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Factors Influencing Farmers Adopting the Government Supported Fish Farming Strategy to Food Security in Nyeri County, Kenya

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Abstract:
Fish farming is among the programs started by the government of Kenya to cushion its citizens against the effects of global economic recession of 2008-2009. The program aimed at providing income to farmers and diversifying livelihoods in Nyeri County. The study examined factors that influenced adoption of fish farming and its effects on consumption patterns in Mathira Sub County Nyeri County The study employed descriptive research design and applied both qualitative and quantitative approaches. The study targeted fish farmers who benefited from the program. The study site was Mathira Sub-counties which was purposively selected since it had the highest number of fish farmers (439) and systematic sampling employed to identify the study respondents comprising of 343 fish farmers. Field survey was carried out using open ended questionnaires administered to fish farmers. Logit regression model was used to determine factors influencing adoption of fish farming in Mathira Sub Counties, Nyeri County. The study found that the age of the farmer, family size, education level, membership to a farmers group, frequency of fish consumption and household and marital status were significant in explaining farmers will to adopt fish farming. Further, farmers training had a strong association with adoption of fish farming at x^2 98.571, p =0.001. It also recommends the incorporation of farmers' socio-economic characteristics to arouse fish farming adoption and more investment on farmers training and extension. The finding will assist the stakeholders in agriculture formulate, execute and monitor policies that will support farmers to ascertain food security concerns in Kenya.

Keywords: *Adoption of fish farming, fish farming, fish farm, fish, performance, training*

1. Introduction

The world experienced one of greatest economic recession in 2008 and 2009 which was caused by financial deregulation and high household borrowing by creditors with poor credit history in USA (Verick and Islam, 2010). This led to a sharp drop in major investment and customer spending lowering importation and exportation of goods. This was worsened by introduction of single currency in European countries and rise in oil prices. As a result, many investments laid-off their employees and Europe and USA fell into a recession. The economic crisis in these continents led to some unemployed African immigrants return to their home countries, foreign remittances and direct foreign investments reduced, private sector financing programs restricted and foreign aid to African countries reduced drastically leading to Africa economic slow-down and rise in poverty levels (Dullen *et. al*2010). In Kenya the post-election violence of 2008, rise in oil prices and adverse weather conditions aggravated its effects resulting the decline in economic growth from 7.1% in 2007 to 1.7%in 2009 (GoK, 2009).

To counter the effects of the recession, government of USA provided trillions of dollars inform of stimulus to bail out loans, asset purchase guarantees and direct spending to its banks (Katkov, 2012). In Canada investors wrote off short losses and banks reduced their interest rates to lowest bound and a fixed period of time (Gordon, 2017). United Kingdom government bought shares in some banks and later injected a rescue package in the banks stabilizing the banking system in the country (Pettinger, 2020). Through her state-owned enterprises and banks the government of China introduced a stimulus package spur investment and local consumption of goods a shift from export market reliance to internal consumption of her own goods (Dullen*et.al* 2010). Similarly African government responded with stimulus of varied magnitude, the government of South Africa lowered interest rates and initiated a three years stimulus on public work; the government of Tanzania directed her stimulus on loan scheduling guarantee and compensation and on food distribution and social support programs and agricultural subsidies. The government of Kenya apart from reforming and strengthening her stock and financial institutions it introduced a stimulus package to boost domestic consumption create employment

and provide long tern food security solution (GoK, 2009). The government channeled her stimuli on good security towards expansion on irrigable land and establishment of small-scale commercial fish farming (GoK, 2009).

The funding of fish farming was structured in two phases. At the end of the second phase the government of Kenya had supported the funding of the construction, training of farmers, fingerling stocking and initial fish feeds to 300 fish ponds in each of her selected 160 constituencies (MoFD, 2012). Nyeri county, despite fish farming and consumption been alien, about 2400 fish ponds were established; Mathira constituency have 439 fish farmers, the highest number compared to the other 5 constituencies of the county (MoFD, 2012). The study examines the factors that influenced the adoption of the fish farming and its effects of consumption pattern in the county despite the negative cultural orientation towards fish and fish farming.

