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Research Paper

Status of Socio-Economic Parameters of Fish Farmers in Kitui Central Sub-County, Kitui County

*Joyce M. Nzevu[1], Dorothy A. Amwata[2]. Amos K. Mutua[3]
1. Department of Dry land Agriculture, South Eastern Kenya University, Kenya.
2. Department of Range and Wildlife sciences, South Eastern Kenya University, Kenya.
3. Department of Fisheries Management and Aquaculture Technology, South Eastern Kenya University.
Correspondence to: Joyce M. Nzevu

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ABSTRACT: *Fisheries are a significant sector to the national and household economies in Kenya. The Kenya government initiated the economic stimulus program (ESP) in 2010 to help aquaculture projects in order to jump start the economy by providing food and income to the rural inhabitants as a way of eradicating poverty and creating jobs to the poverty stricken areas. However, there is little information on the socio-economic factors of the farmers adopting the fish farming that may influence the adoption of fish farming in Kitui Central sub-county. Therefore, the researcher carried out this study to determine the status of the significant socio-economic factors of the fish farmers in the Kitui Central Sub- County, Kitui County. A sample of sixty (60) fish farmers were used from the targeted 200 fish farmers who benefitted from the government ESP support. Semi structured questionnaires were used to collect primary data that was analyzed usingExcel and Statistical Package for Social Sciences (SPSS) version 22. The study revealed that 70.4% of fish pond farmers abandoned their pond with only 29.6% functional. The chi-square (χ^2) test has showed a significant difference between the male and female adopters of the fish farming. Further, Chi-square (χ^2) test established a significant difference between the levels of education of these fish farmers. The majority (57.4%) of fish farmers had no access to quality fingerlings compared to farmers (42.6%) who had access to quality fingerlings for their fish farming. In addition, the Chi-Square (χ^2) test established that there was very significant difference between fish farmers with and without access to quality fingerlings. This study presents lessons from farmers who are attempting to eke out a livelihood from small scale fish farming with or without government support. It illustrates some of the successes and challenges of the activity and offers insight to future fish farming success for farmers willing to attempt it. To the existing farmers it provides an eye opener on their weaknesses. This research will enable the government, other development partners to get information to help them make informed decisions in future and refocus on how best to support the fish farming industry for sustainability.*

KEY WORDS*:* Economic Stimulus Program, Aquaculture, Adoption, Gender

I. INTRODUCTION

Fish farming improves the lives of its citizens through enhancing the sectors' contribution to wealth creation, increased employment for youth and women, food security and improves the economy through foreign exchange earnings of fish exports (ESP, 2009). Aquaculture is of increasing importance globally, and plays an important role in global food security. It is the fastest food growing production system globally, with an increase of 8.8% in production of animal products per year since 1995 (FAO, 2007. Aquaculture was introduced to sub-Saharan Africa in the 1950s' with the main objectives of improved nutrition in rural areas, generation of additional income, diversification of activities to reduce risk of crop failures and the creation of employment in rural areas (Hecht, 2006) In some countries in Sub-Saharan Africa, growth has been held back by persistent bottlenecks such as access to good-quality feed, seeds and market. However, Africa governments have demonstrated increasing support for aquaculture, presumably anticipating benefits for economic growth, food supply and security as well as in the form of poverty alleviation (FAO, 2010). In addition, about 43% of African continent has the potential for Tilapia, African Catfish and Carp culture (Ridler and Hishamunda, 2001)

Fish farming was first begun in Kenya by colonists in the early 1900 through the introduction of trout in rivers for sport fishing (Ngugi et al., 2007). This progressed into static pond culture of species such as Tilapia, Common carp and Cat fish in 1920s' (Maaret al., 1966). According to Ngugi et al., (2007), the government popularized fish farming in 1960s' through the "eat more fish campaign", as a result fish farming spread in many parts of Kenya including areas of non-fish eating communities. However, the number of productive ponds declined in 1970s' mainly because of inadequate extension services, lack of quality fingerings and insufficient training for extension workers. Until mid-1990s' fish farming in Kenya followed a pattern similar to that observed in many African countries which is characterized by small ponds, subsistence level of management and very low levels of production (Ngugi et al., 2007) The Kenyan aquaculture industry has seen slow growth for decades until recently, when government funded Economic Stimulus Program (ESP) that increased fish farming nationwide..

The ESP coordinated by the ministry of fisheries development was introduced through the 2009/2010 budget with the aim of stimulating the long term growth and development of Kenya's economy through rapid creation of business opportunities and jobs (MoFD, 2010). The program focused on sectors of the Kenyan economy that would generate maximum benefits, restore confidence and assist the business community, while protecting the livelihood of the poor and creating jobs to the youth (GoK, 2009). This program had key objectives of boosting the country's economic recovery as well as returns the economy to the envisioned medium term growth plan. The program invested in long term solutions to the challenges of food security, expanding economic opportunities in rural areas for employment creation and promoting regional development of equity and social stability (Manyala, 2011).

Under the ESP, large investments were undertaken in 27 key sectors of the economy, fisheries/aquaculture being one of them. According to a study conducted by Mwangi (2008), the government has taken keen interest in fisheries due to its potential and has given it the priority it deserves. His sentiments are confirmed by the government's incorporation of fish farming in the ESP to help jump start the economy by providing food and income to the rural inhabitants eradicating poverty and creating jobs to the poverty stricken areas (GoK, 2009). The program targeted areas with high population, small farmland and mass poverty with low incomes and fluctuating farm productivity but with water available to sustain the program.

In 2010, the ministry of fisheries development rolled out the Fish Farming Enterprise Productivity Program (FFEPP) under the ESP and the Economic Recovery Poverty Alleviation and Regional Development Program (ERPARDP). Phases1 and 2 of the FFEPP were implemented in 2010 under the ESP and ERPARDP respectively (Maina et al., 2014).The main activity of both phases was to establish fish ponds in selected regions in the country in order to promote commercial aquaculture. This was executed through the provision of extension services where farmers were trained in order to improve nutrition, alleviate poverty and create over 120,000 employment opportunities (TISA, 2010). Two hundred fish ponds were constructed for 140 selected political constituencies (Charo, 2012) at an estimated cost of Kshs. 1.12 billion (Kshs 8 million per constituency), GoK, 2012). During the second phase 2011/2012 financial year, additional 100 fish ponds were added to each of the first 140 constituencies and an additional 20 new constituencies benefited with 300 fish ponds each making a total of 48,000 ponds countrywide.

