EFFECT OF FARMER PRODUCTION MANAGEMENT SKILLS ON STATUS OF ECONOMIC STIMULUS AQUACULTURE PROJECTS IN KISUMU WEST CONSTITUENCY, KISUMU COUNTY, KENYA

BY

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DECLARATION

I certify that this thesis is my original work and that all the materials in it which have been borrowed have been referenced.

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I confirm that the work carried out in this research was carried out by the candidate under my supervision as university supervisor.

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DEDICATION

I dedicate this work to my late Father Henry and Mother Roselidah.

ABSTRACT

Food and nutrition insecurity is a concern for the Kenyan government. As a result, various policy interventions have over time been implemented to deal with food and nutrition challenges within the country. Economic Stimulus program is one such intervention with specific objectives to create employment opportunities, improve nutritional status of the constituents and contribute towards rural development across the 140 selected constituencies, Kisumu West Constituency being amongst them. Despite the significant investment of resources by government, small holder aquaculture production showed a decline both nationally and within the area of study. Production within area of study was below the national average despite having suitable conditions alongside farmers being trained and capacity built on pond management skills. This awakened the necessity to establish the effect of farmer production management skills on the status of the Economic Stimulus aquaculture projects in Kisumu West Constituency, Kisumu County, Kenya. The study's specific objectives were to: evaluate the influence of resource mobilization on production of aquaculture, assess the effect of farmer acquisition of pond management skills on the status of aquaculture, and determine the effect of post-harvest interventions on the income earned through aquaculture. The study results could inform stakeholders as agents to come up with appropriate corrective measures to address the emerging issues affecting aquaculture performance. A total of 389 farmers were administered with questionnaires in person, through the snowball sampling method from a population of 417 farmers. A descriptive research design was employed through a survey to collect both quantitative and qualitative data. Primary data was collected using questionnaire, key informant interviews and observation. Secondary data was collected from peer-reviewed publications, and journals. Quantitative data generated frequency tables, then analyzed to percentages, mean, Chi-square, and Pearson's correlation coefficient between the variables. Qualitative data was coded to create themes and categories. Thematic analysis was done for themes and contingency tables developed for categories. The analyzed results were then presented using text, tables, pictorials and graphs. Personal-financed farms experienced better production levels and fewer dropout rates compared to those funded by the government. Though farmers were trained on pond management skills at the initiation stage, subsequent training and capacity building by extension officers was not satisfactorily done to ensure farmer acquisition of the required skills. At 0.05 confidence level, the Chi-square values on farm status and predator identification, early disease detection, feeding, record management, pricing, storage, and value addition showed dependence hence the need for enhanced training. At 0.05 confidence level, the Chi-square values on farm status and cold storage, funds to restock, sourcing for the market, and value addition evidenced dependence, directly affecting fish pricing. The study recommends the establishment of the best management practice and capacity-building on pond management skills, and the creation of improved marketing infrastructure for the farmers. The County Government should increase budgetary allocation for aquaculture and enlist extension officers for in-service training on aquaculture professional development and capacity building. The study results would be beneficial to planners and policy makers for management and implementation of future projects and interventions.

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LIST OF ABBREVIATIONS AND ACRONYMS

EDD – Economic Diversification Drive

ESP – Economic Stimulus Program

EU – European Union

FAO – Food and Agriculture Organization

FFEPP – Fish Farming Enterprise Production Program

GDP – Gross Domestic Product

GoK – Government of Kenya

HOTOSM – Humanitarian open street map team.

KMFRI – Kenya Marine Fisheries Research Institute

LBDA – Lake Basin Development Authority

LVFO – Lake Victoria Fisheries Organization

MDGs – Millennium Development Goals

NO & FP – National Oceans and Fisheries Policy

MT - Metric Tonnes

MT/Y – Metric Tonnes per year

SEZ – Special Economic Zones

US – United States

WORKING DEFINITION OF TERMS

Active farm –a farm that is currently in operation or has not taken more than 3 months from the last fish harvest.

Aquaculture – is the cultivation of fish for food on fish ponds.

Economic stimulus Program – it is an intensive, high-impact program that stimulates economic activities, spurs entrepreneurship, and supports the building –blocks that anchor a healthy, educated, and innovative populace.

Farm status – is the current state of operational activity of the farm that is whether active or inactive, and if the farm is in production and the current level of production.

Food Consumption – includes four sub-components: purchases, own production, stocks, and gifts of food items with a recall period of seven days (KNBS, 2018).

Inactive farm – is a fish pond that is currently not operational and has taken more than three months without restocking after the previous harvest.

In-service training – is the training given to employees during the course of employment.

Pond performance – is the measurement of pond production across the constituency in relation to the number of fingerlings stocked.

Production management skills – involves technical expertise required by a farmer and all activities carried out in a fish pond, aimed at ensuring resource mobilization, pond management and post-harvest interventions leading to a conducive environment to improve fish yield.

Resource mobilization – is the acquisition of financial capital and human resource at the right time in a cost-effective manner to ensure sustainable fish production.

Skills – is the acquisition of expertise to perform responsibilities of a business-oriented aquaculture farmer.

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CHAPTER ONE: INTRODUCTION

1.1 Background of the study

Management is the process of designing and maintaining an environment to effectively and efficiently accomplish selected objectives. Managers carry out the functions of planning, organizing, staffing, leading, and controlling (Weihrich,2008). According to Bateman and Zeithaml (1993), management functions are a cornerstone of a manager's job. Managers, therefore, need a variety of skills to execute these functions successfully. These management skills include technical skills, conceptual and decision-making skills, interpersonal and communication skills. To sustainably commercialize aquaculture, a farmer's acquisition of production management skills is of fundamental consideration. The technical skills that were fundamental in the study included early fish disease detection, feeding program, predator identification and management, water source management, record keeping, fish pricing after harvest, fish storage, and value addition. The skills require all the tenets of a good manager that includes good planning, controlling, organizing, leading, and proper staffing.

The Food and Agriculture Organization (FAO) has estimated that more than 30% of all fish used for human consumption originate from Aquaculture. In 2010, the world aquaculture production was 60 million tons of fish and crustaceans, and 20 million tons of aquatic plants (FAO, 2012). For comparison, capture fisheries provided 90 million tons, that is, the share from aquaculture was about 47% of the total aquatic production while excluding aquatic plants, the share from fish and crustaceans was about 35%. The world's human consumption was estimated to be about 18kg per capita per year. Globally, aquaculture is the fastest-growing food producing sector. Outpacing population growth, that is the global production of fish, crustaceans, and aquatic plants increased by about 5% per year from 2001 to 2010 (FAO, 2012). As evidenced, the high consumption rate of fish products provides valuable market for aquaculture products globally.

Aquaculture growth is highest in Asia, which accounts for more than 89% of global production, while EU growth in the sector is stagnant (FAO, 2012). In the EU, lack of accessible aquaculture space, competition in the global market and administrative constraints, in particular concerning licensing procedures, as well as financing for investment in aquaculture, are among the challenges to growth of European aquaculture. Key findings published by FAO (2014) on the strategies for

the economic viability of commercial aquaculture farms in the Pacific include management of production risks and improvement of technical and operational efficiency, management of marketing risks, and better market access. Boyd et al (2013), write on the best management practices of aquaculture in Alabama, USA positing that local people with inadequate technical knowledge and capital often have developed aquaculture projects which are often abandoned within a few years. This ostensibly led to a decline in production of the aquaculture farms.

Although Egyptian aquaculture sector has developed over several decades, many fish farmers have recorded little extension advice or training. The farmers complained of declined profitability due to the increasing production cost and static or declining selling price for their fish (Dickson et al, 2016). According to Hishamunda (2001), in the rural parts of the Ivory Coast, aquaculture failed because of the separation of ownership of the project and management with farmers lacking adequate skills. Shrewd management skills therefore served as a key ingredient to the performance of aquaculture.

Aquaculture was first introduced in Kenya by the colonial Government in the 1920s (Vermon & Someren, 1960; Munguti et al, 2021). From the 1920s, static water pond culture was introduced beginning with native tilapia followed by carp and African Catfish. Between the 1940s and the 1960s aquaculture was promoted as a means of sustainable food production to improve nutrition in rural areas, providing supplementary income generation, diversification to reduce crop failure risks, and employment creation in rural areas (Adeleke et al, 2020). The number of productive ponds in Kenya declined in the 1970s, mainly because of inadequate extension services, a lack of quality fingerlings, and insufficient training for extension workers. Until the mid-1990s, farming in Kenya followed a pattern similar to that observed in many African countries characterized by small ponds, subsistence-level management, and very low levels of production (Ngugi et al, 2007).

Based on the underlying factors, the Kenyan Government supported aquaculture through the provision of capital and the engagement of qualified personnel to improve the farmer's production management skills. According to Nyonje et al (2011), the Kenyan Government initiated the ambitious ESP in 2009 to stimulate economic development and foster economic recovery after the post-election violence, alleviate poverty and spur regional development.

The key ESP interventions affecting the agriculture sector included the expansion of irrigation-based agriculture; the construction of wholesale and fresh produce markets; the construction and stocking of fish ponds with fingerlings; provision of aquaculture advisory services. Under fisheries the project aimed to support the commercialization of aquaculture through the construction of 200 farming ponds in 140 constituencies, ponds stocked with appropriate fingerling, training of trainers in fish pond construction, and hatchery management (Kioi, 2014). If the key interventions were well implemented then there was a need to find out the state of activity of the ponds and if indeed, they met the objective of improving the rural economy through employment and source of food.

According to Muir and Allison (2007) in their study which states that, through loss of cultured stock, increased production costs due to low water quality and unavailability for aquaculture during droughts. The impacts were likely to be felt most strongly by the poorest aquaculture farmers whose typically small ponds retain less water and dry up faster. The study determined if sufficient resources were allocated to Kisumu west constituency, one of the rural based constituencies through ESP for establishment of commercialized aquaculture. Being a rural constituency, the farmers experience financial challenges during daily management of their farms.

Fish and other aquatic foods have an array of roles in the food systems of Africa including generating revenue and serving as a vital source of micronutrients especially for women and young children (Chan et al, 2019). However, the value of fish and aquatic foods in Africa are often overlooked in development of research, policy and investment cycles (Chan et al, 2021). Indeed, the vital contribution of fish to food and nutrition security has largely been overlooked in high-level food policy dialog and associated funding portfolios of major international organizations and actors (Brennett et al,2021). For instance, between 1968 and 2018, world Bank Investment in capture fisheries and aquaculture accounted for an average of 1.8% of all agricultural funding; although funding has increased to an average of 2.6% (and as high as 5.4% in 2018) over the past decade (Brennett et al, 2021). Sustainable financing and investment are required to sustain capture fisheries and promote aquaculture expansion in sub-Saharan Africa to shift to aquatic food chain towards healthier diets (Chan et al, 2021). This study therefore, sought to determine if the amount of resource that had been mobilized and allocated as funding towards aquaculture production by private entrepreneurs, the national government and the county government of Kisumu was sufficient towards growth of sustainable aquaculture in Kisumu west constituency.

Obiero et al (2019) state that through supportive government policies and substantial public investments aquaculture production increased rapidly from less than 1000 Mt in 2006 to 24,000 MT in the mid – 2010s. However according to KNBS (2020), Pond-based aquaculture production registered depressed performance for the third consecutive year with total fish output dropping from 24,096 MT in 2014 the maximum recorded production achieved, 15,320 MT in 2018 and 18, 542 MT in 2019. Data provided by the Department of Fisheries, Kisumu West Sub-county during the pre-visit interview, showed that in the financial year 2016 – 2017, 2,319 Kg of fish was harvested from 47 ponds with an average of 49.34 Kg per pond. In the 2017 – 2018 financial year, 6, 130 Kg were harvested from 48 ponds, giving an average of 127.71 Kg per pond, and in the financial year 2018- 2019, 3,867 Kg of fish was harvested from 53 ponds which is an average of 72.96 Kg per pond. Despite the significant investment of resources by government through ESP, small holder aquaculture results showed a decline both nationally and within the area of study.

Nationally the country experienced declined pond production which was replicated within Nyanza region. Results from research done by Munguti et al (2021) shows that wild fish catch registered by beach management units along Lake Victoria shores indicate that Homabay county registered the highest wild fish harvest followed by Migori, Busia, Siaya and Kisumu County respectively. From the results Homabay and Migori counties had a higher quantity of wild fish catch and had access to fish from Tanzania for their market. Siaya county had a higher wild fish catch compared to Kisumu but had a limited market for the fish products. Busia county had a higher wild catch from the Lake Victoria than Kisumu, but also benefited extensively from fish from Uganda. Kisumu county on the other hand had ready market for fish with minimal catch from Lake Victoria compared to neighboring counties. According to Shitote et al (2013), thirteen fish breeding grounds on Lake Victoria in Kisumu County were demarcated to curb fish kills. This article classifies Kisumu county shores as predominantly a fish breeding zone. Kisumu East Constituency though with a ready market for fish the soil type is not very supportive for pond farming while Kisumu central is largely an urban area. Kisumu West Constituency on the other hand had an established fingerlings production farm. The area had suitable soils for pond establishment coupled with the availability of both seasonal and permanent rivers as a source of water for the ponds. Though these basic requirements for commercial fish farming exist, the study evaluated how pond management skills would influence the farm's state of activity and ability to develop into a commercialized enterprise.

Mwatsuma, Cherutich, and Nyamu (2012), state that the production of fish required a different set of technical and managerial skills than other agricultural activities. Therefore, to maximize the productivity of the ponds, farmers should have sufficient knowledge of predator management and basic skills in disease identification and control. Once maximum pond production is attained the farmer should have proper storage facilities, do value addition, and market and price the fish product appropriately to maximize profitability. Previous studies have not looked at the effect of management skills on fish farming under ESP since its implementation in 2009/2010. For example, Shitote et al., (2013), looked at the challenges facing fish farming development in Western Kenya, Mwatsuma et al, (2012) looked at the performance of aquaculture under the Economic Stimulus Program in Kenya, and Musyoka and Mutia, (2016) looked at the status of fish farming development in arid and semi-arid counties of Kenya in Makueni. This study is set to bridge the gap in knowledge by trying to find out the status and contribution of pond management skills to the development of aquaculture in Kisumu West Constituency. Munguti et al (2021) further enumerate that with adequate training on basic fish pond husbandry, fish farmers can eradicate these basic challenges by themselves. There is a need for competency-based training on special skills in aquaculture. The youth can be encouraged to join training in various Technical and Vocational Education and Training centers (TVETs) and Universities. Weak extension service is a perennial challenge in the aquaculture sector. This is because the government does not employ staff regularly. The devolution of fisheries and aquaculture sectors to county levels presents the need for local people to educate the local fish farmers using the local dialect. This is a perfect opportunity for young people to be trained as extension officers so that they can offer consultancy services to aquaculture farmers.

The research by Munguti enlists the importance of training in pond management skills. As one of the key considerations during the implementation of ESP. This study was geared towards ascertaining if the farmers acquired the pond management skills they were trained on and the effect on the current status of the ponds. These were to be measured using farm production. Other indicators of the farm’s performance could be observed in records kept, value addition tools or equipment, availability of storage facilities, and the farm's general layout and ambiance. Relationships were to be established between production and the various training areas on production management skills to provide an independent and objective conclusion on the farmer's

acquisition of the fundamental management skills. The study would also find out the availability of extension officers and their support in aiding the farmers to gain the required skills.

Thant (2018), aquaculture in Myanmar has grown rapidly in the last decade and plays an important role in the national fish supply. Aquaculture production had reported slightly over one million tons in 2016 which is around a 2 percent increase from the previous year. The growth was sustained due to the proper handling of fish post-harvest to realize maximum income for the farmer. The study indicates the importance of post-harvest interventions, therefore there is a need to find out if similar initiatives were put in place by Kenyan farmers to attain commercialized farms. Adrien (2015), in an attempt to promote sustainable small-scale fisheries in the context of food security and poverty eradication in Kenya, numerous post-harvest management interventions have been made by the government, development partners, and stakeholders. The study would establish if such interventions were cascaded to support pond farmers in the Kisumu West constituency, in the spirit of realization of commercialized farms.

Macharia and Njagi (2020) elucidate that in Kenya major challenges of fish post-harvest handling include lack of infrastructure at the farms for fish preservation, lack of nearby markets, and the remoteness of the production areas, in most of the scenarios fish drying often occurs on the bare ground where the product is exposed to soil, bacteria and birds and poor market linkages between production and marketing sites. The challenges expose the lack of sufficient skills by the farmers to suitably handle fish after harvest leading to losses. Harvesting and proper handling of fish post-harvest determine the amount of income that a farmer would earn. Though there is high demand for fish products. The availability of cold storage facility at the farm and a value addition program was of great importance to allow minimization of fish loss after harvest.

The findings by Macharia and Njagi (2020), informed on the importance of commercializing post-harvest practices. This would serve to avert the fish losses through value addition, processing, and instituting astute marketing skills. The main objectives of value chain management are to maximize profit and ensure long-term sustainability. This study was therefore focused on establishing the relationship between farm activity and farmer integration of business-oriented post-harvest practices. The effect of the commercialized post-harvest practices on the income earned by the farmer and establish the challenges faced by the farmer in the process.

1.2 Statement of the problem

Food and nutrition insecurity is a concern for the Kenyan government. As a result, various policy interventions both short and long term have over time been implemented to deal with food and nutrition challenges within the country. Economic Stimulus program (ESP) is one such intervention with specific objectives to create employment opportunities, improve nutritional status of the constituents and contribute towards rural development across the 140 selected constituencies, Kisumu West Constituency being amongst them. ESP supported the aquaculture farmer to commercialize aquaculture through pond construction, farmer capacity building on production management skills and post-harvest interventions.

Through supportive government policies and substantial public investments, aquaculture production increased rapidly from less than 1000 MT in 2006 to 24,000 MT in the mid – 2010s. However, pond-based aquaculture production registered depressed pond performance for the third consecutive year with total fish output dropping from 24,096 MT in 2014 the maximum recorded production achieved, 15,320 MT in 2018 and 18, 542 MT in 2019. In Kisumu West constituency pond production showed a similar declining trend to that at the national level since, in the financial year 2016 – 2017, 2,319 Kg of fish was harvested from 47 ponds with an average of 49.34 Kg per pond. In the 2017 – 2018 financial year, 6, 130 Kg were harvested from 48 ponds, giving an average of 127.71 Kg per pond, and in the financial year 2018- 2019, 3,867 Kg of fish was harvested from 53 ponds which is an average of 72.96 Kg per pond. Despite the significant investment of resources by government through ESP, small holder aquaculture results showed a decline both nationally and within the area of study. It was therefore prudent to establish the level of activity of the ESP projects within the area of study, and challenges attributed to the decline in productivity in relation to how the resources were mobilized.

Kisumu West Constituency has an established fingerlings production farm, the county government of Kisumu supported fish farmers through issuance of fertilizer and employment of extension officers to ensure farmers challenges on production management were constantly addressed. The area of study largely has suitable soils for pond establishment coupled with the availability of both seasonal and permanent rivers as a source of water for the ponds.

Notwithstanding the availability of suitable environment, fish farming in Kenya and Kisumu West Constituency in particular still lags behind compared to the national fish production average. It was therefore imperative to critically evaluate how farmer acquisition of pond management skills influenced the farm's current state of activity and ability to develop to commercialized enterprises in the study area.

ESP intended to integrate business-oriented post-harvest interventions to improve farmers' income earned from the enterprise however, dire conditions still exist on the ground. This study therefore examined the point of disconnect. The study sought to find out the effect of post-harvest interventions on income earned through measurement of indicators that include; records kept by the farmer, availability of value addition tools and equipment, availability of fish storage facilities, the ability of the farmer to prudently price the fish harvests and the general farm layout and ambience.

1.3 Study objectives

1.3.1 Main objective

The main objective of the study was to establish the effect of production management skills on the status of the Economic Stimulus aquaculture projects in Kisumu West Constituency, Kisumu County.

