An Evaluation of Factors Affecting Sustainability of Fish Farming Projects in Public Secondary Schools in Kiambu County

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Abstract- The study aimed at establishing the factors that affect sustainability of fish farming projects in public secondary schools in Kiambu County. The study was guided by the following specific objectives: to establish costs of inputs effect on sustainability of fish farming in public secondary schools in Kiambu County; technology effect on sustainability of fish farming projects in public secondary schools in Kiambu County; skills and training effect on sustainability fish farming projects in public secondary schools in Kiambu County and social-cultural factors effect on sustainability of fish farming projects in secondary schools in Kiambu County. The research used the descriptive survey approach. The target population of the study was 65fish farming secondary schools project managers in Kiambu County and 10 fisheries officers in each of the constituency. This corresponded to a target population of 75.By the time of data collection some projects had closed down and therefore data was collected from 44 secondary schools. The study adopted the census sampling technique which involved sampling all project managers in the fish farming projects and a fishery officer in each of the constituencies. The sample size of the study was therefore 54 respondents. The study used questionnaires to gather data from project managers and informant interviews from fisheries officers. Descriptive (mean, standard deviations, frequencies and percentages) were adopted together with inferential statistics (correlation and regression) so as to come to a measure of relationship and meanings. The study established that fish farming sustainability in public secondary schools is greatly affected by social- cultural effects where attitudes play a key role. Cost of inputs was another factor where high costs would mean less production. Technology proved to have an effect on sustainability since adoption of technology would result to higher production and thus more sustainability. Skills and training did also have an effect as better skills and training would result to better management. The study recommended more involvement by the government to lower costs of inputs, avail technology together with extension services and enhance the campaign of "eat more fish" together with involving more women in the projects.

Index Terms- Input costs, Technology, Skills, Training, Sustainability, Socio-cultural

I. INTRODUCTION

The global fishing industry has nearly exhausted fish stocks and catches are declining. The United Nations and major fishery countries have placed significant emphasis on the development of the aquaculture industry (Chen, Huang & Chiang, 2010). The production of fish and shellfish from the African continent totaled approximately 79,500 metric tons in 1998; 57% of this was produced by three countries bordering the Mediterranean, with Egypt producing most (i.e. 43,000 tons) .Thirty-three sub-Saharan countries produced the remaining 34,000 metric tons, of which 93% can be attributed to 6 countries, which include Nigeria (16,700 tons), South Africa (4,500 tons), Zambia (4,100 tons), Zimbabwe (3,800 tons), Namibia (1,300 metric tons) and Kenya (1,100 tons) (Hecht, 2001).

The role of aquaculture in food production, economic development and food security is therefore increasingly becoming important in the country and the whole world. Aquaculture has primarily been a developing world activity, especially in the Asian countries. Asia accounts for 87% of global aquaculture production by weight, while China alone is responsible for about 68% of the global production. India and Southeast Asia contribute about 15% of production in 1997 (Delgado, 2003). However, fish consumption in Africa is still lowest relative to other parts of the world, (FAO, 2012).

In Kenya, fish farming can be traced back to the 1920s, using tilapia species and later including the common carp and the African catfish. In the 1960s rural fish farming was popularized by the Kenya Government through the "Eat More Fish" campaign; as a result of this effort, tilapia farming expanded rapidly, with the construction of many small ponds, especially in Kenya's Central and Western Provinces (Ngugi, Bowman, & Omolo, 2007). However, in the 1970s, there was a decline in number of productive ponds mainly because of inadequate extension services, a lack of quality fingerlings, and insufficient training for extension workers. Until the mid-1990s, fish 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).

Studies conducted by Mwangi (2008), show that a myriad of challenges face fish farming enterprises in Kenya These include uncoordinated promotion of fish farming through many institutions, Government, research institution, Universities,

NGOs and Regional authorities among others. Furthermore, there are no comprehensive policies on fish farming and legislation is inadequate. The inadequacy in provision of extension services has been a major challenge to development of fish farming in Kenya. This situation results from lack of resources and technical staff (GoK, 2010). In addition these challenges are compounded by inadequate entrepreneurship skills by the farmers and lack of credit. Nonetheless, although it has not been scientifically quantified, Kenya has enormous potential for fish farming in the agricultural rural zones.

In Israel, more than half the fish eaten was produced from fish farms, similarly 25% of fish in China and in India, 11% in USA and 10% in Japan were aquaculture products. In developing countries, fish farms not only improved a nation's diet but brought income to small farmers and created employment particularly in rural areas, (Mwamuye *et al.*, 2012). In Kenya, fish productions from the capture fisheries are steadily declining. Lake Victoria fish productions alone have declined from about 200,000 metric tonnes in 1999 to about 130,000 metric tonnes in 2007 with no signs of this fishery recovering in the near future. Aquaculture potential in the country is enormous (currently contributes 2.5 % to our fishery while it has potential to contribute close to 50 % to Kenya's fishery output) and its utilization requires moderate investment and technology.

According to Ngugi et al. (2007), the number of productive ponds declined in the 1980s.Fish farming in Kenya followed a pattern similar to that observed in many African countries characterized by small ponds, very low levels of production and subsistence level of management until the mid-1990s. The government through the 2009 Economic Stimulus Programme (ESP) proposed the construction of 200 fish ponds in 140 constituencies for fish farming. The project was rolled out through the Ministry of Fisheries development as the Fish Farming Enterprise Productivity Programme. The primary beneficiaries of the project are the unemployed young Kenyan's in the selected households, public institutions (schools, coffee factories, irrigation schemes etc.) whereas the secondary beneficiary will be the rest of the household members and other fish stakeholders (GoK, 2009).

Despite these efforts to improve fish production while promoting food security, employment and income generation, the sustainability of these aquaculture projects has been found to be below expectations. Majority of the ventures in both public and primary schools have either totally stalled or continue to run on recurrent expenditures. This poses a risk to the future of aquaculture in Kenya which would alleviate the problems of unemployment and food insecurity. MacFadayen (2008) mentions that fishery development projects and programmes in the Sub Saharan African region generally lack adequate baselines, final evaluations and ex-post impact assessments.

Previous studies have not looked at factors affecting sustainability of fish farming in secondary schools; for example, Onzere (2013) looked at factors affecting performance of community based fish farming projects in Nyeri, Shitote et al. (2012), looked at challenges facing fish farming development in Western Kenya; Kariuki (2013), looked at Strategic Practices for effective implementation of fish farming enterprise programme in Kenya in Molo constituency. Mwangi (2011), found that fish farmers in Kiambu County have considered abandoning the practice. Despite the government providing finances for startup, Mwangi found that the fish farming projects started through the Economic Stimulus Programme in Kiambu County are facing challenges and some of these ventures have been fully abandoned. Therefore this study is motivated to bridge the gap in knowledge by trying to find out the factors influencing project participants in abandoning the fish farming ventures.

The purpose of the study is to explore the factors affecting sustainability of fish farming in public secondary schools. The study were guided by the following specific objectives; to establish how costs of inputs affect sustainability of fish farming in public secondary schools in Kiambu County, to determine how technology affects sustainability of fish farming projects in public secondary schools in Kiambu County, to ascertain how skills and training affect sustainability fish farming projects in public secondary schools in Kiambu County and to determine how social-cultural factors affect sustainability of fish farming projects in secondary schools in Kiambu County

II. LITERATURE REVIEW

2.1 Theoretical Framework

2.1.1 Symbolic Interaction Theory

According to this theory; human beings do not act individually but interact with each other thus reacting to each other. This perspective is centered on the notion that communication—or the exchange of meaning through language and symbols—is how people make sense of their social worlds. As pointed out by Herman and Reynolds (1994), this viewpoint sees people as active in shaping their world, rather than as entities who are acted upon by society (Herman & Reynolds, 1994). This approach looks at society and people from a micro-level perspective. The use of the symbolic interaction theory in the study will help analyze group members' behaviour towards fish farming projects. The fish farming projects are rolled out in a setting that allows community member participation in fish farming activities which include public schools and also youth and women group members.

2.1.2 Stakeholder Engagement Theory

The researcher proposes to adopt the stakeholder engagement theory for the study. According to Freeman (1984), a stakeholder is any group or individual who can be affected or is affected by the achievement of the organization's objectives". According to the Project Management Institute (PMI) Standards Committee, project stakeholders are individuals and organizations who are actively involved in the project or whose interests may be affected by the execution of the project or by successful project completion (PMI, 2004). Chinyio and Olomolaiye (2010) stated that stakeholders can affect an organization's functioning, goals, development and even survival. They also mentioned that stakeholders are beneficial when they help to achieve its goals and they are antagonistic when they oppose to the mission. Freeman (1984) argues that this process is not actually linear; rather it is an iterative process in which an organization learns and improves its ability to perform meaningful stakeholder engagement through developing relationships of mutual respect, in place of one-off consultations.

