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Opportunities in adoption of commercial fish farming as a new enterprise for small scale farmers in Kisii county, Kenya

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ABSTRACT

The paper focuses on the opportunities which are present in the livestock sector in terms of new enterprises and which are not exploited by the farmers in the study area. It analyses the socioeconomics behind adoption of fish farming as an enterprise- describing the adopters' characteristics and explaining the factors that influence the adoption process. Most of the analyzed factors are important and significantly influence the decision to adopt fish farming enterprise, with land size only having a negative relationship. The enterprise is also found to be a profitable venture when the financial analysis is done.

Key words: adoption, fish farming, household, small scale farmer, socioeconomic factors

INTRODUCTION

Fish is ranked the fifth most important agricultural commodity and accounts for 7.5 percent of total world food production with about 1 billion people in developing countries depending on fish products as the primary source of animal protein [5]. Nevertheless, aquaculture production is dominated by Asian countries contributing 85% of total output and China alone accounting for about 70%; in 2004, Sub-Saharan Africa contributed only 1.6 percent (93500 tonnes) of the total fish production [12].

The fisheries sub-sector provides employment and income to over 500,000 Kenyans engaged in fish production and related enterprises [15]. The main fish species presently farmed in Kenya are the African Catfish (Clarias gariepinus), Nile tilapia (Oreochromis niloticus), Common carp (Cyprinus carpio) and Tilapia zillii. Current data shows that the value of fish farmed in Kenya grew from 1047 MT valued at Ksh. 55,627,000 in 2006 to 4897 MT in 2009 with a value of Ksh.971,120,000 [10]. About 30% of the fish is exported.

There are estimated to be 22000 ponds in Kenya currently and approximately 5000 fish farmers [12]. Though Kenya has the potential fish farming area of over 1.14 million hectares and if fully exploited, production could be increased to 11 million metric tones per annum and fetch Ksh.750 billion, farmers have not come out fully to maximize the opportunities in this sector. Latest developments in the sector indicate that the government rolled out Ksh.1.12 billion to support fish farming activities in the country and constructed 200 ponds in 140 constituencies with the aim of reducing poverty [7].

Despite the potential in fish farming, farmers in high potential agricultural zones in Kenya still majorly depend of food crop farming. These farmers are faced with ever increasing land fragmentation due to high population and they have continuously cultivated available arable land resulting in low productivity. This study looks into viability of fish farming as an alternative enterprise for farmers in such high potential areas and also delves into the socioeconomics characteristics of the farmers.

MATERIALS AND METHODS

Study Area

Kisii County is located to the south east of Lake Victoria. The total area of the county is 1,317.4km2. It lies on a highland equatorial climate thus receives rain almost throughout the year, and there are two rainy seasons; short season of September to November and long season from February to June. Rainfall is of over 1500mm per annum and temperatures can range from 16 to 27 degrees Celsius. The area has well drained red clay soils that support a variety of crops including cash crop production (tea and coffee) and subsistence crops (maize, beans, millet and potatoes). The area also has several permanent rivers and streams that drain into Lake Victoria. With a population of 1,152,282 people (48% male and 52% female) and an annual growth rate of 2.75 %, most farmers are small scale holders with farm sizes ranging from 0.1 to

1 hectare. The area is also characterized by high population density with over 800 persons per square kilometer. Kisii County is in fact ranked among the top ten most populated counties in the country (census, Donor 2009). Fifty one per cent of the population in this county lives below poverty line and the age dependency ratio is 100:94 [9].

Sampling design and Data collection

Comprehensive information was collected from the study area. Multistage sampling technique was used to sample small scale farmers in this study. The county was first divided into two strata on a district basis. Gucha South and Kisii central districts were purposively selected because of the presence of significantly high number of fish farmers. From the two districts, farmers were divided into adopters and non-adopters of fish farming. Using a source list divisions with the highest numbers of fish farmers were identified. The fish farmers who had practiced fish farming for more than two years were all purposively selected, in order to increase reliability of data collected and recall. From the same divisions, a random sampling of non-adopters was done. A sample size of 160 was used, 80 adopters and 80 non-adopters.

Data Analysis

Chi square test and z-test were used to test whether adopters and non-adopters of fish farming had any difference in terms of their characteristics. Chi square was used to determine whether there was an association between the categorical variables. Z-test was used because the sample size was greater than 30. Where the P value was less than the conventional 0.05, the null hypothesis was rejected.