1.3.2 Specific objectives

The specific objectives of the study were:

1. To determine the influence of resource mobilization on aquaculture production in Kisumu West Constituency.
2. To assess farmer acquisition of pond management skills on aquaculture status in Kisumu West Constituency.
3. To evaluate the effect of post-harvest interventions on income earned through aquaculture in Kisumu West Constituency

1.3.3 Research questions

1. How does resource mobilization influence aquaculture production in Kisumu West Constituency?
2. How has the farmer acquisition of pond management skills affected aquaculture status in Kisumu West Constituency?
3. What are the effects of post-harvest interventions on income earned through aquaculture in Kisumu West Constituency?

1.4 Scope and limitations of the study

The study scope was within Kisumu West Constituency that falls on the Northern part of Kisumu County, and Western part of Kenya. The study targeted 417 active aquaculture farmers in Kisumu West Constituency. The study focused on the effect of farmer production management skills on the status of aquaculture in the area of study. This covered resource mobilization, the farmer's acquisition of pond management skills and post-harvest interventions concerning farm production levels.

The study scope did not cover: Establishment and citing of fish ponds; Feed composition; Fish pond environment and fish diseases and their recommended treatments. Most of the farm owner's personal details were incomplete based on the data held at the Sub-County Fisheries office. hence finding the actual location of the fish ponds was a challenge. The challenge was overcome through enquiry of the nearest aquaculture farm and the farm owner’s name. The lack of farm records by most of the farmers led to the use of estimated values and a restriction of production data to a period within the last year.

1.5 Significance of the study

This study targeted to establish the effect of production management skills on the status of Economic Stimulus aquaculture projects in Kisumu West Constituency, Kisumu County.

This study was anchored on the attainment of two Sustainable Development Goals (SDGs); SDG 1, Ending poverty in all its forms everywhere, and SDG 2, Ending hunger, achieving food security and improved nutrition and promoting sustainable agriculture. Through the National Planning Framework, the SDGs were incorporated in the Kenya Vision 2030 economic pillar; to attain innovative, commercially oriented and modern livestock and fisheries sector. This was intended to be attained through Medium Plan I (2008 -2012) and Medium Plan II (2013 -2017), through value addition of agricultural products and economic stimulus package to rural areas in form of funding of commercialized aquaculture farms and, employment of more aquaculture extension officers and capacity building of the farmers.

The findings of the study could inform the stakeholders as agents to come up with appropriate corrective measures to address the emerging issues affecting the performance of aquaculture farms. Planners and policymakers are currently in top gear to establish and implement projects that would lead towards improving access to food and reduction of the high cost of living by the Kenyan citizenry. The study results may be beneficial to project implementers and policy makers, on the choice of key activities that leads to the establishment of sustainable projects. These activities could positively influence both short-term and long-term objectives of commercializing aquaculture

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter provides literature review grounding the current study in extant literature with a critical examination of how past research provides the conceptual framing for the current study as well as any gaps the current study may fill. This is expressed through three objectives of the study which include the influence of resource mobilization on production of aquaculture farms, farmer acquisition of pond management skills on status of aquaculture and effect of post-harvest interventions on income earned through aquaculture, and the conceptual framework.

2.2 Resource mobilization and aquaculture production.

There is a renewed interest in aquaculture in Kenya, a fact contributed by the government's initiative on ESP. Farmers in aquaculture potential areas across the country turned to fish farming as a way of producing high quality fish either for their families or for extra income. FAO (2018) global aquaculture production (including aquatic plants) in 2016 was 110.2 million tons with the first sale value estimated at USD 243.5 billion, of which 80.0 million tons of food fish (USD 231.6 billion) this accounted for 5.8 percent growth during the period 2001 - 2016. Earthen ponds remain the most commonly used type of facility in inland aquaculture production. In 2016, inland aquaculture was the source of 52.4 million tons of food fish or 64.2 percent of the world's farmed food fish production. According to Muir and Allison (2007) globally aquaculture has expanded at an average annual rate of 8.9 percent since 1970, making it the fastest-growing food production sector. Aquaculture produces around half of the fish for human consumption and must continue to grow because limited capture fisheries will be unable to meet demand from a growing population. Aquaculture has listed significant growth in terms of production, a clear indication that most of the farms within the country and by extension the study area had active ponds. The study however does not indicate how the resources used to sustain the ponds were mobilized by the fish farmers.

According to Brennett et al (2021), between 1968 and 2018, World Bank Investment in capture fisheries and aquaculture accounted for an average of 1.8% of all agricultural funding; although funding has increased to an average of 2.6% (and as high as 5.4% in 2018) over the past decade. Sustainable financing and investment are required to sustain capture fisheries and promote aquaculture expansion in sub-Saharan Africa to shift to aquatic food chain towards healthier diets

(Chan et al, 2021). The research studies have shown a clear indication that to attain sustainable growth in aquaculture then resource mobilization is fundamental. However, the research results do not clearly indicate the form and nature of funding used by the institutions towards ensuring growth of commercialized fish farms. Source of initial capital to establish a pond therefore could be through ESP funding personal savings, taking a loan from a Sacco or group and taking a loan facility from a bank.

Bradley (2007) aquaculture production is rising rapidly and by 2030 is estimated that aquaculture production will be close to that of capture production. This is against the backdrop that many inland fisheries are threatened by climate change which has direct effects through reduced precipitation and greater evaporation and indirect effects when more water is used for irrigation Muir and Allison (2007) through loss of cultured stock, increased production costs due to low water quality and availability for aquaculture during droughts. The studies however do not show programs put in place to mitigate on pond water quality management. These impacts are likely to be felt most strongly by the poorest aquaculture farmers whose typically small ponds retain less water and dry up faster. ESP on the other hand provided sufficient resources to the farmers in the program to acquire pond liners. Pond farming was focused on to reach many rural farmers to improve the rural economy through provision of food and both direct and indirect employment at the farms. This would achieve the objective of poverty alleviation. Participatory approach in learning and project initiation are key to attaining the project's key objectives. The study sought to find out if the beneficiary farmers needs were established before and during project implementation in terms of resources to actualize the sustainable fish farms.

Although aquaculture continues to be the world's fastest growing and most diverse food production sector, the production of fish within the developing countries is highly dependent upon the local manufacture of aquaculture feeds composed of mainly imported feed ingredient sources, it, therefore, follows that future aquaculture feed industry and government efforts should be focused on the increased use of locally available nonfood grade feed resources (FAO, 2018). In Egypt, pond-based aquaculture of tilapia was highly profitable which resulted in private sector investment and total aquaculture production grew from only 19 thousand tons per year in 1980 to 340 thousand tons per year in 2000, reaching an estimated total of 1.137 million tons per year in 2014. Aquaculture represented 77 per cent of total Egyptian fish production in 2014 compared to

only 54 per cent in 2004 (Dickson et al, 2016). The studies have clearly indicated the growth of production however, they are silent on the level of resource mobilized in terms of skilled or unskilled labour to realize the attained pond production.

Fish ponds in Kenya range from small dug holes to designed ponds with inlet channels and outlet channels and harvest basins yielding approximately 1 – 2 tons per hectare per year under competent management (Munguti et al, 2021; Brummet and Noble, 1995). Aquaculture production in Kenya between 1970 – 2006 oscillated between 1000 – 4000 MT. In 2007 about 4, 250 MT of fish was produced by 2,742 farmers countrywide from 7,477 ponds covering 217 Ha, 301 dams and reservoirs (497 Ha) and 248 tanks and raceways (Nyandat and Owiti, 2013). Data provided by the Department of Fisheries, Kisumu West Sub-county during the pre-visit interview, showed that in the financial year 2016 – 2017, 2,319 Kg of fish was harvested from 47 ponds with an average of 49.34 Kg per pond. In the 2017 – 2018 financial year, 6, 130 Kg were harvested from 48 ponds, giving an average of 127.71 Kg per pond, and in the financial year 2018- 2019, 3,867 Kg of fish was harvested from 53 ponds which is an average of 72.96 Kg per pond. From 2009 – 2013 the Government of Kenya in its commitment to revitalize the economy introduced and implemented a large-scale subsidy program called the Economic Stimulus Program (ESP) under which aquaculture was identified as a key pillar in the agriculture production sector (Ole – Moiyoi, 2017; Munguti et al, 2021). The number of farmers increased tremendously to 49,050 with an estimated 69,998 ponds occupying 2,063 Ha at the peak of the subsidy in 2012 (Nyandat and Owiti, 2013). Despite the increase in the number of ponds under production in 2012, the current research sought to find out if all the ponds were under ESP or if some had alternative sources of finances. Secondly, it would be important to note how many of the ponds are actively in production and out of the number, how many are not active. The information gathered on the pond performance would be instrumental in the identification of scope of improvement in areas with challenges, improve on service delivery plans to ensure value for money was achieved in the program and allow interested parties to track the progress, outcome and impact of ESP on the rural economy. A comparative analysis on the pond performance with alternative sources of funding was instrumental to be able to address the issues of ESP sustainability.

Kenya has made remarkable progress in promoting aquaculture. Kenya's Vision 2030, together with other legal policy and institutional frameworks also recognizes aquaculture as a source of

food security, poverty reduction and employment creation. However, pond-based aquaculture production registered depressed pond performance for the third consecutive year with total fish output dropping from 24,096 MT in 2014 the maximum recorded production achieved, 15,320 MT in 2018 and 18, 542 MT in 2019 (KNBS, 2020). The study was focused to establish the performance of aquaculture within the study area about the source of funding of the specific project. The research results detail the decline in production of ponds over the years. However, it does not clearly indicate whether the challenges in production were only faced by ponds funded under ESP or through alternative sources of funds. The study used pond performance indicators that include capacity of GoK to deliver resources inform of inputs equitably across all the farms within the study area, if the services were delivered on time or within the required time frame to ensure optimum production at the farm, to reflect on the quantity of input or output relative to the need or demand, assess the extent to which the beneficiaries were able to access the inputs and the effectiveness of the program in realizing the objective of increased food production in the rural areas and improving the rural economy.

The reduction in fish production was as a result of poor water retention capacity of ponds in some counties especially the Coastal and the Eastern region; poor extension services, inadequate capacity support, poor husbandry practices, low quality and quantity of fish farm inputs, poor marketing infrastructure, dependency syndrome on government/donor support and lack of value addition. The establishment of county governments and subsequent removal of aquaculture from the functions of the national government to county governments also led to a reduction in aquaculture activities in several counties in Kenya which lacked support programs for fish farming (Charo- Karisa, 2010). The study results clearly enumerate the import of resource mobilization and allocation. However, it did not indicate if the same challenges affected the study area. The factors that led to the decline of aquaculture formed part of ESP fundamental objective in terms of farmer capacity building and availability of qualified extension officers for consistent guidance on pond management. The study sought to establish if the issues were addressed within the study area.

2.3 Farmer acquisition of pond management skills and farm status.

Pond management is the process of designing and maintaining an environment to effectively and efficiently establish a sustainable commercialized aquaculture farm. The farmers should be able to acquire management skills that include technical skills, conceptual and decision-making skills,

interpersonal and communication skills. Henri Fayol, the father of modern management theory recognized a widespread need for principles and management teaching. The principles identified were flexile, not absolute, and must be usable regardless of the changing conditions. Some of the principles of management include authority and responsibility, unity of command, scalar chain, esprit de corps (Cole, 2004). Commercializing aquaculture to improve on production levels requires the farmer to operate as an enterprise and embrace the position of a manager. In this regard as a manager the aquaculture farmer should be adequately trained on functions and skills of management. According to Mwatsuma, Cherutich and Nyamu et al (2012) commercial aquaculture failed in other African countries due to little or no pre-stocking preparation of ponds occasioned by poorly resourced extension agents. This thought is significant since it determines to what extent aquaculture farmers are technically resourced to undertake the enterprise to prosperity. ESP through its objectives factored in capacity building and provision of extension officers within all the areas the program was earmarked to be implemented. This study sought to find out if the objective was achieved and the impact it had on farmer technical management skills on pond farming.

Dickson et al (2016), Egyptian aquaculture production tripled over the period between 2000 – 2012 to over 1 million tons per year. This was achieved by taking the farmers through Best Management Practice (BMP) training. The training followed a field survey that established the areas that farmers had serious deficit on pond management skills. A group of experts mainly private – sector Egyptian fish farmers participated in a planning workshop to define Egyptian aquaculture BMPs and helped to design a series of ten, short, field-based, practical training modules covering subjects from pond construction and preparation to post-harvest handling. The training sessions were held at the pond side with a group of ten farmers per session. The training sessions covered between two and three modules of the scheduled 15 topical modules. The program was spread for a three-year period ending December 2014 leading to the capacity building of over 2400 small scale farmers and farm managers. To ensure success in pond production the training as enumerated by Dickson during the study indicated that good planning and farmer involvement and participation in a well-structured capacity building was instrumental on the success of the program.

In Kenya, fish farming began in the 1920s, initially using Tilapia species and later including the common carp and the African catfish. In the 1960s Kenya Government popularized rural fish farming with the construction of many small ponds and as a result of this effort, Tilapia farming expanded rapidly in Kenya's central and western provinces. The number of productive ponds declined in the 1970s, mainly because of inadequate extension services, a lack of quality fingerlings and insufficient training for extension workers. Until the mid-1990s, farming in Kenya followed a pattern similar to that observed in many African countries characterized by small ponds, subsistence-level management, and very low levels of production (Ngugi et at, 2007).

Performance of aquaculture farms based on the skills acquired was measured using the farm production. Other indicators of the farm's performance could be observable evidence that includes records kept, value addition tools or equipment, availability of storage facilities, the farms general layout and ambience. Though these indicators would serve as indirect measure as during the study. The use of production as the direct indicator was justified as it provides a quantitative measure on achievement of the main objective as spelt out by ESP, that is increase aquaculture production in rural Kenya. Relationships established between production and the various training areas on production management skills provided an independent and objective conclusion on the farmer attaining the required fundamental management skills.

According to Mwangi (2008), the Tilapine species constitute about 90% of aquaculture production in Kenya. The production of the Tilapines and the African Catfish is characterized by low pond productivity mainly due to low quality fish feed and employment of low pond management practices. This resulted to stagnated national aquaculture production over the past decades. Fakoya et al (2001) affirms that fish feed and fingerlings availability represent significant cost components in the commercial aquaculture, with the feed cost alone estimated to represent between 40% and 70% of the cost of fish production. According to Otieno (2011), although most of the country is suitable for aquaculture, only about 0.014% of the 1.4 million Hectares of potential aquaculture sites are used for aquaculture. From this, about 95% is on small scale. Though Bradler, Muir and Allison have brought forth the challenge of climate change resulting to the drying up of water sources. The study focused on whether the farmers were provided with sufficient skills on how to manage the water sources in order to mitigate such challenges in the long term.

Several Government fish rearing facilities were renovated, research programs were established to determine best pond culture practices and intensive training of fisheries extension workers this led to increased interest in fish farming in Kenya. Inappropriate pond construction techniques and poor soils, low quality feed obtained from agro-industrial by-products have been observed as a hindrance to commercial aquaculture (Fakoya, 2001). According to Amadiva and Tarus (2018), the Fisheries Management and Development Act No. 35 of 2016 is in place. The Act provides for the development of a National Aquaculture Development Plan for promoting the sustainable development of aquaculture in Kenya. The National Aquaculture Policy (2011); National Aquaculture Strategy and Development Plan (2010 – 2015) and Aquaculture Communication Strategy (2012) are earmarked for review. The GoK under its achievements on the Medium-Term Plan 1 enacted the consolidated Agricultural reform bill that included Agriculture, Fisheries and Food (AFFA) Act 2012. This led to the establishment of the Agriculture Fisheries and Food Authority (AFFA) that regulates the operations of and management of the fisheries industry. This development was instrumental as it provided a proper grounding to ensure farmers are well enlightened and skilled in pond management and food handling to ensure profitability.

Munguti et al (2021) in their report on the state of aquaculture in the country note that Aquaculture Business Development Project (ABDP) had rolled out an interesting opportunity in Field Farmer Schools (FFS) for training local youth on aquaculture production technologies, management and aquapreneurship. Aquaculture is fast growing and there is a need for the development of new production technologies in aquaculture to maximize production and profits. Technologies such as Recirculating Aquaculture Systems (RAS), which are mainly useful for dryland aquaculture, Biofloc and Periphyton Technology that uses fewer feeds), are modern innovations that can be adopted for better fish production. The studies by Fakoya (2001), Mwangi (2008) and Mwatsuma et al (2012) enumerate technical skills that are a necessity for prudent development of commercial aquaculture. However, the studies emphasize the training levelled towards extension officers but do not mention if this training was adequately disseminated to the fish farmer. Neither do they enlist any training programs focusing on the fish farmer to ensure technical preparedness for the agribusiness enterprise.

In a study conducted on aquaculture extension service in Kenya by Ngugi et al (2004), one of the biggest constraints facing aquaculture development is the lack of extension staff and infrastructure

to deliver technical knowledge about aquaculture to rural small holders. The study further reveals that the technical aspects of constructing small ponds of the appropriate size and depth and ensuring that they will have suitable sources of water, filtration and aeration is complex requiring significant education and extension support. Though Mwatsuma et al (2012) study found no relationship between staff capacity on the performance of aquaculture, they provide a rider that their target group were technical staff and recommends a similar study to be done using the farmers as the unit of study. This study focused on the farmer and related their technical capacities to the performance of aquaculture. ESP's objective was to provide sufficient technical staff and build their capacity in aquaculture management (Kenya, Republic of, 2012). An assessment if sufficient infrastructure was provided to enable the technical staff disseminate the technical skills to the farmers was done.

According to Hishamunda et al (2017), commercializing aquaculture entails aspects of project sustainability. First, the aquaculture project should be technically adequate and feasible. Fish farmers should have the necessary knowledge and technical skills to grow given aquaculture organisms and ensure the production inputs and growing conditions of cultured species are adapted to the local conditions. Second, the project should be economically viable. The farms should be profitable and competitive over time thus minimizing dependency on government subsidies. Third, the project should be socially acceptable. This ensures the farm operations should benefit a broader proportion of the community including women and the youth. Fourth, it should meet environmental integrity. This ensures the mitigation of negative environmental impact that maximizes benefits from the use of resources without compromising those of future generations. Fifth, be governed by adequate, clear, stable laws and regulations. Lastly, furtherance to these, the farmer should be adequately trained on basic principles of production that has a primary goal to maximize profits, adequately understand how to competitively price aquaculture products, proper record keeping and have basic skills in budgeting, and develop simple cash flow statements.

Harvesting optimal quantities of fish per pond requires the farmer to have basic knowledge of predator management and early detection of fish diseases. Shitote et al (2013), summarize that 88.3% of fish farms were affected by predators indicating that predation was a serious threat to fish farming. The major predators include Kingfisher and other birds at 44.3%, human beings, 23.6% crabs, 10.7%, snakes 9.9% and frogs at 5.2%. However, this study did not capture if proper

training or awareness was done to the farmers on fish predators and skills to manage the predators in order to get optimum pond production relative to fingerlings stocked.

Munguti et al (2021) further enumerate that with adequate training on basic fish pond husbandry, fish farmers are able to eradicate these basic challenges by themselves. There is a need for competency-based training on special skills in aquaculture. The youth can be encouraged to join training in various TVETs and Universities. Weak extension service is a perennial challenge in the aquaculture sector. This is because the government does not employ staff regularly. The devolution of fisheries and aquaculture sectors to county levels present the need for local people to educate the local fish farmers using local dialect. In fact, this is a perfect opportunity for the young people to be trained as extension officers so that they can offer consultancy services to the aquaculture farmers.