2.1.3 Theory of Production

Based on Cobb and Douglas (1928), theory of production, the study will attempt to explain the effects of cost of inputs to sustainability of fish farming. According to the theory of production, gross output is affected by the amount of labour involved and the amount of capital invested together with the intermediate materials. This implies that amount of production in fish projects depends on the cost of inputs. These inputs include the capital invested to start the projects, the daily running costs and cost of labour when the costs of inputs are low; the level of production goes up. This in turn means that the projects are profit making and therefore are sustainable in the long run. The theory is significant to the study as it emphasizes the influence of inputs in the sustainability of an enterprise. Similarly, the costs of inputs are an important component of sustainability of fish farming projects.

2.2 Conceptual Framework

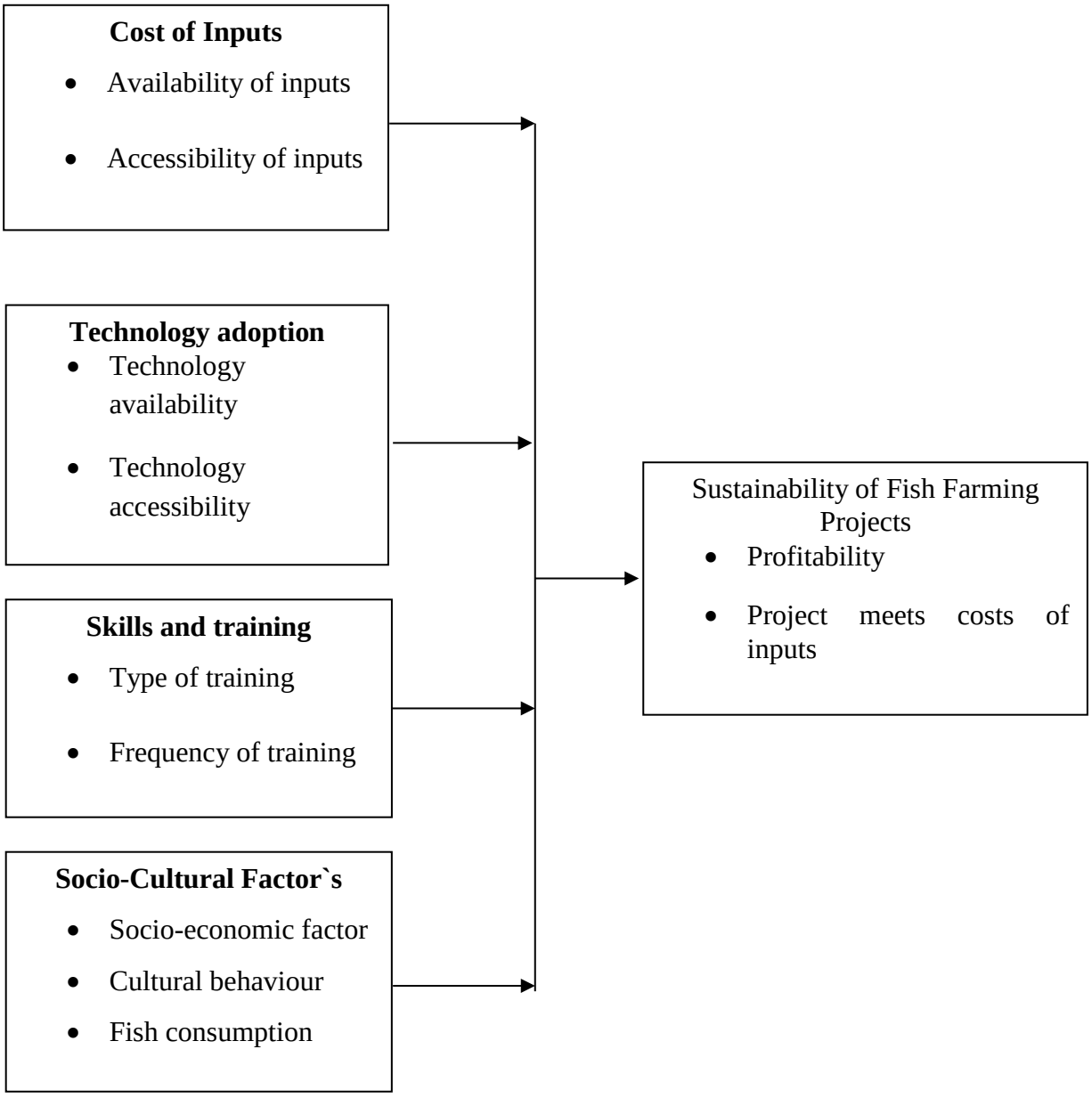

Figure 2.1 Conceptual Framework Model.

2.3 Empirical Review

According to SARNISSA (2011), good quality, affordable and accessible inputs such as fish seed and feed are the main components for successful aquaculture farms and projects. Aquaculture farming systems are dependent upon the market availability of `feed resources' for the provision of nutrient inputs. Feed and fingerlings availability also represent significant cost components in the commercial aquaculture. On the other hand, it is difficult for farmers to adopt aquaculture technology if farmers do not have access to funds to maintain their ponds and to buy feed (Singas & Manus, 2014). Ele et al. (2013) found out that, high prices of fish feed; declining fish prices and lack of finance were the top ranking serious constraints facing fish farmers in that area. Amongst the variable inputs, fingerlings/juveniles (42.82%) and feed (34.70%) constituted the highest (77.52%) to cost of production, while hired labour constitutes 16.91%.

The cost of feed alone is estimated to represent between 40% and 70% of the cost of producing the fish. Intensive fish farming is a major commitment, requiring considerable financial and physical resources, as well as a keen business sense. Ogello et al. (2013) suggest fish rearing can be integrated with fish farming to reduce the cost of inputs such as fertilizer and feed to maximize profits. Besides credit for investments, money is needed to cover operational costs, such as buying good quality feeds (often up to 50% or more of total operational costs) and fingerlings, (Brummet &Rana, 2010). Singas and Manus (2014) also found evidence among fish farmers that the cost of commercial feed, misuse of funds and lack of credit facilities affected the profitability of fish farming enterprises in Papua New Guinea.
Inappropriate pond construction techniques and poor soils affect performance. Poor feeds obtained from agro-industrial by-product have also been observed as a hindrance to commercial aquaculture, (Ele*et al.,* 2013). For instance, lack of fingerlings delayed the establishment of fish ponds under a Kshs. 22 billion government stimulus plan, aimed at creating 120,000 new jobs. The project also grappled with lack of fish food which met the requirement standards (World News, 2010).According to GoK (2009), farm inputs which include fish feeds (industrial feeds of minimum 26% crude protein) and manure/fertilizer will be supplied to individual farmers through their clusters in quantities enough to run one production season as will be determined by the DFO based on the pond size and the stocking densities. However, despite this accessibility and availability farmers, have had to pay for them, (Oloo, 2011).

Aquaculture potential in the country is enormous (currently contributes 2.5 % to our fishery while it has potential to contribute close to 50 % to Kenya's fishery output) and its utilization requires moderate investment and technology, (GoK, 2009). Wetengere (2010) agrees that despite high potentials that fish farming possess, the adoption of the technology leaves much to be desired. Oloo (2011) found that aquaculture farmers in the ESP still faced challenges in terms of access to credit, access to technical information, predatory animals and lack of support from government extension services. The inadequacy in provision of extension services has been a major challenge to development of fish farming in Kenya. This situation results from lack of resources and technical staff, (GoK, 2011). Mwamuye et al. (2012) cites inefficiency in dissemination of technology transfer to farmers also ranked high among key challenges of aquaculture in Kenya.

Ogello et al. (2013), point to a dearth of information on how to design integrated aquaculture systems, which are ecologically and economically sustainable in East Africa; Citing poor information dissemination and technology transfer, Henry-Okuha, (2011) contend that technology adoption in fish farming is more likely to be adopted by relatively younger farmers. Knowledge about design, construction and hatchery equipment and other accessories needed for certain types of aquaculture, for example, pumps, aerators, cages, tanks, hatching jars and incubators or cribs, is hard to obtain in most countries (SARNISSA, 2011). In addition, fish farming technology adopted has been characterized by a low level of technology adoption such as small size ponds likened to holes, poor quality seed, low input allocation in terms of cash income, labor time, feeds and fertilizers, and infrequent harvest (Wetengere, 2010).