2. Literature Review

Fish consumption provide human with vital low-fat proteins, vitamins D and B2 and minerals which help in nerve development, improvement of brain and vision and decreases risks of diseases like arthritis and diabetes (FAO, 2017). This has led to influx in demand for fish while capture fisheries are shrinking (FAO, 2012). To supplement on the fish demand, governments and donors are supporting fish farming which has grown significantly from a tonnage of 0.8 million to 2.8 million between year 2000 to 2014 (FAO, 2017). The government of Pakistan supported the integration of fish farming in the rice fields, and these increased farmers' income by 20 percent (Muddasin and Wanquis, 2019). Agriculture reform program introduced by the government of China led many farm workers jobless however, they were absorbed by the introduction of government supported fish farming program (World Bank, 2007). The government of Thailand institutionalized her fish farming support program through training of the farmers, providing inputs and extensional services to the farmers who owned or rented land and understood the value of fish (Edwards, 2000). Islam and Sakib (2014) however, observed that age, level of education, family income, social participation and knowledge of fish culturing correlated positively to adoption of fish farming in rice fields of Bangladesh.

Most fish farming in Africa were supported by donors and government (Brummet and Williams, 2000) who reported both successes and failures after withdrawal of the support (Dey*et.al,* 2006). Mostly successes were on large scale and failures on small scale projects in rural areas (FAO, 2002). The successful projects provide nutritious food and constant income to farmers (FAO, 2011), uplifting social welfare of the farmers and enhancing food security (Gupta and Halwart, 2004) therefore, impacting positively in the provision of nutritious food to large number of rural and urban population (Filipski and Belton, 2018). Wetegere (2009) identified social cultural variables; sex, age, formal education, farmers' religious beliefs and training and economic variables; family income, land size, risks and profitability of the project to be factors that influences the adoption of fish farming in Africa.

Having been introduced in Kenya in 1920s, fish farming was supported and popularized in 1960s and later declined significantly; by 1990s it was marked as subsistence, small scale farming with low production (Ngugi*et.al,* 2007). However, the introduction of a government stimulus package in 2011 reawakened the farming (Obudho, 2014). About 48,000 fish ponds were established country-wide (MoFD 2012) and fish production increased from 12,154 metric tonnage to in 2011 to 21,800 metric tonnage in 2012 (Obudho, 2014), due to government supporting farmers with funding, training and extensional services (Gatonye and Gakuu, 2018).Apart from social cultural and economic variables cited by Wetegere (2009), FAO, (2011) puts forward other variables to be considered; it benefits on household income, ability to provide household food, farmers training and extension services, cost of inputs and the project profitability.

An outbreak of lung cattle disease in Botswana saw an increase in fishing activities (Mosopele 2017), which increased nutritional status to children from the fishing household compare to those form non-fishing households (Nnyepi*et.al*, 2015), results that were similar to Nguka*et.al*, (2017) in their comparative study to children of fish farming and non-fish farming household in western Kenya. This shows a positive correlation between fish farming and fish consumption (Kimathi *et.al* 2013). The study was aimed to evaluate the factors that influenced farmers to adopt fish farming in Nyeri county and associated benefits to farmers.

3. Methods and Materials

3.1. Description of the Study Area

The study was carried out in Mathira Sub County in Nyeri County within the central region of Kenya bordered by Mt Kenya (5199M high) to the North and Aberdare ranges (3999m high) to the South. The county falls between latitudes 0^0 and 0^0 38' South and 36^0 38'East and 37^0 2' East. The region receives double maxima rainfall March to May (MAM) and October to December (OND). However, the pattern is occasionally altered and disrupted unpredictable adverse weather changes. The temperatures at the highland region range from 12^0 to 18^0 Celsius and that at the lowland range from 16^0 to 32^0 Celsius with an annual rainfall ranging between 500 to 1500mm (GoK, 2015). Small scale agriculture is the main economic activity in Nyeri county mainly both food crops; maize, beans, potatoes and vegetables and cash crops; coffee tea and horticulture. The farmers' equally practice dairy, pig, sheep goat and poultry keeping. However, agriculture is been faced by myriad of challenges which include market prices fluctuations, mismanagement of co-operatives, crop failures due to unpredictable weather pattern changes and high cost of inputs. This has resulted to low income among farmers'.