Fish farming in Kitui County begun in 1980s' but on extensive levels whereby the fish farmers did very little in terms of pond management practices, Mutambuki, (2011). When the government introduced fish farming in over 140 constituencies in Kenya under ESP, farmers in Kitui County particularly Kitui Central Sub-County jumped at the offer in what promised to revolutionalize fish farming which has been a sojourn of trials and error over many years in the area. The first phase of ESP (2009/2010) was implemented through the Ministry of Agriculture under the Kitui district fisheries department currently the Kitui County fisheries department Two hundred farmers were identified as beneficiaries in Kitui central Sub-County. Fish farmers who were selected as beneficiaries were funded with Kshs. 40,000 to construct a pond, provided with 1000 fingerlings of monosex tilapia per fish pond and 15kg of fish feeds. Ponds were dug by the willing youth within the benefiting constituency.

Despite the government's effort to promote aquaculture, the projects did not perform as expected, and most farmers in Kenya and Kitui region slowly adopted the fish farming projects. In addition, not all fish ponds constructed were stocked with the 1000 tilapia fingerlings. The beneficiaries of the project had the responsibility to purchase and install the polythene pond liners; some of the farmers were not able to meet these requirements by the time the ESP program funding come to close, Musyoka and Mutia, (2016). There are many cases where farmers eventually abandoned their ponds even before the first harvest. Mwamuye et al., (2012) and 4Munguti et al., (2014) found out that, most farmers who are still holding on to the venture are yet to realize their returns due to challenges they are faced with. This was the case in Kitui Central sub-county, where many of the fish ponds that were initiated under the ESP are being abandoned or have been abandoned, while other ponds have a low output in terms of harvest That notwithstanding, very little has been done to establish the status of fish

*Corresponding Author: *Joyce M. Nzevu*

Department of Dry land Agriculture, South Eastern Kenya University, Kenya.

farming in Kitui, Central Sub-County It is against this backdrop that a study was conducted in order to investigate the factors influencing fish farming in Kitui Central sub-county Kitui County and establish why this initiative on fish farming has suffered from slow adoption and non-sustainability

II. MATERIALS AND METHODS.

2.1 Study Area

The research was carried out in Kitui Central sub-county,Kitui County. The study population included fish farmers who benefitted from the ESP of the governments undertheFish farming Enterprise and Productivity Programme(FFEPP).

Kitui County is situated in the former Eastern province of Kenya and borders TaitaTaveta County to the South, Makueni County to the West, Machakos to the North West, Tana River to the East,andEmbu and TharakaNithi to the North. The county has eight sub-counties namely: Kitui Central, Kitui South, Kitui East, Kitui Rural, Kitui West, Mwingi North, Mwingi West and Mwingi Central.

Kitui County covers an area of 3057.30Km^2 of which 6369 Km^2 is occupied by Tsavo East National Park(Kitui County Integrated Development Plan, 2013-2017).According to 2009 population censusithas a total population of 1,012,709 comprising of 205,492 households (KNBS, 2009).The human population growth rate is 2.1% (MOLFD, 2013).In addition, the Kitui County has high poverty levels (63%) and high age dependency ratio of 100:1089 .This necessitates the need for various livelihood support activities, like introduction of aquaculture under ESP to alleviate this high poverty levels and households to have economic gains from aquaculture.

The local people depend mostly on rain fed agriculture mainly crop farming of maize and small scale mixed farming of maize beans, millet, vegetables, dairy farming, poultry farming and fish farming. The government introduced ESP aquaculture project aimed to improve nutrition, alleviate poverty and create over 120,000 employment opportunities (TISA, 2010) to poverty stricken areas in Kenya, like Kitui County.

Figure 1: Map of Kitui County showing various sub-counties

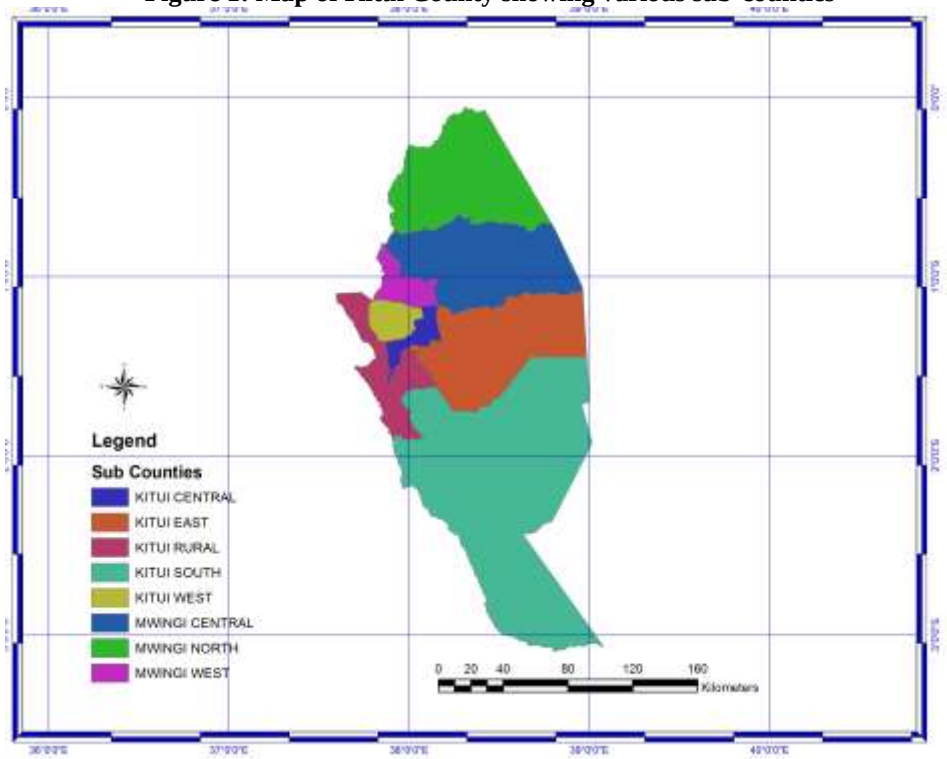

Figure 1: Map of Kitui County showing various sub-counties

Source: Author: 2017

Kitui Central sub-county, where this research was done has five political wards namely; Miambani, Township, Kyangwithya West, Mulango and KyangwithyaEast.Kitui Central sub-county has a total population of 131,715 as follows: Miambani (22,164), Township (26, 016), Kyangwithya West (22, 121), Mulango (28, 573) and Kyangwithya East (32, 841. (Kitui County Integrated Development Plan 2013-2017).The local inhabitants are mainly the Kambacommunity. The main economic activities are agriculture mainly crop farming

*Corresponding Author: *Joyce M. Nzevu*

Department of Dry land Agriculture, South Eastern Kenya University, Kenya.

of maize and small scale mixed farming of maize ,beans, millet, vegetables, dairy farming, poultry farming and fish farming.