According to Jacobi (2013), the reasons for slow aquaculture development in Kenya have been:lack of a tradition of fish and water husbandry, numerous political, social and economic constraints that restrict investment and delay expansion, lack of information on fish farming technology and culture practices (Fisheries Department, 2012) and unknown investment return-rates. Jacobi (2013) supports this idea as they found that due to primarily low levels of investment, aquaculture research and extension services are weak in most countries in SSA. It is very difficult for smallholder farmers to get up-to-date information about locally appropriate and improved technologies and management practices (Beveridge *et al.*, 2010).

One way of achieving higher pond productivities, and hence self-sustainable aquaculture practices, is the promotion of sustainable and integrated aquaculture-agriculture farming practices, allowing for the use of locally available and cost-effective aquaculture inputs. This fish farming technology was, however, not widely used by ESP supported farmers (Jacobi, 2013). However, SARNISSA (2011), case studies show that development and extension systems still apply an approach of "transfer of technology" to farmers. Generally, producers have little or no say in the choice of techniques to be researched and developed (and often technologies promoted are not adapted to the local context and know-how. Brummet and Rana (2010) propose for a participatory research and extension and a focus on socio-economic, technical and organizational innovations are very much needed in order to achieve better results and improve rates of technology adaptation and adoption.

In regard to knowledge of various technological components, Rajan et al. (2013), found that pond management, feed and fertilizer management, selection of seed and management as important technological components, while the less important technological components to the fish farmers were, unwanted fishes and weed management fish protection management, harvesting and storage management. Ike and Onuegbu (2010), found that majority of fish farming projects adopted pond construction practice (54%) and pond installation (51%) respectively. Also, 50 % of them adopted the

recommended transportation practice of fingerlings, but only 27 % of them adopted the proper site selection. However, less than 50 % of the farmers adopted other practices like pond preparation (44%) feeding (47%) pond maintenance (44%) and stocking practice (34%). In contrast, although 39 percent adopted harvesting practice, only 19 % of them adopted the preservation practices.

Onzere (2013) found that community based still utilizes traditional methods of fish farming, harvesting and preservation. There has been very minimal technological innovation made in this area. Lack of technology has led to reduced output as well as wastages and losses since the fish harvest cannot be stored for extended periods that would have enabled the fish farmers market their produce at a later date or transport it to other areas for sale. According to Singas and Manus (2014) farmers adopt fish farming technologies if they believe that fish farming is profitable and would benefit the livelihood of society, (Stanley et al, 2010). This implies that that the significance or superiority of the recommended technology relative to existing practices must be clearly demonstrated to farmers, (Wetengere, 2010).

The knowledge and awareness of undertaking any economic activity is a major determinant on the success and sustainability of the enterprise. The organic farmer magazine reports that Kenyans and indeed farmers in Africa have acquired a habit of rushing for new ventures just because one farmer makes good money from it; fish farming is one of them. However, many farmers have failed in this venture because they dug fishponds and started fish farming without undergoing any training or acquiring the right skills on how it is done. Fish farming requires that farmers undergo training and seek advice from fisheries experts on where to locate the ponds and about general fish management, (The Organic Farmer, 2012).

In a study on the Factors Influencing Adoption of Pond Fish Farming Innovations in Papua New Guinea, Singas and Manus (2014), found that lack of knowledge and skills was ranked as the number one problem facing the sustainability of fish farming projects. Singas and Manus findings further revealed that although 97 % of the farmers in their sample received formal schooling ranging from primary to university education, yet they lacked knowledge and skills of adopting fish innovations. The study found that the fish farming was not adequately supported through farmer training and extension. Njankouawandji et al. (2012), agree that education, among others, can be a constraint and where this is present, further trainings must be conducted.

Singas and Manus (2014), argue that the key constraint to aquaculture development is dissemination of existing knowledge, whether derived from research or indigenous technical knowledge of farmer. In order to enhance the productivity of the fish pond, this requires regular maintenance and monitoring is vital which includes various activities such as daily management includes: checking the water quality (oxygen, pH, colour, transparency, temperature, etc.), checking the pond for possible water leaks, cleaning the screen of the water inlet and outlet, observing the fish while they feed and removing aquatic weeds growing in the pond because water quality is a vital factor for good health and growth in fish (Abiona *et al.,* 2012).

Social constraints include an absence of a traditional culture of fish farming in sub-Saharan Africa. Maina et al. (2014) conducted a study on the Influence of social-economic factors, gender and the Fish Farming Enterprise and Productivity Project (FFEPP) on fish farming practices indicates that over 90.3% of households sampled were headed by men. Wetengere (2010) observes that adoption of fish farming technologies in Eastern Tanzania was influenced by the level of education of farmers, gender, age, education, income, religious beliefs and knowledge and skills of the farmer among others. Cultural factors were said to have caused the failure of many of the subsistence fish culture projects supported through two USAID programs in Guatemala and Panama in the 1980s, (Mwamuye *et al.,* 2012).

Despite enormous resources and great potential, the integrated livestock-fish farming has failed to take off due to social and economic challenges. Integrated livestock-fish aquaculture is confined to remote villages by few poor farmers with little knowledge, whose work in most cases is unreported even in national aquaculture statistics, (Ogello, 2013). Haque et al.(2010) explain high levels of uptake and retention of fish farming culture introduced by a rice field-based tilapia seed production project, despite low financial returns, which is attributed to socio-cultural factors which appear insignificant if considered discretely.

Gender has always played a significant role in agricultural productions systems. Several sub-Saharan African countries provided information on the role of women in fish farming and the data show that women play a minor role in fish production and own or manage approximately 16 % of the farms .The highest proportion of women fish farmers (30 %) is in Zambia. Onzere, (2013) argues that project adaptability to the community as an important challenge and together agreed that community ownership and adequate support are required for sustainability. Consumer attitudes and preferences are a factor that influences the demand for fish. Fish has been seen as a 'healthy' product and has benefited from the trend towards reducing red meat consumption. Besides price and quality, consumers are increasingly concerned with how their food is produced. Farmed fish may arouse concerns for animal welfare as any intensive livestock production system. The environmental effects of intensive fish farming may also provoke a negative consumer response (Brummett, *et al.,* 2010).

III. RESEARCH METHODOLOGY

Descriptive research design was adopted in this study as it involves accurate description of characteristics of the population for the study with respect to the variables of the study. According to Burns and Grove (2003), descriptive research is designed to provide a picture of a situation as it naturally happens. It may be used to justify current practice and make judgment and also to develop theories. The design is appropriate as descriptive research attempts to answer what, who and why questions. The researcher wanted to uncover the factors affecting the sustainability of fish farming projects and collected information from respondents who were involved in fish farming projects in Kiambu County. According to Orodho and Njeru (2003), descriptive research is a method of collecting information by interviewing or administering a questionnaire to a sample of individuals.

The target population for the study was project managers' of public secondary schools fish farming projects in Kiambu

County. The county has 65 public secondary school fish farming projects registered under the Economic Stimulus Programme (ESP). The target population for the study therefore was 65project managers of the fish farming projects and 10 fisheries officers from each of the constituencies. Thus the target population of the study was 75respondents.

Table 3. 1 Fish Farming Projects in Kiambu County

Constituency	Fish farming projects	Project managers
Kikuyu	3	3
Kabete	5	5
Lari	11	11
Limuru	6	6
Githunguri	11	11
Kiambu	6	6
Thika	1	1
Gatundu North	11	11
Gatundu South	9	9
Juja	2	2
Total	**65**	**65**

Source: Economic Stimulus Programme (ESP)

The researcher used the list of all the public secondary schools that were funded by the government through the Economic Stimulus Programme in Kiambu County. The researcher proposed to adopt the cluster sampling technique. Cluster sampling technique was used to identify the constituencies in Kiambu County. The researcher proposed to adopt the census sampling technique. In this technique, the researcher used all the members of the population as the sample size for the study. The target population was 65 project managers and performing further sampling size formulas would reduce the sample size, further increasing the margin of error. The sample size for the study was therefore 75 respondents.

The researcher proposed to use both qualitative (in-depth interviews) and quantitative (questionnaire) methods of data collection. The researcher adopted a structured questionnaire to collect data from fish farming project managers. The researcher administered the questionnaires through personal interviews. This approach was preferred so as to provide an opportunity for the researcher to engage the respondents of the study. Personal interviews allowed the researcher to clarify, explain and probe for information from fish farming project managers. The option to use the questionnaire is that it is cheaper and quicker to administer and collect information from a large sample of the respondents for academic researchers, (Cohen *et al.*, 2007).