2.4 Post-harvest interventions and income earned.

Akande and Diei (2010) say that it has been estimated that 10 percent of world fish caught by weight is lost through poor handling process, storage and distribution. However, losses in small-scale fish processing are said to be particularly high. Similar losses may be attributed to the current area of study. However, Akade and Diei (2010) in their study do not clearly spell out the specific government interventions put in place to support the small sale farmers to minimize the fish loss post-harvest. Thant (2018), aquaculture in Myanmar has grown rapidly in the last decade and plays an important role in the national fish supply. Aquaculture production had reported slightly over one million tons in 2016 which is around 2 percent increase from the previous year. The growth was sustained due to proper handling of fish post-harvest to realize maximum income to the farmer. Study results by Thant (2018) is a clear indication that aquaculture is a high-income earner with the ability to turn around the rural economy. However, the results do not show clearly how the farmers priced their fish, if their existed wild fish catch that is competition to pond farming. According to Kolding et al (2016), studies done in some sub-Saharan countries (Ghana, Kenya, Mali, Tanzania and Uganda) show that substantial losses in small-scale fisheries occur at all stages after harvest including during distribution and utilization from capture to consumption. Adrien (2015), in an attempt to promote sustainable small-scale fisheries in the context of food security and poverty eradication in Kenya, numerous post-harvest management interventions have been made by the government, development partners and stakeholders. From the research by Adrien

(2015) it clearly shows that there is a lot of investment in post-harvest intervention to ensure sustainable commercialized small sale fisheries. The current study would find out if the interventions reached the aquaculture farmers within the area of study and how they affected the income earned.

Macharia and Njagi (2020) elucidate that in Kenya major challenges of fish post-harvest handling includes lack of infrastructure at the farms for fish preservation, lack of nearby markets and the remoteness of the production areas, in most of the scenarios fish drying often occurs on the bare ground where the product is exposed to soil, bacteria and birds and poor market linkages between production and marketing sites. The challenges enlisted by Macharia and Njagi (2020), expose the lack of sufficient skills by the farmers to suitably handle fish after harvest leading to losses. Harvesting and proper handling of fish post-harvest determine the amount of income that a farmer would earn. Though there is high demand for fish products. The availability of cold storage facility at the farm and value addition program is of great importance to allow minimization of fish loss after harvest.

Tesfay and Tefers (2017), classify post-harvest losses as either nutritive or economic losses that render fish unavailable or nutritionally deficient for human use. Thant (2018), explains that as soon as fish dies spoilage begins. The body becomes stiff and rigid caused by rigor mortis within the first seven hours. The study further classifies post-harvest losses into five categories nutritive loss that included discard of fish after harvest due to spoilage or bad handling which could lead to loss of its nutritional value during storage or lower economic returns because of its low price. Physical losses are the wasting or throwing out of fish after harvesting or landing. Quality loss relates to fish that has undergone changes due to spoilage or physical damage and has suffered quality deterioration. Economic losses are the result of the changes in market demands due to oversupply or lower demand. Processing losses are the result of using improper techniques in traditional fish processing that might give negative impacts on the nutritional value of fishes.

In order to avert the fish losses value addition should be undertaken through processing and instituting astute marketing skills. According to FAO (2015), the perishable nature of fish requires special attention to handling, grading and packing and the market price is usually dependent upon the quality of the fish. Market considerations differ from country to country, region to region and

have close connections with food habits and consumption patterns. The main objectives of value chain management are to maximize profit and long-term sustainability. Fish can be sold in many forms with the simplest form as whole fresh fish. It can be processed further to either increase the appeal of the product or increase the shelf life. Some techniques are based on temperature control that includes icing the fish, refrigeration or freezing. Other techniques involve the removal of water from fish and include drying, smoking and salting FAO (2015, b) fermenting fish, fish canning, vacuum sealing and cooking through frying, boiling and baking. The choice of value addition method depends on available processing materials and sources of energy, the storage facilities and the costs of each method as well as the tradition and the market demand.

FAO (2015, b) note that marketing is about understanding your customers' buying habits and persuading them to buy your products rather than those of the competition. It involves identifying, anticipating, satisfying and even exceeding your customer's needs. Marketing includes finding out what customers want, producing a product that meets their needs, pricing the product appropriately, distributing where the customers are located and promoting through appropriate advertising. As part of the planning process the farmer is expected to market the product in advance to be sure of the market before the harvesting day. Hishamunda et al (2017) state that a market plan should be composed of two sections: the market analysis and the market strategy. The marketing plan should identify among other things the distance between markets and the fish farms, the markets accessibility, the transportation costs, the frequency and scheduling of deliveries, the volume and size requirements of the market, the historical prices paid. Bueno and Pongthanapanic (2014) enumerate that good market analysis informs good production and marketing strategies by keeping up to date on market information enables the farmer to negotiate fair and uniform price, the reputation of product and farm improves market access and competitiveness and avoid direct completion for instance harvesting when the wild-caught fish harvest is scarce. After an astute marketing plan is laid out then the farmer should be in a position to price the fish products well.

According to Hishamunda et al (2017) prices are determined by the interaction of supply and demand in competitive markets. When determining the price of aquaculture products farmers have to cover the costs of production at the very least, aim to generate a profit and, at the same time set a price which consumers are willing to pay. The important consideration for a farmer should be

that for a given quantity of fish harvested the break-even price above total cost (BPTC) given by $= TC/Q$, should be the minimum selling price without making any profit. Proper pricing, therefore, is an important component in commercializing aquaculture and this study assessed if the farmers enlisted under ESP were taken through sufficient training.

FAO (2015, b) there are many organizations in fisheries and aquaculture. Some are formed to represent groups of fishers to have a voice in management decisions, market products together and serve as joint production and distribution centers. Advantages of working together – being stronger, more visible and having a voice increase bargaining power. Rutaisire et al (2009) effective organizations that can link producers with markets will be needed if aquaculture is to grow and produce enough farmed fish to meet the current and future demand for fish. Such producer organizations can develop systems for transportation to markets, the sale of the produce from the farms, and information sharing and gathering among members. The existence of such organizations was sought during the current research to ascertain their support during training and capacity building of the farmers, provision of sufficient market and commensurate fish prices for the fish produced within the area of study.

According to Schut et al (2015), Agricultural Innovation Systems (AIS) approach, innovation perceived as a process of combined technological (e.g in fisheries: cold chain infrastructure, processing equipment and non-technological changes. The changes occur across different levels and are shaped by interactions between stakeholders and organizations inside and outside the sector. This emphasizes the need for a better understanding of the drivers of post-harvest innovation and the identification of entry points for the innovation to overcome reported losses.

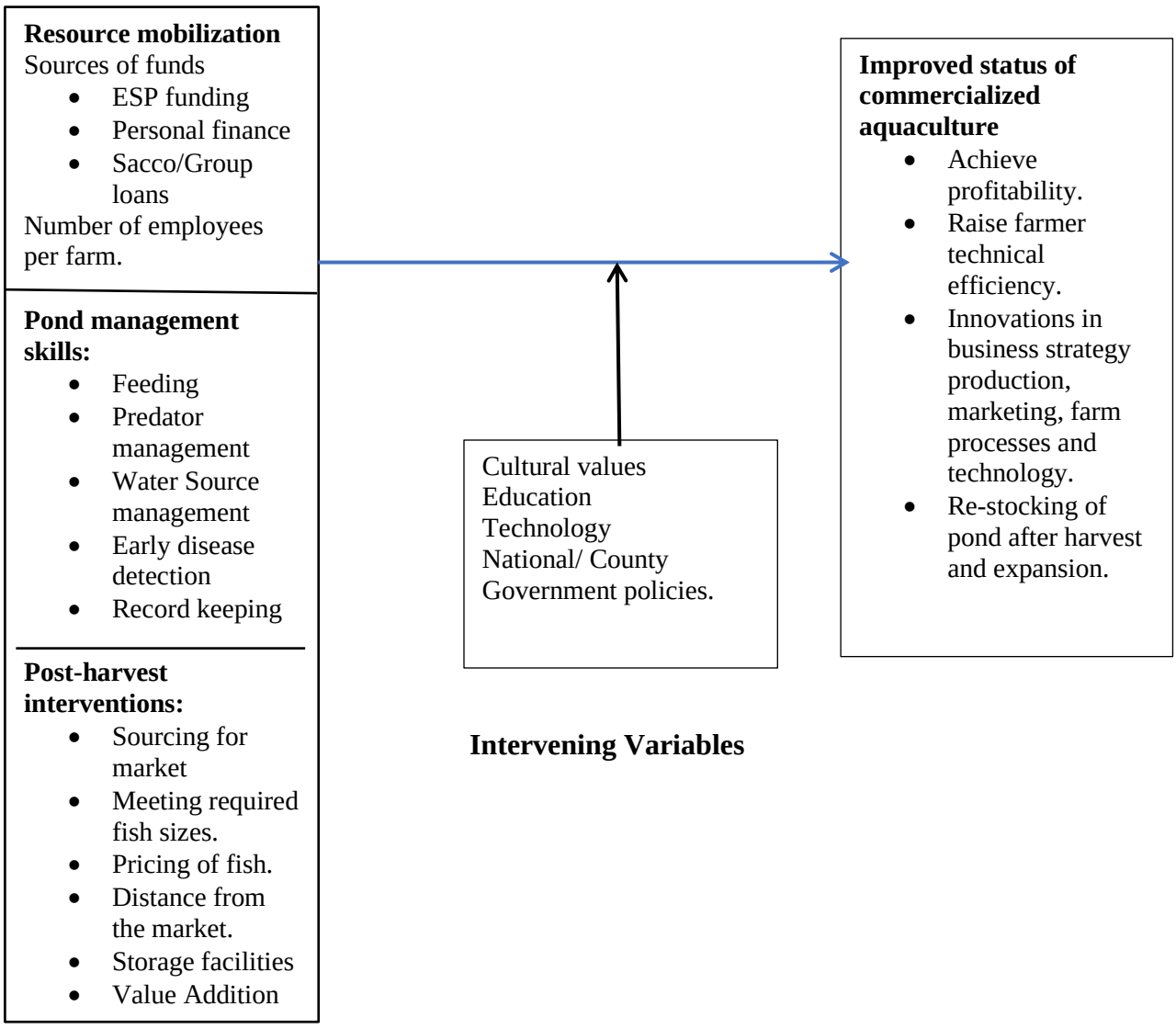
Munguti et al (2021) posit that failure to secure direct markets leads to fish spoilage and low prices. To maximize the available financial and market opportunities fish traders (mostly women) can be organized into groups to attract funding. The opportunities created by changing eating habits where more people are now eating fish, the youth can also venture and explore opportunities in value-added product development and introduce the developed products into the markets. Examples of these products and commercial importance include fish fillets, fish balls, fish fingers, sausages, and fish gel from fish scales (used in pharmaceutical and cosmetic industries). These are opportunities in training the youth on value-addition technologies and the fabrication of value-

addition equipment. opportunities also exist in modern fish processing technologies and marketing techniques and platforms.

2.5 Conceptual Framework

The conceptual framework defines the variable of research and shows how the independent variable influences the dependent variables. The conceptual framework adapted for the study depicts farmer production management skills that evidence performance of commercialized aquaculture in the area of study.

Figure 2.1 Conceptual framework



Source: Author, 2022.

Resource mobilization is the bedrock in performance of a business enterprise. The farmer ability to mobilize financial resources from different sources that include ESP, personal savings and access to Sacco or group loans may result in sustainable commercialized farm. Skilled and unskilled labour plays a pivotal role in ensuring sooth implementation of daily farm operations. Employees use of technology results in innovative business strategies and marketing for the fish products.

Farmer acquisition of pond management skills to support in maintaining the reasonably sized stocked ponds, depending on the farmers' resources may result in performing commercialized farms. Pond management skills that include fish feeding program, predator identification and management, water source management, early disease detection and record keeping training can be applied through use of technology (though some of the farmers lack the requisite ICT skills) to get reach to as many farmers as possible at the same time. This will also provide an avenue for peer interaction to address challenges being faced at the farm level by different farmers. It also provides an avenue for real-time feedback to extension officers and the department of fisheries on emerging challenges. The farmers current education level may impact on acquisition of skills imparted during training. The training and capacity building should be in line with the national and county Government's policy framework and inform on requisite policy changes to aid in realizing commercialized aquaculture farms.

The acquired skills should inform the farmer on suitable post-harvest interventions that include sourcing for fish market, with the populace and how to market the produce to realize better returns from the enterprise. Attaining the pond production levels worked on the project assumption that there was no GoK change on policy and regulation framework affecting the fisheries industry, no drastic climate change that would result in either serious drought or flooding calamities, all the budgeted inputs provided to the farmer within the required time frame, all the beneficiaries attended training and capacity building sessions and extension officers regularly made visits to the farms to assess and monitor the progress made by the farmers at the farms.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Research design

A research design is a set of methods and procedures that have been created to find answers to research questions. During the study, descriptive research design was used. According to Bhattacherjee (2021), descriptive research is directed towards making careful observations and detailed documentation of a phenomenon of interest. These observations must be based on the scientific method and therefore are more reliable than casual observations of untrained people. Kumar (2011), further states that descriptive study attempts to describe systematically a situation, phenomenon, problem, service or program or provides information about say the living conditions of a community or describes the attitude towards the issue.

In order to achieve these results a method of survey research is applied for efficient data collection. According to McCombes (2023), survey research is a quantitative research method used for collecting data from a set of respondents. Survey research is implemented by researchers in cases where there is a limited cost involved and there is need to access details easily. The research design best suits the study in which a lot of insightful information was to be collected from the farmers. Use of survey in data collection was of great importance based on its flexibility to use non-probability sampling methods like snowballing.

This study was geared towards establishing the effects of farmer production management skills on aquaculture projects within the area of study. The survey focused on farmers who were engaged in aquaculture in Kisumu West Constituency. The farmers who were not actively engaged in aquaculture formed an integral part of the study in getting the perspective of why certain farmers dropped out of the ESP, if there were management challenges. The collected data was utilized based on the source of finance for the project (ESP, personal, and/or Sacco/group) to assess parameters such as resource mobilization, farmer acquisition of pond management skills and post-harvest interventions in aquaculture. Comparisons were derived on the level of attainment of the requisite skills and performance of the farms depending on the source of funds.

Questionnaire, observation and key informant interviews were used to collect data during the study from the respondents. The data collected was both qualitative and quantitative in nature. The collected data was such that they could reliably and validly address the specific objectives of the

study. The collected data were coded to enable data analysis for both quantitative and qualitative data. The qualitative data was analyzed to present patterns and categories. Quantitative data on the other hand were analyzed using percentages, Pearson's correlation coefficient, Chi-square and cross-tabulation.

3.2 Area of study

Kisumu West Constituency was formed from Kisumu Town West and Kisumu Rural Constituencies. Kisumu West Constituency is strategically located and borders Kisumu Central Constituency to the South East, Kisumu East Constituency to the East and North East, Seme Constituency to the West, Vihiga County to the North and Lake Victoria to the South. Kisumu west Constituency has five wards namely Central Kisumu, North West Kisumu, West Kisumu, South West Kisumu and North Kisumu. Though cosmopolitan, the main spoken languages are Dholuo, Kiswahili and English. The topography is undulating with seasonal streams meandering through the plain land and hills towards Lake Victoria. The terrain and weather of the area provides a suitable environment to establish fish ponds. The major economic activities in the area include small, medium and micro business enterprises, subsistence agriculture, livestock farming and commercial residential housing.

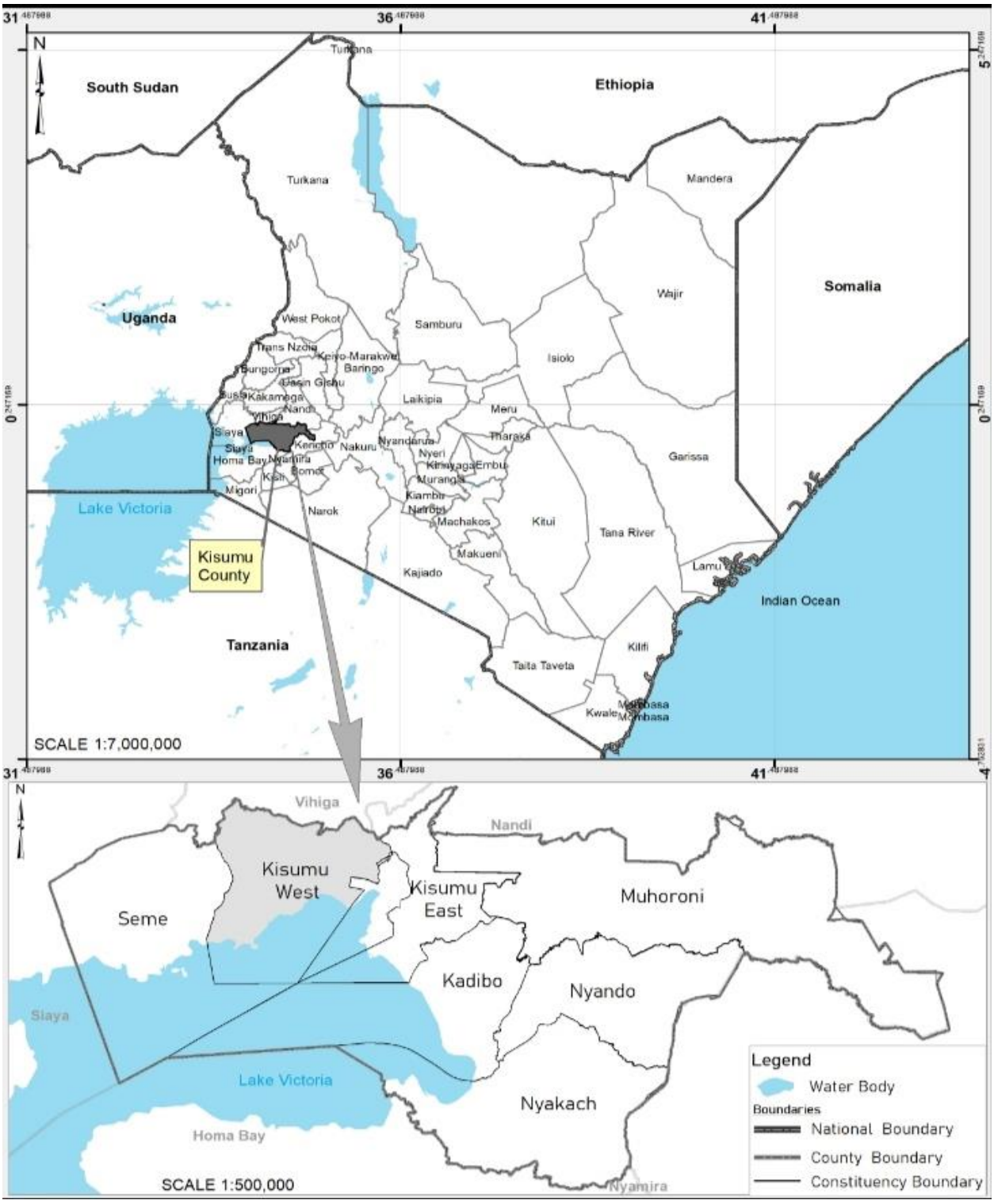


Figure 3.1 Map showing the location of Kisumu West Constituency.

Source: Hotosm (Kenya Open Data)

3.3 Population of study

From the Kisumu West Sub-County Fisheries department office, the total number of listed aquaculture farmers was 417. The farmers' distribution across the five wards in Kisumu West Constituency was provided by the department of fisheries. However, the details of the farmers in terms of contact and actual locations were not available. The farmers were also not categorized in terms of source of funds for the capitation of the enterprise.

3.4 Sampling and sampling procedure

Ben – Shlomo et al (2013) state that snowballing sampling is commonly used in social science when a sampling frame is difficult to get. Existing subjects are asked to nominate further subjects known to them as such, the sample increases in size like a rolling snowball. The sample frame for the farmers in Kisumu West Constituency was difficult to get since only a few contacts o the farmers were provided at the Kisumu West sub-county fisheries office during the pre-study visit. Based on this, the interviews were carried out starting with farmers, who could be engaged through the contacts provided by the fisheries office. Once a farmer was taken through the questionnaire, they were probing was done to get contacts and locations of other farmers they knew to be active or had practiced aquaculture before.