The study area was chosen for thisresearchbecauseKituiCentral sub-county has the highest concentration of fish farmers in KituiCounty. Therefore results of this study will be helpful to the farmers who are trying to eke their livelihoods in fish farming. In additionKituiCentral,Mutito hills and YattaPlateau. Receive more rainfall than the other parts in the county, this is attributed to their high altitude between 600m and 900mthe, rainfall pattern is bi-modal with long rains in March to May, which is usually very erratic and unreliable. Short rains occur in October to December and are more reliable with average annual rainfall of between 200mm and 600mm and mean monthly temperatures of between 19 and 35^0C (MoLFD, 2013).rainfall is the main source of water for all aquatic organisms like fish.

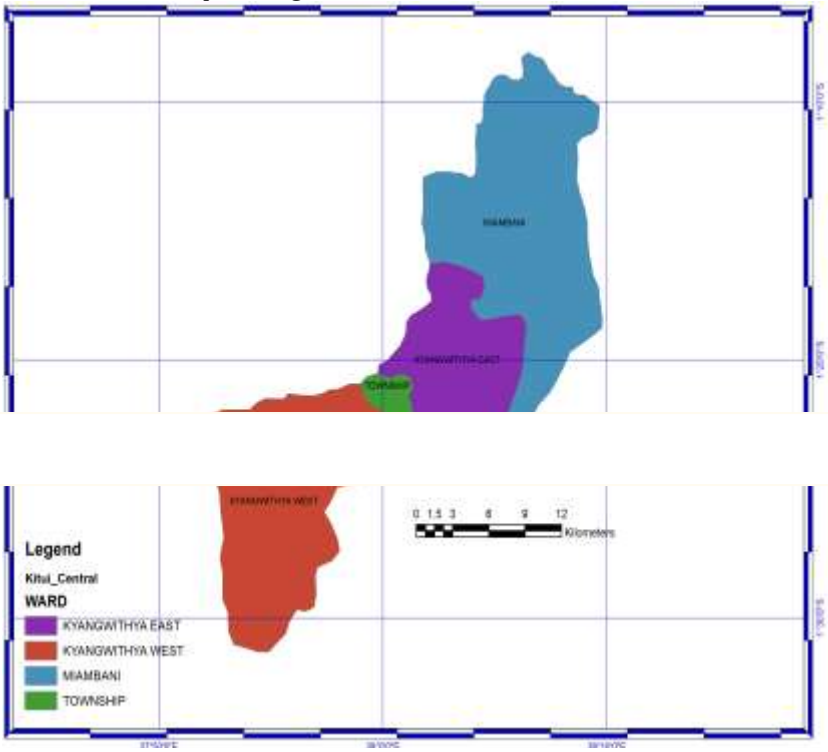

Figure 2 map of Kitui Central Sub-county showing the different wards.

Source: Author. 2017

2.2 *Research Methodology*

The study adopted a descriptive research method which focused on individual fish farmers as the unit of analysis (Kathori, 2004). Simple random sampling was used to select the respondents from the targeted farmers in the study area to participate in the study. The researcher considered farmers whose fish ponds were still functional and those who have abandoned their fish ponds. A record of fish farmers who benefitted from 2009 /2010 ESP was obtained from the Kitui Central sub-county fisheries offices in Kituitown. Thereresearcher targeted a population of 200 fish farmers under ESP in Kitui Central sub-county, Kitui County.

2.3 Sampling Procedure

The study used multi- stage sampling technique. First, purposive sampling was used to obtain fish farmers and key informants that benefitted from 2009 /2010 ESP from the sub-county fisheries office the records indicated that 200 fish farmers were engaged in the ESP in Kitui Central sub-county which was the target populationinthis study. Secondly, the study used simple random sampling technique to select the respondents from the targeted fish farmers. A sample of 60 (which represents 30% of the 200 target fish farmer's population) individual fish farmers was selected. This was in line with the suggestion by Mugenda and Mugenda (2009) that 30% of the population is deemed to be sufficient for statistical analysis in research work. Further, the study used random sampling to identify the farmers in the field during the administration of the sampling instrument.

*Corresponding Author: *Joyce M. Nzevu*

Department of Dry land Agriculture, South Eastern Kenya University, Kenya.

2.4 Sampling Instrument

A semi-structured questionnaire was used to collect data. This was because most farmers were able to read and write without assistance and this ensured unbiased responses. The farmers who were not able to read and write were aided in understanding the answering of the questions.

2.5 Validity of Instrument

Orodho (2002) defines validity as appropriateness, meaningfulness and usefulness of the inferences a researcher makes Kathori(2001), defines validity as the extent to which a test measures what the researcher actually wishes to measure and how well a test measures what it is purposed to measure. To ensure that the instrument was valid, the researcher sought assistance from University supervisors. In addition, pilot testing of the research instrument was done with 5 respondents from KituiRural sub-county as information was not required for statistical analysis.

2.6 Reliability of the Instrument

According to Cozby (2001) reliability refers to participants actual score on an instrument which is influenced by both their true score and error. In the study, 54 randomly selected fish farmers willingly participated in the survey and 6 fish farmers didn't participate due to unavoidable circumstances, like sickness and commitment to social obligations or being uncooperative. The acceptance score was calculated by dividing the number of respondents who participated in the survey with the calculated sample size.

$$\text{Acceptance Score} = \frac{\text{Number of participants in survey}}{\text{sample size}}$$

Where 54 is the number of participants and 60 is the sample size
Therefore the acceptance score of the instrument was 0.88, was established and was deemed adequate and reliable.

