapt and develop advanced IT for the better management of aquaculture facilities as well as the regional planning for aquaculture development. According to Wetengere, (2009) improving farm production through intergrated modern technologies into the existing farming systems is essential for the enhancement of household food and income security. His study recommended

that technology developers should strive to improve the profitability of fish farming through the reduction of the rish of losing fish, shortening culture cycle to target market size fish, use of low cost inputs and/or intergrating fish farming with the existing farming systems and access to urban market.According to Olatunji and Ogunremi (2016) findings on awareness of fish farming technolgies by fuish farmers they found out that lack of awareness, lack of knowledge of effects of recommended technology or negative attitude to the innivation may be responsible for non-adoption among farmers. Being a technology era in Kenya reserchers such as Bowman *et al*, (2007) have found the need to serch for moer knowlwdge on the use and uptake of new technologies through extension to ensure sustainabilty of small scale fish farming projects

A research by Jacobi, (2013) indicates that one of the reasons for slow aquaculture development in Kenya has been; use of traditional fish and water husbandry, political, social and economic constains that restrict investment and delay expansion and lack of information on fish farming technology (Fisheries Department, 2012). In his study Henri *et al*, (2011) contend that adoption of fish farming technology is more likely to be adopted by the yonger farmers. However, SANISSA (2011) case study shows that it is difficult for some countries to obtain knowledge on pond designand construction, hatchery equipments and other farm inputs such as aerators, cages and hatching incubators.

In regards to the use of technology Rajan *e.t al,* (2013) research found out that feed management, selection and management of seed are some of the important technological components in fish farming. In his study Onzere, (2013) found that comminities still used traditional methods of fish farming, harvesting and preservation. In her research Kagiri, (2016) stated that lack of technology has lead to reduced output as well losses since the fish harvested cannot be stotred for long period that would enable fish farmers market their produce at a later

date or even transport to a different location for sale. Wetenegere, (2010) states that fish farming has very high potental which can be fully utilized if only technology was adopted. According to Singas and Manus,(2014) farmers adopt fish farming technologies if they are assured that fish farming is a profitable venture. In his study Wetenegere, (2010) implies that importance of the recommended technology related to existing practices must be clearly demostrated to farmers. To ensure that the small scale farmers get the desired benefit, low cost technologies appropriate to the farmers needs to be extended widely. Contant information on new innovations made by research institutions like KMFRI can also help in drawing benefits from the innovations.

In conclusion technology adoption and use is quite broad and is affected by development, dissemination and application of the technologies at farm level especially farm capital and othe inputs. Its also affacted by extension, advise and information which form the basic of farmer knowledge as well as techniologies and practices in the overall agri-food sector that have an impact at the farm level. Fish farmers have always looked at new aquaculture technology as a way of reducing cost of production a clear indication that demand driven adoption and use of technology. Fish farmers invest in sustainable technology and farm practise if they expect the investment to be propfitable, have the right eductaion, information and motivation.

2.7 Theoretical Framework

This section explains in details the theories used in the research study. These theories include; theory of change, theory of production, diffusion of innovation theory and unified theory of acceptance and use of technology.

2.7.1 Theory of production

According to study by Douglas and Cobb, (1928) the theory of production attempts to explain the effect of cost of inputs on sustainability of small-scale fish farming projects. Theory of production answers the question "how to produce" which further discusses the supply side of the product prices which ultimately depends on cost of production. Cost of production depends on the physical relationships between inputs and outputs as well as prices of inputs. This implies that the amount of production in fish farming projects depends on the cost of input (Kagiri, 2016). Some of these inputs include the invested capital to a fish farming project and the day-to-day running cost of the project meaning that the lower the cost of inputs, the lower the cost of production hence high level of production. This therefore, means that fish farming projects are making profits and hence sustainable in the long run. Hence, the cost of inputs is vital in the sustainability of fish farming projects. This theory therefore is important to this study since it highlights the influence of cost inputs in the sustainability of fish business enterprise.

2.7.2 Diffusion of innovation (DOI) Theory

Adoption of new technologies process studied for the past few decades with Rogers book Diffusion of Innovation being the most popular. This theory is appropriate for the study for investigating the adoption of innovation in fish farming. An innovation is any idea, practice or any object seen as new Rogers, (1995) by farmers while diffusion is the stages or processes of communicating these innovations using different channels over a certain period of time (Rogers, 1995). DOI looks at the how, why and at what rate new ideas and technology spread through cultures (Oliveria and Martins, 2011). According to Rogers, (1995) DOI theory stresses on importance of communication and stakeholder networking within the adoption

process. Rogers distinguished adopters of innovation in five categories namely; innovator; the technology enthusiasts; early adopter; the visionaries , role models of the technology; early majority; the pragmatists, opinion leaders; late majority; the conservatives who were technology shy and required bullet proof solutions and laggards; the skeptics always maintain their status quo. This theory is a good example of how fish farmers adopt technology. Some farmers have managed to increase the level of adoption in fish farming by changing perception from subsistence to commercial and sustainable farming practices Roseline, (2007) by incorpotating simple improved fish production technologies. While other have collapsed and droped out of fish farming.

This theory proposed five stages of adoption process: awareness stage; where the farmers is exposed to innovation/ new technology but does not have adequate information; interest stage; the farmers gains interests in the new idea and look for more information; decision / evaluation stage; the farmer decides to either try or not to try the idea; trial stage; where the farmer implements the new idea on trial bases and adoption stage; on this stage the farmer decides to fully utilize the innovation/ technology (Spring 2011). DOI theory is important for small scale fish farmers as it benefits the targets of change by ensuring involvement of all stakeholders with strong strategies for implementing innovative change.

2.8 Conceptual Framework

Conceptual framework in this study considered a way of structuring ideas together with the aim of achieving the research objectives. (Shield and Rangarjan ,2013). It shows how the independent variables are linked with the dependent variable (Antony *et al*. 2013). In this study, the conceptual framewoirk shows how the hypothesized factors such as cost of inputs, provision of extension services, accessibility of market and use of technology influence

sustainability of small scale fish farming projects. Figure 2.8.1 shows an illustration of the conceptual framework for the study.

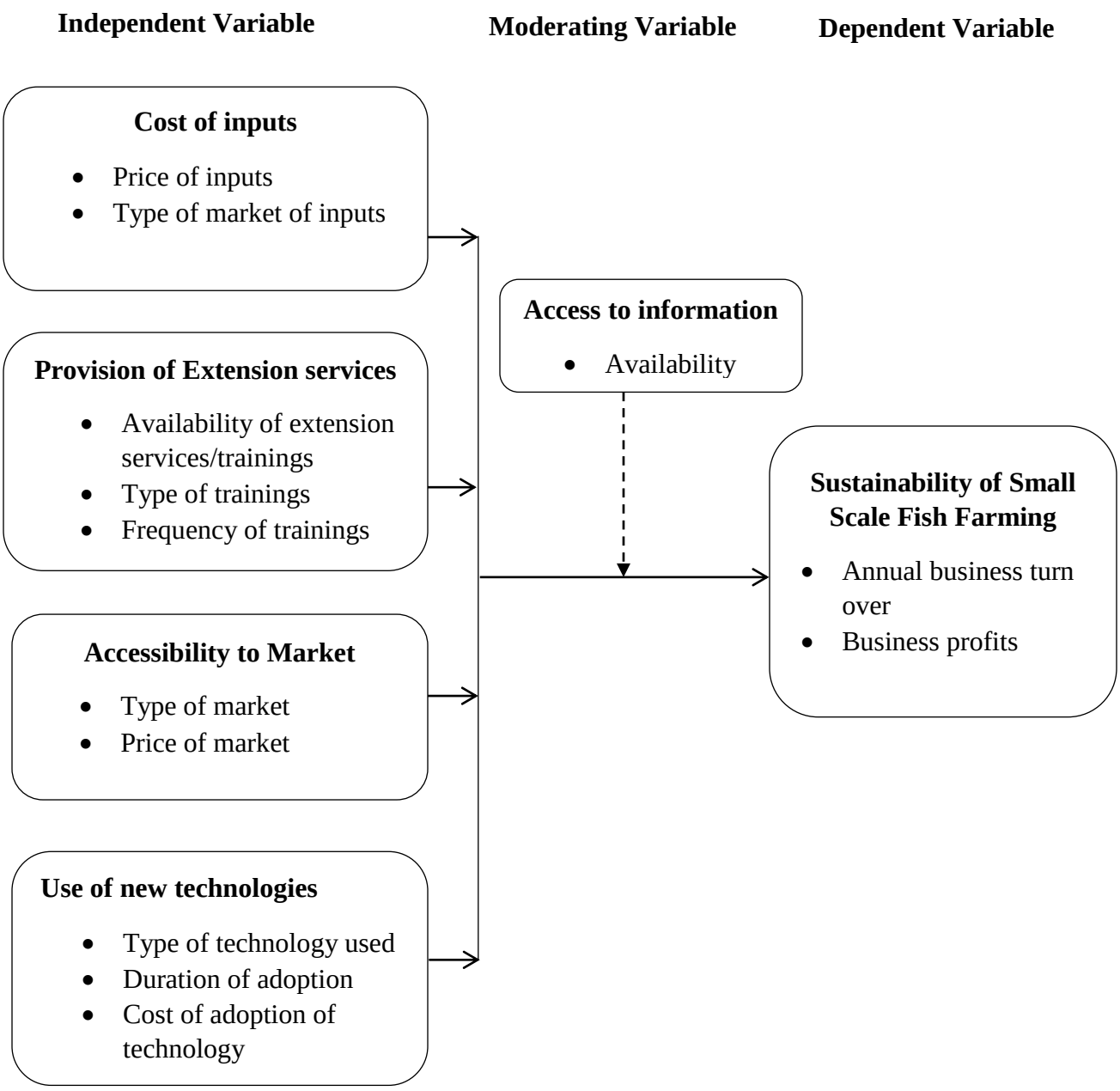


Figure 2.8 1 Conceptual Framework

Based on the Figure 2.8.1, profitability of small scale fish farming projects is greatly influenced by the independent, dependent and moderating variable and all combined influence sustainability of small scale fish farming projects which is evidence as seen in the outcomes, high yields, increased returns, food security and sustained small scale fish farming.

Sustainability of small scale fish farming is greatly influenced by independent variable, moderating variable and dependent variable. The cost of input, provision of extension services, accessibilty of market and use of new technology such as source of finance, availability of extension services , type and frequency of training offered such as business enterprise skill and pond management skills; accesibility to market such as type, nature and size of market; use of technology for example adoption of technology, cost of adoption and cost of technolgy plus access to information for instance availabilty of information. All this combined do influence sustainability of small scale fish farming which is evident through profitability of fish farming business.