Table 3.1: ***Sampling Frame***

WARD	Total number of farmers registered	Number of farmers sampled	Percentage of total number of farmers sampled
Central Kisumu	25	23 (92%)	5.9%
Kisumu North	223	217 (97%)	55.8%
North West Kisumu	63	57 (90%)	14.6%
South West Kisumu	55	49 (89%)	12.6%
West Kisumu	51	43 (84%)	11.1%
TOTAL	**417**	**389 (93%)**	**100%**

Source of Data: Kisumu West Sub County Fisheries Office.

3.5 Data collection procedures

The study was based on two types of data; primary data and secondary data. Primary data was collected using Observation, questionnaires and key informant interviews with a focus on the three specific study objectives. The following three data collection methods used served complimentary roles allowing for triangulation these included observation, questionnaire and key informant interview.

3.5.1 Observation

According to Kumar (2011), observation is a purposeful, systematic and selective way of watching and listening to an interaction, or phenomenon as it takes place. Observation is usually done by developing a close interaction with members of a group which is being studied.

Observation assisted in recording vital information for the study that may not be captured on the questionnaire this included the conditions of the farm after flooding, ponds covered with grass after the farmer dropped out and some farms with pond liners spread only on the walls of the pond leading to water pilferage at the base. Photographs of such ponds were taken to aid in the documentation of the status of the ponds. This assisted in verification of information provided to ascertain resource mobilization, application of knowledge to justify farmer acquisition of pond management skills and post-harvest interventions.

3.5.2 Farmer survey.

A farmer survey was carried out by use of valid and reliable questionnaire. The questionnaire was administered in person to the farmers. It was instrumental in systematic and consistent data collection across Kisumu West Constituency. The tool had both closed ended and open-ended questions. This allowed collection of both quantitative and qualitative data on the three specific objectives of the study.

The farmers did not keep long term records, so the data collected on production was limited to one year. The questionnaire also addressed the socio demographic factors such as education and age of the framer which were instrumental in the study as intervening variables. The responses were then categorized to generate frequency tables ready for further analysis.

3.5.3 Key informant interview

This is defined as a qualitative in-depth interview for people with first-hand knowledge and expertise under a less formal structure using one on one interviews either on the telephone or face-to-face. The key informants have first-hand knowledge of the community and their particular knowledge and understanding can provide insight into the nature of problems and recommend solutions (Mugenda and Mugenda, 2003). The key informants interviewed included three Sub County Department of Fisheries officials, in this case, 2 extension officers and the Kisumu West Sub County Fisheries Officer, the Manager of Agriculture and Extension Services LBDA based at the Head Quarters, and aquaculture research officer at KMFRI. The extension officers were instrumental in the provision of farmer's contacts through a large number that could not be reached. The nature of the roles of the key informants provided a different perspective on the impact and challenges faced by the project. Moreover, the nature of their roles in the area of study enabled them to have access to the information in the official domain which may have escaped scrutiny during the farm interview. Hence the information was used for triangulation covering the three specific objectives of the study. The interview schedule addressed the production level of the farms, and training of farmers in both farmer technical management skills and post-harvest management skills.

3.5.4 Secondary data collection

There are numerous types of secondary data, the main being documentary sources in the form of written materials and the survey data in the form of statistical information (Walliman, 2011). Secondary data was collected from information in academic journals, periodicals, seminar papers, publications from KMFRI and books.

3.6 Data analysis procedure

During the study data collected by the tools were both qualitative and quantitative data which were handled as follows:

3.6.1 Data analysis

Walliman (2011), states that qualitative analysis depends on careful definition of the meaning of words, development of the concepts and variables and the plotting of the inter-relationships. Since there was use of both open ended and closed ended questions all the three specific objectives had qualitative and quantitative data collected for analysis.

Qualitative data should be pre-analyzed to allow data organization, coded to create categories, themes and patterns and finally analysis and interpretation of the information. The process of data analysis of qualitative data involves: editing of field notes to ensure data organization, detection of various categories which are distinct, establish relationships between the categories, develop codes that are used to generate categories. The codes for various themes, categories once created the data can be analyzed using quantitative methods. Differences noted are equally important for the study (Mugenda and Mugenda, 2003). Data processing and analysis began as soon as data was received. Qualitative data were coded to create themes and categories. Thematic analysis was done on the results from the key informant interviews for purposes of triangulation. Categories realized were used to create contingency tables, which were further analyzed in form of quantitative data to find chi-square values. The results generated addressed all the three research objectives and questions conclusively.

The quantitative data were summarized through frequency tables. From the frequency tables the data was analyzed using software tools in this case Excel and Stata to get attain frequency, percentages, mean, chi-square and Pearson's correlation coefficient between the variables. The analysis was done at 0.05 confidence level. In order to facilitate data interpretation ease of communication and understanding of results text, tables, cross –tabulation, frequency tables, pie charts, graphs were used.

3.7 Content validity of the tools

According to Mugenda and Mugenda (2003) validity is the degree to which results obtained from the analysis of the data actually represent the phenomenon under study. It is determined by a lack of systemic error in data. Validity of a tool can be determined by establishing a logical link between the questions and objectives of the study by an expert (Kumar, 2011).

Walliman (2011) posits that in order to be able to generalize the results beyond the confines of the study itself the study should reflect the situation in the real world – that is it should possess both internal validity (the intent to which the ideas about cause and effect are supported by the study) and external validity (the extent to which findings can be generalized to populations or to other settings).

The questionnaire and key informant interview schedule were put through a pre- test analysis. This was achieved through independent experts and professionals, who are the study supervisors from the University, who evaluated them for construct, content and criterion-related validity. The components of the questionnaire that were consistently considered by the supervisors to measure the construct of the study were retained while those that were inconsistent expunged.

3.8 Reliability of the tools

If a research tool is consistent and stable hence predictable and accurate it is said to be reliable (Kumar, 2011). According to Mugenda and Mugenda (2003), reliability of data may be affected by inaccurate coding, ambiguous instructions, the interviewer's and interviewee's fatigue and interviewer's bias. A reliability coefficient of + 0.80 or more implies that there is a high reliability of the data.

To ascertain the reliability of the questionnaire, it was administered to a random sample of farmers in Kisumu East constituency that also benefited from ESP. The same questionnaire was administered within a span of two weeks a correlation coefficient of +0.872 was attained. This was slightly more than + 0.8 showing that there was a strong relationship between the two tests and hence the tool used was reliable.

3.9 Ethical Issues

A successful study must adhere to high standards of ethical protocols recommended during the study, and this was complied with during the study. First, explicit consent of the respondent was sought to ensure participation in the study is out of their free will and volition. The respondents were made aware of the objectives of the study and the expectation of their level of contribution through the study to its completion. Respondents were indulged with respect and courtesy. This was done to ensure the confidence of the respondents was achieved and would result in candid

feedback during the interview session. The respondents were assured of utmost privacy and confidentiality regarding the information gathered and both its intended use and the beneficiaries. During the study the respondents were not required to include their names on the questionnaire as a measure to safeguard their confidentiality. To ensure integrity of the data collected, accuracy during encoding of the interview responses was critical; this ensured statistics generated during the study were factual and verifiable.

CHAPTER FOUR: RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents information on the results and discussions organized as per the specific objectives of the study. Age and gender were considered on the premise that ESP targeted youth and women. Education being an intervening variable may cause variations in the study especially on farmer acquisition of pond management skills.

4.1.1 Socio – demographic information

Gender equality and equity have remained a major focus for the government of Kenya with an expectation to at least reach out to a third of the minority gender. The same is a concern for planners during implementation of projects. In this study, the gender and age of the respondents were considered since it may influence the production management skills at the farms.

Table 4.1: ***Age and Gender of the respondent.***

AGE	**GENDER**		**FREQUENCY**	**PERCENTAGE**
	MALE	**FEMALE**		
18 – 27	32	17	49	12.6
28 – 37	39	4	43	11.1
38 – 47	48	26	74	19.0
48 – 57	61	42	103	26.5
58 – 67	36	21	57	14.6
68 – 77	16	20	36	9.3
78 – 87	14	13	27	6.9
TOTAL	**246**	**143**	**389**	**100**
% OF TOTAL	**63.2**	**36.8**		

Table 4.1 shows that 63.2 % of the 389 respondents interviewed were males and 36.8% were female. The male outnumbered the female in all age clusters apart from 68 – 77 and 78 – 87 age group clusters. The age groups 58 – 67, 38 – 47 and 48 – 47 were dominant with percentage representation of 14.6%, 19.0% and 26.5% respectively, accounting for 60.2% of the population.

The project was earmarked to be a source of employment for the unemployed youth bracket however, from the results of the study the participants were only 23.7% of the total population of the farmers. The average age of the farm respondent was 50 years, that of the male respondent 48 years and that of the female respondents 53 years. The average ages show that the participants in aquaculture have a majority who are adults above 35 years of age with established homes and are land owners. These results indicate that ESP did not meet the expectation of creating employment for youth and women in order to spruce up the rural economy.

According to Amadiva and Tarus (2018), Women's participation in aquaculture as a business is on the rise (22% ownership of all fish ponds in Kenya). The main cause of the disparity with males includes low access to production inputs such as land and capital, insecure land property rights among women leads to under- investment and underutilization of productive inputs which in turn translate into lower yields. Apart from the crosscutting challenges some women face constraints that include inadequate skills, information and knowledge; negative attitude towards fisheries as a career; public sector systems that have concentrated more on production leaving out value addition, processing and marketing rendering the sector unprofitable and unattractive for entrepreneurship; lack of access to financial services or credit and it is both capital and labor intensive at the initial stages. It was further observed that men control the land units and family income in most households. However, most of the labour in the fish ponds were undertaken by female despite the ownership being male.

4.1.2 Education level of the respondent

The study served to enumerate the percentage of farmers engaged in aquaculture based on the highest level of literacy and numeracy skills attained before under taking training and capacity building offered by the various organizations.

Table 4.2: ***Educational level of the respondent.***

Educational level reached	Frequency	Percentage of farmers
None	6	1.4
Primary	102	26.3
Secondary	96	24.8
College	125	32.2
University	60	15.3

Table 4.2 shows that 1.4 % did not attend any level of education, 26.3 % had primary level of education, 24.8% had secondary level, and 32.2% had college level while 15.3% had University level of education. This clearly indicates that from the population of study about 98.6% of people handling the farms had basic literacy and numeracy skills.

The education level in Kenya has been sub divided into two major areas that is basic education (that includes primary education (Classes 1 – 8) and secondary education (Form 1 – 4)), and higher education (that includes tertiary (College and TVET) and University education).

The various levels of education cover different levels of literacy and numeracy skills. Basic education involves basic learning and psychomotor skills, however at the higher education level learning is centered on developing and applying learned skills relevant for the functioning of the society and effectiveness at the work place.

In majority of cases, a population with high literacy levels also shows marked improvements over time especially when these sectors of the population are called upon to put the learned skills in solving some of the life's challenges. The value of education has further emphasized the role knowledge plays in enhancing capacity for self-assessment and management of projects as observed by Liston (2008). From the level competencies noted from the levels of education, though university education has the highest competency skills expected, the findings of the study showed that individuals with college level of education engaged more in aquaculture. With the level of competency and the training offered by the government on commercialization of aquaculture it is therefore expected that the aquaculture farms should be well managed.

A study at Tingail District in Bangladesh by Rahman et al (2014) observed that 16.67% of fish farmers did not have any formal education, 28.33% had primary level of education, 40% had secondary education, 11.67% had high school level of education while only 3.33% had a university degree and above. They concluded that overall fish farmers were literate in the study district. The study was in line with the current results showing 98.6% had basic level of education.

Results of a study by Ngwili et al (2014) showed that 23.8% and 16% of fish farmers in Kiambu and Machakos counties respectively had not attained a minimum of primary education. this study showed that the percentage of fish farmers who had completed primary level of education was the

highest under ESP program. Shitote et al (2013) in their study in western Kenya found out that a majority (61.7%) of fish farmers had primary education while 26.0% had secondary education while 12.3% had tertiary education. The studies by Shitote et al (2013) and Ngwili et al (2014) were equally in line with the current study results on the numeracy and literacy levels of farmers in the area of study.

4.2 Resource mobilization and aquaculture production

This section addresses how resource mobilization influenced the production of aquaculture in Kisumu West Constituency. The indicators of current status of the farm were whether the farms are active or inactive, number of employees within the active farms to address the need for direct and indirect employment , number of ponds harvested within a period of a year from the time of the study and the number of pieces of fish harvested and their sum weight. A comparative analysis of these indicators would be done with the different sources of capital to establish the source that has more sustainable farms. The limitations and challenges faced by the farmers was also analyzed.

4.2.1 Sources of capital

The Kenyan government through ESP provided financial support to identified farmers to develop commercialized aquaculture farms. The information gathered from the respondents is represented in table 4.3.

Table 4.3: Source of capital for the aquaculture project

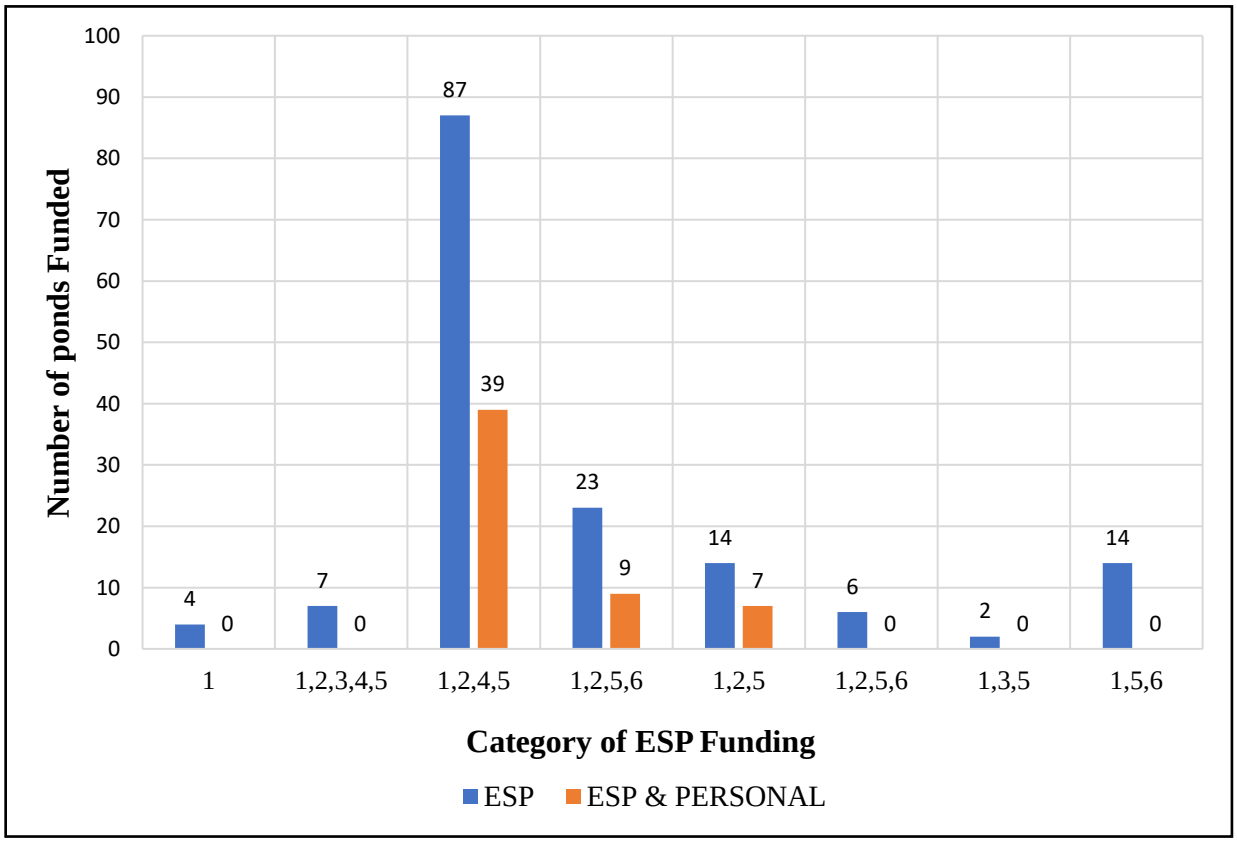
SOURCE OF CAPITAL	NUMBER OF FARMERS	PERCENTAGE
ESP	157	40
Pesrsonal	126	32
Sacco/Group	43	11
ESP and Personal	55	14
Personal and Sacco/Group	8	2
Total	**389**	**100**

From table 4.3 of the respondents interviewed, 40% of the farmers were financed from the ESP kitty, 32 per cent established the projects from personal finances, 14% used both personal and ESP

funds, 11 per cent received their funding from Group/Sacco loans while 2% of those interviewed used had both personal and Sacco/Group loan as source of funds to establish the projects. This indicates that about 54% of the farmers received funding from the government to establish their farms. The main stream financial institutions including banks and microfinance institutions did not finance any aquaculture project within the constituency.

> '*ESP was earmarked to fully finance the farmers until harvesting of fish'.* (Sub-County Fisheries Officer).

The assertion by the sub-County Fisheries Officer was not realized on the ground. The results from the study indicates that 15% of the farmers were not fully funded since they had to mobilize for alternative resources to manage the ponds. Further results from the farmers showed that, some did not receive other categories of financing leading to drop out as shown on the figure 4.1 below.



Category: Forms of ESP funding: 1 – Pond construction; 2 – Feeds purchase; 3 – Fertilizer; 4 – Training; 5 – Fingerlings; 6 – Pond Liner

Figure 4.1: Categories of ESP financing for the aquaculture projects

Figure 4.1 shows the different combinations of forms of finance received from ESP. From the farm interviews carried out, of the 389 farmers, 157 farmers received full funding for some components of the aquaculture project. Four farmers received funds towards construction of ponds without any further additional funding, hence they were not operationalized. Seven ponds received capitation for full establishment however, no pond liner was issued on assumption that the soil type could comfortably retain water. 87 ponds were fully funded inclusive of the pond liner but did not receive fertilizer which was a key component in production. From the results it was clearly evident that most of the farmers capitalized through ESP, missed out on the fertilizer component. Farmers received only a measure of 2 Kg fertilizer, against an expectation of 15 kg as was indicated on the project program. It is also evident that fertilizer though being a key ingredient during growth and development of the fingerlings during production it was not distributed to most of the farmers who were beneficiaries of ESP.

The Department of Fisheries though could not quantify the number of farmers financed through ESP, they provided an explanation that the deviation from the expected 200 fully financed ponds was due to the fact that, Kisumu West constituency was formed during the electoral boundary review and was hived off from Kisumu Rural and Kisumu Town constituencies that received capitation for the projects.

The Fisheries Officer from the Department of Fisheries in Kisumu West Sub County stated that:

> *'Funding for projects by ESP was done based on different categories that included pond construction, purchase of pond liners for areas with low water retention soils, purchase of 1,000 fingerlings to stock each pond, provision of feeds for the entire production cycle and training of the farmers on the production management skills'.*

The result was however not in line with the findings from the individual farmers as captured in figure 4.1. The fish farmers received funding for some components only. For example, four farmers received only funding for pond construction leading to their drop out at the initial stage. This was a clear indication that there was under distribution of resources that had been mobilized by GoK towards implementation of ESP.

According to Musyoka and Mutia (2016), not all fish ponds constructed were stocked with the 1000 tilapia fingerlings and some beneficiaries of the project did not receive and install the polythene pond liners. Some of the farmers were not able to meet these requirements by the time the ESP program funding came to close. There were many cases where farmers eventually abandoned their ponds even before the first harvest.

According to Musa et al, (2012) through ESP the country experienced a rapid expansion of fish farming providing high protein food income and employment opportunities. The ESP focused on pond construction, fish feed and fingerlings supply, post-harvest management and human resource capacity building of fish farmers and associated institutions. The research results were not in line with those of the study done in Kisumu West constituency noting that all the farmers did not receive the full package of financing as stipulated in the ESP performance activities.

The figure 4.2 below shows a pond within Kisumu West constituency funded by ESP but could not retain water since the pond liner provided to the farmer was not sufficient for the pond leading to farmer drop out.