2.7 Data Collection

The study used both primary and secondary data. The collection of primary data was through the use of semi structured questionnaire for the fish farmers. This was in line with Sherri, (2010) who noted that questionnaire is an important research tool in socio-economic survey. The questionnaire for fish farmers were structured with open-ended questions and closed questions. Respondents were randomly selected from the identified ESP fish farmers. Each individual respondent was allowed to fill only one questionnaire, the respondents were given a period of four days after which the researcher collected the filled questionnaire.
A return rate of 54 responses was obtained and6 respondents out of the 60 did not fill the questionnaires and were uncooperative. The researcher therefore adopted the sample size of 54 fish farmers. Secondary data was obtained from the records of Kitui County fisheries offices. A questionnaire guide was prepared and administered to two of the county extension officers, who successfully filled the questionnaire. Additional secondary data was obtained from books, journals and articles.

2.8 Data Analysis

According to Mugenda and Mugenda (2003) Data analysis is the process of bringing meaning to raw data obtained from the questionnaires was processed through editing and coding, It was then analyzed using Excel and Statistical Package for Social Sciences (SPSS) version 22software. The SPSS version 22 offers extensive data handling capabilities and numerous statistical analysis procedures that analyze small to large data set-to give descriptive statistics and regression analysis. Descriptive statistics involved the use of percentages and frequencies. Inferential and regression analysis involved the use of Chi-square and Pearson's correlation Coefficients. Results were presented in form of tables and correlation matrices.

III. RESULTS AND DISCUSSION

The demographic and socio-economic information considered for this study included; gender of the household head, level of education, marital status, age, family size, access to extension services, access to credit facilities, access to markets, availability of water and quality of the fingerlings.

3.1 Gender and Fishing Farming

The respondents selected for the interviews were either the owners of the fish pond or the individuals who took part in pond management. This condition was put in place to ensure that the respondents would give true information on pond management and other aquaculture practices. The respondents were categorized in

*Corresponding Author: *Joyce M. Nzevu*

Department of Dry land Agriculture, South Eastern Kenya University, Kenya.

two; those whose fish ponds were functional and those who had abandoned their fish ponds in relation to gender as shown in Table 4.1.

Table 3.1: Current status of fish farming based on the gender of the household heads

	M	F	Total	(χ^2)	P<.05
Abandoned	31 (57.4%)	7 (13.0%)	38 (70.4%)	4.555	0.000*
Functional	13 (24.1%)	3 (5.5%)	16 (29.6%)		
Total	44 (81.5%)	10 (18.5%)	54 (100.0%)		

***Significant at p<0.05**

Fish farming in the study area was majorly dominated by the males (81.5%) while the females only constituted 18.5%. The chi-square (χ^2) test showed a significant difference between the male and female adopters of the fish farming. This is attributed to fact that males own land and also dominates in decision-making as they are mostly the head of the households. Fish farming was introduced in 2009/2010 financial year, however, a majority (70.4%) of the households had non-functional fish ponds compared to those whose ponds were functional (29.6%). However, about 70% of both males and females had abandoned their fish farms. The chi- square (χ^2) test, showed no significant difference in terms of functional and non-functional fish ponds between males and females. This finding concurs with that of Chikopela, (2014),Maina et al., (2014) and Musyoka and Mutia (2016) that fish farming is dominantly carried out by male farmers.

3.2 Age of the Household head and Fish Farming

In the study the pond fish farmers were classified into three age groups namely: 18-35 years, 35-60 years and above 60 years as shown in Table 3.2

Table 3.2: Current status of fish ponds in relation to age of the household heads

Fish ponds	18-35 years	>35- 60 years	>60Years	Total	(χ^2)	P<0.05
Abandoned	3 (5.6%)	35 (64.8%)	-0(0)	38(70.4%)	2.687	0.021*
Functional	4 (7.4%)	12 (22.2%)	-0(0)	16(29.6%)		
Total	7 (13.0%)	47 (87.0%)	-0(0)	54(100.0%)		

***Significant at p<0.05**

The fish farming was largely (87.0%) adopted by the farmers aged between 35-60 years. This finding concurs with the findings of Chikopela, (2014); MwajiandeandLugendo, (2015); Maina et al., (2014) and Musyoka and Mutia (2016), who revealed that fish farming is carried by productive farmers and were able adopt new farming practices and innovations. Further, Chi-square (χ^2) test established a significant difference between age groups and fish farming. The majority of the adopters were in their prime and most productive age and probably had a stable income that enabled them to invest in fish farming to increase income for their households. In addition, these respondents had many years of experience in agricultural production, thus used their skills and experience to diversify their agricultural and dietary practices. Then, these farmers were followed by farmers in the age bracket of 18-35 years. This was attributed to the fact that these farmers were youthful and flexible in the decision-making. Therefore, they could understand new innovations better than their older counterparts and would venture into new commercial agricultural enterprises despite the risks and challenges involved. The descriptive statistics showed that there were no old farmers (>60 years) who were involved in the fish farming in the study area. This could be attributed to the fact that the old persons tend to stick to their traditional ways of farming and they are not risk takers. In addition, fish farming is expensive and technical and old farmers prefer to do what they know rather than adopt new agriculture ventures and innovations that would strain their meager resources and energy.

Abandonment of the fish farming was highest (64.8%) among the middle-aged famers compared to younger farmers. This could be attributed to the fact that these farmers could evaluate the profitability of the fish farming and make concrete decisions to adopt other agricultural enterprises with relative advantages over fish farming in Kitui Central sub-county, Kitui County.

3.3 Level Education and Fish Farming

The farmers were classified into three categories depending on their levels of education namely primary, secondary, and tertiary levels as shown Table 3.3.

*Corresponding Author: *Joyce M. Nzevu*

Department of Dry land Agriculture, South Eastern Kenya University, Kenya.

Table 3.3: Current status of fish ponds in relation to education level of the household heads

Status of Fish ponds	Levels of education of the Household Head					
	Primary	Secondary	Tertiary	Total	(χ^2)	P<0.05
Abandoned	11 (20.4%)	18 (33.3%)	0 (0.0%)	29 (53.7%)	2.687	0.023*
Functional	6 (11.1%)	10 (18.5%)	9 (16.7%)	25 (46.3%)		
Total	17 (31.5%)	28 (51.8%)	9 (16.7%)	54(100.0%)		

***Significant at p<0.05**

Most fish farmers (51.8%) had attained secondary levels of education. These group of farmers had adequate education to better comprehend trainings on fish farming technologies in pamphlets and other materials written in English compared to those who did not go beyond primary level. This was followed by the farmers who had attained the basic primary education (31.5%). Fish farmers with tertiary level of education were few (16.7%).Further, Chi-square (χ^2) test established a significant difference between the levels of education of these fish farmers. This finding is in agreement with Kimenye (2001); Rose (2013) and Mainaet al., (2014) who found out that there were positive correlation between level of education and adoption of fish farming.