The questionnaire contained six sections. These were: the background information section, costs of inputs, technology, skills and training and social-cultural factors. The questionnaire comprised of both open-ended and closed-ended question items. The questionnaire also comprised of Likert scale questions. These questions were used to develop scales to measure the relationship between the independent and dependent variables.

Key informant interview guides were developed and administered to fisheries officers. In-depth interviews are an appropriate method of data collection as it allows the researcher to gather information from respondents who have a better and in-depth understanding and knowledge of the subject under study. The researcher adopted a semi-structured interview guide which allowed the interview to be open ended. This enabled the researcher to probe for more information from the interview participants' responses.

The data collection process began with the researcher seeking a letter of authorization from the university department. This letter introduced the researcher and the subject of the study to the respondents. The letter also motivated the respondents to participate in the study as it was only for academic purposes. The researcher also visited the Kiambu County Fisheries department and the Kiambu County Education department in order to seek for permission to collect data among the fish farming project participants. Data was collected through direct communication with the respondents by use of questionnaires.

Pilot testing was carried out on five respondents where a small scale trial run of a given small study was carried out to test research protocols, data collection instruments. The importance of pre-testing an instrument is for ensuring that the items in it are clearly stated and that they have the same meaning to all respondents (Mugenda & Mugenda, 2003). It also helps in discovering any errors and also assesses clarity. Data obtained during pilot testing was used to revise the instrument. A pilot

study was used to pretest the questionnaire's validity and reliability. In order to test and enhance the validity of the questionnaire, the researcher selected five respondent, three project managers and two fisheries officers. This aimed at assessing the content validity of the questionnaire. The comments from the five respondents were reviewed and incorporated to enhance the validity of the questionnaire.

Reliability is a measure of the degree to which a research instrument produces consistent outcomes after repeated trials, (Mugenda & Mugenda, 2003). In short, it is the repeatability of measurement. A measure is considered reliable if a person's score on the same test given twice is similar. Five questionnaires were piloted, with three project managers and two fisheries officers. The five questionnaires were then coded and responses input into SPSS which was used to generate the reliability coefficient. The researcher used the most common internal consistency measure known as Cronbach's Alpha (α) which was generated by SPSS. The recommended valueof0.7 was used as a cut–off for reliability for this study

Data analysis is the processing of raw data collected from surveys and interviews to make sense to the reader. It is also a process that seeks to identify themes, patterns and trends in the data collected, (Nachmias & Nachmias, 2000). The researcher proof read the raw data collected through the questionnaire with an effort to detect errors and omissions and ensured that data quality standards had been achieved. In order to analyze the quantitative data, the researcher coded the responses from the questionnaire for easier data entry process. The data was then entered into the Statistical Package for the Social Science (SPSS) for analysis. Descriptive analysis was performed which assisted in summarizing data and identifying data trends which allowed the researcher to undertake further statistical analysis to establish relationships between the dependent and independent variables of the study. Multiple regression analysis and correlation analysis are the inferential statistics which were undertaken to measure the relationships between the independent and dependent variables.

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon$

Where

β_0=Constant term

X_1 =Cost of inputs

X_2=Technology adoption

X_3=Skills and training

X_4 =Socio cultural factors

ε= error term

Y= Fish farming Project Sustainability

The results were presented in tables and figures and the researchers' own interpretation and comparison to the literature reviewed. Qualitative data was analyzed based on the content matter of the responses. The researcher also used the reviewed literature for discussion of the study findings.

IV. DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.1 Response Rate

The study was a census survey of project managers of fish farming projects in public secondary schools in Kiambu County and a questionnaire was used to collect the data. The study targeted 65 project managers but only 44 responded due to the fact that the other 21 projects had been closed down and the managers had left. All the targeted extension officers responded. This represented 72%which was considered as very good response rate of making references (Mugenda & Mugenda, 2003).

Table 4. 1 Target population

	Response frequency	**Target**	**Percentage**
Project managers	44	65	67.7
Extension officers	10	10	100
Total	**54**	**75**	**72**

4.2 Results of the Pilot Study

During pilot testing the researcher found out that the fisheries officers required authority to release information from their coordinator in Thika from whom the researcher had to request the officer to inform them in person. On validity, the researcher made corrections on some of the questions that the respondents were not sure of the specific responses required. On reliability, the researcher coded the responses into SPSS and generated reliability coefficient which was 0.805 which was found to be reliable. Table 4.2 shows results of reliability test.

Table 4. 2 Reliability statistics

Cronbach's Alpha	Cronbach's Alpha based on standardized items
0.793	0.805

4.3 Demographic information

So as to capture the general information of the respondents' issues such as gender, age, level of education, experience in fish farming, duration in the project and mode of involvement were sought.

4.3.1 Gender of the respondents

Majority of the individuals involved in the management of the projects were males comprising of 97.7% of the respondent while 2.3 % were females. This was an indication that women were few in the management of the projects which could be attributed as a social culture aspect which could be attributing to the sustainability of the projects.

Table4. 3 Gender of the Respondents

Gender	Frequency	Percent
Male	43	97.7
Female	1	2.3
Total	**44**	**100.0**

4.3.2 Age of the respondents

54.5% of the respondents were below 44 years while 45.5 % were above 44 years. This meant that the projects are managed by middle aged people.

Table4. 4 Age of the Respondents

Age	Frequency	Percent
25-34 years	10	22.7
35-44 years	14	31.8
45-54 years	19	43.2
Above 55 years	1	2.3
Total	**44**	**100.0**

4.3.3 Education level of the Respondents

59.2% of the managers had tertiary education and above while 40.8% of the manager's education level was below tertiary. This shows that the managers could be able to access information from the net on their own and could also interpret the behavior of the fish.

Table4. 5 Education level of the Respondents

Education Level	Frequency	Percentage
No formal education	1	2.3
Primary education	4	9.1
Secondary education	13	29.5
Tertiary education	25	56.8
Masters	1	2.3
Total	**44**	**100.0**

4.3.4 Experience in fish farming

Majority of the managers had experience in fish farming ranging from 1 year and above which comprised of 81.8% with 18.2% having had no experience in fish farming. This meant that majority were versant with the projects.

Table4. 6 Experience in Fish Farming

Experience in Fish farming	Frequency	Percent
Nil	8	18.2
1-5 years	33	75.0
Above 10 years	3	6.8
Total	**44**	**100.0**

4.3.5 Duration in the Project

84.1% of the managers had been in the projects for more than a year which implied that they had experience with the daily operations of the projects.15.9% of the respondents had an experience of less than 1 year which could mean that they had not gained enough experience in the projects management.

Table 4. 7 Duration in Project

Years in the project	Frequency	Percent
Less than 1 year	7	15.9
1-3 years	21	47.7
4-5 years	16	36.4
Total	**44**	**100.0**

4.3.6 Mode of involvement

75% of the managers were involved on fulltime basis which meant that they were well informed of the projects activities and had information of the management systems of the projects.25% of the managers were involved in part time basis which meant if issues arose in their absence, they were to be attended by other people who were not experts in the projects which could in turn affect sustainability of the projects.

Table4. 8 Mode of involvement

Mode of involvement	frequency	percent
Fulltime	33	75.0
Part-time	11	25.0
Total	**44**	**100.0**

4.4 Costs of inputs and sustainability of fish farming projects

4.4.1 Costs of inputs

Respondents, using a scale from 1= no extent at all to 5= a great extent, indicated that buying of fingerlings (4.16 mean score), purchase of feeds (4.61 mean score), water supply (4.32 mean score) and capital (4.77 mean score) did affect fish farming sustainability to some extent. On controlling of diseases and pests (1.98 mean score) the response was no extent effect.

On access to organized market (2.48 mean score), transportation (2.66 mean score) and storage (2.75 mean score), majority responded to no extent. This could be attributed to the fact that the fish produced was consumed in most of schools as the market.

Table4. 9 Likert Responses on inputs

Input	Mean	Std. Deviation
-buying of fingerlings/juveniles	4.16	1.363
-purchase of feeds	4.61	.993
-water supply	4.32	1.272
-capital/finance	4.77	.424
-controlling diseases and pests	1.98	1.191
-Access to organized market	2.48	1.548
-transportation	2.66	1.569
-Storage	2.75	1.686

4.4.2 Other input costs

70.5% of the respondents indicated that the projects did have other costs which were indicated as: buying of liners, digging ponds, training, security, buying nets, fencing round, and maintenance, managerial, sourcing of quality feeds, purchase of fertilizer / manure and land which would have been used for other economic activities. 29.5% of the respondent reported nil costs. This could be due to the fact that under E.S.P, the government was providing everything.