2.9 Gaps in Literature Review

Studies done in the previous years have shied off from looking at factors influencing sustainability of small scale fish farming projects in Kenya, South Imenti, Meru County. For instance Kagiri (2016) looked at the evaluation of fish farming projects in secondary schools in Kiambu. While Antoney (2013), researched on factors affecting profitability of fish farming under Economic Stimulus Programme in Tigania East district, Meru County.

Further Joseph (2011), looked at factors affecting the adoption of small-scale fish farming in Meru Central District, and in his paper, Bernard (2016), researched on determinants of sustainability for fish farming projects initiative under Economic Stimulus Programme in Kirinyaga County. While (Wairimu, 2008), on her report “Meru turn to modern fish farming”

stated that farmers in Meru have adopted fish farming activities and are learning new methods of constructing ponds in their backyards not just for better balance recipe but also for generating income. Research done by (Antony *et al*, 2013), shows that despite the economic benefits of fish farming and the government's initiatives to promote fish farming in the country some small scale fish farmers have abandoned or/and pay little attention to the activity due to various challenges that make the enterprise non profitable hence becoming unsustainable.

2.10 Summary of Literature Review

This chapter reviewed the previous studies conducted by different researchers to try to get a deeper understanding of the variables under study. The chapter looks at the sustainability of small-scale fish farming projects as the dependent variable and explains how different researchers such as Njogu (2013) highlight the importance of sustainability in any project. It goes ahead to critically look at the independent variables such as the cost of inputs focusing of the fish seed and feed; provision of extension services; market accessibility and use of technology which are very vital in the research study.

To be able to get a deeper understanding of the area of study the researchers identified two theories; theory of change; which tries to identify long tern goals while looking at the early changes of project which state that if changes would be key in the success and sustainability of any project. In addition, diffusion of innovation theory a model Rogers which looks at five stages that fish farmers can use to adopt technology which are awareness, interest, decision, trial and adoption. Based on the theory gender, age, experience and voluntariness variables are suggested to moderate the impact of the above four constructs.

Conceptual framework was used by the researcher to show how factors such as cost of inputs, provision of extension services, accessibility to market and use of new technology interlinked

by availability of access to information and how this variables influence profitability of small scale fish farming projects..

The chapter also pinpointed the gaps within the literature review by recognizing other similar research conducted by researchers such as Kagiri (2016), Njagi (2013), Njogu (2016) and Wairimu (2008) who all have attempted in different context to research on sustainability of fish farming in Kenya.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter initially introduced the nature of the research design, targeted population as well as the sample size and procedure undertaken when conducting the research. It then elaborates, explains and justifies the data collection tools by identifying the pilot testing, validity and reliability of the instruments to be used. The chapter subsequently discusses the time frame, data collection procedures and data analysis techniques to be adopted during the study. Finally, the discussion ends with presenting ethical considerations made and highlighting the operational definition of the variables of the research

3.2 Research Design

The methodology that researchers employ in a scientific enquiry can take the form of qualitative, quantitative or mixed approaches/method (Kalmar *et. al*, 2016). Quantitative research method are used with any numerical data e.g questionnaires; qualitative research methods represent non-numerical data e.g. interviews. While the two methods seem clearly different and constrasting, some authors like, Taylor and Bogdan (1998); Crewell, (2003) and Bryman, (2012)), regard them as complementaly rather than opposing. Mixed method approach on the other hand involves marrying of qualitative and quatitative approaches through a transformative process (Christopher and Kidombo, 2010).

Bearing in mind that the purpose of this study is to gain a deeper understanding of the factors influencing sustainability of small scale fish farming projects, the choice of mixed method design is the best, since it provides a better understanding of research problems. When used in

combination, qualitative and quantitative data complement one another and gives a more complete analysis (Creswell *et. al,* 2004). According to Classen *et. al* (2007), mixed method research gives a better way of looking at the principles and values of a population while also considering the happenings ate the community level.

The research adopted mixed method design, which gathers both qualitative and quantitative data, analyses both separtely, then an intepretaion was done on both to check whether they support or contradict one another (Creswell and Clark, 2011). To use the identifed research questions, parallel questions were be created for qualitative and quantitative aspects of the study.

3.3 Target population

The target population refers to the entire set of units for which the survey data are to be used to make inferences. The target population therefore, defined the units where generalizations of the research findings were.

The survey was conducted in South Imenti Subcounty, Meru County. The target population was 200 participants ranging from small-scale fish farmers male, female and youth with individual, group or other projects as shown in Table 3.1. The Ministry of Agriculture, Livestock and Fisheries, Fisheries department South Imenti, Meru County and Meru Fish Farmers Cooperative provided the list.

Table 3.1 Target Population

Target population	Frequency
Individual projects	74
Group Projects	26
Other projects	100
Total	**200**

3.4 Sample Size and Sampling Procedure

To obtain the sample size and determine the minimum returned sample size the researcher used Yamane formula. To show the sampling procedure the researcher used a systematic procedure.

3.4.1 Sampling Size

A formula by Yamane (1967) was used for this particular study. This is as follows;

$$= \frac{N}{1+N(e^2)} = \frac{200}{1+200(e^2)} = 133.33$$

Where n is the sample size N is preferred target population and e is the margin of error

For this research the sample was 134 plus 10% of 134 to cater for sampling errors, which yields a sample of 148 fish farmers for the study.

3.4.2 Sampling Procedure

Saunders *et. al* (2012), research on probabilistic/random sampling specifies the probability of a case being included in the study while non-probability/non-random sampling uses an element of subjective judgement to select the sample for the study. The research questions required an indepth understanding of the factors influencing sustainability of small scale fish farming projects by exploring different variables, thus justifying the use of probability sampling. For

this particular study the researcher used cluster sampling to ensure time and cost efficiency and also to be able to cover a large geographical area.

3.5 Data Collection Instruments

The research data was collected using questionnaire, interview schedule/focus group discussions and document analysis.

The primary data was collected by use of a semi-structured questionnaire (Appendix 3) to solicit data on cost of inputs, provision of extension services, accessibility to market and technology used for small scale fish farming projects. Questionnaire is a data collection instrument made of several questions for purpose of gathering information from respondents.

According to Saunders *et al*, (2012) interviews are the most used data collection instruments for qualitative research. They have several categories, viz; structured, semi-structured and unstructured. Structured interviews are based on predetermined set of questions aimed at removing biaseness. (Saunder *et al*. 2012, Bryman and Bell, 2015). Unstructured interviews on the other hand to explore a general area in an informal non-directed manner where the interviewee is allowed to talk freely about different parts of the topics.

Semi structured interviews were the most suitable data collection method for this study. A interviews schedule (Appendix 4), was used to collect more in-depth information. Interviews presented multiple benefits that would ensure quality data collection. This method was preferred because face to face encounter with respondents would encourage them to cooperate in providing the required information. It also enabled the researcher to explain and clarify the purpose of the research and respond to any concern raised by the respondents.

Data was obtained by use of document analysis method. These documents were obtained from relevant institutions and organizations with an aim of complementing the primary data. The State Department of Fisheries and the Blue Economy at national and county levels and Aquacultural Association of Kenya were the main source of information on the status of aquaculture and general information on small scale fish farmers in the country respectively while the district fisheries offices provided information on the status of fish farming in the sub-county.

3.5.1 Pilot Testing of the Instrument

One of the major challenges in interview and questionnaire designs is making it clear to all respondents. To identify and solve the problem, the questionnaire was pre-tested in a pilot study. During the pilot trials both the interview and questionnaire participants were randomly selected from the study population. The pilot test was conducted in Kiambu County, Thika, Sub County where a total of 10 participants were randomly selected from the study area to participate in the pilot phase. The selection criteria were based on convenience, but care was taken to ensure participants represent various dimensions important to the study i.e. gender, fish farming experience and geographical location. The questionnaires were then adjusted based on the comments of the respondents to vividly capture the required objectives. The 10 respondents in the pilot study represented 9% of the target population, which agrees with the Mugenda and Mugenda (2003) suggestion of between 1% and 10% of the population.

3.5.2 Validity of the Instrument

According to Merriam (1998), qualitative research is stated as “holistic, multidimensional and ever changing”. It is therefore up to the researcher and the research participant to attempt in different phases of research i.e. data collection, analysis and interpretation to build validity.

Validity considers as to whether the research is true, believable and evaluating what it's expected to evaluate.

Research by Burns (1999), looks at validity as an essential criterion for evaluating the quality and acceptability of research. It is critical to ensure quality of the instruments used by the researcher to help draw conclusions based on the information obtained using the instruments. There are several types of validity that the researcher used to validate the research study. Content validity measured the adequacy and efficiency of different elements, skills and behaviors. The supervisor reviewed the data and based on the comments given the unclear and ambiguous questions were revised and complex items rephrased.

Internal validity, in the study was concerned with analogy of the research findings (Zahrabi, 2013). On this study the researcher applied methods recommended by Marriam (1998): for example the trangulation: use of several sources such as questionnare and interviews to strengthen the validity of data evaluation and findings; participatory mode of research: the involvement of participants in all parts of inquiry, with the aim of arriving at evaluation conclusions as a result of a consensures among people of different perspectives in relation to the study (Lynch, 1996); Researchers bias: every researcher has their own belief, value and point of view. On this study, the researcher collected, analysed and interplated data as objectively, remain non judgemental and clear as possible through out the research process. External validity was concerned with the applicability of the findings in a different setting. The researcher ensured that the research design could be generalized beyond the study area to a wider population.

3.5.3 Reliability of the Instrument

According to Nunan (1999), reliability looks at the consistency, dependability and replicability of results obtained from a research study. It is relatively straightforward to achieve similar results in quantitative research since the data is in numerical form as compare to qualitative approach which is quite demanding and difficult since the data are in narrative form and biased. Therefore, instead of obtaining same results it is better to think about the dependency and consistency of the data (Lincoln and Guba, 1985). The aim of this study was not to obtain same results but to rather agree that the data collection procedure, findings and results are consistent and trustworthy.

On this study, the researcher used two types of reliability. External reliability which is concerned with replicability of the study. Of the five aspects of inquiry as guided by LeCompte and Goetz (1985) and Nunan (1999), the researcher looked at the two aspects of inquiry: the status of the researcher; that clarified that the researchers social position on participants of the study and the method of data collection and analysis; which required that procedures of data collection be clearly explained. The study used mixed method research to collect data which include questionnare and interviews.

Internal reliability looks at the consistency in collecting, analyzing and interpreting data. It is involved in finding out whether the data collected can yield similar results if the analysis was done by an independent researcher. To ensure no threats in internal validity, the researcher used the two strategies espoused by LeCompte and Goetz (1985) and elabotrated by Nunan (1999), which are mechanicaly recording data and low inference descriptors.