However, the rate of abandoning the fish farming production was common among farmers with secondary education (33.3%), followed by those with primary education (20.4%). This could be attributed to the fact that those with secondary education had skills to venture into other agricultural practices in addition to fish farming while those with primary education had limited choices due to inadequate skills so they preferred to continue with fish farming. The rate of abandonment of the fish farming was zero among those with tertiary levels of education. The likely explanation is that they understood the principles and concepts of fish farming which enabled them to have sound management practices in fish farming and remained in business for long. Further, they had alternative sources of employment that made them have enough capital to venture into new innovations in fish farming.

3.4 Marital status of Respondents and Fish Farming

The researcher hypothesized that marital status of the respondents could influence fish farming. The relationship is shown in Table 3.4 below.

Table 3.4: Current status of fish ponds in relation to marital status of the household heads

Status of Fish ponds	Marital status of Household heads					
	Single	Married	Divorced/Separated/ Widowed	Total	(χ^2)	P<0.05
Abandoned	7(13.0%)	28(51.8%)	3(5.6%)	38(70.4%)	19.187	0.000*
Functional	13(24.0%)	3(5.6%)	0 (0.0%)	16(29.6%)		
Total	20(37.0%)	31(57.4%)	3 (5.6%)	54		

***Significant at p<0.05**

Married farmers were the majority (57.4%) in fish farming. This is attributed to the fact that these farmers were more serious and committed to income generating farm activities to support the family needs and wants. In addition, these farmers had secure land ownership and they felt confident in their investments. Further, the family members supplied labour for the labour-intensive fish farming enterprises. This finding concurs with those of Chikopela (2014), Rose (2013) and Musyoka and Mutia (2016) who found out that married farmers highly adopted fish farming.

However, the married farmers had the highest percent of abandoned fish ponds (51.8%). This could attribute to the fact that married couples were likely to have greater financial commitment in catering for their families and non-profitable fish ponds were a great constrain. This was followed by the rate of abandonment of adoption of fish farming by the single farmers (37.0%). However, the rate of abandonment of the fish farming was relatively low (13.0%) for the single farmers. This could be attributed to consistency and inflexibility associated with single farmers. In addition, the category of divorced / separated / widowed had the lowest (5.6%) adoption rate of fish farming, with zero rateof functional fish ponds. This low rate of adoption of fish farming could be associated with psychological disturbances and upset amongst these farmers. However, once these farmers make decisions, they are not firm in their decisions to ensure constant flow of income, accounting for the total abandonment of the fish farming amongst these farmers. In addition, the Chi-square (χ^2) test showed that there was significant difference between these farmers in their ability to adopt fish farming in the study area.

3.5 Family Size and Fish Farming

The respondents were asked to indicate their family sizes. Table 3.5 below shows the distribution of the respondents by family sizes and the current status of the ponds.

*Corresponding Author: *Joyce M. Nzevu*

Department of Dry land Agriculture, South Eastern Kenya University, Kenya.

Table 4.5: Current status of fish ponds in relation to Family size of the household heads

Status of Fish ponds	Family size				
	0-4 persons	>5- 15 persons	Total	(χ^2)	P<.05
Abandoned	21 (38.8%)	17 (31.5%)	38 (70.4%)	3.261	0.000*
Functional	13 (24.1%)	3 (5.6%)	16 (29.6%)		
Total	34 (62.9%)	20 (37.1%)	54 (100.0%)		

***Significant at p<0.05**

The majority (62.9%) of fish farmers had small family sizes of less than four members. This could be attributed to the fact that small sized families have low family expenses and could allocate their extra income to investment in other ventures such as fish farming. This concurs with the findings of Rose (2013), who found out that small sized households had high chances of adopting fish farming compared to large sized families. This research finding, however, contradicts that of Chikopela (2014) who found out that adoption of fish farming was high among large sized households due to availability of cheap family labour which reduced the cost of production.

However, the rate of abandonment of fish farming was high (38.8%) among the small sized families compared to the large sized families. This could be associated to the fact that the large sized families lacked extra income to indulge into other commercial ventures. In addition, the Chi-square (χ^2) test showed a significant difference between small and large families in relation to fish farming. .

3.6 Access to Extension Service and Fish Farming

The respondents were asked to indicate whether they attended trainings organized by ministry of fisheries and any other relevant service providers. The relation between fish farming and access to extension services is show in Table 3.6 below.

Table 3.6: Current status of fish ponds in relation to extension services to household heads

Status of Fish ponds	Access to Extension services				
	Yes	No	Total	(χ^2)	P<.05
Abandonment	32 (59.3%)	6 (11.1%)	38 (70.4%)	10.071	0.028*
Functional	13 (24.0%)	3 (5.6%)	16 (29.6%)		
Total	45 (83.3%)	9 (16.7%)	54 (100.0%)		

***Significant at p<0.05**

Access to extension services for fish farming in the study area was good; with about 83.3% of the fish farmers having access to extension services. The descriptive statistics showed that the extension services were received from mass media – through TV/radio, other farmers, extension officers of the ministry of fisheries, development partners and NGOs and books and journals. This contradicts the findings of Kamathi (2013) who observed that extension services were poor among the fish farmers in Tigania in MeruCounty which contributed to low adoption rate of fish farming in the Meru region.

However, the rate of abandonment of the fish farming was high (59.3%) among farmers who had access to extension services compared to those who didn't have. This could associated with problems affecting the fish ponds, like lack of quality of fingerlings, lack of adequate water and destruction of the fish pond liners in the study area. In addition, the Chi-square (χ^2) test showed a significant difference between those farmers with and those without access to extension services in the study area.

3.7 Access to Credit Facilities and Fish Farming

The respondents were asked to indicate how they raised money to carry out fish pond management practices including access to credit facilities.