From the interview guide the major costs highlighted were: Pond construction, purchase of liners, purchase of feeds, purchase of fingerlings, pumping water, personnel for pond management, fencing round and purchase of fishing nets. This was in line with the responses collected.

Table4. 10 Other inputs

Other input costs	Frequency	Percent
-Nil	13	29.5
-buying liner	4	9.1
-digging ponds	1	2.3
-training before/ during	1	2.3
-security/nets	1	2.3
`-fencing round	4	9.1
a-Maintenance	1	2.3
l-Managerial	1	2.3
i-Sourcing quality feeds	1	2.3
ɑ-Purchase of fertilizer/manure	2	4.5
-buying liners/nets	4	9.1
-buying nets	4	9.1
-land	7	15.9
Total	**44**	**100.0**

4.4.3 Sources of Funding

93.2 % of the respondents indicated that their funding was from the government which was as a result of the economic stimulus programme.6.8% of the respondents had their projects funded by the school which was as a result of having exhausted the government funded lot of fish.

Table4. 11 Sources of Funding

	Sources of Funding	Frequency	Percent
Valid	National government	32	72.7
	County government	9	20.5
	School	3	6.8
	Total	**44**	**100.0**

4.4.4 Extent of cost of inputs

84.1% of the respondents indicated that costs of inputs affect sustainability of the projects to a large extent. This indicates that the projects are affected by the cost of inputs and their sustainability depends on costs of inputs.4.5% were neutral while 11.4% reported that costs of inputs affected sustainability to a less extent.

Table4. 12 Extent of costs Effect

	Extent of costs effect	Frequency	Percent
Valid	great extent	27	61.4
	large extent	10	22.7
	Neutral	2	4.5
	Less extent	5	11.4
	Total	**44**	**100.0**

4.5 Technology and sustainability of fish farming projects

4.5.1 Level of awareness of different technologies

Respondents, on a scale of 1 = very high to 5 =Not aware on the level of awareness, indicated that they had low level of awareness in the flow through (4.27 mean), Re-circulatory (4.39 mean), Induced breeding (4.48 mean), Sex reversal (4.55 mean) and use of homestead fish tanks (3.75 mean) technologies. This meant that these technologies are rarely or not used in the projects, meaning levels of economies of scale contributed by technology are not enjoyed in the projects thus affecting sustainability. Respondents were highly aware of floating feeds pellets (2.30 mean) which mean that, it's highly used in the projects.

Table4. 13 Level of Awareness

Technology	Mean	Std. Deviation
-flow through technology	4.27	1.283
-Re-circulatory technology	4.39	.920
-Induced breeding technology	4.48	.849
-Floating feeds technology	2.30	1.286
-Sex reversal technology	4.55	.848
-homestead fish tanks technology	3.75	1.164

4.5.2 Other Technologies

Other technologies noted were; availability of coolers, general management, integrated farming, use of green houses, predator security, control of water pollution, use of raised ponds, using sex reversal, different fishing methods, use of re-circulatory/ consecutive dams, control of population explosion, controlling interbreeding and pond fertilization. From the interview guide, the technologies adopted were: Intensive farming, hydroponics, green house rearing (few), aquaponics, integrated farming, raised ponds, recirculatory (very few), monosex farming, cage farming and sex reversal.

Table4. 14 Other Technologies

Other technologies	Frequency	Percent
-Nil	8	18.2
-Availability of coolers/white meet awareness	1	2.3
-General management	1	2.3
-integrated farming	1	2.3
-Green house	15	34.1
-Predator security/pollution control	1	2.3
-Raised ponds	1	2.3
-greenhouse/sex reversal	1	2.3
-Sex reversal	1	2.3
-Fishing methods	2	4.5
-Green house/raised ponds	2	4.5
-re-circulatory/consecutive dams	2	4.5
-population explosion	2	4.5
-interbreeding for control	4	9.1
-fertilizing ponds	2	4.5
Total	**44**	**100**

4.5.3 Availability of the other Technologies

54.55 % of the respondents indicated that other technologies were available which meant they were aware that they could be used in the projects. 6.8% were partly aware of other technologies while 38.6% were not aware of other technologies indicating they could not be used. Table 4.14 indicates the availability of other technologies

Table4. 15 Availability of other Technologies

Are the other technologies available	Frequency	Percent
No	17	38.6
Partly	3	6.8
Yes	24	54.5
Total	**44**	**100.0**

4.5.4 Factors affecting technology adoption

Respondents, on a scale of 1 =strongly agree to5 = strongly disagree, agreed to the fact that technology adoptions were hindered by the fact that they were too costly (2.09 mean), timing of introduction (2.36 mean), the farm size (2.36 mean) and inadequate source of information (2.41 mean).This meant that due to the hindrances, the technologies were not being used. Respondents were neutral on complex to utilize (3.48 mean) and lack of inputs (2.59 mean).This could be due to the fact that they were not aware of the technologies. There was a disagreement that they were culturally incompatible (4.25 mean).This indicates that if introduced, the respondents would embrace them.

From the interview guide adoption was hindered by: Land size, climatic factors, lack of finances, inadequate training, high costs of inputs, low quality of inputs, competition with other agricultural enterprises and unwillingness to invest. Table 4.15 shows the responses on the likert scale questions on the factors that hinder technology adoptions.

Table4. 16 Hindrances of Technology Adoption

Technology adoptions are hindered by	Mean	Std. Deviation
-complex to utilize	3.48	1.502
-too costly	2.09	1.273
-culturally incompatible	4.25	1.014
-lack of inputs	2.59	1.575
-timing of introduction	2.36	1.296
-farm size	2.36	1.586
-inadequate source of information	2.41	1.575

4.5.5 Extent to which Technology affect sustainability of fish projects

75 % of the respondents felt that to a large extent, technology does affect sustainability of fish farming which meant that technology does contribute to the sustainability of fish farming projects.22.7% felt that effect of technology was to a less extent while 2.3% felt the effect of technology to sustainability was to no effect. Table 4.16 shows the extent technology affects sustainability.

Table 4. 17 Extent technology affects

Extent technology affects	Frequency	Percent
great extent	29	65.9
large extent	4	9.1
less extent	10	22.7
No extent	1	2.3
Total	**44**	**100.0**

4.5.7 Technologies used in the Project

The technologies the projects had initiated on their own are: own feed formulation, use of manure and use of nets for protection against predators, for which use of nets consists of 40.9% which is majority.22.7% had initiated no technology,29.5% had initiated use of manure while 6.8% had initiated own feed formulation.

Responses from the interview guide showed the innovative technologies used were:

Semi intensive farming, greenhouse, predator traps/nylon strings, feed formulation, polyculture (mixed species), water exchange, growing of worms and algae, improvised bio filtration and rearing fish on water raceways. Table 4.17 shows the technologies used in the fish projects.

Table4. 18 Technologies used

Technologies used in the projects	Frequency	Percent
Nil	10	22.7
Nets	18	40.9
using manure	13	29.5
Valid own feeding making	3	6.8
Total	**44**	**100.0**

4.6 Influence of skills and training on fish farming projects

4.6.1 Skills and training

70.5% of the respondents had received training. This shows they were well informed of the projects requirements.29.5% had not received training which could mean they did not get the basic information of the farming which could in turn affect sustainability. Table 4.18 indicates if members received training

Table4. 19 Training Received

Training received	Frequency	Percent
No	13	29.5
Yes	31	70.5
Total	**44**	**100.0**

4.6.2 Skills Trained

75% 0f the respondents reported to have had received skills and training on: feeding, harvesting, green house, floating feeds, cage system, grading, slaughtering, fingerlings introduction, cooking, marketing, choice of fingerlings, pond fertilization, breeding control, types of feeds and water management. 25% of the respondents indicated to not have received no training.

From the informant guide, some of the skills and training offered were: water management, feeding, Sampling, harvesting and slaughtering, feed formulation, cooking and eating, pond site selection, construction and fertilization, predator control, record keeping types of fish, preservation, value addition, stocking and marketing systems and linkages. Table 4.19 shows the skills managers were trained on.

Table 4. 20 Skills Trained

Skills trained on		Frequency	Percent
Valid	-nil	11	25.0
	-feeding/harvesting	8	18.2
	-greenhouse/floating feeds/cage system	1	2.3
	-grading/slaughtering/fingerlings introduction	1	2.3
	-cooking	1	2.3
	-marketing	1	2.3
	-choice of fingerlings/feeding/pond fertilization	1	2.3
	-fingerlings introduction	1	2.3
	-feeding/pond fertilization	6	13.6
	-breeding control	1	2.3
	-feeding/types of fish	2	4.5
	-feeding/ water management	2	4.5
	-pond fertilization/fingerlings introduction/harvesting/ cooking	8	18.2
	Total	**44**	**100.0**

4.6.3 Members undergoing training

72.7% of the respondent would undergo training in the course of the project undertaking. This meant they were informed of new developments while 27.3 had not undergone any training which meant they were managing the projects from their own understanding. Table 4.20 indicates if members would undergo training.