3.6 Data Collection Procedure

Data collection procedures used were in line with the research design. Both quantitative and qualitative data collection methods were used to collect primary and secondary data. Quantitative method included questionnaire survey. The researcher used both open and closed format questions for this study. Open format questions are those without a predetermined set of response while closed format questions took the form of multiple-choice questions. The questionnaire consisted of five sections. The first section sought to gather personal information; gender, age bracket and level of education. The second part of the questionnaire focused on the cost of input, this included the prices of inputs, and costs incurred. The third section focused on the provision of extension services i.e. availability of extension services, types of training and frequency of the trainings. The fourth section looked at the accessibility to market such as type, nature and size of market and finally the fifth section will focus on at the use of new technology paying close attention on the adoptability of technology, cost of adoption of these technologies and cost of the technology. The items contained in the questionnaire included both open-ended and closed questions that attempted to identify factors influencing sustainability of small scale fish farming projects in Meru, South Imenti area. While qualitative method included participant's assessment through semi structured interviews and focus group discussions.

3.7 Data Analysis Techniques

Marshall and Rossman (1999) describe data analysis as a way of organizing data in orderly structured way so as to make sense out of it. It is considered as messy, ambiguous and time-consuming, but also as a creative and fascinating process. In this regard, the analysis and

interpretation of data represents the application of deductive and inductive logic to the research (Best and Khan, 2006).

Antonius (2003) clearly states that data involves information that is collected in a systematic way, organized, then recorded so as to enable the reader to correctly interpret the provided information. As such, data are not collected haphazardly, but with a view of answering the research objectives. Schostak and Schostak (2008) capture the essences of capturing data well when they further state that data are not fixed but are open to manipulations so as to provide alternative ways of finding answers to the research questions.

The researcher collected data, then organized and checked for accuracy, uniformity and completeness. The researcher used statistical method Statistical Package for Social Scientists (SPSS) and presented the findings in frequency and percentages from which descriptive statistics were made. Pearson's correlation coefficient was computed to check the strength of relationship between the individual independent variables and the dependent variable.

3.8 Ethical Consideration

At the heart of every research conducted within the area of social sciences are the ethical considerations made by the researcher (Saunders *et. al*, 2009). According to Saunders et. al, (2009), ethics is interplated as moral choice that affects decisions and behaviors in regards to those who form the subject of a study. In this study the ethical considerations adopted are those made by Rubbin and Babbie (1997) which states that participation in research should be voluntary and based on informed consent to ensure there is no harm to the participant as well as be anonymous, confidential and not deceive issues.

To ensure voluntary participation and informed concent by participants the researcher shared a consent form that included information on the purpose of the study, the interview process, the benefit of taking part in the study and the rights of the participant. To safegurd the participant and ensure that no harm can affect the participant the researcher observed the physical and psychological comfort of the participant throughout the interview including any communication leading to the discussion. To ensure autonomy of the participants, the researcher ensured no names were included anywhere, both in the questionnaires and during the interviews and focus groups. Further, confidentiality of the raw data collected and the interview transcripts was ensured by not sharing any of this information without the participants consent.

Ethical considerations made by Rubbin and Babbie (1997) on participants behavior is the way data is analysed and reported to the research community. As part of the researcher's core values that report will be an honest and open account of the research process including the problems faced during the field study and by doing this the researcher promoted transperency and accountability.

Table 3.1: Operational Definition of the Variables

Objective	Independent Variable	Dependent Variable	Indicator	Measurement of scale	Data collection tool	Data Analysis
To assess how cost of inputs influence sustainability of small scale fish farming projects in Kenya.	Cost of input	Sustainability of small scale fish farming projects	Price of inputs Type of cost incurred	Ordinal Nominal	Questionnaire	Descriptive Correlation
To establish how provision of extension services influence sustainability of small scale fish farming projects in Kenya	Provision of extension services	Sustainability of small scale fish farming projects	Availability of extension services Type of training Frequency of training	Ordinal Nominal	Questionnaire Interview	Descriptive Correlation
To assess how accessibility to market influence sustainability of small scale fish farming projects in Kenya.	Accessibility to market	Sustainability of small scale fish farming projects	Type of market Nature of market Size of market	Ordinal Nominal	Questionnaire Interview	Descriptive Correlation
To establish in what way use of new technology influence sustainability of small scale fish farming projects in Kenya.	Use of new technology	Sustainability of small scale fish farming projects	Adoptability of technology Cost of technology Cost of adoption of technology	Ordinal Nominal	Questionnaire Interview	Descriptive Correlation

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Introduction

The chapter captured presentation, analysis and interpretation of data in a systematic way. The presentation and analysis aimed at identifying trends and relations that are in tandem with the research objectives. In turn, the identified trends and relations enable the researcher to identify the factors that influence the sustainability of small-scale fish farmers in Kenya. To determine the relationship between sustainability of small-scale fish farming and each of the factors the researcher conducted correlational analysis and testing. Statistical package for social science (SPSS v23) was used to facilitate the analysis since collected data was quantitative in nature. Similarly, qualitative analysis was done to get an in-depth understanding between of the hypothesized factors and the sustainability of small scale fish farming.

4.2 Response rate

Of the 150 questionnaires distributed to the small-scale fish farmers 109 questionnaires were returned giving a response rate of 72.67%. This rate conforms to Mugenda and Mugenda (1999) assertion that a response rate of over 50% is adequate for analysis and reporting.

4.3 Demographic characteristics of the respondents

In section A of the questionnaire respondents were asked to respond to questions seeking to know their age and gender. This was to enable the researcher to compile the target populations' profile.

4.3.1 Gender of respondents

A total of 109 respondents completed their questionnaires, all of them indicating their gender. Of the 109 respondents, 71 (65.1%) were male and 38 (34.9%) female, as shown in Table 4.1.

Table 4.1: Gender of respondents

Gender	Frequency	Percent (%)
Male	71	65.1
Female	38	34.9
Total	**109**	**100**

This implied that the fish farming environment, particularly the small-scale fish farming projects are male dominated.

4.3.2 Age of respondents

Sustainability of fish farming may vary with the age of respondents. To avoid biasness, the study looked at the composition of the respondents in terms of age to better understand their familiarity with factors influencing the sustainability of small scale fish farming. Table 4.2 shows the results of the findings.

Table 4.2: Age distribution of respondents

Age	Frequency	Percent (%)
18 – 25	3	2.8
26 – 35	12	11
36 – 45	24	22
46 – 55	29	26.6
56 and above	41	37.6
Total	**109**	**100**

Regarding the age bracket of the respondents 37.6% (41) were aged between 56 and over while only 2.8% (3) respondents were aged between 18 – 25 years. This denoted that most small-scale fish farmers in South Imenti Sub-county were elderly and that fish farming is not taken as a serious economic activity by the youth in the area.

4.3.3 Education level of respondents

The education level of a farmer may present a yardstick for measuring the sustainability of fish farming. The study therefore sought to establish the education level of the small-scale fish farmers in South Imenti. The findings are presented in Table 4.3.

Table 4.3: Education level of respondents

Education level	Frequency	Percent (%)
Primary School	29	26.6
High School	57	52.3
Diploma	3	2.8
Bachelors	10	9.2
Masters	1	0.9
Doctorate	3	2.8
Others	6	5.5
Total	**109**	**100**

From the study, 52.3% (57) of respondents had high school qualification, 26.6% (29) primary school qualification, while collectively the remaining qualifications accounted for 21.1%. This implied that majority of the of small-scale fish farmers in South Imenti sub-county had high school education therefore have some basic knowledge on fish farming.

4.3.4 Studying Agriculture

Studying agriculture in school can be considered influence the success of small-scale fish farming to some extent. This research sought to find out how many of the respondents had done agriculture in school. The findings are presented in Table 4.4.

Table 4.4: Proportion of respondents who have done agriculture

Studying agriculture	Frequency	Percent (%)
Yes	71	65.1
No	38	34.9
Total	**109**	**100**

Of the 109 fish farmer who returned filled questionnaires, 71 (65%) had done agriculture in school while 38 (35%) had not done agriculture in school. This implied that majority of the respondents had knowledge of the general farming practices that they applied in the fish farming projects.

4.4 Challenges facing small-scale fish farming projects.

The respondents were presented with four challenges that the researcher wished to know in generality without breaking them down into smaller components how they affected fish farming. The four challenges were; cost of input, provision of extension services, access to market and the use of technology. The respondents were needed to rank the four on a scale of 1 to 5 provided such that 1 = Least challenge and 5 = Most challenge. The findings are presented on Table 4.5.

Table 4.5: Challenges facing small scale fish farmers

Challenges	Mean	Std. Dev.
Cost of input	4.5	1.077
Provision of extension services	2.88	1.483
Access to market	4.2	1.318
Use of technology	3.76	1.490

According to the results shown in table 4.5, majority of the respondents feel the cost of inputs in fish farming is the greatest challenge they face with a mean of 4.5, followed by access to market with a mean of 4.2. Use of technology to improve their fish production is a moderate challenge as shown by a mean of 3.76 and lastly, provision of extension services is considered to be the least of the challenges with a mean of 2.88. this implied that the most challenging factor was cost of input, access to market, use of technology and provision of extension services respectively.

The study also involved interviews and focus groups discussion with the small-scale farmers in South Imenti sub-country where the researcher wanted to get an in-depth understanding of the challenges the farmers were facing. Majority of the respondents identified cost of inputs such as fish feed and fish fingerlings as the greatest challenge. Respondent 1 said that “cost of inputs especially the fish feed and marketing of my fish is my major problem”. The respondents also raised other challenges that they felt were critical if fish farming is to become more sustainable. This included; access to market, lack of information and cultural believes. The study also found that majority of the farmers had a dependency mentality relaying heavily on what the government or the donor funded projects had to give, the findings indicate in generality that cost of input was a major setback in sustainability of small scale fish farming.

4.5 Cost of input and sustainability of small-scale fish farming projects

Cost of input was categorized into cost of fingerling and cost of fish feed. First, the researcher wanted to find out where the farmers buy their fish seed/fingerlings from. The source of fingerlings can influence the quality of the final product which will in turn influence its marketing; the findings are presented in Table 4.6.

Table 4.6: Source for fingerlings

Source	Frequency	Percent (%)
Government hatchery	33	30.3
Private hatchery	64	58.7
Self-propagation	4	3.7
All the above	8	7.3
Total	**109**	**100**

The research established that 64 (58.7%) of the respondents get their fingerlings from private hatcheries, government hatcheries contribute 30.3% (33) of the fingerlings, 3.7% of the farmers do self-propagation while 7.3% get their fingerlings from either government hatcheries, private hatcheries or they do self-propagation. This implied that 89% of respondents bought their fingerlings either at government institutions of private hatcheries. These findings show that the major source of fish seeds for farmers in South Imenti is private hatcheries, hence a need for regulation of the hatcheries to have superior quality fingerlings.

Cost of fish seeds/fingerlings was also considered as an aspect of cost of input and the findings are presented in Table 4.7.