The study was based on the maximization of expected utility theory. The traditional consumer theory explains that for a rational consumer to choose between alternatives i and j (the two being discrete choices) the probability of choosing i over j occurs when the utility of i is greater than that of j i.e. .The binary logit model was used to analyze factors affecting the decision to adopt of fish farming in Kisii area. In studies where the dependent variable (Yi) is dichotomous in nature, there are different regression models that can be used like the Linear probability model, logit and probit. Linear probability model is criticized for assuming that marginal probability is constant [8]. Compared to the probit model, a logit model is preferred due to its simpler mathematical structure. According to Mohammed and Ortmann [13], the logit model is based on the logistic cumulative distribution function and its results are thus not sensitive to the distribution sample attributes when estimated by maximum likelihood. The logit model provides the advantage of predicting the probability of farmers adopting any technology.

The empirical model was specified as:

$$Yi=\alpha+\beta1GNDR+\beta2AGE+\beta3SCHYRS+\beta4NOEXTIM+\beta5LSIZ+\beta6AMTCRDT+\beta7NOMFGRP+\beta8HHSIZ+\beta9NOLIVE+\beta10COFINC+\beta11YRSFARM+\mu$$

With the explanatory variables being: gender, age, education level, frequency of extension visits, land size, credit borrowed, membership in farmer groups, household size, livestock ownership, amount of farm income and farming experience (years).

To determine profitability, gross margin analysis was done to assess the enterprise's profitability. The costs the farmer incurred included land clearing, pond construction, purchase of fingerlings, fertilizer costs, harvesting, maintenance and marketing costs. The gross receipts were from sale of marketed fish.

RESULTS

Background information

Total acreage owned by farmers in the study area was 412 acres under various farm enterprises and the mean land holding was 2.5 acres with a standard deviation of 1.1acres. This indicated that producers in this area did not have large land holdings. The average household size was 8.3 people which was higher than the recommended household size in Kenya of 5.1 people [11]. The mean number of years the respondents had attended school was 9.7 indicating that most of the respondents were literate. The respondents were predominantly male, with only 20 percent being females. The most common age group in this study was 41-50, probably because they were still energetic and recognized the importance of farming. The major source of labor on the farms was family labor. Household labor is associated with family size. High population in this area has provided an abundant and cheap labor for those who hired labor for their farms (40 %).

The government of Kenya has provided the fish farmers support in their production through Economic Stimulus Programme (ESP). Over 50% of the farmers sampled agreed that they had their ponds constructed by the government through the constituency development funds, further, 13% percent received training on fish farming through ESP.

Analysis of adopters and non-adopters of fish farming in Kisii

To determine whether there was an association between the dependent variable (adoption of fish farming) and the independent variables, two tests of independence were used. The Chi Square test was used for the categorical variables, while the z-test was used for the discrete variables.

Table 1:Categorical variables tested for independence using Chi square test

Variable	df	p
GNDR	1	0.001**
MARST	1	0.135
COFINC	1	0.593
AMTCDRT	1	0.001**

Source: own survey data **significant at 1 percent

As shown in Table 1 above, only the variables gender and credit borrowed were significant. In the gender variable, since $p<0.001$, it was concluded that adoption of fish farming was associated with gender of the farmer with more males adopting the enterprise than females. According to the above results, more fish farmers accessed credit than the non-fish farmers. The variable showing the amount of credit borrowed was significant at one percent level Of these variables age, education level, years of experience in farming and frequency of extension visits were significant at 1percent level as shown in Table 2 above. For age, the adopters were younger people who were more likely to take to new enterprises from which they expected higher returns. The non adopters on the other hand were older farmers who did not take risks of new enterprises. For education level, the adopters had than attained higher levels of education enabling them to understand the complexities of new technologies. For the adopters, they had

more visits to or from extension services providers than the non adopters. The adopters were more willing to seek extension services especially for the new enterprise. From the results of the chi square and the z-test, there was strong evidence to reject the null hypothesis that there exists no difference between characteristics of adopters and non adopters of fish farming.

Table 2: Variables tested for difference using z test

Variable	z value	Sig(2 tailed)
AGE	-3.70***	0.001
SCHYRS	3.50***	0.001
HHSIZ	-0.04	0.598
NOMFGRP	2.10	0.082
LSIZ	3.30	0.346
YRSFARM	-1.70***	0.001
NOEXTIM	6.20***	0.001

Source: Own survey data ***significant at 1 percent

Decision to adopt fish farming

Differences in the socioeconomic characteristics of adopter and non-adopters of fish farming raise questions regarding which factors influence the farmers' propensity to adopt fish farming. Thus to further analyze the specific factors that determined adoption of fish farming, binary logit was used. The results of the binary logit are as shown in Table 3 below.