Figure 4.2 Pond within Kogony, Central Kisumu Ward not fully covered by a pond liner

According to FAO (2012) one of the major constraints affecting aquaculture in African countries is lack of capital. The lack of capital by the rural based farmers was to be addressed through inception of ESP. However, from the study some framers did not receive full capitation as envisaged leading to farmer drop out resulting to in active farms.

In the first phase of ESP in the 2009/2010 financial year 200 fish ponds were constructed in each of the 140 constituencies, totaling more than 27,000 fish ponds nationally, in addition to this, 15 Kg of fertilizer and 1000 fingerlings of monosex tilapia per fish pond were issued, it was expected that on successful harvest each of the ponds were to produce an average of 240 Kg of fish per year (Musa et al, 2012). This observation contradicts the study findings in Kisumu West Constituency as most of the farmers did not receive the capitation as planned. Most of the ponds financed through ESP are in a dilapidated state a clear indication that resource mobilization was a challenge.

4.2.2 Current status of farm activity

Table 4.5 below provides a summary of the findings of the current status of the farms if active or inactive and level of production. The inactive farms are drop out farmers.

Table 4.4: ***The source of capital and current status of the farm***

	Pond status, production and number of employees			
Source of capital	Number of active farmers	Total number pieces of fish harvested	Total weight of fish harvested (kgs)	Total number of employees
ESP	31(16.6%)	10,040	1,318	143
PERSONAL	89 (47.6%)	20,840	1,530	156
SACCO/GRP	35 (18.7%)	2,100	290	35
ESP & PERSONAL	28 (15.0%)	4,830	955	27
PERSONAL & SACCO/GRP	4 (2.1%)	160	200	4
TOTAL	**187 (100%)**	**37,970**	**4,293**	**365**

From Table 4.4, 48.1 per cent of the farms in Kisumu West Constituency are actively in production against 51.9 percent that are not active. Of the active farms, 16.6% were financed through ESP, about half financed through proprietor personal finance, 18.7 % financed through loans from a group or Sacco, 15.0% financed through both ESP and personal funds and 2.1% funded through personal and Sacco/Group finance. This shows that a third of the firms received funding either partially or fully from the ESP kitty.

For the farms that are not active 62.4% were financed by ESP, and 18.3 % financed through entrepreneurs' personal finances, 4.5% financed through loans from a group or Sacco, 13.9% financed through both ESP and personal funds and 1.0 % were funded through personal and Sacco/Group finance. Taking a comparison of the performance of the farms funded by ESP and personal finance it was noted that a great number of drop out farmers had finance from ESP (126 farms) out of the total 202 inactive farmers, which is 92.3%.

According to Wesonga et al, (2016), Adopters who were fish farmers, had reared fish for over five years continuously. Of the 146 fish farmers surveyed 43.2% were adopters. Non- ESP members adopted fish farming at 76.9% as compared to 39.8% of ESP members. The implication is that non-ESP members might have been prepared to undertake fish farming in resources and expertise. A majority of ESP members were non-adopters as illustrated by 96.4% of the total non-adopters. The number of adopters and non-adopters, almost equals the active or inactive ESP farmers from the current study done within Kisumu West Constituency.

Of the 34 ponds harvested that were funded by ESP, 10, 040 pieces of fish were harvested. Personal financed farms with same size harvested 20,840 pieces which is double the number of fish harvested. ESP funded active farms are 31 and the ponds harvested in the last one year stands at 34, this showed that the farmers are continually dropping out from the enterprise upon harvesting. From the findings there was a clear indication that farms financed through the entrepreneur's personal finances of evidenced more sustainability, followed by Sacco/Group loan financed, those capitalized through ESP only were the least sustainable.

The active farms have a mean of 37.4 farms standard deviation of 31.28 depending on the sources of funds and positively skewed by 0.9045 from the normal curve. The inactive farms on the other hand have a mean of 40.4, a standard deviation of 49.88 and positively skewed by 1.21081 from

the normal curve. This showed that more farms were inactive. Inactive farms showed a wide deviation from the mean value across the different modes of funding that is a minimum of 2 drop out farmers to a maximum of 126 farmers cutting across the different sources of capital.

The number of pieces harvested varied highly from the mean at 8,284, the weight also bears a high variation from the mean at 597, this was an indicator that the farm production varied across all the farms within the constituency. The variation was evidenced even though all the ponds are of the same size and received an input of 1,000 seed fingerlings issued to the ESP-financed farmers. The variations were attributed to the different pond management skills put in place by the farmers with those financed through personal finances showing better harvest quantities in terms of both number of pieces and weight. The study results were in line with that of Dickson et al (2016) that found out that, pond-based farming was a highly profitable venture in Egypt, was widely managed and funded through private sector investment.

The results corroborate with that on development of aquaculture farms in Zambia, Ghana and Malawi as reported by FAO (2012), from the survey of fish farmers (n=129, 98%), practical semi-intensive system of aquaculture. In pond systems, 97% (n=127) of farmers cultured fish in earthen ponds. Earthen pond system is more dominant because of the low cost of establishment and management. However, there was no farmer practicing extensive culture system due to the low productivity and less returns associated with the same. The survey also revealed only 2%, (n=2) engaging in intensive aquaculture practice. This is perhaps attributed to high startup cost, operational costs and the risk associated with such systems. Production reduced drastically in the past 3 years with 14,952 metric tonnes. In order to mitigate on the high level of drop out farmers participatory approach in planning should have been utilized. This would support in actualizing the needs of the farmers and addressing the anticipated challenges like the serious demand for pond liners due to poor soil in some areas, some farmers lack of capacity to sustain the project without consistent funding from the GoK.

Figure 4.3 Pond funded through ESP at Ojolla, South West Kisumu Ward

The photo taken by the author shows a farm that received funding for pond construction through ESP and has since grown the enterprise to own three ponds.

The farmer received funding for Pond construction, feeds purchase, fertilizer, training and purchase of 1,000 fingerlings. From the income earned in addition to personal finances the farmer has been able to increase the number of ponds at the farm to three.

Table 4.5: ***Type of fish farmed and the count of ponds harvested***

	Fish Type					
Source of capital	Cat fish	Other fish	Tilapia	Tilapia Cat fish	Tilapia other	Total
ESP			29	5		34
PERSONAL	1	1	19	3	1	25
SACCO/GROUP		1	4			5
ESP PERSONAL			5	5	1	11
PERSONAL, SACCO/GROUP				1		1
Grand Total	**1**	**2**	**57**	**14**	**2**	**76**

Table 4.6: ***Type of fish and the sum of weight of fish harvested***

Weight of fish harvested per fish type						
Source of funds	**Cat fish**	**Other**	**Tilapia**	**Tilapia Cat fish**	**Tilapia & other**	**Total**
ESP			1194	124		**1318**
PERSONAL	0	14	1401	96	20	**1531**
SACCO/GROUP		75	215			**290**
ESP PERSONAL			650	55	250	**955**
PERSONAL, SACCO/GROUP				200		**200**
Total	0	89	3460	475	270	**4294**
Percentage	0	2.07	80.58	11.06	6.29	**100**
Average weight per pond	**0**	**44.5**	**60.7**	**33.9**	**135**	**56.5**

From the 76 ponds harvested, a total of 4,294 Kg of fish was harvested indicating an average weight of 56.5 Kg per pond. It was noted that one pond stocked with cat fish realized no fish harvested, a clear indication of effects of fish predation and theft. Farms financed by ESP and personal funds exemplified the highest estimated weight harvested at 1,318 Kg and 1,531Kg respectively even though ESP farms had the highest number of ponds harvested over a period of one year.

Data provided by the Department of Fisheries, Kisumu West Sub-county during the interview, showed that in the financial year 2016 – 2017, 2,319 Kg of fish was harvested from 47 ponds with an average of 49.34 Kg per pond. In the 2017 – 2018 financial year, 6, 130 Kg were harvested from 48 ponds, giving an average of 127.71 Kg per pond, and in the financial year 2018- 2019, 3,867 Kg of fish was harvested from 53 ponds which is an average of 72.96 Kg per pond. This was generally a declining trend that was against the projected target of ESP.

Table 4.7: ***Number of ponds harvested against number of employees per farm depending on source of capital***

	Number of employees per farm				Total number of ponds harvested per source of capital
Source of capital	**0**	**1**	**2**	**3**	
ESP	2	30	1	1	34
PERSONAL		16	7	2	25
SACCO/GROUP		5			5
ESP PERSONAL	1	9	1		11
PERSONAL, SACCO/GROUP		1			1
Grand Total	**3**	**61**	**9**	**3**	**76**

Table 4.7 indicates that of the 76 farms harvested in the last one year three ponds did not have any employees at the farm, 61 ponds were manned by one employee each, 9 ponds manned by 2 employees each and 3 ponds manned by 3 employees. The total number of employees was 88 for the 76 ponds harvested. Close to half of the employees handling the ponds harvested in the last one year were funded through ESP. A further interrogation of the respondents showed that the average number of employees per farm is 1.2 earning an average monthly salary of Kshs 3,712.00. Most of the employees in the farms are male youths. ESP had the objective of commercializing the farms to be a source of employment for the youth and women in the rural areas for economic empowerment.

Table 4.8: ***Weight of fish harvested and number of employees per farm***

	Sum of weight harvested in relation to number of employees per farm (Kgs)				
Source of capital/ No. of Employees	**0**	**1**	**2**	**3**	**Total weight harvested (Kgs)**
ESP	0	1,238	35	45	**1,318**
PERSONAL		405	822	304	**1,531**
SACCO/GROUP		290			**290**
ESP PERSONAL	100	855	0		**954**
PERSONAL, SACCO/GROUP		200			**200**
Grand Total	**100**	**2,988**	**857**	**349**	**4,294**
Average weight per pond	**33.33**	**48.98**	**95.22**	**116.33**	**56.5**

Table 4.8 shows the impact of the employees on the farms they work in. The three ponds harvested with no employee assigned recorded an average 33.33 Kg of fish per pond. One of the ESP ponds with no employee did not register any harvest. Ponds having a single employee working had an average of 48.98 Kg which was 69.5% of the total production, two employees 95.22 Kg and 3 employees 116.33 Kg. This implies that the optimum number of employees per pond should be two for maximum return. From the study it is also evident that the male youth recorded the highest production level at 49.1%, followed by the male adult at 31.2%, female adult at 17.8% and female youth at 1.8% denoting the lowest pond production.

Table 4.9: ***Correlation between farm status, number of ponds, number of pieces, weight harvested and the number of employees***

	Active	**No. of Ponds**	**No. of Pieces**	**Weight harvested**	**No. of employees**
Active	1.0000				
No. of Ponds	0.5311	1.0000			
No. of Pieces	0.9217	0.7577	1.0000		
Weight harvested	0.7245	0.9019	0.8975	1.0000	
No. of employees	0.7511	0.9360	0.9021	0.8881	1.0000

From table 4.9 the following Pearson's correlation coefficients realized show the following relationships:

Active and inactive farms showed a weak positive relationship due to the high increase in drop out farmers financed through ESP compared to other sources of finance. However, the active farmers did not show such wide disparity.

Active farms showed a moderate relationship, while inactive farms showed a strong positive relationship with the number of ponds harvested. This leads to a conclusion that consistent drop in the number of ponds harvested in the last one year signifies a high dropout rate of farmers from fish farming.

The number of pieces of fish harvested depends on the activity of the farmers. Therefore, the strong positive relationship between active farms and number of pieces harvested confirms the trend. The weak positive relationship with inactive farms shows the lack of consistency in production of the farms before the farmer finally dropped out of farming.

Government of Kenya in 2009 initiated ESP, with the aim of commercializing aquaculture. The program aimed to increase production of farmed fish from 4,000 MT, to over 20,000 MT in the

medium term and to more than 100,000 MT in the long term (Charo-Karisa and Gichuhi, 2010). The figures would provide an average production of 95.23 MT per constituency in the medium term and in the long term 476.19 MT. The study showed harvest of 4,294 Kgs of fish from the constituency was far short of the expected ESP projected figure in the long term.

On interrogation of some of the farm owners they decried delayed delivery of feeds and fertilizer and in some instances against an expectation of 15 Kg of fertilizer only 2 Kg was delivered to the farm by the fisheries department officers. Department of Fisheries reaction to this was:

> "*There was no budgetary allocation on facilitation of aquaculture extension officers to visit the farms from the County Government of Kisumu".*

Results from the survey done showed that 50% of the farmers indicated that it's rare to get visits from the fisheries department. The established farms with high production levels per pond decried lack of support from the fisheries department. The lack of farmer visits exposes farmers to challenges in pond management. The result provides justification for the low pond production in the area of study. The pond production level was far below the expectations as captured by Munguti et al (2021) that fish ponds in Kenya range from dug holes to designed ponds with inlet and outlet channels and harvest basins yielding approximately 1 – 2 tons/Ha/year under competent management.

According to KMFRI officer:

> *Production of farms is affected by lack of effective group organization which reduces ability to negotiate on cost of input and share experiences. Best management practices not formally adopted or applied in culture systems, over reliance on funding from government and development partners creating a 'donor syndrome.*

This observation is replicated on the ESP program since farmers recruited to manage ponds failed to progress to the first harvest due to lack of support from the government. Though the funds were availed by the government to ensure full funding of the projects it is evident to note that some of the funds did not reach the intended farmers.

The decline in production levels of the farms evidenced is contrary to Brandler (2007) who stated that aquaculture is rising rapidly and by 2030 is estimated that aquaculture production will be close to that of capture production and Dickson et al (2016) in Egypt aquaculture represented 77% of total fish production in 2014 compared to 54% in 2000.

According to Amadiva and Tarus (2018) aquaculture provides opportunities for employment and income generation to youth and women especially in the rural areas. To this end, ESP had an objective to increase employment opportunities in the fisheries and aquaculture sectors from 80,000 to approximately 2.0 million by 2030. From the findings, if the optimum number of employees that maximizes production per farm is 2 per pond then 200 ponds per farm should at least have 400 employees. The total count of ponds constructed in Kisumu west constituency total 441 both active and inactive and therefore the projected employee number per farm should be 882 employees.

Bueno and Pongthanapanic (2014) in their study of success of aquaculture in Pakistan found out that farm innovation and skilled farm labor reduce costs and raise efficiency. This therefore informs that farmers in Kisumu West constituency should focus on employing skilled labor to improve on pond performance. The increase in drop out farmers in form farm inactivity directly affects pond production. The trend therefore affects the realization of the medium-term and long-term objectives of ESP. Therefore, measures should be taken to adequately provide the farmers with the requisite production management skills. Production directly relates to the number of ponds that are active and strongly related to the active ponds and if the numbers would increase then the projected medium term and long-term values would be attained.

Generally, the weight of fish harvested showed a strong positive relationship to the active ponds, a number of ponds harvested and a number of pieces harvested. This was attributed to low weight per piece harvested that showed a similar trend. This could be alleviated by engaging the farmers in proper management of the feeding program for the farms to allow the fish to attain the requisite weight. The evidenced decline in farm production especially for the ESP-financed farms was a clear indicator that most of the activities were not diligently implemented to ensure achievement of the projected goals. To establish sufficient and prudent control and monitoring of the progress

of the farms. Gannt charts should be introduced within the farms to illustrate achievement of various activities and timelines within which they were attained.

4.3 Farmer acquisition of pond management skills and farm status

This section discusses how farmer acquisition of pond management skills affects production of aquaculture in Kisumu West Constituency leading to its current status whether active or not. The pond management skills that farmers were trained on include predator identification and management, water source management, early fish disease detection, fish feeding program, record keeping, fish pricing, fish storage and value addition. The study will concentrate on finding out if farmers were trained on the various aspects enumerated, the level acquisition of the management skills and the effect of attainment of the skills on the current status of the farm. Farm in production is indicated by its state of activity during the time of the study.

4.3.1 Pond management skills in areas farmers received training

Table 4.10: ***Tabulation of the percentage of farmers trained on pond management skills***

Training on pond management skills	Number of farmers trained	Percentage trained
Predator identification and management	235	60.4
Water source management	332	85.3
Early fish disease detection	209	53.7
Fish feeding program	302	77.6
Record keeping	172	44.2
Fish pricing	162	41.6
Fish storage	162	41.6
Fish value addition	152	39.1

All interviewed farmers indicated at least receive one form of training on the areas listed in Table 4.10 above.

More than two thirds of the farmers were trained on predator identification and management, water resource management and fish feeding program. More than half were trained in early fish disease detection while over forty percent of the farmers were trained in record keeping, fish pricing, fish storage and value addition. From the interviewed respondents the greatest percentage loss of fingerlings was through predation by birds, tortoise, snakes, frogs and geckos.

However, for matured fish the main challenge rests on security on the farms since theft by neighbours' children and youth from the village has been a major avenue for loss of fish leading to lower production levels. The study results are in line with the challenges enumerated by Shitote et al (2013), which state that 88.3% of fish farms were affected by predators indicating that predation was a serious threat to fish farming. The major predators include Kingfisher and other birds at 44.3%, human beings at 23.6% , crabs at 10.7%, snakes at 9.9% and frogs at 5.2%.

Figure 4.4 Dried-up pond due to lack of water, at Huma, West Kisumu Ward.

The figure 4.4 above shows a farm within Kisumu West Constituency indicating a farm with poor water source management despite over two thirds of the farmers undergoing training.

The soil type could not retain water especially during the dry season, and the pond lacked a pond liner. The farmer did not have sufficient resources to purchase the pond liner which in effect led to the farm inactivity. The farmer depended on water from a nearby spring as a source of water with backup from the rains. The challenge for the farmer was water use conflict with neighbours who depended on the spring for home consumption.

Figure 4.5 Farmer feeding fish within the schedules as trained, at Eluhobe, North West Kisumu Ward

The farmer in Figure 4.5 received training on all the areas of pond management and applied the knowledge learned at the farm. This proved resourceful as the farmer was able to harvest and earn income from the farm. The farm managed by the youth acted as an income earner and source of employment. The farmer maintained proper farm records.

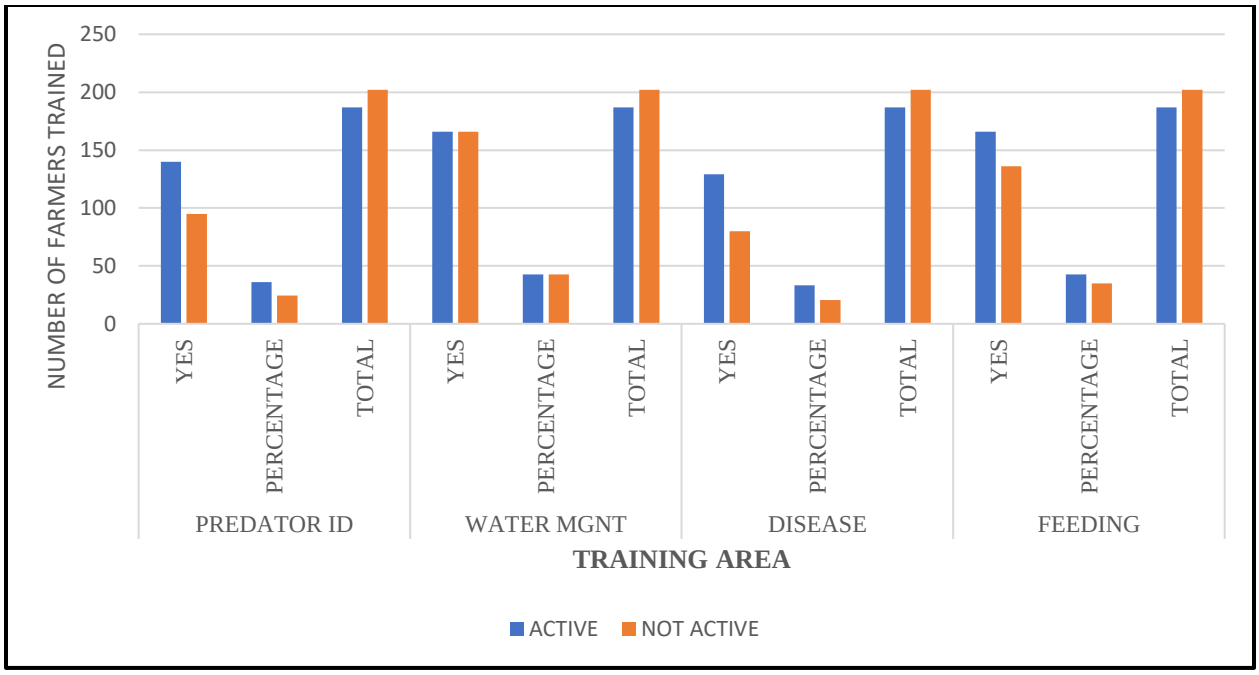


Figure 4.6(a): ***Relationship between status of farm and the various areas of training***

From figure 4.6 (a) shows that the chi-square values for predator management and identification fell outside the critical value of 3.841 at 0.05 confidence level. The status and performance of the farm is therefore highly dependent on the training area. From the results its evident that both the inactive farmers (drop out farmers) and active farmers need further training to realize improved performance and re-engagement of the drop out farmers. A comparative analysis to the production levels of the farms it is evidenced that despite the issuance of 1,000 fingerlings per farmer per pond, the farmers realized harvests averaging 499 pieces per pond as shown on table 4.5 (number of ponds harvested = 76, number of pieces harvested = 37,970, average number of pieces harvest per pond = 499). Shitote et al (2013) study shows that 88.3 % of fish farmers were affected by predators indicating that predation was a serious threat to aquaculture. The results are in line with the current study. More dedicated training should be afforded to the farmers taking into consideration their individual needs, to ensure improved performance of the ponds.