Table 4.7: Cost of fingerlings

Cost per fingerling (Kshs.)	Frequency	Percent (%)
< 5	5	4.6
5 – 10	18	16.5
10 – 15	57	52.3
> 15	29	26.6
Total	**109**	**100**

Averagely, the cost of fish seed/fingerlings in South Imenti appears to be ranging between Kshs. 10 and Kshs. 15 as reported by 52.3% (57) respondents. 26.6% bought their fingerlings at more than Kshs. 15 per fingerling, 16.5% (18) respondents bought their fingerlings at Kshs. 5 – 10, while only 4.6% (5) bought their seeds at less than Kshs. 5 per fingerling. The findings show that the price of fingerlings is more than Kshs. 10.

Next the researcher sought to know the cost at which the fish farmers bought the feeds per kilo since this is a key component of the cost of input. The findings are presented on Table 4.8.

Table 4.8: Cost of fish feed per kilo

Cost per kilo	Frequency	Percent (%)
Below 100	28	25.5
100 – 200	52	48.1
200 – 300	19	17.0
Above 300	10	9.4
Total	**109**	**100**

Majority of the respondents (48.1%) buy their fish feeds per kilo at between Kshs. 100 and Kshs. 200, while few 9.4% buy the feeds at more than Kshs.300 per kilo. The findings show that the cost of feeds per kilo in South Imenti is less than Kshs. 200, which is affordable.

From the interview and focus groups majority of the respondents felt the cost of inputs which included the cost of fish feed and cost of fingerlings was the greatest problem. Respondent 3

stated that “the availability, quality and high cost of fish feed is a big challenge in these areas, I have resulted to formulating my own feed which costs me less than Kshs 100 to make as compared to buying from local manufacturer”. The researcher also noted that high cost and availability of liner as a fish farming input was also a challenge to some farmers.

4.6 Extension services and Sustainability

Extension services are an important aspect of any form of farming. This research investigated the frequency, types, and satisfaction with the extension services among fish farmers in South Imenti, Meru County. To begin with, the researcher sought to find out whether the respondents had received any extension services, the findings are as presented in Table 4.9.

Table 4.9: Whether the respondents received extension services

Response	Frequency	Percent (%)
Yes	70	64.5
No	39	35.5
Total	**107**	**100**

About frequency of extension services, it was found that 32.1% (35) respondents received the services monthly, 19.3% (21) yearly, 7.3% (8) after every three (3) months and 5.5% (6) after every six (6) months. Two respondents did not fill this part hence the total respondents of 107.

There are several extension services that are offered to fish farmers, the respondents were provided with options to choose the type of extension service they have received. The findings are presented in Table 4.10.

Table 4.10: Type of extension service

Type of extension service	Frequency	Percent (%)
Pond management	36	43.9
Feed management	22	26.8
Record keeping	9	11.0
Marketing and value addition	15	18.3
Total	**82**	**100**

Most of the respondents 43.9% (36) as shown in table 4.10, reported to have received services on pond management training, this indicates that more emphasis by the extension officers was on how to manage the ponds. The least effort seems to have been put on record keeping at only 11% (9). The total number of respondents reduced from the initial 109 to 82, since the response to this question was reliant on whether the respondent had received extension services or not. The 82 are the ones who could have received extension services and therefore were capable of responding to this question. These findings indicate that most of the emphasis by the extension service provides is on pond and feed management. It would be important if the officers would train the farmers on all extension aspects available.

Based on the findings from the interviews and focus groups discussions many respondents said they had not received formal trainings from the fisheries officers however, they consult the officers from time to time when need arises or/and when they are faced with a challenge that needs technical expertise. Majority of the respondents claimed to consult mostly on pond management, feeding schedules and management, and fish marketing. For example, respondent 9 said “I recently had a problem with my fish pond the algae in the pond was too green and every time I fed the fish the food was left floating for days”. Respondent 13 has this to say” I was used to seeing my fish play all the time then one day as I was feeding them I realized they

were not as jovial and usual and this got me worried but when I called the extension officer in my area he was able to help and now my fish a playing". This two are isolated cases of how the farmers in the area receive extension services making it a least challenging factor since they can get extension as need arise.

Satisfaction with extension services was also considered and the research found out that 61.8% of the respondents were satisfied while 38.2% were not satisfied with the extension services they were being offered.

Lastly, the researcher sought to find out whether the respondents thought provision of extension services would improve their yields. The findings are presented in Table 4.11.

Table 4.11: Extension services and production

Response	Frequency	Percent (%)
Yes	96	89.7
No	13	10.3
Total	109	100

4.7 Accessibility to Market

For any business to be successful, the product must have a ready market. In this section, the researcher sought to find out where the farmers sell their fish and the price at which they sold the fish.

4.7.1: Fish market

Farmers were asked to indicate where they sold their fish and the findings are presented in Table 4.12

Table 4.12: Fish market

Fish market	Frequency	Percent (%)
Farm gate	62	57.9
Restaurants	7	5.6
Fish processing plants	19	17.8
Supermarket	5	3.7
Others	16	15.0
Total	107	100

Majority of the farmers (57.9%) sell their fish to farm gate after harvesting, 17.8% take the fish to fish processing plants for sale, and 15.0% have alternative markets which they did not specify. Those who take their fish to restaurants were 5.6% while only 3.7% take their fish to supermarkets. Two (2) respondents did not indicate where they sell their fish. From the responses, it is observed that the major market for the farmers fish in South Imenti, Meru County is farm gate.

4.7.2 Price of fish

The respondents were required to indicate the price at which they sold their fish. The findings are on Table 4.13.

Table 4.13: Price of fish

Price of fish (Kshs.)	Frequency	Percent (%)
Below 100	23	21.5
100 – 200	36	32.7
200 – 300	28	25.2
Above 300	22	20.6
Total	109	100

From the above table 4.13 it is clear that majority of the farmers 54.2% (58) sell their fish from Kshs 200 and below with 48.8% (48) respondents selling their fish above Kshs 200. This

shows that the price at which farmers sell their fish in South Imenti ranges from Kshs. 100 to Kshs. 300.

From the interviews and focus groups discussions majority of the respondents felt that access to market was wanting. Most farmers said they sold their fish from their farms which fetched a low price; other said that they had joined Kanyakini fish farmers' cooperative society that helped them market their fish. The cooperative is a membership society and farmers have to pay a fee which also gives them an opportunity to buy shares that gets dividends at the end of the year. "I first joined the cooperative in August 2016 after I was referred by a friend, I was a startup farmer at the time and I didn't know where to sell my fish. Kanyakini fish factory told me they could buy catfish and tilapia at Kshs 350 and Kshs 300 from 300grams and to me this was better than the farm gate price my friend was getting" said Respondent 4.

These findings show that price at which fish is sold could be dependent on where the farmers sell their fish, this is due to the almost equal distribution of respondents among the different class prices presented to them.

4.8 Use of new technology

4.8.1 Type of farming

The respondents were needed to indicate the type of farming they use. The findings are presented on Table 4.14.

Table 4.14: Type of farming

Type	Frequency	Percent (%)
Intensive	10	9.3
Semi-Intensive	77	71.3
Extensive	22	19.4

Total	**109**	**100**

Regarding the type of farming employed by the small-scale fish farmers in South Imenti, Meru County, 71% indicate that they used semi-intensive farming method, 20% who use extensive method, while only 9% of the respondents use intensive farming method. These findings indicate that most farmers used semi-intensive farming method in their fish farming.

4.8.2 Duration to adopt technology

The research also investigated how long it took the farmers to fully adopt the technology they are currently using. The results are presented in Table 4.15.

Table 4.15: Duration to adopt technology

Duration	Frequency	Percent (%)
1 month	24	24.7
3 months	26	26.8
6 months	19	19.6
1 year	15	15.5
Others	13	13.4
Total	**97**	**100**

Majority of the respondents 51.5 % (50) take duration of 1 to 3 months to adopt any technology. 19.6 % (19) take 6 months, 15.5% (15) take a year with 13.4% (13) taking more than a year to adopt technology. This denoted that farmers were willing to take up and use technology hence improving on their production.

4.8.3 Source of technology knowledge

This section looks at where the respondents got knowledge on the technology they are using. Respondents were asked to indicate where they learnt about the technology from and the findings are presented in Table 4.16.

Table 4.16: Source of technology knowledge

Source	Frequency	Percent (%)
Government fisheries officers	53	54.6
Donor programmes	5	5.2
Other farmers	31	32.0
Internet	8	8.2
Total	**97**	**100**

From table 4.16, the researcher found that majority of the respondents (54.6%) got knowledge on technology from government fisheries, 32% from other farmers, 8.2% from the internet while only 5.2% learnt about technology from the donor sponsored programmes.

From the interviews and focus groups discussions a big percentage of the respondents said they engaged in semi-intensive type of farming. Most respondents said they had installed liners in their earthen ponds while a smaller percentage (20%) said they had gone ahead and added raised wooden ponds to help improve their fish production. Majority said they took 1 month to put up a liner in their ponds while those with more advanced wooden raised ponds took up to 6 months with most of the respondents learning the new technologies from fisheries officers and other farmers. “I went to visit a farmer friend and I saw this technology I had to have, right now I have 24 small raised wooden ponds that I constructed in 7 months” says Respondent 10.

The results from the questionnaires and interviews both indicate that the predominant mode of fish farming in South Imenti is semi-intensive, which can be assumed to influence the sustainability of small scale fish farming.

4.8.4 Influence of technology

The research sought to get the opinion of the respondents on the influence of technology on fish farming, in particular improvement in quality and quantity of fish produced. The findings are presented on Table 4.17.

Table 4.17: Influence of technology

Response	Frequency	Percent (%)
Yes	85	79.8
No	24	20.2
Total	**109**	**100**

79.8% (83) of the respondents said that technology influences fish farming by improving the quality and quantity of fish produces while 20.2% (21) said technology did not have any influence on their production.

From the interview and focus groups findings 80% of the respondents felt that technology did influence the fish farming. “When I started fish farming I started with grow out fish which at the time did not fetch good prices, I decided to venture in to fingerling production when I heard a few farmers in my area say they could not find good quality and affordable fingerlings. After a 6 months course at the National Aquaculture Training center in Sagana, I now have a small hatchery that I use to propagate catfish fingerlings and sell to farmers” said Respondent 5. This shows that most farmers believe that modern technology is helpful to their fish farming.

4.9 Fish farming sustainability

Sustainability of fish farming for this research was measured in terms of profit made after sale of fish and the annual turn-over. The farmers were asked through the questionnaire and interview to respond on these two aspects.