Table4. 21 Undergoing training

Undergoes training	Frequency	Percent
No	12	27.3
Yes	32	72.7
Total	**44**	**100.0**

4.6.4 Frequency of Training

75% of the respondents did receive training at least once in a year. This show there was adequate training. Of all the respondents, 25% had not undergone any training at all and this could mean that they were not aware of any new information on the projects.

From the interview guide the responses on frequency on training were: on demand, quarterly, when funds are available, yearly and Semi-annually. Table 4.21 shows the frequency with which training was received.

Table4. 22 Frequency of Training

Frequency of training		Frequency	Percent
Valid	Nil	11	25.0
	Monthly	3	6.8
	Quarterly	8	18.2
	Half Yearly	9	20.5
	Yearly	13	29.5
	Total	**44**	**100.0**

4.6.5 Training Providers

Of those who received training, 70.5% received training from extension officers which meant it was from the government. 6.8% got their training from contact farmers (selected farmers who had undergone training by visiting well performing projects) while 22.7% had no training. From the interview guide the training was offered by extension officers, farm visits and suppliers of fingerlings and feeds. Table 4.22 shows training providers

Table4. 23 Training Providers

Training providers		Frequency	Percent
Valid	Nil	10	22.7
	Extension officer	31	70.5
	Contact farmer	3	6.8
	Total	44	100.0

4.6.6 Manager's skills and knowledge

Respondents , on a scale of 1=strongly agree to 5= strongly disagree, agreed that extension services were readily available (1.95 mean), project performance are affected by performance skills (1.50 mean) and managers were always informed of new skills (1.25 mean).Respondents were neutral to the statement that they were trained before the project roll out (2.61 mean)while they disagreed with the statement that they had adequate training (3.66 mean).This would mean that more training was required. Table 4.23 shows the response to the likert scale questions on manager's skills and knowledge.

Table4. 24 Opinion on Management skills

Opinion on management skills	Mean	Std. Deviation
-managers trained before roll out	2.61	1.660
-extension services readily available	1.95	1.200
-adequate management training available	3.66	1.077
-project performance affected by management skills	1.50	.792
-Managers always informed of new skills.	1.25	.576

4.6.7 Extent skills affect sustainability

93.2% of the respondents indicated that skills and training did affect sustainability to a large extent while 6.8% were neutral on whether skills do affect sustainability. This shows that skills do affect sustainability. Table 4.24 shows the extent to which fish farming skills affect sustainability

Table4. 25 Extent Skills affect sustainability

Extent skills affect sustainability		Frequency	Percent	Cumulative Percent
Valid	great extent	36	81.8	81.8
	large extent	5	11.4	93.2
	Neutral	3	6.8	100.0
	Total	**44**	**100.0**	

4.6.8 Skills and training required

The skills and training that were identified as required were: handling fingerlings, diseases, feed formulation, sex reversal, integrated farming, breeding, slaughtering, cooking, genetic improvement, marketing, and preservation. Table 4.25 shows the skills that the mangers felt they require to be trained on.

Table4. 26 Skills and training required

Skills and training required		Frequency	Percent
Valid	-Nil	2	4.5
	-Handling fingerlings/diseases/ feed formulation	7	15.9
	-diseases/sex reversal/integrated farming	3	6.8
	-integrated farming/greenhouse	2	4.5
	-breeding/feed formulation	4	9.1
	-slaughtering/cooking	2	4.5
	-sex reversal/feeding	1	2.3
	-genetic improvement	1	2.3
	-marketing	1	2.3
	-sex reversal	5	11.4
	-feeding/sex reversal	13	29.5
	-preservation	3	6.8
	Total	**44**	**100.0**

4.7 Social Cultural Issues

4.7.1 Attitudes, Culture change, Ethnic values, Family structure and Religious practices

Using a scale of 0=disagree and 1= agree, respondents indicated that attitude do affect sustainability of the projects while Culture change, Ethnic values, Family structure and religious practices do not affect sustainability

Responses from the interview guide showed that the social –cultural aspects as: beliefs that fish is for some communities, eating phobia (fear of bones),religious issues (cat fish), quick money(alternative agricultural practices), lack of preparation skills, smell, upbringing, water phobia and competition.. Table 4.26 indicates social cultural effects on the fish projects

Table4. 27 Social Cultural Issues

Social Cultural Issues	Mean	Std. Deviation
Attitudes	.66	.479
Culture change	.36	.487
Ethnic values	.18	.390
Family structure	.30	.462
Religious practices	.14	.347

4.7.2 Extent of fish consumption by surrounding community

86.4% of the respondents indicated that the consumption of fish by the surrounding community was to a large extent. This indicated that they have a positive attitude towards fish consumption and a ready market for the produce which in turn meant that sustainability of fish farming projects are affected by the attitude of the surrounding communities.11.4% was neutral while 1% felt that consumption was to a less extent. Table 4.27 indicates the extent with which the surrounding communities consume fish.

Table4. 28 Extent of consumption

Extent of consumption		Frequency	Percent	Cumulative Percent
Valid	great extent	28	63.6	63.6
	large extent	10	22.7	86.4
	Neutral	5	11.4	97.7
	less extent	1	2.3	100.0
	Total	**44**	**100.0**	

4.8 Fish Farming Sustainability

On a scale of 1=strongly agree to 5=strongly disagree, respondents agreed that availability of ready market (1.43 mean),financial reliability of the project (1.41 mean), project meeting its profit thresh hold(1.91 mean), access to training (1.64 mean) and costs of input (1.84 mean) do affect the sustainability of the project. This showed that these factors would determine if the projects will continue operating. Respondents were neutral on risk posed by the risks involved (2.5 mean) and that the projects had acquired a lot of technology (3.02 mean).

Respondents from the interview guide indicated the factors as:

Lack of project ownership, poor quality liners, water factors (at times not reliable and polluted), land sizes, lack of capital, proximity to market, climate, infrastructure (electricity for greenhouses), comparison to other agricultural enterprises and lack of initial training.

The strategies adopted so as to improve fish farming sustainability were indicated to be:

use of aquaponics, farming catfish, improving extension services, train on feed formulation, buying liners on behalf of farmers , provide fingerlings, linking with reputable suppliers, strict follow up, formation of cluster groups, exchange visits, encourage mono sex farming(catfish) and encourage value addition. Table 4.28indicates the opinion of the respondents on factors affecting fish farming sustainability.

Table 4. 29 Factors Affecting Sustainability

Factors affecting projects' sustainability	Mean	Std. Deviation
-availability of ready market	1.43	.873
-project is financially reliable	1.41	.583
-losses do not pose risk	2.50	1.563
-project meets profit thresh hold	1.91	.960
-a lot of technology acquired	3.02	1.285
-access to training affect project	1.64	1.123
-costs of input affect project	1.84	1.119

4.9 Inferential statistics on sustainability of fish farming projects.

Variables were correlated using Pearson correlation analysis at a 0.05 level of significance so as to determine the relationship. From the results, there is a significant positive correlation between costs of inputs and sustainability of fish farming with a correlation of 0.165 and p value of 0.285.This agrees with research done in 2013 which confirmed that, "good quality, affordable and accessible inputs such as fish seed and feed are the main components for successful aquaculture projects, (SARNISSA, 2011). Technology factors had a positive correlation with fish farming sustainability value of 0.33.which was in agreement with Wetengere, (2010), who found out that despite high potentials that fish farming possess, the adoption of technology leaves much to be desired. There was a positive correlation of 0.27 between skills and knowledge and fish farming sustainability. The results agreed with those of Singas and Manus, (2014), who found out that lack of knowledge and skills, was ranked a problem facing fish farming projects. Social cultural Attitudes had the highest positive correlation of 0.421 with fish farming sustainability. This confirmed the observations made by Mwamuye *et al.* (2012), that cultural factors were said to have caused the failure of many of the subsistence fish culture projects supported through USAID programs in Guatemala and panama. Inferential statistics were used so as to reach conclusions extending beyond immediate data alone. They were used to infer from the sample data what the population might think of the probability that the factors affecting sustainability are dependable.