Water management had a chi-square value for the active farms at 1.5 for those not trained and 0.3 for those trained. Consequently, with a critical value of 3.841 at 0.05 confidence level, the training area was independent on the status of the farm. For the drop out farmers the chi-square values are at 1.4 for farmers not trained and 0.2 for those trained, therefore indicating independence from the

status and performance of the farms. This was attributed to the fact that the ponds were established in areas with sufficient water. The results are supported by the study by Otieno (2011), which showed that most of the country is suitable for aquaculture and only 1.4 hectares of potential land for aquaculture sites is used for the practice. 95% of the established farms are small scale farmers. The challenge raised by the farmers during the study was loss of water through seepage especially for farmers not provided with pond liners as shown on table 4.4.

Shitote et al (2013) found out that pond management was a serious problem facing fish farmers in Siaya County, Kenya. Their findings revealed that majority (95%) of the respondents faced serious difficulties in managing the ponds. These fish farmers cited problems like drying ponds during drought, lack of fingerlings, siltation of ponds, poor pond maintenance and poor security. Similar issues were raised by the farmers during this study. According to Bryan et al (2000) water quality is critical for the beneficial use of pond water, it plays a critical role in determining the types and number of fish species that live in the pond as well as their growth and survival rates. Many parameters of water quality vary seasonally and these changes are normal and accepted. Routine testing of water quality helps to identify problems before they become too serious to cause death of fish. The study provides an overview of the importance of training the farmers on water management. This will provide a benchmark for the farmers to learn the cause of low number of fish harvested. From the study 85.4% of farmers were trained on water management and this could have led to the acquisition of skills as enumerated by the study by Byan et al (2000).

Early fish disease detection had chi-square values of 9.4 for those not trained and 8.1 for those trained and a total of 17.5 for the 48.1% active farmers. Similarly, chi-square values of 8.7 for farmers not trained and 7.5 for farmers trained and a total of 16.2 was realized for the 51.9% inactive farmers. Comparing with the critical value of 3.841 at 0.05 confidence level, the results showed that status of the farm still depended on fish disease management training area. Consequently, training on the area should be improved in Kisumu West constituency taking keen interest on skills that individual farmers require.

42.7% of farmers were trained on fish feeding compared to 5.4% who were not trained. The chi-square values attained were 10.4 for not trained but active farmers and 3.0 for trained active farmers. This indicated that once a farmer was well trained and had acquired skills on fish feeding,

the farms attained independence from reliance on training of skills in this area. Converse of the results are shown on the untrained farmers who still showed dependence on the training area noting the critical value of 3.841 and 0.05 confidence level. The results showed that with sufficient training pond production can be improved thereby ensuring reduction of the numbers of dropout farmers. In overall the total chi-square value of 25.7 was attained for all the 389 farmers showing that the status of the farms was still dependent on training skills on feeding program and management. More training should therefore be done by extension officers to ensure improved production levels of the farms.

According to Opiyo et al (2018), most common feeding mistakes like over feeding which occur anytime fish are eating more than they need, make fish sick and produce excessive waste. This strains the limit that can biologically be reduced resulting in decline in water quality. It is recommended that fish should be fed more than three times per day. The study provides important information that should be included as part of training content during capacity building sessions. This will support mitigate on the farmer drop out which was at 17.0%.

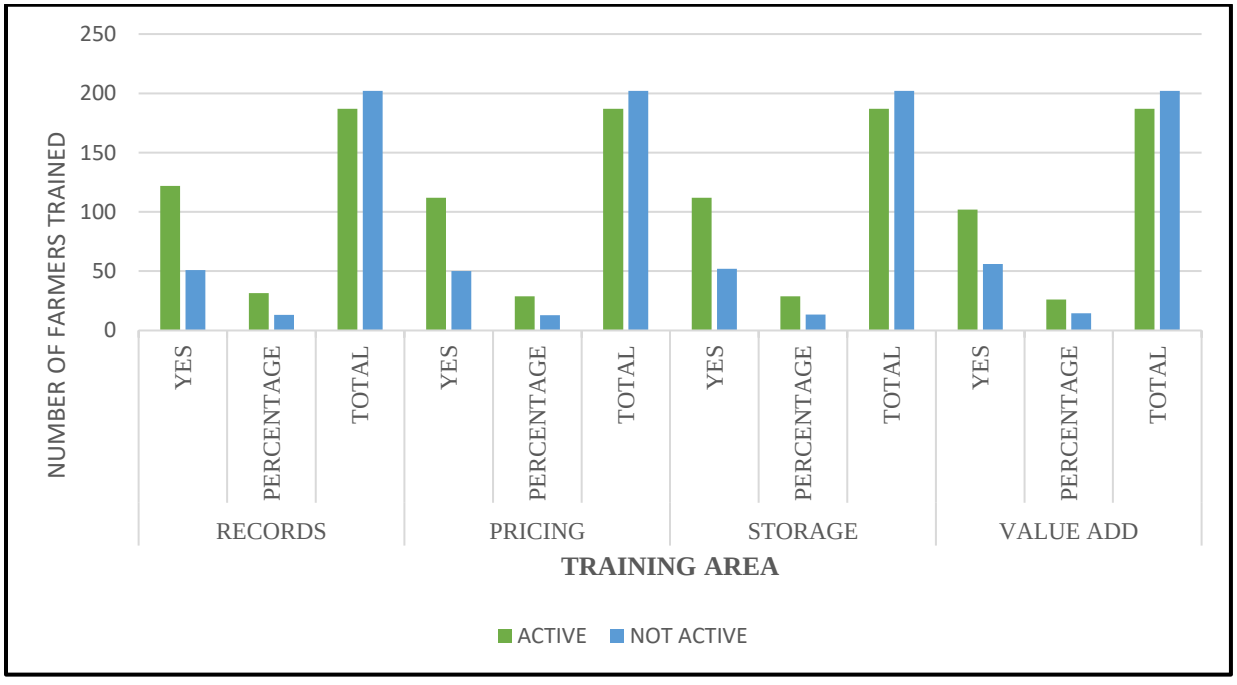


Figure 4.6 (b): ***Relationship between status of farm and the various areas of training***

From the results in Figure 4.6 (b) status of the farm showed high dependence on records management as training area. 31.4% of the farmers who are active were trained while 16.7% of the farmers (n = 65) were not trained. The active farmers had a chi-square value of 33.5, critical value 3.841 at 0.05 confidence level, showing dependency of status of the farm to the training component. The farmers who were inactive showed a chi-square value of 30.2, critical value 3.841 at 0.05 confidence level showing dependence to records management training component. Overall, 44.5% (n =173) were trained on records management while 55.5% (n = 216) were not trained. The training component registered a chi-square value of 62.9, and 3.841 critical value at 0.05 confidence level. This attested to the high dependence of the status of the farms on the training component. The farmers should therefore receive more training on the tenets of shrewd record management. This will provide an indicator to the farmer on the progress attained at the farm in terms of the costs incurred at the farm and how to price the fish to maximize profits.

Pricing of fish after harvest was one of the components of training that ESP focused on. 28.8% of the farmers (n=112) were active and trained on pricing of fish, while 19.3% (n = 75) were not trained. The chi-square value of the active farmers was at 25.6, critical value 3.841 at 0.05 confidence level. This showed dependence of the status of the farm to pricing of fish. 12.8% of the farmers (n = 50) were trained on pricing but were inactive during the study. 39.1% (n = 152), were not trained. The drop out farmers attained a chi-square value of 51.9, critical value 3.841 at 0.05 confidence level. This indicated a high level of dependence of the status of the farm to pricing as a component of training. Overall, 49.3 chi-square value was attained with a critical value of 3.841 at 0.05 confidence level. More training on the pricing of fish should be done in future to the farmers to realize the objective of commercialized small-scale aquaculture.

28.8% (n = 112) of the farmers (active) were trained in storage of fish products while 19.3% (n = 75) were not trained. the chi-square value for the active farmers was 24.1, critical value 3.841 at 0.05 confidence level. This showed dependence of status of the farms on training on storage of fish after harvest. 13.4% (n = 52), of the farmers (inactive) received training on storage of fish while 38.5% (n = 150) were not trained. the drop out farmers had a chi-square value of 23.7 critical value of 3.841 at a 0.05 confidence level. This also indicated dependence on the status of the farm on the training component. Overall, 42,2% (n = 164) farmers were trained on storage of fish after harvest while 57.8% (n = 225) of the farmers were not trained. The chi-square value for storage of

fish was 46.4, critical value 3.841 at 0.05 confidence level. this indicated dependence of the status of the farm on the training area.

Value addition was another component of training administered through ESP for farmer capacity building. 26.2% (n = 102), of the farmers (active) were trained while 21.9% (n = 85) were not trained. The chi-square value for the active farmers was 15.0, critical value 3.841 at 0.05 confidence level. This was an indication of dependence of status of the farm to value addition after harvest as a training component.14.4% (n = 56) of the farmers (inactive), were trained on value addition, while 37.5% (n = 146) of the farmers were no trained. the chi-square value for this capacity building component was 13.9, critical value 3.841 at 0.05 confidence level an indication of dependence. Overall, 40.6% (n = 158) of the farmers were trained on value addition, 59.4% (n = 231) were not trained. The chi-square value attained was 29.0, critical value 3.841 at 0.05 confidence level. This indicated dependence of status of the farms to the training component and more capacity building should be advanced to the farmers.

In summary status of the farm whether active or not active was dependent on the component trained on, apart from the water source management which showed some independence. The critical value is 3.841 at 0.05 confidence level, only the value for water source management, 1.8, falls within the accepted area. Therefore, training and capacity building on the identified components afforded to the farmers are essential to achieve the objective of commercializing aquaculture through improved performance.

Through organizational skills the farms establish proper relationship between work to be done, people to do the work and place of work. Constraining activities within the limits of predetermined plans, set standards of performance. For control purposes the manager must be able to schedule, dispatch, direct, supervise and undertake corrective measures relative to the specified work. In line with the functions of management, the findings are in line with the position that farmers should be well enlightened and trained on their applications of the various technical skills to lead to sustainability of the farms.

The findings are also in agreement with Mwatsuma et al (2012) that the production of fish or fisheries products required a different set of technical and management skills than other agriculture activities. Before a would be aqua culturalist could successfully grow aquatic organisms, he needed

specialized training in water quality management, aquatic weed control, parasite and disease control, nutrition and feeds, cultural techniques, marketing and value addition skills. Shitote et al (2013) in their study on challenges facing fish farming development in Western Kenya found that management was a serious problem for a majority in terms of the high cost of feeds, drying up of ponds during drought, siltation of ponds, pond maintenance and poor security. These challenges were also evidenced within Kisumu West therefore training on technical pond management skills should be prioritized.

Opiyo et al (2018) notes that despite the gains in growth of the number of ponds aquaculture production in Kenya reduced from 24,096 MT in 2014, to 18,656 MT in 2015 and further to 14, 952 MT in 2016. The number of operational fish ponds reduced from 69,194 (2013) to 60,277 in 2015. The reduction was cited as a result of poor water retention capacity of ponds in some counties especially Coastal and Eastern regions of Kenya, poor extension services, inadequate capacity support, low quality and quantity of fish farm inputs, poor marketing infrastructure, dependency syndrome on Government/donor support and lack of value addition. The findings are agreeable to the challenges that lead to the drop out of farmers since performance of the farms depends on the level of training and capacity building attained by the farmers. The findings are also in tandem with a statement by Muir and Allison (2007) that climate change especially drought affects inland aquaculture production through loss of cultured stock, increased production costs due to low water quality and availability for aquaculture since most of the farmers in Kisumu West Constituency raised it as a challenge with some of the ponds drying up due to lack of pond liners and seasonality of some of the rivers.

Though the farmers were trained on predator identification and management it remained a challenge towards loss of fish within the ponds. Extension officers should adequately address the component of management of the predators. The farms should be zoned and ponds located within close neighbourhoods to aid in sharing of security and management of common predators.

According to Munguti et al (2021), with adequate training on basic fish pond management, there is need for competency-based training on special skills in aquaculture. The youth can be encouraged to join training in various TVETs and Universities. Weak extension service is a perennial challenge to the aquaculture sector. This is because the government does not employ

staff regularly. The devolution of fisheries and aquaculture sectors to county levels present the need for local people to educate the local fish farmers using the local dialect. This is a perfect opportunity for young people to be trained as extension officers so that they can offer consultancy services to the aquaculture farmers. Based on the challenges advanced by the farmers during capacity building, the approach would be the most suitable to ensure that quality training and capacity building is afforded to all the farmers.

4.3.2 Training by extension officers at the farm

Table 4.11: Percentages of areas not adequately addressed by extension officers during their visits

Area Not Adequately addressed	Number of farmers	Percentage
Pricing and value addition.	1	3%
Fingerlings	1	3%
Fish diseases identification	1	3%
Marketing	2	5%
Most don't have enough information.	3	6%
Maintenance of the pond	4	8%
Issues with feeds	4	8%
Predator management	6	14%

Table 4.11 shows respondents' feedback on areas where extension officers who visited the farms had difficulty in handling. The figures were low with percentages ranging between 3 and 5 per cent for the various categories apart from maintenance of the pond and issues with feeds had a higher level of challenge at 8%. Predator management was at 14% however, it was significant to note that half of the respondents raised the concern about extension officers not visiting the farms at all. This response resonates with the challenges affecting the farmers and in effect leading to a high number of dropouts from the enterprise.

The extension officers cited a lack of sufficient funding to enable them to traverse the allocated work areas within the vast constituency. At the Sub-county Fisheries Office, the two extension officers were allocated specific wards with the first being in charge of Kisumu North and North

West Kisumu Wards while the second handled Central Kisumu, Southwest Kisumu and West Kisumu wards.

The Sub-County Department of Fisheries officials had a common submission that after their functions were devolved to the counties, pond farming has not received positive consideration in form of budgetary allocation. Aquaculture though is still touted by the government as a source of both food and income to the local citizen. The Kisumu County Integrated Development Plan for 2013 and 2019, emphasizes aquaculture as a source of food and an income earner for the residents.

KEMRI official cited the area of coverage as the challenge to not visiting the farms adequately since the only available resource handles research and extension services in the whole western part of Kenya and focused on the development of cage fish farming within Lake Victoria.

Table 4.12 (a) Comparison of farmer education level, training and farm production

Education level	**None**	**Primary**	**Secondary**	**College**	**University**	**Total**
Number of farmers trained and pond production						
Number of farmers trained	1 0.2%	11 24%	12 26.1%	12 26.1%	10 21.7%	46 100%
Number of Pieces Harvested	50 0.2%	3,670 15.4%	5,280 22.2%	6,270 26.4%	8,520 35.8%	23,790 100%
Average number of pieces per pond	50	333	440	567	852	517

From Table 4.12 (a) out of the 46 ponds harvested that were owned by farmers who were trained on pond management skills, pond production was such that, farmers with 0.2% of the produce did not attend formal school , 15.4% had primary education, while 35.8% of the number of pieces produced were of farmers trained and with university level education. The number of fingerlings per pond was 1,000 indicating that farmers trained and with higher level of education had the best performing ponds. Therefore, education background is supportive in acquisition of pond management skills.

Table 4.12 (b) Comparison of farmer education level, training and farm production

Education level	**None**	**Primary**	**Secondary**	**College**	**University**	**Total**
Number of farmers trained and pond production						
Number of farmers NOT trained	0 0%	4 23.5%	9 53%	3 17.6%	1 0.6%	17 100%
Number of Pieces Harvested	0 0%	500 9.5%	2620 49.6%	1380 26.1%	780 14.8%	5,280 100%
Average number of pieces per pond	0	125	291	437	780	306

From Table 4.2 (b) it is evidenced that lack of training led to decline in production of the pond. This is shown by the average pond production level of the ponds with farmers trained and those not trained. Farmers with university level of education though they did not attend training the production level was still high with minimal losses since they could apply knowledge learned from internet or engage experts in the management of the farms. The deviation in the number of farmers who harvested ponds from those trained was due to existence of 13 farmers who partially attended the various components of training and therefore could not be used for comparison.

The Ministry of Fisheries was initially under the national government and then devolved to the County government after the 2012 election and promulgation of the new constitution in the year 2010, led in percentage of farmers trained, at 65%. Fingerling outlet expert and fish farming expert managed to train 1.43% each. KEMRI with sufficient expertise in aquaculture and has a regional research Centre within the constituency did not offer any form of training on management skills to the farmers.

Ngugi et al (2004) denote that the biggest constraint facing aquaculture development are the lack of extension staff and infrastructure to deliver technical knowledge about aquaculture to rural smallholders. Through ESP two extension officers were employed by the government to oversee the production and extension services of the farms within Kisumu West Constituency.

According to Hishamunda (2001) in the rural parts of the Ivory Coast, aquaculture failed because of the separation of ownership of the project and management with farmers lacking adequate skills. Satia (1991) reported similar cases of unsuccessful aquaculture as a result of the lack of entrepreneurial dedication by salaried managers. Mwangi (2008) alludes to inadequate technical skills by extension staff occasioned by low staff levels with limited practical aquaculture skills as the main constraint to commercialized aquaculture in Kenya.

The study findings are in agreement with this as it was widely noted that most farmers did not have sufficient technical skills to successfully manage aquaculture farms in Kisumu West Constituency and only employed unskilled workers at the farms. Through ESP two extension officers were recruited, though they qualified in aquaculture, they lacked sufficient practical exposure to aquaculture. Further interrogation showed that the department of fisheries had not facilitated them to attend capacity-building workshops on aquaculture. The Department of Fisheries conversely, decried the lack of sufficient resources to mobilize the extension officers to consistently perform their duties.

In light of these, it can be noted that the government through ESP, made a step in employing extension officers. However, after the functions were devolved to the counties the fisheries department has not been well resourced to adequately perform their functions. Therefore, the Kisumu County Government should adequately allocate sufficient resources to the Department of Fisheries through a review of the training and management master plan of aquaculture to ensure the objective of commercialized farms is accomplished. This finding corroborates with that of Opiyo et al (2018) that one of the challenges in aquaculture was due to the subsequent removal of aquaculture from functions of the National Government to County Governments which led to a reduction of aquaculture activities in several counties in Kenya.