4.9.1 Annual business turn-over

Respondents were required to indicate their annual business turn-over. The findings are indicated on Table 4.18

Table 4.18: Annual turn-over

Annual turn-over (Kshs)	Frequency	Percent (%)
Less than 50,000	75	69.4
50,000 – 100,000	29	26.9
Above 100,000	5	3.7
Total	**109**	**100**

Majority of the respondents, 69.4% indicated they earn less than Kshs. 50,000 annually, 26.9% earned between Kshs. 50,000 and Kshs. 100,000, while only 3.7% had a turnover of above Kshs. 100,000. This implied that 69.4 % of the respondents had less than Ksh 50,000 annual turnover hence did not earn much from their business.

4.9.2 Business profits

Business profit was used as a measure of fish farming sustainability. Respondents were required to indicate whether they made profit or not, and the findings are indicated on Table 4.19.

Table 4.19: Fish farming profit

Amount of profit (Kshs)	Frequency	Percent (%)
Yes	53	48.6
No	56	51.4
Total	109	100

The proportion of the respondents who made profits and those who didn't make profits was almost equal as indicated in Table 4.19. This implied that even though 69.4% of the farmers

earned less than Kshs 50,000 annually they still made profit from their business hence was sustainable.

For any business to become sustainable one has to be making some profits and fish farming is no different. From the interviews and focus group discussions the researcher was curious to find out the approximately annual turnover of the respondents and whether they were making any profits from the fish farming enterprises. This however, proved to be a double-edged sword question for the respondents as some said they did not make any profit from their farming business while some said they were making a small profit meaning those who did and dint make profit were almost equal. The researcher wanted to get a deeper understanding as to what the annual turnover of those making profits was as compared to those not making profit. Majority of the respondents making profits had an annual turnover of Kshs 50,000 and above while those not making profits had turnover of Kshs 50,000 and below.

Respondent 50 gave an example of how since he started his fish farming business; he had not broken even from the business and is still operating on recurrent expenditure". Respondent 50, attributed his lack of breaking even to high cost of inputs that take up almost 70% of total fish production cost. On the other hand, Respondent 67 was keen to share his experiences that transformed his business. He started his business under losses and for a while he thought of leaving the fish farming and count his losses but after attending a seminar organized by Aquacultural Association of Kenya a farmers organization he learnt how to do fish farming as a business". He continued to say "after harvesting the fish I had at the time, I decided to add and upgrade my ponds, I also started buying mono-sex fingerlings and imported feed from Aller Aqua feed distributer in Meru and that's when I stated seeing the change. The fish that would take 10months to a year to grow now took 6-8 months, since I had already added more

ponds and I was stocking at different times of the month, I was guaranteed to sell my fish every month and this made the whole lot of difference for me". The findings show that the number of farmers who made profit from their farming was almost equal to those who did not make profits.

4.10 Inferential Statistics of sustainability of small scale fish farming projects

The strength of relationship between the variables in the study was quantified using the Karl Pearson's product moment correlation coefficient (r).

Table 4.20: Correlation of variables

	Cost of input	**Provision of extension services**	**Access to market**	**Use of technology**	**Sustainability of fish farming**
Cost of input	1				
Sig. (2-tailed)					
Provision of extension services	.059	1			
Sig. (2-tailed)	.768				
Access to market	.026	.102	1		
Sig. (2-tailed)	.514	.614			
Use of technology	.011	.121	.012	1	
Sig. (2-tailed)	.788	.811	.312		
Sustainability of fish farming	.013	.521	.411	.301	1
Sig. (2-tailed)	.144	.013	.025	.218	

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

Based on Table 4.18 on correlation of variables, it can be observed that the cost of input and sustainability of fish farming have a weak positive correlation, r = 0.013, with p = 0.144, provision of extension services and sustainability had a moderate positive correlation, r = 0.521, with p = 0.013, this implies that providing farmers with extension services would help improve their farming practice and hence make fish farming sustainable.

In regard to access to market and sustainable fish farming, the study found a correlation coefficient r = 0.411, with p = 0.025 which is a positive correlation, this means that if the fish farmers can access broader markets for their fish and fish products, then fish farming will become sustainable.

Lastly, the use of technology and sustainability of fish farming were also found to be positively correlated with a coefficient of r = 0.301, with p =0.218 meaning that if the fish farmers used technology to improve their annual fish production, then fish farming will become sustainable.

CHAPTER 5

SUMMARY OF FINDING, DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter presents the summary of the research findings, the discussions made by the researcher on the findings, the conclusions drawn from the analysis based on the research findings, and the researcher's recommendations based on the findings.

5.2 Summary of Findings

The purpose of the study was to investigate the factors that influence sustainability of small scale fish farming projects in Kenya, South Imenti Subcounty, Meru County. The following specific objectives were followed: assess if cost of inputs, provision of extension services, access to market and use of technology do influence sustainability of small scale fish farming projects in South Imenti sub-county Meru County. The researcher adopted mixed method research design, descriptive and inferential statistics and person coefficient correlation was used to analyze both qualitative and quantitative data. The target population for the research was 200 participants' men, women and youth. Sample populations of 143 participants were expected to respond but only 109 responses were received. Data for the research for the research was collected using questionnaire, interview schedules, focus groups and document analysis. The questionnaire contained six sections which were: personal information; cost of input on sustainability of small scale fish farming projects; influence of provision of extension services on sustainability of small scale fish farming projects; access to market and its effects on sustainability of small scale fish farming projects; use of technology and sustainability of

small scale fish farming projects and fish farming sustainability. The research was carried out between July and September 2017.

Descriptive (mean, standard deviation, frequencies and percentages) and inferential statistics (Pearson's product moment correlation coefficient) were adopted so as to quantify the strength of relationship between the variables. Further, to have a better understanding and analysis of the findings tables were generated.

Table 5.1: Summary of finding as per the research objective

Objective	Data collection	Type of analysis	Main Finding
To assess how cost of inputs influence sustainability of small scale fish farming projects in Kenya.	Questionnaire Interview /focus groups	Descriptive Correlation	Majority of the respondents felt that cost of inputs was the greatest challenge they faced with a mean of 4.5 and standard deviation of 1.077. The cost of fingerings ranged between Kshs 10-15 which they bought from private hatcheries. The cost of feed was a major challenge with cost per kilo going between Kshs 100-200 as stated by the majority. The cost of input and sustainability of small scale fish farming had a week correlation. r = 0.013, with p = 0.144
To establish how provision of extension services influence sustainability of small scale fish farming	Questionnaire Interview /focus groups	Descriptive Correlation	64.5% of the respondents received extension services. While relating to frequency of the services 58.7% of the respondents received extension services between 1 to 3 months. Most if the respondents 43.9% received services on pond management training. The researcher also found that 61.8% of the respondents were satisfied with the extension services while 38.2% were not.

projects in Kenya			90% of the respondents felt that extension services can indeed improve on production. Provision of extension services and sustainability had moderate positive correlation, r =0,521, with p = 0.013, this shows offering farmers extension services would improve their farming practice hence, make their fish farming sustainable.
To assess how accessibility to market influence sustainability of small scale fish farming projects in Kenya.	Questionnaire Interview /focus groups	Descriptive Correlation	To understand the fish markets the researcher found that 57.9 % of respondents sold their fish at farm gate and 17.8% at fish processing plant with only 5.6% and 3.7% selling their products in restaurants and supermarkets respectively Access to market and sustainability of small scale fish farming projects had correlation coefficient r = 0.411, with p = 0.025 which is a positive correlation, showing that if farmers were able to access wider market for their product fish farming would be sustainable.
To establish influence of new technology on sustainability of	Questionnaire Interview /focus groups	Descriptive Correlation	Majority of the respondents 71% used semi intensive type of farming, with 51.5 % indicating that it took them 1 to 3 months to fully adopt the technology they are currently using. 54.6 % of the

small scale fish farming projects in Kenya.			respondents got the knowledge on the technology from government fisheries officer, 32% from other farmers. 79.8% of the respondents strongly agreed that technology did influence their fish farming. Use of technology and sustainability of small scale fish farming projects were positively correlated with a coefficient of r =0.301 with p = 0.218.
Small scale fish farming projects sustainability	Questionnaire Interview /focus groups	Descriptive Correlation	In this research sustainability was measure in terms of profit made after sales and the annual turnover. Majority of the respondents 64.4% indicated they earned less than Ksh 50,000 annually with only 3.7% earning above Kshs 100, 000. From the findings, the proportion of the respondents who made profits and those who didn't was almost equal, 48.6% and 51.4% respectively.

5.3 Discussion of Findings

Cost of inputs which comprised cost of fish feed and cost of fingerlings was found to be the most challenging giving a clear indication that this were the main inputs that greatly influenced small scale fish farming sustainability. This finding concurs with AAK (2015) who report found that fish feed accounted for about 60% of the total fish production in Kenya. Similarly, the results agree with (Brummet and Rana, (2010) who found that 50% and/or more of the fish farming operation cost were on fish feed and seed (fingerling). The research findings also concurs with (Sarnissa, 2011) who found that for a successful fish farming projects, readily available and affordable inputs such as fish feed and fingerlings were the main components. It also concurs with Mary *et. al* (2017), who found that lack of quality fish seed (fingerlings) was the one of the main constarins of aquaculture development in Kenya.

The results showed that there was negative relationship between cost of inputs and small scale fish farming sustainability. This was because some respondents felt that the cost of inputs was too expensive therefore negatively influencing their production while other felt that getting quality fish feed and seed gave them high returns and when this two senarial canceled out statisticaly the research got negative correlation (r =0.013). Meaning that an increase in cost of inputs would positively or negatively influence smale scale fish farming sustainability.

From the analyzed data, there was a clear indication that farmers received some sort of training after every one to three months. The repondents were in agreement that the extension fisheries officer were available and ready to assist on need basis or/and when they found challenges that required technical expertise and that their farming practice was affceted by trainings and skills. This concurs with Christian *et al* (2016) who found that provison of extension services plays a

significant role in aquaculture development. It also concurs with The Organic Farmer (2012) who highlighted that farmers needed to undrego training and seek advice from fisheries extension experts on management of their fish farming projects. Bernard, (2016) also found that there was need to radically restructure extension services to make disemeination responsive to small farmers. Similary, Singas and Manus (2014) urgued that disemeination of existing knowledge from research or/and technical knowledge of farmers was the main challenge for aquaculture development.

From the Karl Pearson's correlation coefficient there was a moderate positive correlation (r =0.521), though not statistically significant, this implied that if farmers were provided with extension service it would improve their fish farming practices hence, making their fish farming business sustainable.

On access to market the result indicated that majority of the respondents sold their fish at farm gate despite it fetching low prices while other sought out to look for other markets such as fish processing plant, restaurants, supermarket and other regional and international markets which fetched fairly higher prices. This coincides with unpublished reports by AAK (2015), which stated that supermarkets, hotels, fish outlet centers are some of the main markets where small scale farmers sell their fish. It also concurs with Mary *et. al* (2017) research which found that marketing of aquaculture products an area of concern leading to farmers desiring to attract regional and international markets.