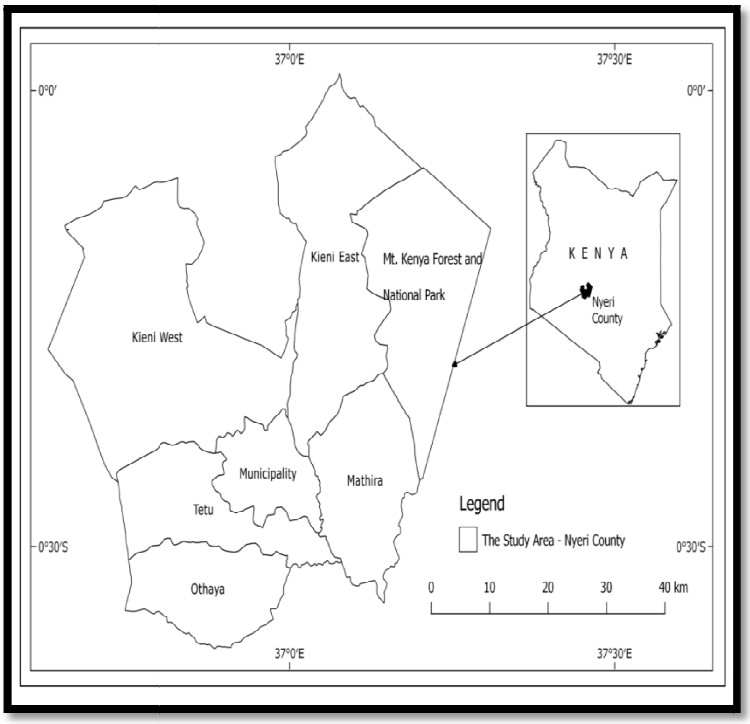

Figure 1: Map of Nyeri County
Source: Nyeri County CIDP, 2018

3.2. Research Design and Sampling Methods

The study adopted a survey design to determine the factors influencing adoption of fish farming and the corresponding socio-economic benefits of fish farming to farmers and neighbouring community in Nyeri County. Both qualitative and quantitative techniques were adopted to collect data using open ended questionnaire which were administered face to face to the fish farmers by research assistants to provide in-depth and holistic relationship between the variables (Bryman and Bell, 2003). The study area was purposively selected and included the constituency within the county with the highest number of fish farmers; Mathira constituency with 439 fish farmers distributed in two sub-counties; Mathira West (266) and Mathira East (173). The study target population was 439 fish farmers (Mathira Development Plan, 2018). Simple random sampling method was used to select the study respondents thus a sample of 343 respondent farmers was sufficient for the study.

Quantitative methods included the use of surveys to collect data on fish sales and socio demographic and economic characteristics of the respondent using open ended questionnaires administered to respondents to capture varied key factors determining adoption of fish farming. Qualitative methods of data collection such as interview schedules with key study informants who included county fisheries officer, sub-county extension and training officers, chiefs and Development officer who validity data collected from the farmers. Photographs and observation were also used to enrich the primary data.

3.3. Data Analysis

Primary data collected from the questionnaires were numerically coded and entered in SPSS version 23 for analysis. Logit model was used to estimate the factors influencing farmers to adopt fish farming strategy. Farmers' socio-demographic characteristics were analyzed using logistic regression.

Thus $$p = \frac{e^{a+bx}}{1 + e^{a+bx}}$$

Where
p is the probability of a 1
e is the base of the natural logarithm
a and b are the parameters of the model

4. Results and Discussions

In response a variety of approaches were used by the fish farming extension, training officers and the entire fisheries department to create awareness of existence of government supported fish farming through and economic stimulus. The information was disseminated through television and radio advertisement and news, written materials like newspapers and brochures, public campaigns at local administration (Chiefs *barazas*) and extension officers going around the farms sensitizing farmers about the program. majority of the respondents (58%) got the information through public campaigns at chiefs *barazas*, about 15.8% heard from the extension services who went around the farms recruiting farmers, 13.5% read from newspapers and brochures while 10.8% form television set and radio broadcasts (Table 1).

Source of Information	Frequency	Percent
Heard on TV/ Radio broadcasts	24	11
Reading Newspapers and brochures	30	14
public awareness campaign at Chief's *Baraza*	128	58
Extension officers	35	16
All of the above	5	2
Total	222	100

Table 1: Sources of Information about Government Supported Fish Farming Program
Source: Own Field Data, 2020

From the findings, variety of strategies to reach the potential fish farmers and inform them about fish farming was employed. Most farmers were reached and convinced by word of mouth at chiefs' awareness *barazas.* During the *barazas* local administration (chiefs) teamed up with the training officers and development officer and explained the importance of fish farming and its corresponding benefits on income generation and food security. It also provided direct interaction with prospective farmers, forum to explain expected government support and respond to farmers' fears and risks of the new engagement (fish farming).

4.1. Socio Demographic Factors Influencing Adoption of Fish Farming in Nyeri County

Data collected on socio-demography of the fish farmers was subjected to the univariate analysis in Table 2 below.