Table 3.7: Current status of fish ponds in relation to Access to credit facilities

Status of Fish ponds	Access to Credit				
	Yes	No	Total	(χ^2)	P<.05
Abandoned	31 (57.4%)	7 (13.0%)	38 (70.4%)	19.057	0.000*
Functional	3 (5.6%)	13 (24.0%)	16 (29.6%)		
Total	34 (63.0%)	20 (37.0%)	54		

***Significant at p<0.05**

Most (63.0%) of the fish farmers had access to credit facilities. This implied that the fish farmers had enough funds to cater for the initial costs of starting fish ponds, maintenance and purchase of the fish farming inputs, like the ultra-violet treated pond liners and the fingerlings. This finding concurs with those of Mungutiet al., (2014) and Musyoka and Mutia (2016) who found out that there is positive correlation between access to credit and adoption of fish farming among farmers in Kibwezi sub-county, Makueni County. However, the farmers with access to credit had high (70.4%) rate of abandonment of the commercial fishing farming ventures. This could be attributed to the low level of harvest and or withdrawal of government subsidies. In addition,

*Corresponding Author: *Joyce M. Nzevu*

Department of Dry land Agriculture, South Eastern Kenya University, Kenya.

substantial number (37.0%) of fish farmers had no access to credit facilities. This implied that they faced financial constraints in adopting and maintaining the fish ponds. However, most of these fish farmers (24.0%) continued with the fish farming as a business venture compared to that those fish farmers who had access to credit facilities (5.6%). The Chi-square (χ^2) test established that there was a significant difference between the farmers with access to credit facilities and those with limited access to credit facilities.

3.8 Access to Quality Fingerlings and Fish Farming

The respondents were asked to state whether they had access to quality fingerlings. The farmers were classified into two: those who had access to quality fingerlings and those with no access to quality fingerlings as shown in Table 3.8below.

Table 3.8: Current status of fish ponds in relation to Access to quality fingerlings

Status of Fish ponds	Access to Quality Fingerlings				
	Yes	No	Total	(χ^2)	P<.05
Abandoned	0 (0.0%)	16(29.6%)	16 (29.6%)	16.897	0.000*
Functional	23 (42.6%)	15 (27.8%)	38 (70.4%)		
Total	23 (42.6%)	31(57.4%)	54		

***Significant at p<0.05**

The majority (57.4%) of fish farmers had no access to quality fingerlings compared to farmers (42.6%) who had access to quality fingerlings for their fish farming business. This finding shows that availability of quality fingerlings was a major factor that could have contributed to sustainability of the fish farming in the study area. This is supported by no abandonment of the fish farming among farmers with access to quality fingerlings compared to 29.6% of farmers who abandoned and had no access to quality fingerlings. In addition, the Chi-Square (χ^2) test established that there was very significant difference between fish farmers with and without access to quality fingerlings. This finding is in agreement with those of Munguti et al., (2014) and Musyoka and Mutia (2016), who found out that access to quality fingerlings was a limitation to fish farmers in KibweziSub-county of Makueni County

3.9 Access to Adequate Water and Fish Farming

The respondents were asked to indicate their sources of water for their fish ponds and whether the water was adequate or limited the results are shown in table 3.9 below.

Table 3.9: Current status of fish ponds in relation to Access to adequate water

Status of Fish ponds	Access to Adequate Water				
	Adequate water	Limited water	Total	(χ^2)	P<.05
Abandoned	20 (37.0%)	18 (33.4%)	38 (70.4%)	11.024	0.237
Functional	6 (11.1%)	10(18.5%)	16 (29.6%)		
Total	26 (48.1%)	28 (51.9%)	54		

***Significant at p<0.05**

Scarcity of water affected 51.9% of the fish farmers while 48.1% of them had access to adequate water. In addition, the Chi-Square (χ^2) test established that there was insignificant difference between the fish farmers with access to adequate water and those without. This study established that rate of abandonment of fish farming in Kitui Central sub-county was high at 70.4% on basis of access to adequate water, though insignificant differences were reported between farmers who had access to adequate water and those without. This implied that there are other contributory factors influencing abandonment of fish farming rather than water availability. This contradicts findings of Jacobi (2013), who studied fish farming in Kisumu and Homa Bay Counties and found out that access to quality water for fish farming was a major challenge in these areas.

3.10 Access to Quality feedstuffs and Fish Farming

The researcher hypothesized that the fish farming could be influenced by access to adequate quality feedstuffs for the fish farming. The respondents were asked to indicate their sources of feedstuff for their fish ponds and whether the feedstuffs were adequate or limited and of good quality and the results are shown in Table 3.10 below

Table 3.10: Current status of Fish ponds in relation to Access to Quality Feedstuffs

Status of Fish ponds	Access to Quality Feedstuffs				
	Adequate Feeds	Limited Feeds	Total	(χ^2)	P<.05
Abandoned	12 (22.2%)	26 (48.2%)	38 (70.4%)	7.003	0.002
Functional	4 (07.4%)	12 (22.2%)	16 (29.6%)		
Total	16 (29.6%)	38 (70.4%)	54		

***Significant at p<0.05**

*Corresponding Author: *Joyce M. Nzevu*

Department of Dry land Agriculture, South Eastern Kenya University, Kenya.

Scarcity of quality feedstuffs affected 70.4% of the fish farmers while 29.6% of them had access to adequate quality feedstuffs. In addition, the Chi-Square (χ^2) test established that there was significant difference between the fish farmers with access to adequate and quality feedstuffs and those without. This study established that rate of abandonment of fish farming in Kitui Central sub-county was high at 70.4%and could be attributed limited access to quality feedstuffs. This implied that the limited access to adequate and quality feedstuffs was a contributory factor that influenced abandonment of fish farming among other factors.

3.11 Pond Management Skills of the Fish Farmers

The researcher hypothesized that skills in pond management of the respondents could influence fish farming. The relationship is shown in Table 3.11 below.

Table 3.11: Current status of fish ponds in relation to Pond Management Skills

Fish ponds	Skills	No Skills	Total	(χ^2)	P<.05
Abandoned	7 (13.0%)	31 (57.4%)	38 (70.4%)	5.243	0.001*
Functional	11 (20.4%)	5 (9.2%)	16 (29.6%)		
Total	18 (33.4%)	36 (66.6%)	54		

***Significant at p<0.05**

Majority (66.6%) of the fish farmers had no skills in pond management. The Chi Square test indicate that there was significant difference between the fish farmers who had skills in pond management at p<0.05. This concurs with research finding of Shitote et al., (2013) who found out skills in pond management is crucial for successful fish farming.

3.12 Training of the Fish Farmers

The researcher hypothesized that training in pond management and fish farming of the respondents could influence fish farming. The relationship is shown in Table 3.12 below.