The results showed a correlation coefficient (r =0.411), which is a positive correlation meaning that if farmers could have access to ready, guaranteed and wider market for their products, then fish farming would become more sustainable.

On the usage of new technology, results indicated that majority of the respondents took one (1) month to a year to fully adopt any new technology. A big percentage of the respondents got the knowledge on technology from government fisheries officer and other farmers. Jacobi, (2013) in his reseash found that the reasons for slow aquaculture development in Kenya was use of traditional methods of farming that hinders investment in fish farming technologies. This coincides with Mwamuye *et. al* (2012) findings which noted that the main challenge of aquaculture development in Kenya was inefficiency in dissemination of technology transfer to farmers. Majority of the farmers agreed that technology greatly influences sustainability of small scale fish farming projects. This concurs with Wetenegere, (2010) who found that fish farming has very high potental which can be fully utilized if only technology was adopted.

The use of technology and sustainability of small scale fish farming projects were positively correlated with a coefficient of (r =0.301) though not statistically significant.

5.4 Conclusion of the study

Despite the Government having injected funds through the ESP to boost fish farming in Kenya; both government and private sector constructing two fish mini processing plant in the area; farmers having access to information on how to manage their fish farming enterprises, sustainability of small scale fish farming projects is still influenced by a number of factors. These factors include; cost of inputs which need to be readily available, of good quality and require small scale farmers to have access to finance; provision of extension services such as trainings which will provide farmers with good aquaculture practices and better management; access to market which need to be broadly available and the farmer able to produce enough to

supply continually to meet the high demand for fish and use of technology so as to have high fish productions.

5.5 Recommendation

The following are the recommendations of the study:

From the research findings it is clear that there is still a lot that needs to be done to lower the cost of inputs for small scale farmers. The government of Kenya should lower the cost of inputs by providing subsidies for raw materials to make fish feed; ensure that the farmers gets quality and affordable fish feed and fingerlings to lower the cost of production thus having sustainable projects.

The government should employ more extension officers and avail resources to help them easily access farmers at the grass root level and disseminate information. The extension officers should also be regularly trained to keep abreast of the new and innovative technologies in aquaculture. Government should lower the costs of obtaining simple technologies for farmers by providing them at subsidized rate.

Farmers' organizations should ensure to lobby the government to provide subsidies and lower taxes on farm inputs and other aquaculture equipment to help the farmer improve their production. The organizations should constantly promote fish consumption in the surrounding communities to create awareness and sensitize of the benefits of consuming fish and also being non fish-eating community conduct regular campaigns like "Eat More Fish" campaign and social media campaign to change the communities' cultural perception hence have a wider market for fish.

The organizations should encourage the women and youth farmers to start up fish farming enterprise especially on processing and marketing of fish to help diversify fish for easy access to market

Farmers should learn from each other experience and challenge to help improve their farming enterprises as well as constantly inquire on the new technologies that can improve their productions.

Farmers should also be organized into cluster group to help better produce and market together by joining fish cooperatives to help them avoid brokers' exploitation.

Fish farmers need to have a mindset change towards fish business and move from donor dependency syndrome to trading in fish.

5.6 Suggest further research

This study suggests that further studies be done on other factors that influence sustainability of small scale fish farming projects such as cultural beliefs and dependency mentality.

This study further suggests that studies be done on patterns and trends of access and utilization of output market of small scale fish farming projects in Kenya: Process Approach.

REFERENCES

2015/1338, E. (2015). Amending Decision 2011/163/EU on the approval of plans submitted by third countries in accodance with Artical 29 of Council Directive 96/23/EC by Commission Implementing Decision (EU) 2015/1338. *Official Journal of the European Union* , L 206/69.

AAK. (2015). *Fish marketing in Kenya: A report by Aquacultural Association of Kenya* . Nairobi.

AAK. (2015). *Major Challanges Facing fish farming in Kenya: Report by Aquaculture Association of Kenya* . Nairobi.

Alberto Alesino, S. O. (1996). Political Instability and Economic Growth:. *Journal of Economic Growth* .

Andreson, A. (2005). *The Community Builders Approach to Theory of Change: A Practical guide to theory and developmet* . New York: The Aspen Institute Roundtable on Community Change .

Antonius, R. (2003). *Interpreting Quantitative data with SPSS.* SAGE Publication .

Arjo Rothuis, M. A. (2014). *Aquaculture in East Africa: A regional Approach.* Food tech Africa .

Braun, V. &. (2006). Using thematic analysis in psycology. *Qualitative Reserch in Psychology, Volume 3- Issue 2*, pp77-101.

Bryman A, &. B. (2015). *Business Research Methods. 4th Edition* . Oxford : Oxford University press.

Bryman, A. (2012). *Social Reserch Method, 4th Edition* . Oxford: Oxford University Press.

Burns, A. (1999). *Collaborative action researchfor english language teachers* . Cambridge: CUP.

Charles C. Ngugi, J. R. (2007). *A new Guid e to Fish Farming in Kenya.* Kenya : Aquculture CRSP.

Christian Larbi Ayisi, E. H. (2016). *Aquaculture Extension Services: A case of fish farms in the eastern region of Ghana.* Ghana: International Journal of Fisheries and aquatic studies .

CIDP. (2013). First Meru County Integrated Development Plan 2013-2017.

Classen Sherrilene, E. D. (2007). *Population-based health promotion perspective for old driver safety: conceptual framework to intervention plan.* Gainesville USA: Dove medical Press Limited.

Creswell JW, F. M. (2004). *Designing a mixed method study in primary care.* Ann Fam Med 2:7-12.

Creswell, J. (2011). *Educational research.* New Delhi: PHI learining private limited .

Crewell, J. (2003). *Research Design Qualitative, Quantitative and Mixed Methods Approaches, 2nd Edition.* London: Sage Publications Ltd.

Dana H. Taplin, H. C. (2013). *Theory of Change: A series of papre to support development of theories of change based on practice in the field.* New York: Actknowledge Theoryt to results.

Danie N.Mungai, P. K. (2015). *Fish Farmers Training Manual:EU Kenya Standards and market Programme- Private sector component: UNIDO Project number 130016.* Nairobi: Westlink Services.

Douglas, P. H. (1928). Theory of Production . *The American Economic review, 18 (1)*, 139-165.

E, H. (2002). *The role and limitation of producer associations, .* Montpellier: European Forum for rural Development Cooperation, 4 Septemebr .

E. Okemwa, A. G. (1996). Fish Farming in kenya with particular reference to the lake victoria basin . 1.

El-Gayar, O. F. (1997). The use of information technology in aquaculture management: Volume 1 Issue 1-2. *Aquaculture Economics & management- online publication* , 109-128.

Eyster, G. (2014). *Economic Development and Regional Integration in East African Community.* Indiana University: Policy Analysis.

FAO. (2004). *Aquaculture Extension Services: FAO Fisheries Circular No. 1002.* Rome, Italy: Food and Agriculture Organisation of the United Nations .

FAO. (2012). *The state of World Fisheries and Aquaculture* . FAO.

FAO. (2014). *The State of World Fisheries and aquaculture* . Rome: FAO.

FAO. (2016). Fisheries and Aquaculture country profiles: The Republic of Kenya:http://www.fao.org/fishery/facp/KEN/en.

FAO. (2017). *Aquaculture Technology*. Rome: http://www.fao.org/fishery/technology/aquaculture/en.

G. M Senyolo, P. C. (2009). Patterns of acess and utilization of output markets by emerging farmers in South Africa: Factor analysis approach. *African Journal of Agricultural Reserch Vol.4* , Pp208-2014.

GOK. (2009). *Annual Report* . Nairobi: Government Printers .

GOK. (2012). *Age of majority Act, Chapter33: Laws of Kenya- Revised 2012 www.kenyalaw.org.* Nairobi: National Council for law Reporting with the Authority of the Attorney-General .

Harrison Charo- Karisa, M. A. (2017). *Overview of Good Aquaculture Practices in Kenya: Kenya Marine and Fisheries Research Institute and Kenya Agricultural productiuvity programme* . Nairobi: Westlink Services LTD.

Henri-Ukohal, A. O. (2011). Effect of World Bank Assisted Fadama II Project on the Performance of Fish Farming in IOM State,. *A Compararative Evaluation. American Journal of Experimental Agricultural, I* , 450-457.

HLPE. (2014). *Sustainable fisheries and aquaculture for food security and nutrition. A report by the High Level of Experts on Food Security and Nutrition of the Committee on World Food Security* . Rome .

Holder, R. J.-T. (2010). The Technology Acceptance Model: its p[ast and its future in Health Care . *Journal of Biomedical Informatics 43(1)*, 159-172.

https://en.wikipedia.org/wiki/Causal_model. (n.d.).

IFAD. (May 2009). Sustainability of rural development projects: occassional papers on knowledge for development effectiveness. 15.

Inc., S. I. (2003). *Basic Concepts in Reserch and Data Analysis: JMP Statistics and Graphic Guide;A step-by-step Guide* . Cary, : NC:SAS Institute Inc.

INSP. (2005). *Theory of change tool manual by International Network on Strategic Philanthropy working group: Full version* . INSP: http://www.dochas.ie/Shared/Files/4/Theory_of_Change_Tool_Manual.pdf.

Jacobi, N. (2013). Examining the potential of fish farming to improve the livilihood of farmers in the lake victoria region, kenya assessing impact of governemental support. *unpublished thesis. The University of Akureyri* .

J.R, E. S. (2008). *Introduction to Qualitative Research.* International Encyclopedia of Education .

John Bostock, B. M. (2010). Review Aquaculture: global status and trends . *Philosophical Translations of The Royal Society*, 2897.

Jonathan Mbonge Munguti, S. M.-K. (2014). *An Overview of currenyt status of Kenyan fish feed industry and feed managenment practise, challanges and opportunities* . Kenya: International Journal of Fisheries and Aquatic studies .

Joseph, R. (2011). factors influencing the adoption of small scale fish farming in Meru Central District, Kenya.

Kagiri, E. W. (2016). An Evaluation of Factors Affecting Sustainability of Fish farming projects in public secondary schools in Kiambu County. *International Journal of Scientific and Research Publications*.

Kalmar, s. R. (2016). *Sustainability in project management: Eight principles in practice: Masters Thesis 15 p supervised by Natalia Semenova.*

Kaminski, J. (Spring 2011). Diffusion Of Innovation Theory. *Canadian Journal of Nursing Informatic, 6(2). Theory in Nursing Informatics Column http://cjni.net/journal/?p=1444*.

KEMFRI. (2013). *Fish Feed Production, Storage and application produced by KEMFRI under ASARECA Project* . Sagana: KEMFRI Aquaculture Research Division.

KEMFRI. (2017). *http://www.kmfri.co.ke/index.php/divisions/110-aquaculture-research-division.* Nairobi: KEMFRI.

KEPSA. (2013). *The kenya National Business Agenda II 2013-2018.* Nairobi: Developoment management services.