Table 3: Logit model results on factors influencing adoption of fish farming

Variable	Coefficient	P(z)	Odds ratio
GNDR	-0.343	0.001***	0.22
AGE	0.015	0.005**	1.06
SCHYRS	0.040	0.013*	0.84
HHSIZE	0.020	0.290	1.08
LSIZ	-0.188	0.000***	0.47
YRSFARM	-0.002	0.742	0.98
NOEXTIM	0.049	0.009**	0.81
NOLIVE	0.004	0.888	1.01

Source: Own survey data

***significant at 1 percent, **significant at 5 percent, significant at 10 percent

The results showed that there was a negative relationship between gender of the household head and adoption of fish farming. Women were less likely to adopt fish farming because of the high workload involved such as in construction of ponds. Another reason was that most women were not decision makers in the household and they also did not own land. The findings of the study were similar to those of Edwards and Demaine (1997). As with a study by Adesina et al., 2000 due to the lack of a wealth variable in the model, it is possible that gender also captures the effects of the difference in access to wealth that exists between men and women.

The odds ratio of 1.06 associated with the relationship between adoption of fish farming and age of the household head indicated that ceteris paribus the odds of younger household head adopting fish farming were 1.06 times more likely than older household heads. However, the mean age of fish farmers was found to be 43 years as most were between 35 and 48 years. Relatively young people are more likely to adopt new technologies as they are more of risk takers than older households. Similar results were found by Kapanga et al [9].

The variable showing education level had a positive relationship to adoption of fish farming. The results of this study indicate that farmers who were more educated had a higher probability of adopting fish farming than their counterparts. Education reduces the amount of complexity that a new technology might present thus increase its adoption. A large percentage of the respondents had attained secondary education (61%), 36% of the respondents attained primary education while the smallest proportion (3%), had attained tertiary education which included colleges and universities. Farmers who have some level of formal education are able to process information and are more willing to try out new ideas.

According to the regression results, other factors held constant, the odd ratio of 0.47 indicated that the odds of farmers with large land size adopting fish farming were 0.47 times higher than the farmers with smaller land holdings. Thus land size had a negative relationship to adoption of fish farming. The household with smaller acreage of land were more likely to adopt fish farming. This is because of the need to adopt enterprises that are more land intensive in order to increase farm income. The average land size was 2.5 acres indicating that in this study area, the availability of land was low; consequently, most agricultural farms are small. In a study by Yaron et al. [16], land size was found to negatively influence adoption of a new technology. A small land area provided an incentive to adopt a technology especially in the case of an input-intensive such as a labor saving or land-saving technology. In fact, the fish farmers had 60m2 as the smallest pond and 400m2 as the largest. In areas with small sized farms, adoption of land saving technologies seems to be the only alternative to increase agricultural production. Further, in the study by Fernandez-Cornejo [4], farm size did not positively influence adoption.

Frequency of extension visits was found to positively influence the farmers' decision to adopt fish farming. Extension services have an important role in influencing adoption of new technologies. Farmers contact with extension agents exposes him to availability of information thus is expected to have a positive influence on adoption. The odds ratio of 0.80 in this variable indicate that the odds of a farmer who does not access extension services to adopt fish farming were 0.80 times higher than those of a farmer who accessed extension services at a higher frequency. These results concur with those of Njeri, [14] and [2] that extension services promote agricultural productivity and adoption of new farm technologies. It provides farmers with adequate and appropriate information in order to make better decisions and that helps them to optimize their use of limited resources.

Economic analysis of fish farming

The fish farmers sampled have been practicing fish farming for 3 years and this was an indicator of experience the farmers have had in fish farming. All of the respondents had earthen ponds as it was less costly to construct and easy to maintain. Of the fish

species reared in the ponds, tilapia was found to be the most common with all of the farmers rearing it exclusively.