Table 3.12: Current status of fish ponds in relation to Training

Fish ponds	Training	No Training	Total	(χ^2)	P<.05
Abandoned	16 (29.6%)	22 (40.7%)	38 (70.4%)	9.004	0.003*
Functional	9 (16.7%)	7 (12.9%)	16 (29.6%)		
Total	25 (46.3%)	29 (53.7%)	54		

***Significant at p<0.05**

The research found out that majority (53.7%) of the respondents had not received training on fish farming especially on pond management. The Chi-Square test indicated that there is significant difference between the farmers who had been trained on fish farming and those who had not. This could be a contributory factor to the high farmers who had abandoned fish farming. Training fish farmers enhances the understanding of the concepts and theories in fish farming.

3.13 Predation and Fish Farming

The researcher hypothesized that predation in pond managementcould influence fish farming. The relationship is shown in Table 3.13 below.

Table 4.13: Current status of fish ponds in relation to Predation

Fish ponds	Predation	No Predation	Total	(χ^2)	P<.05
Abandoned	30 (55.6%)	8 (14.8%)	38 (70.4%)	6.012	0.007*
Functional	12 (22.2%)	4 (7.4%)	16 (29.6%)		
Total	42 (77.8%)	12 (22.2%)	54		

***Significant at p<0.05**

Majority (77.8%) of the fish farmers identified predation of the fish by birds, like Kingfisher birds was challenge. In addition, the respondents claimed that the birds destroyed the pond liners. The Chi-Square test showed a significant difference between the fish farmers who had their fish preyed on by the predators and those who had no such cases. This research finding agreed with findings of Kimathi et al., (2013); Shitote et al., (2013) and Maina et al., (2017) who fought out that predation by birds and frogs were major challenge in fish farming.

3.14 Factors Influencing Fish Farming in Kitui Central Sub-County

The study aimed at establishing the factors influencing fish farming in Kitui Central sub-county, Kitui County. Multiple regression model and Pearson moment correlation tests were used to establish the factors that influence the state of the fish farming in the study area and the results presented in multiple regression table and correlation matrix for the variables. This involved establishing the coefficient (r) values for the independent

*Corresponding Author: *Joyce M. Nzevu*

Department of Dry land Agriculture, South Eastern Kenya University, Kenya.

variables against the dependent variable (adoption of fish farming). The adoption of the fish farming was established by relating the state of the fish ponds in the area of study.
It was also hypothesized that the variables influenced each other amongst the households and the table 3.14 shows the results of the correlation matrix analysis obtained.

Table 3.14: Correlation Matrix for Variables used in Kitui Central Sub-County

Variable	Age	Gender	Education	Marital status	Family size	Water	Training	Extension	Credit	Pond Mgt	Fingerlings	Predation
Age	**1.000**											
Gender	**.184**	**1.000**										
Education	**-.063**	**-.036**	**1.000**									
Mar. Status	**-.116**	**.263**	**.214**	**1.000**								
Family size	**-.275**	**.325**	**.054**	**.489****	**1.000**							
Water	**.180**	**-.113**	**.008**	**-.012**	**-.335**	**1.000**						
Training	**.164**	**.248**	**-.011**	**-.273***	**-.324**	**.244**	**1.000**					
Extension	**.173**	**.554**	**-.122**	**-.188**	**.171**	**-.265**	**.017**	**1.000**				
Credit	**-.161**	**-.366**	**-.398**	**-.118**	**-.191**	**.125**	**.238**	**.137**	**1.000**			
Pond Mgt	**.262**	**.173**	**-.063**	**-.571**	**-.391**	**-.261**	**.661***	**.166***	**.566***	**1.000**		
Fingerlings	**-.221**	**-.264**	**-.354**	**.671**	**.118**	**-.305**	**.164**	**.017**	**.666**	**.155**	**1.000**	
Predation	**-128**	**.087**	**.234**	**.976**	**.123**	**.612**	**.239**	**.078**	**.375**	**.296**	**.675**	**1.000**

***Significant at p<0.05.**

The correlation matrix shows that most variables had either negatively or positively correlation with insignificant influence over each other. However, training, access to extension services and credit had positive and significant influence that enhanced pond management by the household. This implied that fish farmers who attended training on fish farming and had access to extension services improved their knowledge of fish farming and could manage their ponds well and address any constraint that they faced. In addition, access to credit had positive and significant influence on pond management as enabled the fish farmers to purchase the necessary input required for the fish farming venture.

Table 3.15: Parameter Estimates for Factors affecting Adoption of Fish Farming

Explanatory Variable	Parameter Estimate (β)	Wald Statistic	Exp (β)	P-Value
Constant	0.764*	34.23	3.243	.032
Gender of HHH*	-0.381	0.104	0.552	.483
Age of HHH	-0.203	0.142	0.703	.612
Education of HHH	1.126	1.253	1.673	.096
Marital status of HHH	2.345	.816	.508	.002*
Family Size of HHH	-2.272	2.421	2.216	.9687
Training of HHH	4.323*	2.045	1.005	.001*
Skills of HHH	1.120*	2.502	2.784	.089
Access to water	2.56	1.210	3.212	.065
Access to Extension	1.035	1.512	1.12	.407
Access to Credit	1.432	1.327	.630	.001*
Access to fingerlings	2.214*	32.344	2.912	.003*
Access to Feedstuffs	3.122	12.111	4.132	.002*
Predation of fish	-2.124	3.455	2.134	.002*

Note: $\chi 2$ = 32.39*; -2LL= 105.521; Overall Statistics= 68.7%; *Significant at p<0.05; HHH – Household Head

The adopted multiple regression models were good as it explained 68.7% of the total variation in the adoption of fish farming. It further showed how each parameter change would change the adoption of the fish farming. It was chosen as the factors act independent in influencing the adoption of the fish farming in the regression model.

Age of the head of household is a critical factor that influences adoption of innovations and technological advancements amongst farmers, like the fish farmers. The age of the farmers had negative and insignificant influence on the adoption and sustainability of the aquaculture (fish farming using the fish ponds). This concurs with Chikopela (2014); Mwajiende and Lugendo (2015); Rose (2013); Maina et al., (2014)andMusyoka and Mutia (2016). This implied the old farmers were not likely to adopt fish farming compared to relative young farmers. This is likely to be contributed by the fact that fish farming is technical venture and its concepts and maintenance practices can easily be understood by relatively enthusiastic, flexible and productive farmers compared to conservative and risk adverse old farmers in the study area.
Gender of the farmer plays an important role in determining adoption of innovations and technological advancements in agriculture among other fields for livelihood support. The multiple regression tests established

*Corresponding Author: *Joyce M. Nzevu*

Department of Dry land Agriculture, South Eastern Kenya University, Kenya.

that the influence of gender on adoption of fish farming was negative and insignificant. This implied that female farmers were likely to adopt fish farming compared to their male counterparts. This further supports that the fish farming is male dominated in Kitui Central sub-county. This concurs with suggestion by Rodgers (2003) those men, who controls most of the resources in the households and are risk takers, influences decision making in commercial ventures of most households in Africa. This is in agreement with the findings of Chikopela (2014); Abdoucie (2013); Maina et al., (2014) and Musyoka and Mutia (2016) that male farmers dominantly engage in fish farming compared to their female counterparts.