Kidombo, C. M. (2010). *Research Methods:Lecture Series, printed by Collage of Education and External Studies, University of Nairobi.* Nairobi : University of Nairobi Press .

Kimathi Antoney Njagi, I. C. (2013). *Factors affecting Profitability of Fish Farming Under Economic Stimulus Programme in Tigania East, Meru County, Kenya.* IOSR Journal of Business and Management .

LeCompte, M. &. (1985). *Problem of Reliability and validity in ethnography reserch.Review of Educational reserch, 52(1), 31-60.*

Lee, Y. K. (2003). The Technology Acceptance Model: Past, Present and Future. . *Communication of the association for information system* , 752-780.

Lincoln, Y. S. (1985). *Naturalistic Inquiry. Thoiusands Oaks,* . Calif: Sage.

Lucy A. Obungu, D. M. (2015). *Sanitary requirements for Aquaculture Indudtry in Kenya: A trainers manual, EU Kenya standards and Market Access Programme-Public/private sector component; UNIDO Project number 13001628.* Nairobi: Westlink Services.

Lynch, B. (1996). *Language program evaluation: theory and practical* . Cambridge : CUP.

M. Saunders, L. P. (2012). *Research Methods For Business Students. 6th Edition* . Harlow: Finance Times Printice Hall.

M. Saunders, p. L. (2009). *Research Methods for Business Students* . Harlow: Finance Times Prentice Hall .

M.A Rahman, F. A. (2015). Pond fish culture and need for credit: A Study in selected areas of Tangail District . *J. Bangladesh Agril. Uni. 13(1): 117-124*.

Manyala, C. N. (2004). Aquaculture Extension Services in Kenya.

Mary Opiyo, H. C.-K. (2017). *Good Aquuaculture Practices for Seed production in Kenya: Volume 1 Tilapia and Catfish.* Kenya: Kenya Literature Bureau.

Merriam, S. B. (1998). *Qualitative research and case study application in eduacation* . San Francisco: Jossey-Bass.

MOALF. (2015). *Economic Review of Agriculture[ERA]: Ministry of Agriculture, Livestiock and Fisheries; prepared by Central Planning and Project Monitoring unit* . Kenya : Governement printer .

MOALF-SDF. (2013). *Fisheries Annual Statistical Bulleting* .

MOFD. (2008). *National Oceans and Fisheries Policy* .

MOFD. (2009). *Annual Statistical Bullettin.*

MOFD. (2010). *Natioanl Aquaculture Strategy and development Plan 2010-2015: Filling the fish supply gap for food security, income and healthy living: Edition one* . Nairobi-Kenya: Government Printer.

MOFD. (2011). *National aquaculture Policy (2011): Ministry of Fisheries Developemt* . Nairobi-Kenya: Governemnet Printers .

Mwamuye, M. C. (2012). Performance of Commercial Aquaculture under the Economic Stimulus Program in Kenya. *International Journal of Business and Economics, 2 (3),* pp 1-20.

Mwangi, M. H. (2008). *Aquaculture in Kenya: Status, C hallanges and Opportunities* . Kenya: DOA.

N., S. .. (2013). A Playbook for Research Methods: Integrating Conceptual Framework and Project Management: Revised 2nd May 2015 from http://en.wikipedia.org/wiki/Conceptual _Framework. *New Forums Press.P*, 24 .

NARDTC. (2013). Fish Genetics:by the National Aquaculture and research Development traioning center. www.nardtc.org. *Nardtc website* .

NARDTC, G. a. (2014). *Production of Quality Fish Feed: Catfish, Tilapia and ningu. A Bronchure produced by NARDTC Sagana in collaboration with KEMFRI Sagana, Aquacultural Association of Kenya through Kenya Agricultural and Agribusiness programme project* . Sagana: http://www.kmfri.co.ke/images/pdf/Brochure_Quality_seed_Production.pdf.

Nguyen Van Huong, T. H. (2016). Factors affecting small scale fish farmers in accessing market: a case study of fish value chain in haidoung Province, Vietnam. *http://hdl.handle.net/2268/203269*, pg 14.

Njogu Bernard Munyi, D. E. (2016). *Determinants of Sustainability for Fish Farming Project Initiative under Economic Stimulus Prograamme in Kenya; Kirinyaga County.* Journal of Resource Development and management.

Nunan, D. (1999). *research methods in language learning. Eighth printing* . Cambridge: CUP.

Oliveria, T. &. (2011). Literature Review of Information Technology Adoption Models at Firm Level. *The Electronic Journal information System Evaluation Volume 14 Issue 1*, pp110-121.

Onzere, L. N. (2013). Factors Influencing Performance of Community Based Projects: A case of Fish Farming in Nyeri County, Kenya . *Unpublished Masters Project. Univversity of Nairobi*.

ORS. (2004). *Theory of Change: A practical Tool for Action, Results and learning prepared by Organisattion Research Service* . Annie E. Casey Foundation .

Questionnare. (2012). *Wikipedia: The free Encyclopedia, September 2012: http://en.wikipedia.org/wiki/questionnaire#References* .

Raja, P. M. (2013). Factors Affecting Knowledge of Fish farmers Regarding Fish Production Technology . *Indian Res.J. Extension Education, 13 (2),* 126-128.

Randall E. Brummett, J. L. (2008). *African Aquaculture: Realizing the potential.* Science Direct .

Reza Azimi, S. L. (2012). Appling basic control theory principles to project control: A case of off-site construction shops . *Journal of Computing in Civil Engineering*.

Richards, J. C. (2002). *Longman dictionary of language teaching and applied linguistics. Third Edition* . London: Longman.

R. O. (2007). Adoption of aquaculture Technology by Fisgh Farmers in Imo State of Nigeria. *The Joutnal of technology studies: http://scholar.lib.vt.edu/ejournals/JOTS/v33/v33n1/ike.pdf*, 57-62.

Rogers, E. M. (1995). Diffusion of Innovations 4th Edition . *The Free Press. New York*.

Rossman, C. M. (1999). *Defining qualitative Research 5.* Melaka.

Rubbin, A. &. (1997). *Reserch Methods for Social Work, 3rd edition* . California: Books/Cole Publishing Company.

Antonius, R. (2003). *Interpreting Quantitative data with SPSS.* SAGE Publication .

E, H. (2002). *The role and limitation of producer associations, .* Montpellier: European Forum for rural Development Cooperation, 4 Septemebr .

G. M Senyolo, P. C. (2009). Patterns of acess and utilization of output markets by emerging farmers in South Africa: Factor analysis approach. *African Journal of Agricultural Reserch Vol.4* , Pp208-2014.

J.R, E. S. (2008). *Introduction to Qualitative Research.* International Encyclopedia of Education .

Mwamuye, M. C. (2012). Performance of Commercial Aquaculture under the Economic Stimulus Program in Kenya. *International Journal of Business and Economics, 2 (3),* pp 1-20.

Nguyen Van Huong, T. H. (2016). Factors affecting small scale fish farmers in accessing market: a case study of fish value chain in haidoung Province, Vietnam. *http://hdl.handle.net/2268/203269*, pg 14.

Rossman, C. M. (1999). *Defining qualitative Research 5.* Melaka.

Sarnissa. (2011). *Sarnissa Newsletter.* Sarnissa.

Schwandt, T. A. (2007). *Dictionary of Qualitative inquiry 3rd* . University of Ilinois , Urbana-Champaign.

V, B. J. (2006). *Research in Education, 10th Edition* . University of illinois at Chicago.

Sangas, S. &. (2014). Factors Influencing Adoption of Pond Fish Farming Innovations in Potsy of Morobe Province, Papua New Guinea. *Universal journal of agriculturee research, 2(6),* 191-197.

Schwandt, T. A. (2007). *Dictionary of Qualitative inquiry 3rd* . University of Ilinois , Urbana-Champaign.

Sharma, R. (2004). *Strenghtening Agricultural Support Services for small farmers* . Japan: Asian productivity Organisation.

Simon, M. (2011). Dissertation and scholary research: Recipe for Success. seattle, WA, Desertation Success, LLC. *(Online) www.dissertationrecipe.com*.

Taylor S. J, &. B. (1998). *Introduction to qualitative Reserch Methods: A Guidebook and Research, 3rd edition* . USA: John Wiley & Son, Inc.

V, B. J. (2006). *Research in Education, 10th Edition* . University of illinois at Chicago.

Venkatesh, V., Morris, & Davis. (2003). User Acceptance of information Technology: towards a unified view . *MIS Quarterly, 27 (3),* 425-478.

Venkatesh, V., Thong, J. Y., & Xu, X. (2012). Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Accptance and Use of Technology. *Mis Quarterly Vol. 36 No1* , 157-178.

Wairimu, P. (2008). Meru County turns to modern fish farming: https://www.youtube.com/watch?v=oimnbIb1XIg. *Voice of Africa*.

WCED. (1987). *Our common future. A report by World Commision on Enviroment and Development* .

Wetenegere, K. (2010). Realizing Farmer's Objective- Vital to adoption process of fish farming technology. The caase of selected villages in Eastern tanzania. *Advance Journal of Food Science and Technology 2 (2),* 116-124.

Wetengere, K. (2009). Socio-economic farctor critical for adoption of fish farming technology: the case of selected villages in eastern Tanzania. *International Journal of Fisheries and Aquaculture Vol.1 No.3*, 28-37.

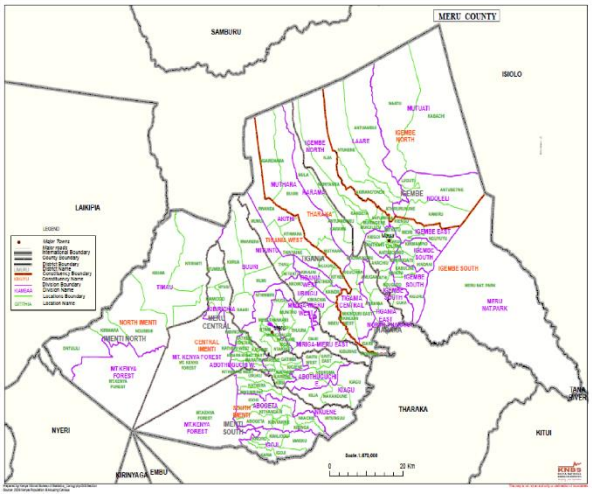
Zahrabi, M. (2013 February). Mixed Methods Research: Instruments, Validity, Reliability and Report Finding . *Theory and Practice in Language Studies, Vol 3, No. 2,*, 254-262.