The farmers should engage skilled workers who will be able to prudently advise on the technical management skills. The findings are in line with Corbin and Young (1997) who states that prerequisites for commercial aquaculture included bio-technical feasibility and economic viability. Failure of one led to failure of the whole project. Shortage of human capacity and poor technical expertise at both technical and farm levels equally contributed to the failure of commercial aquaculture projects. However, the findings from the study are contrary to the findings published

by WHO (2013) on fish farming in South Imenti constituency in Meru County, Kenya which states that most of the participants were adequately equipped with the technical skills required for fish management, handling and storage. It further states that training and refresher training was undertaken in collaboration with the Ministry of Education and a majority of the farmers felt that the extension officers provided continuous training. The disparity between the findings was because there was an intersectoral collaboration between different line ministries in the implementation of the program. The training was handled by the ministry of education and the fisheries department did farm visits, within which continuous training was done, in Kisumu west constituency all the roles were handled by the department of fisheries.

Musyoka and Mutia (2016) in their study in Makueni County found that majority of the sampled farmers, 64% cited lack of information or training as a major problem. It was widely accepted that the ESP projects were hurriedly initiated without proper sensitization of both the farmers and the supervisors. Extension officers were the main source of information for farmers. The majority of the farmers stated that they only received training and information during the early stages of project implementation in 2009. Since then they claim that they are rarely visited by extension officers. However, a great number of farmers with functional ponds appreciated the current County government's effort as they were not only provided with handy information and training but also were exposed to other successful farmers around the country. Despite the internet having all the necessary information which is easily accessible, only 0.4% of the farmers utilize it. These findings are partially in agreement with the current study on the challenges faced by the farmers. However, the Kisumu County Government has not been supportive as their Makueni counterparts on the development of aquaculture.

4.4 Post-harvest interventions and income earned

This section addresses the evaluation of the effects of post-harvest interventions on income earned from aquaculture in Kisumu West Constituency. Aquaculture as an agribusiness should enable farmers earn sufficient income. This involves instituting a business approach to post-harvest management skills to reduce fish losses after harvest. Tesfay and Tefers (2017), define post-harvest losses as nutrient or economic losses that render fish unavailable or nutritionally deficient for human use. Commercialized farms should have sufficient capitation to sustain their operations, the

fish produce should be competitive in the market, therefore, the post-harvest interventions put in place should be beneficial to the farmer. For the interventions to be applied the farm should have been actively in production. This was analyzed through the effect of the interventions on the current farm activity status. The indicators of post-harvest interventions included the records kept by the farmer, value addition tools and equipment available at the farm, availability of storage facilities and the farmer's ability to price fish products.

4.4.1 Pricing of fish produce

The study sought to establish if the price of fish at the fish bandas along the lake shore had a significant contribution towards the pricing of fish after harvest. This also served to underscore the pricing methods used by the farmers in pricing the fish harvested at the farm.

More than half of the farmers inquired about the cost of fish at the fish bandas along the lake before pricing the fish after harvesting. However, in 49.44% of the farms pricing was not dependent on the lake shore prices. On further interrogation of the farmers, it was noted that though they do not depend on lake shore prices their selling price could be lower than the lake catches due to the need to sell the harvest fast. The residents also believe that fish raised from the ponds are less nutritious compared to those from the lake. The fishmongers who purchase in bulk also determine the fish prices due to the low purchasing power of the locals.

Table 4.13: Distance *from the market and if farmers sourced for a market before harvesting*

Distance in Km	Number of farms	Percentage of total number of farms	Number of farmers sourcing for market	Percentage sourcing for market
0	227	58.4	167	43.6
1	61	15.6	252	64.8
2	40	10.4	337	86.7
5	56	14.3	375	96.3
10	5	1.3	378	97.2
	389	**100.0**		

Table 4.13 shows that 58.4 % sold fish at the farm, that is 0 Km. It was further noted that 56.37 % never sourced for a market before harvesting while 43.63% sourced for market before. The

respondents who sourced for the market and informed prospective buyers in advance sold the fish and made good returns from the sale.

For a market distance of 1 Km, there were 15.6 % of the farms of which 64.84% sourced for the market and 35.16 % did not look for a market for the produce. The respondent noted that the distance did not have a substantial effect on the net income.

For a market distance of up to 2 Km, 10.4 % of the farms were in existence, of which 86.72% sourced for the market before harvesting while 13.28% did not. At a market distance of about 5 Km 14.3 % of the farms was represented of which 96.3 % sourced for the market, yet 3.7 % did not. Finally, for a distance of about 10 Km, 1.3% of the farms were represented and 97.2 sought the market before harvesting while 2.8 % did not.

From the trend it can be noted that the further the market was from the farm, a maximum of 97% of the farmers sourced for the market for the produce, the distribution of the market within the constituency is captured on the map on figure 3.2. Some of the farmers did not depend on the locals to make the purchases and looked for established fish mongers or hotels to make the sales. This improved the profit margins as some made purchases in terms of weight as opposed to selling per piece.

A Pearson's Chi-Square analysis was done between the current status of the farms with fish size met, availability of cold storage facility at the farm, ability to restock the farm after harvest, sourcing for a market of the produce before harvesting, taking into consideration distance of the farm from the market while pricing and value addition on fish harvested. Table 4.17 below provides a summary of the analysis done.

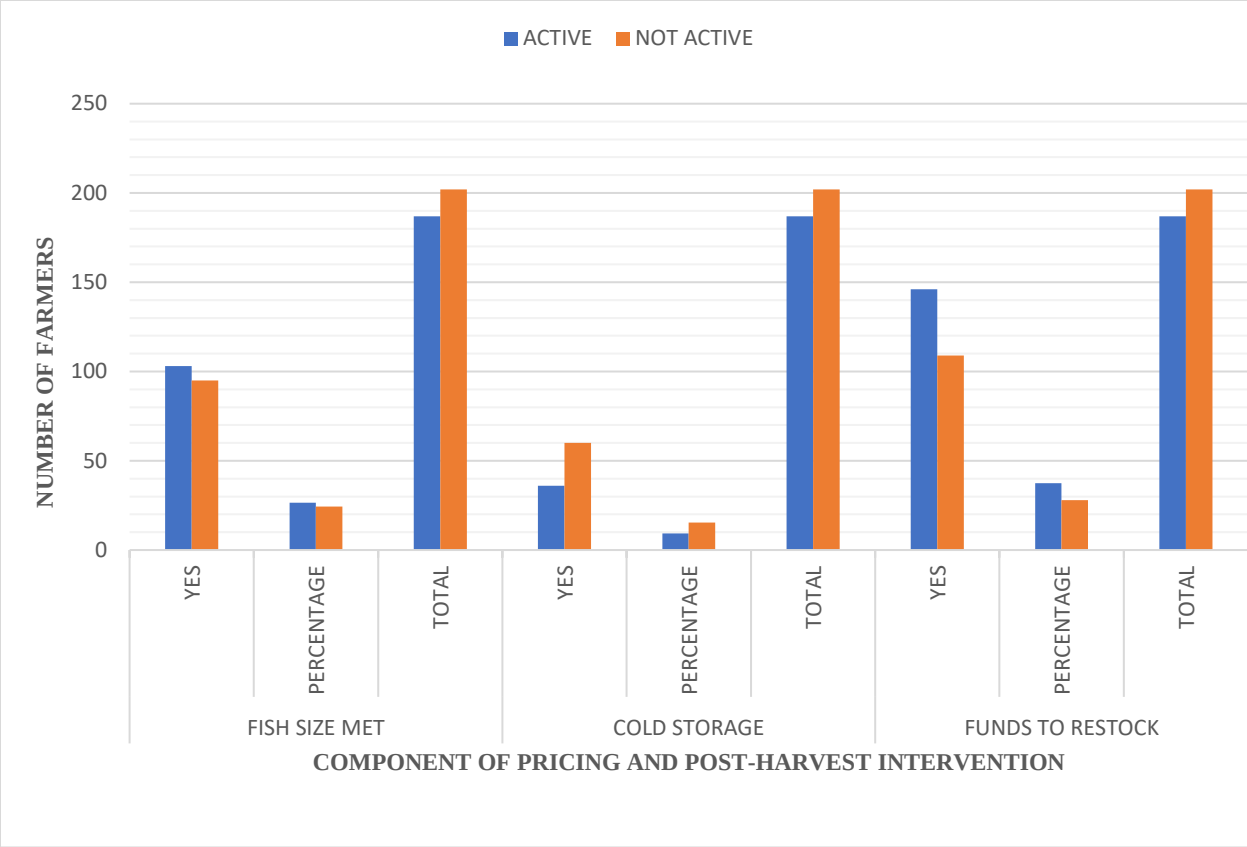


Figure 4.7 (a): ***Relationship between the Status of the farm and components of pricing and post-harvest interventions***

Figure 4.7 (a) provides results attained on factors put into consideration during pricing of fish after harvest. 26.5% (n=103) of the farmers (active) met the fish size required during harvest, 21.6% (n =84) did not meet the requisite fish sizes. The active farmers attained a chi-square value of 1.3, a critical value 3.841 at 0.05 confidence level. The status of the farm was independent of the pricing of fish through ability to meet the fish size. 24.4% (n = 95) of the farmers (not active) met the fish size required during harvest, 27.5% (n = 107) did not meet the requisite fish sizes. From the results the dropout farmers attained a chi-square value of 1.2, critical value 3.841 at 0.05 confidence level. The status of the farm was independent of pricing of fish through the ability to meet the fish size. Overall, 50.9% (n = 198) of the farmers met the fish size required during harvest, 49.1% (n = 191) did not meet the requisite fish sizes. A chi-square value of 2.5, critical value of 3.841 at 0.05 confidence level were attained. The status of the farm was therefore independent of establishing

fish size through the size met during harvest. This is because fish is sold based on the sizes harvested.

On availability of cold storage facilities, 9.3% (n = 36) of the farmers (active) had cold storage facilities at the farm, 38.8% (n = 151) did not have the storage facility. 15.4% (n = 60) of the farmers (not active) had fish storage facilities, 36.5% (n = 142) did not have a fish storage facility. Overall, 24.7% (n = 96) of the farmers had cold storage facilities at their farms, and 75.3% (n = 293) did not have a cold storage facility. The result indicated that very few farmers had cold storage facilities at the farms to ensure preservation of fish after harvest. This calls for the urgent sale of the product immediately after harvest to minimize losses. A chi-square value of 5.7, critical value of 3.841 at 0.05 confidence level were attained, an indicator that the status of the farm and pricing of fish are dependent on the farmer having a cold storage facility. In light of the above, it is prudent that farmers invest on cold storage facilities to provide sufficient time to negotiate for better pricing of the fish harvested.

A higher percentage of farmers at 37.5% (n = 146) of the farmers (active) had set aside funds for restocking, compared to 28.0% (n = 109) of the drop out farmers who budgeted for funds to re-stock. It was also noted that a lower percentage of drop out farmers at 23.9% (n = 93) compared to those of active farmers at 28.0% (n = 109) did not budget for funds to re-stock their ponds after harvest. In total, the percentage of farmers who responded to have properly budgeted funds for restocking the ponds stood at 65.6% (n = 255) against 34.4% (n = 134) who did. A chi-square value of 25.0, critical value 3.841 at 0.05 confidence level were attained. An indicator of dependence of the status and continuity of production at the farm to having a proper budget and plan for funds to restock the farms after harvest.

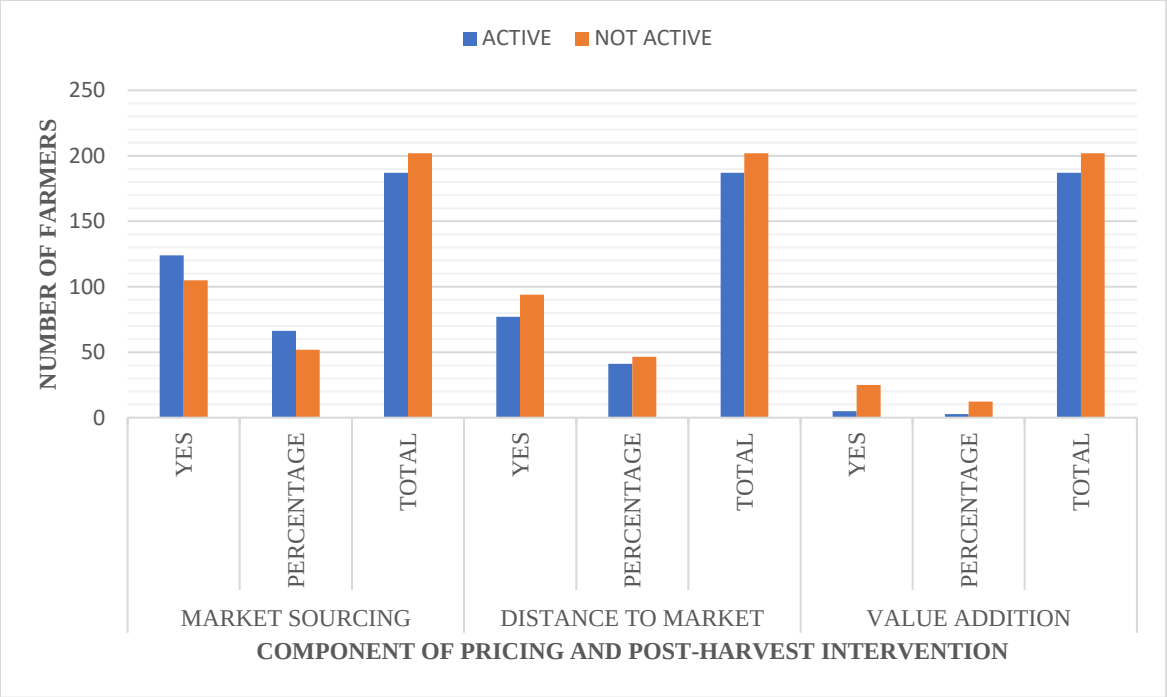


Figure 4.7 (b): ***Relationship between Status of the farm and components of pricing and post-harvest interventions***

From Figure 4.7 (b), 31.9% (n = 124) of the farmers (active) sourced for market for the fish before harvest while 16.2% (n = 63) did not source for market. The chi-square value for the active farmers was 4.3, critical value 3.841 at 0.05 confidence level. This showed dependence of status of the farms and setting fish prices to sourcing of its market before harvesting. 26.9% (n = 105), of the inactive farmers sourced for fish market while, 25.0% (n = 97) did not. The drop out farmers had a chi-square value of 4.0, critical value 3.841 at 0.05 confidence level. This also indicated dependence on the status of the farm on the sourcing for market during their time of activity. Overall, 58.9% (n = 229) farmers sourced for fish market before harvest while 41.1% (n = 160) of the farmers did not. The chi-square value for storage of fish was 8.2, critical value 3.841 at 0.05 confidence level. This indicated dependence of the status of the farm and pricing of fish products to sourcing of its market before harvest. Market for products sourced in advance provides the farmer with the power to negotiate for prices, plan for the nature of value addition to be done on the product based on the buyer's needs, minimize on costs on storage after harvest incase few buyers are realized for the product.

A lower percentage of farmers at 19.8% (n = 77) of the farmers (active) were affected by distance from the market in terms of pricing, compared to 28.3% (n = 110) who were not affected by the distance. It was also noted that a lower percentage of dropout farmers at 24.2% (n = 94) compared to 27.7% (n = 108) were affected by the distance from the market. Entirely, the percentage of farmers who responded to have been affected by the distance from the market in pricing of the fish products stood at 44.0% (n = 171) against 56.0% (n = 218) who were not affected. A chi-square value of 1.1, critical value 3.841 at 0.05 confidence level were attained. An indicator of independence of the status and pricing of fish products. This was addressed through online marketing of products through (WhatsApp, Facebook), use of mobile calls to network and call known customers on availability of products, ease of transportation of fish using motorbikes that can easily access the rural areas at lower cost.

Value addition was another component of pricing that farmers were interviewed. 1.3% (n = 5), of the farmers (active) did value addition to fish while 46.8% (n = 182) did not do any value addition. The chi-square value for the active farmers was 6.7, critical value 3.841 at 0.05 confidence level. This was an indication of dependence of status of the farm and pricing of fish products to value addition after harvest. 6.4% (n = 25) of the farmers (inactive), did value addition, while 45.5% (n = 177) of the farmers did not. The chi-square value for the drop out farmers was 6.2, critical value 3.841 at 0.05 confidence level an indication of dependence of pricing to value addition. Overall, 7.7% (n = 30) of the farmers performed value addition, 92.3% (n = 359) did not. The chi-square value attained was 12.8, critical value 3.841 at 0.05 confidence level. This indicated dependence of status of the farms and pricing of fish product to performing value addition of the products after harvest. Most farmers however stated that due to the high demand for fresh fish products led them not to do value addition. The farmers who did value addition lacked storage facility for the product in order to minimize on loss of the harvested fish product through spoilage.

Research done by Adrien (2015) found out that the attempt to promote sustainable small-scale farmers in the context of food security and poverty eradication in Kenya, numerous post-harvest management interventions (innovations) have been made by government development partners and stakeholders. Nonetheless high post-harvest losses are still reported against the sectors framework in post-harvest management (innovations) aimed at reducing losses and in boosting food security and poverty eradication. Similar findings were found in the study that despite

capacity building on value addition and use of cold storage facilities there was a significant drop on farm production levels.

The challenges enumerated by the farmers during the study concur with those of Macharia and Njagi (2020) who found out that in Kenya major challenges of fish post-harvest handling includes lack of infrastructure at the farms for fish preservation, lack of nearby markets and the remoteness of the production areas, in most of the scenarios fish drying often occurs on the bare ground where the product is exposed to soil, bacteria and birds and poor market linkages between production and marketing sites. The study findings are in line with that of Kolding et al (2016), done in some sub-Saharan countries (Ghana, Kenya, Mali, Tanzania and Uganda) which show that substantial losses in small-scale fisheries occur at all stages after harvest including during distribution and utilization from capture to consumption. In light of this more emphasis should be placed on capacity building in post-harvest management of fish. Different stakeholders should come forward to fund the farmers in order to acquire cold storage facilities, and support in finding markets for value-added products as opposed to the current existing local market of fresh fish. From the study therefore, there is a need to adopt the views made by FAO (2015), that the perishable nature of fish requires special attention to handling, grading and packing and the market price is usually dependent upon the quality of fish. Market considerations differ from country to country, region to region and have close connections with food habits and consumption patterns. The main objectives of value chain management are to maximize profit and long-term sustainability.

Intensive fish farming requires considerable financial and physical commitment. This therefore means that, farmers must adequately plan on how to market and set prices for the produce after about six to eight months of strict farm management. The major items that farmers were trained and capacity developed on as per the guidelines provided by ESP, were marketing for the product, setting up competitive prices from the product, proper storage of the produce and value addition of fish to enable the farmer to maximize the returns. The pricing of a product is determined by interaction of supply and demand in competitive markets. The cost of production must be recovered at the very least to make a profit (Hishamunda et al, 2017). In light of this that due consideration of competitors' price and in this case, the price of fish from the lake.

Hishamunda et al (2017) further write that a good marketing plan should identify distance between markets, market accessibility, transportation costs and historical prices paid among other factors. Poor or selective implementation of these factors may have led to challenges faced by the farms during the harvest and selling of the produce. However, the findings from the farmers in Kisumu West constituency contradict distance from the farm to the market as a challenge leading to dropout in farming. The findings of the study are also contrary to a report by WHO (2013) on fish farming projects in South Imenti Constituency, Meru county in Kenya, which state that most aquaculture farmers were adequately equipped with technical skills required for fish management, handling and storage. The training and refresher training was undertaken in collaboration with the Ministry of Education. A majority of the farmers also felt that field visits by the extension fisheries officer provided continuous technical know-how to farmers. The report summarizes that aquaculture as projected created employment and boosted income however, due to a lack of storage facilities for the harvested fish the venture did not turn out to be a high-income earner as expected.

4.4.2 Post-harvest management skills versus income earned

The main objective for any business enterprise is for the entrepreneur to generate some income. ESP was established to jumpstart the economy from the low economic growth that was evidenced after the 2007/2008 post-election violence.