Education creates proper understanding of concepts and working principles of innovations and technological advancements. The study revealed positive influence of education (highest level of education reached or the number of years spent in school) on the adoption of modern aquaculture in Kitui Central Sub-county although it was insignificant. This explains why the farmers who attained secondary school education and above adopted the fish farming. This is in agreement with the findings of Kimenye (2001) and Maina et al., (2014), who revealed that there is positive correlation between number of years of schooling (level of education) and the adoption of fish farming. In addition, the positive influence of education of the farmers is likely to be accountable for the zero percent of abandonment amongst the farmers with higher levels of education. This implied that these farmers understood the workability of the fish ponds and maintenance principles; hence, they could face limited challenges in management of the fish ponds.

Marital status had a positive and significant influence on the adoption and sustainability of commercial aquaculture in Kitui Central sub-county. This concurs with the findings of Chikopela (2014); Rose (2013); and Musyoka and Mutia (2016), who revealed that married farmers adopted the fish farming more than the single or divorced farmers. Married farmers adopted modern aquaculture compared to either single farmers or other farmers faced with challenges of being divorced, separated or widowed. This implied these farmers were distracted from concentrating on fish farming ventures compared to their married farmers who felt more satisfied in decision making helpful to efficient fish farming.

Training of the farmers had a very positive and significant influence on fish farming at $p<0.01$. This concurs with finding of Kimathi (2013), who found out training of farmers improves their understanding of technical aspects of fish farming and on how to solve the challenges in fish farming. This implied that trained farmers gained knowledge and understanding of the fish farming. This is associated with skills that the trained farmers gained during the training and any unanswered and disturbing questions about fish farming were highlighted by the trainers. The untrained farmers had difficulties in making the right judgments and decision in maintaining the fish ponds.

Access to credit has a positive and significant ($p\leq0.05$) influence on fish farming in Kitui Central sub-county in Kitui County. This is in agreement with those of Munguti et al., (2014) and Musyoka and Mutia (2016) who found out that there is positive correlation between access to credit and adoption of fish farming amongst farmers. This means that households in Kitui Central sub-county without access to credit income were more likely to adopt the capital-intensive fish farming. Credit facilities is a source of funding that can be used to purchase fish pond liners, quality fingerlings, fish feeds although the money can be diverted to other emerging priorities for maintaining the household economy. Household with limited access to credit were likely to faced financial constraints in maintaining the adopted capital intensive fish farming

Availability of quality fingerling positively and significantly ($p<0.05$) influenced fish farming.This is in agreement with those of Munguti et al., (2014) and Musyoka and Mutia (2016), who found out quality fingerlings leads to successful, fish farming. This implied that households in Kitui Central sub-county with access to quality fingerlings for the fish farming ventures invested and continued with the fish farming with ease. Under good pond management, the fish farming by these farmers were likely to be more profitable and farmers felt confident with fish farming as they were assured of good production. In contrast, farmers with limited access to quality fingerlings failed to adopt the fish farming or abandoned the fish farming if little profits or losses are incurred in the study

Access to adequate and quality feedstuffs to the fish farmers positively and significantly influenced fish farming in the study area. This is attributed to the fact that for sound fish production the nutritional requirements of the fish has to be met. In the ASALs, sources and supply of adequate feedstuffs was quite a challenge. This implied that the fish took longer to mature or had stunted growth and could not fetch good market prices. This could be a contributory factor to the high rate of abandonment of the fish farming in the study area.

Other factors (access to water, access to extension services and pond management skills) tested had positive but insignificant influence on the adoption of modern fish farming in Kitui Central sub-county. This implied that households with good access to water and extension services and have good pond management skills were likely to adopt fish farming compared to households that disadvantaged in access to water and extension services and skills empowerment.

*Corresponding Author: *Joyce M. Nzevu*

Department of Dry land Agriculture, South Eastern Kenya University, Kenya.

However, family size had its negative share of influence on the fish farming, although it was insignificant. This implied that household with large member, family size had its negative share of influence of the family were unlikely to adopt fish farming in Kitui Central sub-county. This could be attributed to the fact that income of the family is mainly used to cater for the social obligations for family members and very little funds were available for investing in the capital intensive aquaculture. In addition, predation negatively influenced fish farming amongst the farmers in the study area.

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IV. CONCLUSION

From the results of this study, the following conclusions can be made;

The study did the following conclusion after thorough examination of responses in the analysis;

1 There is great potential for small holder aquaculture in Kitui central sub- county, however research is needed to develop and manage this potential for high production and sustainability of aquaculture.
2 Fish farming is capable of creating employment, improving food security and hence uplifting the living standards of people.
3 Necessary inputs such as feed ,seed, extension services and credits to start fish farming should be made available and at affordable cost
4 Indeed, the increased interest in aquaculture following the ESP is a testament that much more can be achieved when stakeholders work together.

4.2 Recommendations

This study recommends the following;

i. Aquaculture stakeholders should increase the number of field officers and extension officers in order to reach every fish farmer.
ii. Further research and capacity development is required in the area of fish feeds and the management of feeding for optimal output.
iii. The fisheries department in Kitui County should ensure availability of quality and reliable fingerlings for the fish farmers,
iv. The county Government of Kitui, through the department of fisheries to renovate the abandoned ponds within their offices to serve as a training centre for various groups of farmers.
v. The National government through the county fisheries of Kitui needs to liaise with micro financial institutions for provision of loans and credit to fish farmers to ensure sustainability of projects after Government subsidies are terminated.
vi. A need exists to create linkages and collaboration among all stakeholders (research institutions, universities, Non-Governmental Organizations (NGOs), civil society, government officials, and policy makers) by creating a strong forum for exchange of information of fish farming in the dry lands.

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