Zikmund, W. B. (2012). *Business Reserch methods: with Qualtrics Printed Access Card" Cengage learning http://research-methodology.net/research-methodology/research-design/conclusive-research/causal-research/.*

APPENDICES

Source: Kenya National Bureau of Statistics

Figure 1: Maps of Kenya



Source: Kenya National Bureau of Statistics

Figure 2: Maps of Meru County and Sub-Counties Boundaries

APPENDIX 1:

LETTER OF TRANSMITTAL

Margaret Wanjiru Gatonye

P.O Box 59721-00200

Nairobi Kenya

30th August 2017

Director of Fisheries

Meru County

P.O Box 120-60200

Meru, Kenya.

Dear Sir,

REF: REQUEST TO CARRY OUT RESEARCH ON SUSTAINABILITY OF SMALL SCALE FISH FARMING PROJECTS IN SOUTH IMENTI SUBCOUNTY.

I write to request to be allowed to conduct the above research in south Imenti Sub-County on small scale fish farming projects.

I am a post graduate student at the University of Nairobi Student No. **L50:84473/2016,** and currently pursuing a course in project planning and management. I am conducting a research study on the factors influencing sustainability of small scale fish farming projects in Kenya, South Imenti Sub-County Meru County. The research is meant for academic purposes only; however, evaluation will be made public after completion of the study for future researchers and other relevant organizations to act as guide for their work.

Thank you in advance for your cooperation.

Yours Faithfully,

Gatonye Margaret W.

APPENDIX 2:

CONSENT FORM

Project Title: MA Project- Sustainability of small scale fish farming projects in Kenya

Introduction

You are invited to join an academic research study focused on Factors Influencing sustainability of small scale fish farming projects in Kenya: A case of South Imenti, Meru County

In this research study, the researcher would like to investigate sustainability considerations in fish farming projects, what challenges you face when attempting while trying to apply this condition. The integration of sustainability aspects in fish farming projects can be a stepping stone to delivering small scale fish farming projects sustainably. The researcher aims to ensure adoption of sustainable fish farming projects. Furthermore, the researcher intends to close the gap between theory and application by closing by highlighting the challenges small scale fish farming projects face to ensure sustainability.

What is involved in the research study?

If you decide to participate in this research, you will be asked a set of semi-structured questions related to fish farming projects that you manage. The researcher this will take 30 to 45 minutes. For the purpose of this study the researcher will conduct interviews through an interview schedule that will be shared with you.

For purposes of data analysis, the researcher would like to voice record the interview, copy and use it as a supporting source of the study. The voice record will later be deleted after the transcription has been made. The researcher would like to contact you via call if further clarifications are needed.

Benefits of taking part in the research study

Below are benefits of taking part in the research study for you:

i. It will help you reflect over some of the sustainability considerations you are currently making in your fish farming projects and help you aspire towards integrating sustainable technique in your future fish farming activities.

ii. It will report findings from other small-scale fish farmers that will help observe what other fish farmers are doing to ensure sustainability in their farming projects.

Below are benefits of taking part in the research study for the community

i. It will inform literature on factor influencing sustainability of small scale fish farming activities attempting to bridge the gap between theory and practice.
ii. It will help academia understand challenges to sustainable fish farming and fuel discussions on ways to address them.
iii. It will draw more attention to sustainability of fish farming projects encouraging researchers to come up with models, tools and techniques to assist it integration.
iv. It will serve as a guide to aspiring fish farmer to adopt sustainable thinking farming activities.

Your right as a participant in this research

In this research participation is voluntary. You have the right not to participate in the study and to leave at any time. You also have the right of being anonymous.

Confidentiality

Any sensitive inform you share will not be disclosed unless you agree. The researcher does not intend to criticize you fish farming activity but rather to understand what factors influence sustainability of you fish farming project and considerations you made in the project.

Please click appropriately next to the statements below.

i. I agree to take part in this study Yes ☐ No ☐

ii. I understand that my participation in this research is voluntary Yes ☐ No ☐

iii. I agree to my interview being recorded Yes ☐ No ☐

iv. I confirm that I have read and understood the information above Yes ☐ No ☐

Consent of subject

Signature _____

Date _____

APPENDIX 3:

QUESTIONNAIRE ON SUSTAINABILITY OF SMALL SCALE FISH FARMING PROJECTS IN KENYA

Dear Respondent,

This questionnaire has specifically been designed to assist in the study of factors influencing sustainability of small scale fish farming projects in Kenya, Meru County- South Imenti Sub County. You have been identified as a respondent to this exercise. The information collected from you will be treated with strict confidentiality. Kindly complete the questionnaire as objectively as possible.

SECTION 1						
Personal Information (please tick appropriately)						
1	Gender	Male		2 Age bracket of respondent	(18-25) yrs	
		Female			(26-35) yrs	
					(36-45) yrs	
					(46-55) yrs	
					(56 and above)	
3	Highest education level achieved	KCPE/ Primary				
		High School				
		Diploma				
		Bachelor's Degree				
		Master's Degree				
		Doctorate				
		Other(Specify)				
4(a)	Did you study agriculture related course in school?	Yes				
		No				
4(b)	If No specify where you got the motivation to venture into fish farming. Explain					
SECTION 2						

What challenges do you face in fish farming (tick where appropriate 1 being least challenging while 5 being most challenging)						
		1	2	3	4	5
Cost of inputs						
Provision of extension services						
Accessibility of market						
Use of new technology						
COST OF INPUTS (please tick appropriately)						
Fish Seed/Fingerling						
5	Where do you buy you fish seeds/ fingerlings?	Government hatchery		6 How much do you by the fish seed/ Fingerlings	Less than 5	
		Private hatcheries				
		Self-propagation			5-10	
		All the above			10-15	
					More than 15	
7(a)	What type of fingerling do you buy		Mono sex			
			Mixed sex			
7 (b)	Explain					
Fish Feed						
8	Where do you buy your fish feed					
9	How much do you buy the fish feed per Kg in Kshs		Below 100			
			100-200			
			200-300			

		Above 300	
10	What is the your Feed Conversion ratio(FCR)		
SECTION 3			
PROVISION OF EXTENSION SERVICES(please tick appropriately)			
11(a)	Have you ever received extension services from the government?	Yes	
		No	
11(b)	If YES how often do you get the services?	Monthly	
		After every 3 months	
		After every 6 months	
		Yearly	
	Others (Specify)		
12	What type of extension services have you received?	Pond Management	
		Feed management	
		Record Keeping	
		Marketing & value addition	
12(b)	List any other 1. 2. 3.		
13	Are you satisfied with the extension services offered?	Yes	
		No	
13(b)	If NO which areas and give reason		
14(a)	Do you think provision of extension services can/has improves production in fish farming?	Yes	
		No	
14(b)	If YES explain		
SECTION 4			
ACCESSIBILITY TO MARKET (please tick appropriately)			

15	Where do you sell your fish?	Farm gate	
		Restaurants	
		Supermarkets	
		Fish Processing Plant	
		Other(specify)	
16	How much do you sell your fish per Kg in Ksh?	Below 100	
		100-200	
		200-300	
		Above 300	
17	How do you determine the price of fish?		
SECTION 5			
USE OF NEW TECHNOLOGY(please tick appropriately)			
18	What type of farming system do you currently have in your farm?	Intensive system	
		Semi- intensive system	
		Extensive system	
19(a)	What new technologies have you adopted in the past 5 years? 1. 2. 3.		
19(b)	How long did you take to adopt to the technology you are using	1 month	
		3 months	
		6 months	
		1 year	
		Other(specify)	
20	Where did you learn about the above mentioned technology?	Government Fisheries officers	
		Donor programmes	
		Internet	
		Other Farmers	
21	How much did it cost to adopt the technology?		

22(a)	Did the technology influence your fish production?	Yes	
		No	
22(b)	If YES how, explain?		
	SUSTAINABILITY OF YOUR FISH FARMING BUSINESS		
23	What is your annual turn over	Less than 50,000	
		50,000-100,000	
		Above 100,000	
24	Do you make profit from your business	Yes	
		No	
25	Share your comments on what should be done to make fish farming more profitable for small scale farmers?		

Thank you for information and time taken in completing this questionnaire.

APPENDIX 4:

INTERVIEW SCHEDULE

Section 1: Contextual questions (5mins)

1. What is your name?
2. What is your education level?
3. How many years of experience do you have in fish farming?

Section 2: Questions related to the project (30-45Mins)

1. What are some of the challenges you face in your fish farming project?
2. How have you tried solving some of these challenges?
3. How does the cost of inputs affect or/and influence sustainability of your fish farming project?
4. Have you received any training from the government or other development partners of fish farming? What have you been trained on?
5. How frequent do you receive these trainings?
6. How is the fish market here in South Imenti?
7. How have the use the technology helped improve your fish farming business?
8. What are some of the benefits of your fish farming project?
9. Is fish farming profitable?
10. How much profits do you get per year?

APPENDIX 5:

RESEARCH AUTHORIZATION LETTER

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: 020 400 7000,
0713 788787,0735404245
Fax: +254-20-318245,318249
Email: dg@nacosti.go.ke
Website: www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No. **NACOSTI/P/17/94319/20240** Date: **17th November, 2017**

Margaret Wanjiru Gatonye
University of Nairobi
P.O. Box 30197-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Factors influencing sustainability of small scale fish farming projects in Kenya: The case of South Imenti Sub-County, Meru County"*** I am pleased to inform you that you have been authorized to undertake research in **Meru County** for the period ending **17th November, 2018.**

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

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

GPKalerwa

GODFREY P. KALERWA MSc., MBA, MKIM
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Meru County.

The County Director of Education
Meru County.

APPENDIX 6:

RESEARCH PERMIT

THIS IS TO CERTIFY THAT:
MS. MARGARET WANJIRU GATONYE
of UNIVERSITY OF NAIROBI, 59721-200
Nairobi,has been permitted to conduct
research in *Meru County*

on the topic: *FACTORS INFLUENCING SUSTAINABILITY OF SMALL SCALE FISH FARMING PROJECTS IN KENYA: THE CASE OF SOUTH IMENTI SUB-COUNTY, MERU COUNTY*

for the period ending:
17th November,2018

Permit No : NACOSTI/P/17/94319/20240
Date Of Issue : 17th November,2017
Fee Recieved :Ksh 1000

.....
Applicant's Signature

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

CONDITIONS

1. The License is valid for the proposed research, research site specified period.
2. Both the Licence and any rights thereunder are non-transferable.
3. Upon request of the Commission, the Licensee shall submit a progress report.
4. The Licensee shall report to the County Director of Education and County Governor in the area of research before commencement of the research.
5. Excavation, filming and collection of specimens are subject to further permissions from relevant Government agencies.
6. This Licence does not give authority to transfer research materials.
7. The Licensee shall submit two (2) hard copies and upload a soft copy of their final report.
8. The Commission reserves the right to modify the conditions of this Licence including its cancellation without prior notice.

REPUBLIC OF KENYA

NACOSTI

National Commission for Science, Technology and Innovation

RESEARCH CLEARANCE PERMIT

Serial No.A 16563

CONDITIONS: see back page