Table 4.14: ***Preferred mode of selling fish***

MODE OF SELLING		YES	Percentage	TOTAL
PER KG	**COUNT**	4	5.26	**76**
PER PIECE	**COUNT**	74	97.34	**76**

Table 4.14 shows the mode farmers who harvested their produce in the last one year preferred to sell the produce. 5.26 % is priced per kg while 97.34 priced per piece. Pricing per piece was preferred by locals who buy the produce per piece based on size. Fishmongers who are also key players in the market made purchases based on size per piece than a measure in kilograms.

Based on the most utilized mode of selling the fish harvested, the following table provides a summary of earnings made from the venture by farmers in Kisumu West Constituency in the last year.

Table 4.15: ***Income earned from pond farming***

SOURCE OF CAPITAL	ESTIMATED INCOME EARNED (KSH.)
ESP	1,224,400.00
PERSONAL	2,875,500.00
SACCO/GROUP	812,500.00
ESP & PERSONAL	824,400.00
PERSONAL & SACCO/GRP	5,000.00
TOTAL	5,741,800.00

From table 4.15 the lowest price charged per piece of fish was KES 5.00 and these were mainly sold in batches based on the size. The highly priced fish at the farm retailed for KES 450.00 per piece. About 37,970 pieces of fish harvested within the period netted a gross income of KES 5,741,800.00. This provided an average of KES 151.20 per piece. It can be observed that farms with sources of funding as personal finance earned an income almost twice as those financed through ESP and this could be attributed to better technical and post-harvest management skills. According to Mwatsuma et al (2012) in relation to development of the enterprise in the world, fish culture has proved successful in improving standards of living of rural farmers in Asia, where fish culture has a long tradition. From the report, observations made in Asia and the relationships noted between the status of the farms and the various components of post-harvest management skills, if aquaculture is well managed then it is a profitable venture that could aid in the achievement of the objectives of Vision 2030.

Luntao (1990) states that any business large or small, public or private should maintain an efficient record-keeping system. All business transactions should be recorded in full on paper. Input records should include variable inputs or costs which vary with the level of production such as fingerlings, feeds, fertilizer, labour and pesticides. Output records should show detailed information on date of harvesting, species harvested (with their amount and unit price) and the disposition of the products. Gross revenue should include cash and credit sales of the products and the imputed values of the quantities consumed on the farm. Many businesses fail because of inadequate record-keeping.

Most of the farms visited had no records kept to show history and production trends at the farm over time. Based on this most of the farmers were not able to quantify the levels of profits or losses made. Some of the ESP-financed farms did not find a justification for the records since all the funding came from the government. The lack of trail of performance of the farms justifies the level of dropout and decline in the performance of the farms. In management perspective in the absence of the records, the extension officers and farm managers will be constrained to identify areas of challenge early and prescribe workable interventions. The study results are in line with that of Macharia et al (2020) stating that in Kenya, the major challenges of post-harvest handling of fish include a lack of infrastructure at the farms for fish preservation, lack of markets and the remoteness of production areas. The results are in tandem with that of Rutaisire et al (2009), who state that there exists need to create effective organizations that can link producers with markets for aquaculture to grow and meet current and future fish demands. The organization should develop systems and infrastructure for transportation to markets, sale of produce from the farms and information sharing and gathering among farmers.

CHAPTER 5: SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary

5.1.1 Resource mobilization and aquaculture production.

Comparison taken between ESP-financed farms and other sources of capital showed that ESP aquaculture farms registered a significant number of dropout farmers due to low fish production. Sacco/Group financed projects were best sustained aquaculture projects. There was evidence of inequitable distribution of resources earmarked by the government for the ESP. This led to farmers dropping out and others sourcing for other forms of funding to ensure success of the entrepreneurship.

The production level of farms with ESP as source of funds were affected by among others diversion of funds earmarked for the projects. This was exhibited when farmers do not receive all the forms of financing as allocated for by the Government which included pond construction, feeds purchase, issuance of 15Kg fertilizer, training, issuance of 1000 fingerlings per pond and issuance of a pond liner. A participatory approach in planning and management was not put into practice to ensure proper project beneficiary needs assessment was achieved. A results-based management approach should have been utilized to establish a process and environment where individuals work together to accomplish expected goals of ESP.

Personal financed farms presented notable production level in terms of both the number of pieces and weight of fish harvested. This was evidenced through the commitment of the farmers in the process and lack of dependency on the government-distributed resources. The ESP financed farmers raised concerns on delays in receiving feeds and fertilizer. The farmers only received 2 Kg of fertilizer as opposed to the expected 15 Kg. However, fertilizer was an essential ingredient in raising fish leading to low pond production. This showed below average government resource mobilization and distribution to the farmers to ensure sustainability of the projects.

There was a strong positive correlation between active farms and the number of pieces harvested and a weak relationship between inactive farms and the number of pieces harvested. This was an indicator poor pond production would leader to farmer drop out. Similar correlation was evidenced

between pond activity and the weight of fish harvested, signaling that fish feeding is an essential requirement at the farm.

The number of employees played an important role towards the realization of a higher pond production. Nevertheless, most of the ESP-financed farms did not employ skilled employees to oversee the daily farm activities. Casual labour was only sourced for during harvest and pond construction. This did not satisfy the goal of ESP on improving the rural economy through direct and indirect employment of the youth and women.

5.1.2 Farmer acquisition of pond management skills and farm status.

Capacity building by the department of fisheries and other stakeholders was done to aquaculture farmers covering the following areas predator identification and management, water source management, early fish disease detection, fish feeding program, record keeping, fish pricing, fish storage, and value addition.

Predation and theft remained a major challenge to aquaculture in the rural areas. Farmers cited predation as a major challenge to farm production. For sustainability of aquaculture, farmers should be consistently trained and guided by extension officers to handle emerging challenges.

Farm status whether active or not active was dependent on the components the farmers were trained on, apart from water source management which showed some independence. An indication that farmers should therefore be consistently trained on pond management skills.

Farmers cited minimal to no contact with the extension officers as the course of dropout from the trade. Since they could not handle the emerging pond management challenges experienced at the farms. Aquaculture stakeholders took part in training and capacity-building of farmers on pond management skills required to enhance pond production. Department of fisheries took a lead role followed by the Lake Basin Development Authority. Pioneer farm though a private enterprise was instrumental in addressing challenges faced by farmers in the aforementioned neighborhood. However, KMFRI with a regional office established within the constituency with the highly skilled resource in aquaculture did not participate in capacity building of aquaculture farmers. Extension officers cited lack of sufficient funding to en able them engage farmers within the constituency.

5.1.3 Post-harvest interventions and income earned.

Fish pricing after harvest did not entirely depend on the prices at the lakeshore. Close to half of the farms did not sell their produce depending on the lakeshore prices, due to the small fish size realized in a majority of the ponds harvested and the lack of cold storage facilities. As the distance from the market amplified, a significant number of farmers sourced for market for the produce before harvesting day.

The current farm status and pricing of fish harvest displayed a significant relationship with post-harvest interventions including the ability of farmer to own a cold storage facility, ability to restock the pond after harvesting, sourcing for fish market before harvesting, and performing value addition on the fish harvested. However, the farm status and pricing of fish harvest was independent of meeting the fish size demanded and the distance of the farm from the market. Therefore, farmers should be trained more on marketing and value addition.

Stakeholders should support farmers in owning cold storage facilities. It was noted that most of the farmers did no value addition due to high demand for fresh fish in the local market. Therefore, related stakeholders should create linkage with external market for value added products to ensure farmers attain better prices resulting to higher incomes earned.

Farmers preferred selling their harvest per piece, due to lack of cold storage facilities and resources to do value addition on the fish harvested. Small fish sizes harvested was attributed to lack of appropriate pond management skills thereby farmers fetched low income earnings from the investment. The income realized was consequently not sufficient to restock the ponds with fingerlings after harvest leading to farmer drop out. More than two thirds of the farmers demonstrated positive interest in continuing with aquaculture in future despite the current diminishing earnings from the trade.

5.2 Conclusion

Aquaculture is a capital-intensive venture that requires prudent resource mobilization. Drop out farmers were evident on the ESP financed farms due to lack of sufficient resources to run the farms. Funding through ESP was not done to all the components envisaged propping up challenges to the farmers. This was established when farmers put in additional resources from their personal savings to ensure the projects were a success.

Acquisition of production management skills was fundamental in realization of commercialized aquaculture as envisaged by the establishment of ESP.

Averagely more than half of the farmers were trained on pond management skills at the initiation point of the projects. Pond management skills that include predator identification and management, early fish disease detection, fish feeding program, records keeping, pricing of fish, storage and value addition showed a significant relationship with production of the aquaculture farms.

Post-harvest interventions should be well planned for in advance to achieve competitive pricing of the fish products. Proper record keeping, ability to raise funds to restock the farms, competitive pricing of the fish products and value addition are core factors to sustainable performance of the farms.

Based on the findings and discussions if farmers managed aquaculture as business enterprises it could afford employment opportunities and source of income to both youth and women in the rural areas. Both the National and County Governments can revamp the ESP established projects by ensuring the farmers are clustered regionally into smallholder groups to facilitate ease of training and visit by extension officers. The groups can act as suitable avenues for marketing and value addition of the fish products. The production management skills if accurately implemented, then ESP-funded aquaculture will accomplish the core objective of improved economic status of the rural based entrepreneurs and consequently the country's economic growth.

The study has clearly shown the importance of farmer needs analysis done before project inception to ensure sufficient resources are provided to sustain the venture. Clear relationships have been created on importance of farmer acquisition of pond management skills to ensure farms in rural areas attain maximum productivity. There is need to improve on value addition and provision of

cold storage facilities to pond farmers to improve farmers income. Farmers should be adequately trained on how to keep good business records to track expenses and income.

Training should be done on fish pricing to ensure farmers maximize on profitability.

5.3 Recommendations

(i) ESP capitalized ponds evidenced high farmer drop out and low pond production compared to the privately financed farms. In light of this farmers should be trained on shrewd resource mobilization skills. Future capitalization of the aquaculture smallholder farms should be modelled with a percentage of farmer contribution to the enterprise. The involved stakeholders should ensure resources reach the targeted beneficiaries in full and at the right time. This will realize project effectiveness and efficiency in attaining its objectives.

(ii) Development of aquaculture best production management practice and farmer training program that should be implemented across the constituency to provide consistent information delivery and continuous feedback mechanism. The department of fisheries if not well-resourced in form of manpower should professionally engage other relevant stakeholders for support in training and delivery of refresher courses on production management skills to both extension officers and the farmers.

(iii) To commercialize aquaculture innovative post-harvest interventions should be put in place. This would support the farmers in pricing, marketing and performing value addition to the fish products. There should be engagement of various stakeholders to create external markets (export) of value-added fish products, fund purchase of cold storage facilities and provide capacity building on budgeting and planning for business continuity after every harvest. Post-harvest intervention innovations should be supported by a monitoring and evaluation system, incorporating stakeholders' feedback to deal with emerging issues in the adoption of such innovation.

5.4 Recommendations for future research

- Further research is recommended on effect of management skills on status of cage fish farming in Lake Victoria.
- Further research should be done on developing a computer-aided app that maps out the farms and provides features for feedback mechanisms.

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APPENDICES

Appendix 1: Farmer questionnaire

Dear Respondent,

I am a student at Maseno University pursuing a Master of Arts degree in Project Planning and Management. This survey will be done to establish the effect of farmer production management skills on ESP financed aquaculture projects in Kisumu West Constituency.

The information you will provide during the survey will be confidential and used towards academic research only.

Any questions that you feel uncomfortable to respond to, can be ignored during the survey.

However, your honest feedback will be beneficial towards achieving the objectives of the study.

Effect of farmer production management skills on status of economic stimulus aquaculture projects in Kisumu West Constituency, Kisumu County

Section A: Background Information

1 (a) Sex of respondent

Male	1	
Female	2	

a) Age……..

b) Marital Status

c) Level of Education

None	1	
Primary	2	
Secondary	3	
College	4	
University	5	

d) How many employees are on the farm (including you)……

e) Fill in the following details on the employees at the farm

No.	Employees		Employee Monthly Salary			
	Sex	Age	2000	2000 - 5000	5000 – 10,000	10,000+
1						
2						
3						
5						
6						
7						
8						

SECTION B: Resource mobilization and production of aquaculture.
Tick the appropriate response:

1. What is your current status in fish farming?

   ( ) Active ( ) Not active

   a) If not active, why did you discontinue? .....

   b) If active how many ponds do you own? .....

2. When did you start fish farming? .....

3. What was the source of your initial capital? (Tick more than one if multiple)

( ) ESP ( ) Personal Savings ( ) Chama/Sacco Loan ( ) Bank Loan

(i) If financed by ESP, what form of financing did you receive?

4. Which species of fish do you deal in

( ) Tilapia ( ) Catfish ( ) Other (specify)……..

5. How many ponds do you harvest per year?

6. How many times do you harvest fish in a year?

7. How many pieces of fish did you harvest in the last one year?

8. If the quantities harvested differ with fingerlings stocked, in your opinion, what causes the difference?

9. What is the average total weight per harvest in the last year?

10. How do you sell the fish? (Can tick more than one response)
    Per Piece Per Kilogram
11. How much do you sell per piece/per kilogram?

12. What form of financing did you receive from ESP? You can choose more than one
( ) Pond construction ( ) Feeds purchase ( ) Fertilizer ( ) Training ( ) Fingerlings ( ) Pond liner

13. How long do you take to re-stock your pond with fingerlings after a harvest?

14. Do you re-stock your pond based on income earned from the previous harvest?

If No, how do you raise the funds to re-stock your pond(s)?

SECTION C: Farmer acquisition of pond management skills and farm status.

15. How frequently are you trained on pond management skills?

16. Who offers the training?

17. Which areas have you successfully been trained in related to fish farming? tick (√) more than one if applicable.

Predator identification and management	Water source management	Early fish disease detection and treatment	Fish feeding program	Record keeping	Fish pricing	Fish storage	Fish value addition

18. How often do extension officers visit your farm?

19. During the visits are all the issues adequately addressed by the extension officers?

20. If No in (19) above, then which areas do they have a challenge in handling?

21. How do you handle the challenges not addressed by the extension officer?

Section D: Post-harvest interventions and income earned

22. What is your pond percentage of number of fish harvested in relation to fingerlings stocked ……..

23. How do you price your fish products? .....

24. Do you source for fish market before harvesting?

25. How far from your farm is the fish market, does it affect your net income?

26. Do fish prices at the lake landing sites determine your selling price?

27. Do you meet the fish size demanded by the market from your pond?

28. How long does it take to attain the required fish size?

29. Do you own a cold storage facility? YES/ NO…….

30. After fish harvest do you undertake any value addition? YES/NO……

31. If YES in (l) above, which type of value addition?.....

32. From your current experience in aquaculture, what are your future plans for the activity?

( ) Continue at the current level ( ) Construct more ponds ( ) Reduce restocking level ( ) Increase stocking Level ( ) Discontinue

Appendix 2: Key Informant Interview Schedule – Kisumu West Sub-County Fisheries Department

I am a student at Maseno University pursuing a Master of Arts degree in Project Planning and Management. This interview will be done to establish the effect of farmer production management skills on economic stimulus aquaculture projects in Kisumu West Constituency.

The information you will provide during the survey will be confidential and used towards academic research only.

Any question that you feel uncomfortable responding to can be ignored during the survey.

However, your honest feedback will be beneficial towards achieving the objectives of the study.

1) What is your current role? ……
2) How long have you worked in the current position? ……
3) What is the current uptake of aquaculture in your area of operation
   ( ) Exceptional ( ) Above Average ( ) Average ( ) Below Average ( ) Poor
4) How do you rate the growth of aquaculture in your area of operation?
   ( ) Exceptional ( ) Above Average ( ) Average ( ) Below Average ( ) Poor
5) What are the major factors that affect the performance of aquaculture in your area of operation?
6) What support do they give to the aquaculture farmers
   ( ) Financial ( ) Training ( ) Extension Services ( ) Other, Specify …….
7) How often do you visit fish farms in your area of operation?
8) What are some of the challenges you face during your farmer visits?
9) What level of training have you acquired in aquaculture?
10) In your opinion have the farmers acquired management skills to commercialize aquaculture?
11) If No, in (10) above what are the specific challenges?
12) What are your suggestions in enhancing the performance of aquaculture in your area of operation?
13) What criteria did you use to get eligible aquaculture farmers to enlist in the project?
14) During the process of enlisting farmers, was farmer income level a major factor of consideration?
15) If Yes in (14) how has this affected pond production?

Appendix 3: Key Informant Interview Schedule – LBDA, Kisumu

I am a student at Maseno University pursuing a Master of Arts degree in Project Planning and Management. This interview will be done to establish the effect of farmer production management skills on economic stimulus aquaculture projects in Kisumu West Constituency.

The information you will provide during the survey will be confidential and used towards academic research only.

Any question that you feel uncomfortable responding to can be ignored during the survey.

However, your honest feedback will be beneficial towards achieving the objectives of the study.

1) What is your current role? ……
2) How long have you worked in the current position? ……
3) What is the current uptake aquaculture in your area of operation?
   ( ) Exceptional ( ) Above Average ( ) Average ( ) Below Average ( ) Poor
4) How do you rate the growth of aquaculture in your area of operation?
   ( ) Exceptional ( ) Above Average ( ) Average ( ) Below Average ( ) Poor
5) What are the major factors that affect the performance of aquaculture in your area of operation?
6) What support do they give to the aquaculture farmers
   ( ) Financial ( ) Training ( ) Extension Services ( ) Other, Specify …….
7) How often do you visit fish farms in your area of operation?
8) What are some of the challenges you face during your farmer visits?
9) What level of training have you acquired in aquaculture?
10) In your opinion have the farmers acquired management skills to commercialize aquaculture?
11) If No, in (10) above what are the specific challenges?
12) What are your suggestions in enhancing performance of aquaculture in your area of operation?

Appendix 4: Key Informant Interview Schedule – KMFRI, Kisumu

I am a student at Maseno University pursuing a Master of Arts degree in Project Planning and Management. This interview will be done to establish the effect of farmer production management skills on economic stimulus aquaculture projects in Kisumu West Constituency.

The information you will provide during the survey will be confidential and used towards academic research only.

Any question that you feel uncomfortable to respond to can be ignored during the survey.

However, your honest feedback will be beneficial towards achieving the objectives of the study.

1) What is your current role? ……
2) How long have you worked in the current position? ……
3) What is the current uptake of aquaculture in your area of operation
   ( ) Exceptional ( ) Above Average ( ) Average ( ) Below Average ( ) Poor
4) How do you rate the growth of aquaculture in your area of operation?
   ( ) Exceptional ( ) Above Average ( ) Average ( ) Below Average ( ) Poor
5) What are the major factors that affect performance of aquaculture in your area of operation?
6) What support do they give to the aquaculture farmers
   ( ) Financial ( ) Training ( ) Extension Services ( ) Other, Specify …….
7) How often do you visit fish farms in your area of operation?
8) What are some of the challenges you face during your farmer visits?
9) What level of training have you acquired in aquaculture?
10) In your opinion have the farmers acquired management skills to commercialize aquaculture?
11) If No, in (10) above what are the specific challenges?
12) What are your suggestions in enhancing performance of aquaculture in your area of operation?

Appendix 5: Observation checklist

I am a student at Maseno University pursuing a Master of Arts degree in Project Planning and Management. This survey will be done to establish the effect of farmer production management skills on economic stimulus aquaculture projects in Kisumu West Constituency.

The information you will provide during the survey will be confidential and used towards academic research only.

Any question that you feel uncomfortable to respond to can be ignored during the survey.

However, your honest feedback will be beneficial towards achieving the objectives of the study.

No.	Criterion	Y	N	Observation
1.	The existence of a fish pond at the farm.			
2.	If the pond exists is there signs of live fish within the pond, estimate numbers.			
3.	Who is highly involved in the family in running the farm operations?			
4.	The farmer has records showing those who have visited the farm.			
5.	The farmer has records of farm operations.			
6.	The farm has a general layout of a well-managed farm.			
7.	Existence of security measures put in by the farmer at the pond.			
8.	Signs of fish harvest done at the farm.			
9.	The farmer does value addition at the farm.			