Table4. 30 Correlation of variables

		Fish farming Sustainability: N=44
Costs of inputs	Pearson correlation	0.165
	Sig (2 tailed)	0.285
Technology Factors	Pearson correlation	0.33
Sig (2 tailed)	0.831	
Skills and knowledge	Pearson correlation	0.270
Sig (2 tailed)	0.77	
Social Cultural Attitudes	Pearson correlation	0.421
Sig (2 tailed)	0.004	

Regression analysis was conducted so as to measure the influence of the independent variables (cost of inputs, technology adoption, skills and training, and social cultural factors) onto the dependent variable fish farming project sustainability. The co-efficient of determination (R^2) was found to be 0.252 which means 25.2%of sustainability is influenced by the independent variables, meaning there are other factors not included in the model that influence fish farming sustainability

Table4. 31 Regression Analysis

Model	R	R^2
	0.502	0.252

Predictors: (constant), Social Cultural Attitudes Cost of inputs, Skills and Knowledge, Technology factors.

So as to come up with the regression model, the coefficients of the independent variables were found to be: cost of inputs (0.12), technology adoption (0.08), skills and knowledge (0.14) and social cultural factors (1.47) while the constant was 4.83.Thus the regression model is

$Y = 4.83 + 0.12x_1 + 0.08x_2 + 0.14x_3 + 1.47x_4 + \varepsilon$

Table 4.31 shows the coefficients of independent variables

Table 4. 32 Coefficients

	Coefficients
(Constant)	4.833
Costs of inputs	.12
Technology Factors	.08
Skills and Knowledge	.14
Social Cultural Factors	1.47

V. FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of major Findings

The purpose of the study was to investigate the factors that affect sustainability of fish farming projects in public secondary schools in Kiambu County. The following specific objectives were followed: establish if costs of inputs, technology, skills and training and social cultural factors do affect sustainability of fish farming projects in public secondary schools in Kiambu County. The researcher adopted the descriptive research design .The target population for the research was 65 public secondary schools and 10 fisheries officers totaling up to 75 respondents. A total of 44 project managers participated sine the other 21 had been closed down. Data for the research was collected using a questionnaire for the managers and an interview guide for the fisheries officers. The questionnaire contained five parts which were: background information, costs of inputs on sustainability of fish farming, technology and sustainability on fish farming, influence of skills and training on fish farming projects, social cultural attitudes effect on sustainability of fish farming projects and fish farming sustainability .The research was carried out between May and July 2016.

Descriptive (mean, standard deviations, frequencies and percentages) were adopted together with inferential statistics (correlation and regression) so as to come to a measure of relationship and meanings. For ease of understanding and analysis, tables were used.

On costs of inputs, cost of capital was found to be the highest followed by that of feeds, water supply and costs of fingerlings. This shows that these were the major inputs whose costs affect fish farming sustainability. The findings concur with those of Sarnissa (2011) who found out that affordable and accessible inputs such as fish seed (fingerlings) and feed are the main components for successful aquaculture farms and projects.. It also concurs with (Singas & Manus, 2014) who found out that it is difficult for farmers to adopt aquaculture if they don't have access to funds to maintain their ponds and buy feeds. The results were in agreement with (Brummet & Rana, 2010) who found out that 50% or more of the operational costs were on feeds and fingerlings.

The results showed that there was a positive relationship between costs of inputs (0.165) and fish farming sustainability though not statistically significant. This means that an increase in costs of input would positively affect fish farming sustainability.

On the level of awareness of different technologies, results indicated that respondents were not aware of sex reversal, induced breeding, re-circulatory, flow through and use of homestead fish tanks. This meant that since they were not aware of them, then they were not adopting them. For them to be made aware, then dissemination of information is necessary which calls for access to funds.

This concurs with Mwamuye et al.(2012) who noted that inefficiency in dissemination of technology transfer to farmers ranked high among key challenges of aquaculture in Kenya. Wetengere (2010) agreed that despite high potentials that fish farming possess, the adoption of technology leaves a lot to be desired. The results of not adopting technology were also in line with the observation made by Jacobi, 2013) who observed that, one way of achieving higher pond productivities, and hence self-sustainable aquaculture practices, is the promotion and use of available fish farming technology which was however not widely used by ESP supported farmers. Pearson's correlation indicated that the relationship between technology and fish farming sustainability was positive though not statistically significant.

From the analyzed data, there was an indication that managers received training at least once a year. Respondents were of the agreement that extension services were readily available and that project performance are affected by skills and training .This concurs with (The organic Farmer, 2012) ,who stated that fish farming requires that farmers undergo training and seek advice from fisheries experts about general fish management. Singas and Manus (2014) also argued that the key constraint to aquaculture development is dissemination of existing knowledge, whether derived from research or indigenous technical knowledge of farmer. From Pearson's correlation, there was an indication that skills and knowledge (r=0.27) had a positive relationship with fish farming sustainability though not statistically significant.

Responses showed that social cultural factors like attitude, culture ethnic values and religious issues had an effect on sustainability of the projects. From Pearson's correlation, social cultural factors had a positive effect on sustainability which was statistically significant .

This relationship is supported by Mwamuye *et al.* (2012) who observed that cultural factors were said to have caused the failure of many of the subsistence fish culture projects supported by two USAID programs in Guatemala and Panama in the 1980s.Maina *et al.* (2014) who conducted a study on the influence of social- economic, gender and the Fish Farming Enterprise and Productivity Project (FFEPP) on fish farming practices indicated that over 90.3% of households sampled were men. This concurs with the findings as97.7% of the managers were men which means that their social characteristics would influence the sustainability of the projects.

5.2 Conclusions

Despite the managers being trained and having information to run the projects successfully and the government having ejected funds into the projects, sustainability of fish farming projects still remain affected by a number of key factors. These factors include: costs of inputs which will require one to have funds, technology so as to produce in large scale, skills and training which will assist in better management and social-cultural factors which will determine if the projects will be fully accepted just like the other competing agricultural enterprises.

5.3 Policy Recommendations

The following are the recommendations of the study:

The government of Kenya should be more involved in lowering the costs of input in fish farming and also play a key role in ensuring that farmers get quality inputs so as to have better harvest and thus sustain the projects. As the costs are lowered, government should play a key role in ensuring that quality fingerlings and feeds are produced so as to sustain the projects.

More extension officers should be availed so as to disseminate information on the new technologies. Government should ensure that the cost of acquiring these technologies is affordable to the farmers. Where the technology is too costly for a single farmer to afford, farmers should be encouraged to form groups through which they can be sensitized on the technology and it be provided at a subsidized rate.

up for farmers wishing to start up the projects so as to ensure they acquire the necessary skills and training before, which means a lot of extension services being availed. Government should ensure that enough resources are availed to the extension officers who are the contact experts to the farmers to ensure timely dissemination of training and skills.

The “eat more fish” campaign to be enhanced by educating the surrounding communities on the importance of fish consumption and thus encouraging fish farming .More women need to be involved in management of fish projects so as to change the attitude towards fish consumption and eventually fish farming.

5.4 Suggestions for further study:

This study found that influence of social cultural factors to be the most significant in sustainability of fish farming. This study therefore suggests that further studies be conducted on the role of social cultural factors on fish farming sustainability. From the study, there seem to be other factors that affect fish farming sustainability in secondary schools and the study also suggests that further studies be carried out over these factors .

REFERENCES

[1] Abiona, B. G., Fakoya, E. O., Alegbeleye, W. O., Fapojuwo, E. O., Adeogun, S. O. et al. (2011). Constraints to Integrated and Non – Integrated Fish Farming Activities in Ogun State, Nigeria. *Journal of Agricultural Science*, 3 (4), 233-240

[2] Abiona, B. G., Fakoya, E.O., Apantaku, S.O., Alegbeleye, W. O., Ajayi, M. T., Obasa, S. O., &Arowolo, K. (2012). Assessment of Farmer’s Technologies on Integrated Fish Farming and Non – Integrated Fish Farming in Ogun State, Nigeria. *Global Journal of Science Frontier Research Agriculture & Biology, 12* (2), 1-8

[3] Beveridge, M., Phillips, M., Dugan, P., &Brummett, R. (2010). Barriers to aquaculture development as a pathway to poverty alleviation and food security: Policy coherence and the roles and responsibilities of development agencies. In: OECD (2010), *Advancing the Aquaculture agenda*. Proceedings of a workshop, Paris, 15-16 April 2010. pp. 199- 209. Paris, OECD

[4] Blumer, H. (1969). *Symbolic Interactionism: Perspective and Method*. Englewood Cliffs, NJ: Prentice Hall.