Particulars	Year	
	1	2
A: CASH RECIEPTS		
[1]Sale of tilapia	0	81000
[7]Bank loan	50,000	
Sub total	0	81000
B: CASH PAYMENTS (FIXED COSTS)		
[2]Land Clearing	700	0
[3]Pond construction	20000	0
Sub total	20700	0
C:OPERATING COSTS		
[4]Fingerlings 270frys*ksh3	4500	2500
[5]Feeds and Fertilizers	15000	15000
Harvesting cost	400	400
Miscellaneous (10% of total cost)	4060	1790
Sub total	**23960**	**19690**
D:TT CASH OUTFLOW B+C	44660	19690
TOTAL CASH INFLOW A-D	5340	61310
Loan repayment at 15%p.a interest rate		(57500)
		3810
[6]OCC (20% p.a)		(762)
TOTAL PROFIT (per acre)		**3048=127,000**

Source: Own survey data

[1]The fish farmers harvested at 8 months thus in the financial analysis, calculations were based
on 1.5 harvests in a year.

[1]The farmer harvested 270 tilapia weighing 300 gms and sold at Kshs. 200 each

[2]For land clearing, the farmer employed 2 men paying each Kshs. 350

[3]The costs of pond construction included fencing the pond, construction and paying laborers

[4]The farmer stocked 270 frys each costing Kshs 3 plus transportation costs

[5]Fish feeds cost Kshs.1500 per 20kg bag and the farmer used 10 bags of feeds to harvesting

[6]Opportunity cost of capital assumed at 20 percent per annum

[7]The farmer took a bank loan of Kshs.50,000 as startup capital. The loan is repayable after one
year with an interest of 15% per annum.

From the above economic analysis, fish farming was found to be a profitable enterprise. The farmers had positive returns for two subsequent years. A farmer could cover the cost of a loan within the year. Opportunity cost is the benefit the farmer would have obtained had he used the resources for fish farming for alternative investment available elsewhere in the economy. The fish farmers were encouraged to use organic manure for their ponds; this reduced the costs they would incur in purchase of inorganic manure. The farmers also borrowed the harvesting net from the ministry of fisheries development so no cost was incurred.

When comparing profits per acre, fish farming was found to be more profitable than maize crop farming which was the next best enterprise for farmers in the study area.

Table 5: Gross margin for maize crop (1 acre) in Kshs.

Item	Quantity	Unit	Price/unit(Kshs)	Total
Sales				
Harvested maize	21	bags	1800	37800
Costs				
Hired labor-Ploughing	-		1500	1500
-Weeding	-		970	970
-Planting	-		1000	1000
Seed	6	kgs	300	1800
Fertilizer- DAP	1.5	bags	2100	3150
CAN	1	bag	1700	1700
Total cost				(9820)
Total profit				27,980

Source: Own survey data

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CONCLUSION AND RECOMMENDATIONS

From the above study, it is evident that fish farming adoption presents a new opportunity for farmers to diversify their enterprises. Fish farming has the potential to be successfully adopted in the study area. From the household size, it can be concluded that Kisii county is indeed a highly populated area with the farming population lying in the age group of between 40-50 years. The government had played an important role of promoting production of fish through the Economic Stimulus Programme. From this study, it can also be concluded that the farmers practice tilapia mono-culture and all of them used earthen ponds as holding units. A recommendation from this study was that the fish farmers be introduced to poly-culture. It was also important for the fish farmers be introduced to other types of holding units such as liner and concrete. The farmers should integrate fish farming with other farm enterprises in order to cut down costs incurred in running the enterprise.

Fish farming in the study area is practiced almost entirely by males than females. It is important that gender mainstreaming be done in order to reduce this gender disparity in adoption. Gender mainstreaming can be done through sensitization and capacity building during delivery of extension services by government and non-governmental organizations which promote fish farming.

With the mean age of adopters being 43 years, it can be concluded that relatively young people are more likely to adopt new technologies as they are more of risk takers and most likely have the financial capability. A recommendation from this study is

that the stakeholders promoting fish farming should open up the opportunities to younger people between the ages of 18 and 35 years. This is because this age group is the most affected by unemployment in the county.

From this study, the households with smaller acreage of land were more likely to adopt fish farming because of the need to adopt enterprises that are more land intensive in order to increase farm income. Though the county faces continuous land fragmentation, this study recommends the implementation of the national land policy so that the continuous land fragmentation does not become uneconomical in future.

From the characterization of adopters and non-adopters of fish farming, extension agents may be now able to target their education and training programs towards farmers who are more likely to adopt fish farming and consequently derive benefits from extension programs.

The financial analysis shows that fish farming is a profitable enterprise compared to maize crop farming. It is thus recommended that rather than leave marshes and swamps to waste and consequently spread diseases like malaria and bilharzia, such land should be put into good use by investing in fish ponds.

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