[5] Burns, N. & Grove, S. K. (2003). *Understanding Nursing Research* (3rd Ed). Philadelphia, PA: W. B. Saunders, pp. 195-201

[6] Chinyio, E. &Olomolaiye, P. (2010). *Construction Stakeholder Management* (1st ed.). London, UK: Wiley-Blackwell

[7] Cobb, C. W. & Douglas, P. H. (1928). A theory of production, *the American Economic Review, 18* (1), 139-165

[8] Cohen, L., Manion, L. & Morrison, K. (2007). *Research Methods in Education.* 6th Edition. London, UK: Routeldge.

[9] Delgado, C. L., Wada, N., Rosegrant, M. W., Meijer, S. & Ahmed, M. (2003). *Fish to 2020: Supply and demand in changing global markets.* International Food Policy Research Institute, Washington D.C.

[10] Ele, E. I., Otu W. B., Essien A. A-O., Iniobong, E. O. &Ekaette, S. U. (2013). Economic Analysis of Fish Farming in Calabar, Cross River State, Nigeria, *Greener Journal of Agricultural Sciences, 3* (7), 542-549

[11] Fakoya, K. A., Owodeinde, F. Go Jimoh, A. &Akintolp, S. L. (2001). *An overview of the challenges and prospects in developing an aquaculture industry in Lagos state, Nigeria.* Department of Fisheries, Faculty of science, Lagos state University,

[12] FAO (2012).*The State of World Fisheries and Aquaculture 2012.* FAO Fisheries and Aquaculture Department, Food and Agriculture Organization of the United Nations Rome, Italy.

[13] Fine, G. (1993) ‘The Sad Demise, Mysterious Disappearance, and Glorious Triumph of Symbolic Interactionism’, *Annual Review of Sociology, 19* (2), 61–87.

[14] Freeman, R. E. (1984). *Strategic Management: A Stakeholder Approach* (1st ed.) Boston, MA: Pitman Publishing

[15] GoK (2007). Ministry of Livestock and Fisheries Development, Annual Reports. Livestock Production Division, Nairobi, Kenya.

[16] GoK (2009). *Economic Stimulus Programme*. Office of the Deputy Prime Minister and Ministry of Finance. Nairobi

[17] GoK (2009). Fish Farming Enterprise Productivity Programme. Project Document. Ministry of Fisheries Development. Nairobi

[18] GoK (2010). Fish Farming Enterprise Productivity Programme-Phase 2 (proposal), Ministry of Fisheries Development, Nairobi,

[19] Haque, M. M., Barman, B. K. &Murshed-e-Jahan, K. (2010). Effectiveness of Different Pond Access Arrangements for Cage Based Fish Fingerling Production by Adivasi Households, Policy Brief, the World Fish Center, Bangladesh.

[20] Henri-Ukoha1, A., Ohajianya, D. O., Nwosu, F. O., Onyeagocha, S. U. O. &Nwankwo, U. E. (2011). Effect of World Bank Assisted Fadama II Project on the Performance of Fish Farming in IMO State, South East Nigeria: A Comparative Evaluation. *American Journal of Experimental Agriculture,1* (4),450-457

[21] Herman, N. J. & Reynolds, L. T. (1994). *Symbolic Interaction: An Introduction to Social Psychology*. Lanham, MD: Altamira Press.

[22] Ike, N. &Onuegbu, R. (2010). Adoption of Aquaculture Technology by Fish Farmers in Imo State of Nigeria,*the Journal of Technology Studies, 2* (3), 57-64

[23] Jacobi, N. (2013). Examining the Potential of Fish Farming to Improve the Livelihoods of Farmers in the Lake Victoria Region, Kenya Assessing Impacts of Governmental Support. Unpublished Thesis. University of Akureyri

[24] Kariuki, M. N. (2013). Strategic Practices for Effective Implementation of Fish Farming Enterprise Productivity Programme in Kenya: A Case Study of Molo Constituency. *International journal of innovative research and studies, 2* (8), 88-146

[25] LaRossa, R. &Reitzes, D. C. (1993). Symbolic Interactionism and Family Studies.” Pp. 135–163 in *Sourcebook of Family Theories and Methods: A Contextual Approach*, edited by P. G. Boss, W. J. Doherty, R. LaRossa, W. R. Schumm, and S. K. Steinmetz. New York, NY: Springer.

[26] Maina, J. G., Ngugi, J., Omolo, B., Orina, P., Mbuthia, P. G., Karuri, E. G., Wangia, S. &Owiti, G. O. (2012). Influence of social-economic factors, gender and the Fish Farming Enterprise and Productivity Project on fish

farming practices in Kenya. *Livestock Research for Rural Development, 26* (2), 1-23

[27] Martinussen, J. (1999). Society, State and Market: A guide to competing theories of development. Dhaka. University Press Ltd.

[28] Mbugua, H. M. (2008). *Aquaculture in Kenya; Status, Challenges and Opportunities.* Directorate of Aquaculture Development, Kenya.

[29] Murimi, J. (2014). Nets cast wide as Sh1b fish farming programme launched. [Online]. Available: http://www.thepeople.co.ke/55844/nets-cast-wide-sh1b-fish-farming-programme-launched/

[30] Mwamuye, M. K., Cherutich, B. K. &Nyamu, H. M. (2012). Performance of Commercial Aquaculture under the Economic Stimulus Program in Kenya. *International Journal of Business and Commerce,2* (3), 01-20

[31] Mwangi, H. M. (2008). *Aquaculture in Kenya, Status Challenges and Opportunities.* Directorate of Aquaculture, Nairobi, Kenya.

[32] Nachmias, C. &Nachmias, D. (2000). *Research Methods in the Social Sciences*. (6th Ed). New York, NY: Worth

[33] Ngugi, C. C. &Manyala, J. O. (2004). Review of aquaculture extension service in Kenya. In: Pouomogne V,Brummett RE (eds) *Aquaculture extension in sub-Saharan in Africa*, FAO Fisheries Circular No 1002FIRI/C1002 (en)

[34] Njankouawandji, D., Pouomogne, V., NyemeckBinam, J. &Nouaga, R. (2012). Adoption of New Aquaculture Technologies in the Western Highlands of Cameroon. *Tropicacultura, 30* (3), 180-184.

[35] Ogello, E. O., Mlingi, F. T., Nyonje, B. M., Charo-Karisa, H. &Munguti, J. M. (2013). Can Integrated Livestock-Fish Culture Be a Solution to East Africa's Food Insecurity? A Review. *African Journal of Food Agriculture Nutrition and Development, 13* (4). 8058-8076

[36] Oloo, R. D. A. (2011). Fish Farming As a Means of Boosting the Economy of Kisumu County, Kenya. Unpublished Thesis. Edinburgh Napier University.

[37] Onzere, L. N. (2013). Factors Influencing Performance Of Community Based Projects: A Case Of Fish Farming In Nyeri County, Kenya. Unpublished Masters Project. University of Nairobi

[38] Orodho, J. A. &Njeru, H. E. (2003). *Financing Education in Kenya: Secondary School Bursary School Implementation and Challenges.* Discussion Paper 035/2003, Institute of Policy Analysis and Research

[39] Persson, U.; Olander, S. (2004). *Methods to Estimate Stakeholder Views of Sustainability for Construction Projects.* In Proceedings of the 21th Conference on Passive and Low Energy Architecture, Eindhoven, the Netherlands, 19–22 September 2004.

[40] PMI Standards Committee. (2004). *A Guide to the Project Management Body of Knowledge*. (3rd ed.). Pennsylvania, PA: Project Management Institute (PMI)

[41] Pretty, J. N., Morison, J, I, L. & Hine, R. E. (2003). Reducing Food Poverty byIncreasing Agriculture Sustainability in Developing Countries. *Agric. Ecosyst. Environ., 95*, 217–234.

[42] Rajan, P., Dubey, M. K., Singh, S. R. K. & Khan, M. A. (2013). Factors Affecting Knowledge of Fish Farmers Regarding Fish Production Technology**.** *Indian Res. J. Extension Education,13* (2), 126-128

[43] Shitote, Z., Wakhungu J. & China, S. (2012). Challenges Facing Fish Farming Development in Western Kenya. *Greener Journal of Agricultural Sciences, 3* (5), 305-311

[44] Singas, S. & Manus, P. (2014). Factors Influencing Adoption of Pond Fish Farming Innovations in Potsy of Morobe Province, Papua New Guinea. *Universal Journal of Agricultural Research, 2*(6), 191-197

[45] The Organic Farmer (2012). *Bad start for many fish farmers. Number 91*. [Online]. Available: www.organicfarmermagazine.org

[46] Wetenegere, K. (2010). Realizing Farmer's Objective - Vital to Adoption Process of Fish Farming Technology. The Case of Selected Villages in Eastern Tanzania. *Advance Journal of Food Science and Technology, 2* (2), 116-124

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