Socio-demographic characteristics		No	Yes	$\chi 2$ Value	$\chi 2$ P value
Marital status of the HHH	Married	69 (40%)	104(60%)	2.09	NS
	Single	14(29%)	35(71%)		
Education level of the HHH	Primary education	4(5)	72(95%)	90.41	0.001
	Secondary education	60(78%)	17(22%)		
	Tertiary education	19(28%)	50(72%)		
Main occupation of the HHH	Small-scale	32(22%)	116(78%)	67.53	0.001
	Medium-scale	6(29%)	15(71%)		
	Large-scale	45(85%)	8(15%)		
Training before fishponds	No	4(31%)	9(69%)	0.26	NS
	Yes	79(38%)	130(62%)		
Follow-up trainings	No	15(40%)	22(60%)	0.19	NS
	Yes	68(37%)	117(63%)		
Group membership	No	22(27%)	59(73%)	5.70	0.012
	Yes	61(43%)	80(57%)		
Frequency of household consumption	Daily	15(48%)	16(52%)	4.63	NS
	Weekly	48(39%)	74(61%)		
	Monthly	12(26%)	35(74%)		
	At harvesting	8(36%)	14(64%)		
Training frequency	Weekly	46(38%)	75(62%)	9.85	0.007
	Bi-weekly	12(71%)	5(29%)		
	Monthly	23(30%)	54(70%)		
		Mean	Mean		t-test
Age of the HHH		43.79	42.04		NS
Size of the family		5.14	4.43		0.057
Land size		3.34	3.89		0.005

Table 2: Univariate Results of Socio-Demographic Factors Influencing Adoption of Fish Farming in Nyeri County
NS = Not Significant at 10% Confidence Levels, HHH = Household Head

From the analysis; education levels, farmers' main occupation, group membership, training frequencies, land sizes and family sizes were significantly associated with adoption of fish farming in Nyeri County. Farmer's training, land sizes and farmers' occupation variables concurred with Wetegere, (2009) that were main factors that influences the adoption of fish farming.

4.1.1. Factors Influencing Willingness to Adopt Fish Farming in Nyeri County

The Logit model for explaining factors influencing willingness to adoption of fish farming in Nyeri county was significant at $p<0.01$ and correctly predicted 86% of both those willing and unwilling respondents. Five variables: age of the household head, family size, education level of the household head, membership to farmers group, frequency of fish consumption at the household and marital status were significant in explaining the will to adopt fish farming in Nyeri county (Table 3).

	B	S.E.	Wald	Sig.	Exp(B)
Age of the HHH	0.099*	0.045	4.758	0.029	1.104
Occupation of the HHH	-1.225	0.398	9.484	0.802	0.294
Education level of the HHH	-2.458**	0.55	20.002	0.001	0.086
Family size	0.971*	0.347	7.850	0.005	0.379
Land size	0.502*	0.042	1.667	0.002	0.294
Training before fishpond	0.087*	1.214	0.005	0.043	1.091
Follow-up trainings	0.602	0.558	1.166	0.280	1.826
Membership of the groups	3.28**	0.843	15.124	0.001	0.038
Frequency household consumption	0.627*	0.255	6.035	0.014	1.873
Marital status of the HHH	2.878	0.869	10.966	0.901	1.776
Training frequency	0.263	0.202	1.695	0.193	1.300

*Table 3: Logit Regression Model Analysis of Factors Influencing Adoption of Fish Farming in Nyeri County N=222, *Significant at 5% Probability Level, ** Significant at 1 % Probability Level*

Age of the household head positively (β=0.099, P=0.029) influenced the willingness to adopt fish farming in Nyeri County (Table 4.16). This implies that the willingness to adopt fish farming in Nyeri County increased with an increase in age, and therefore the older the farmers the higher the likelihood of adopting fish farming. This could be explained by the older farmers having more experience in farming and may have mastered the art of farming and were therefore more likely to try out new innovations such as fish farming. More so, the elderly farmers were more likely to have bigger pieces of land as compared to the younger farmers, which they could assign to fish farming. This agrees with Amsalu & de Graaff (2007) who noted that the older farmers were more likely to adopt new innovations in Ethiopia and that the argument that older farmers happen to be resistant to innovations might not hold true everywhere and at all times. These findings disagrees with He *et al.,* (2007) who notes that adoption of innovations is higher among younger farmers than among older farmers. According to Mwangi *et al*. (2015) age of the respondents indicated mixed effects on likelihood to adoption of innovations in Kalama suggesting that there could have been some unknown factor influence in play which was not included in model that could be explored.

Education level of the household head negatively (β=-2.458, P=0.001) influenced the willingness to adopt fish farming in Nyeri County (Table 4.16). This implies that the will to adopt fish farming was high among the household head whose education level was low which also implies that fish farming was not common among the high educated household heads. As the general outcome from various studies have indicated, technology complexity has a negative effect on adoption and this could only be dealt with through education (Mwangi *et al.,* 2015). However, fish farming being a more practical innovation other than complex innovation, the farmers were more likely to adopt the technology with a lot of ease and which implies that the less educated were more practical and therefore took up the innovation better than the more educated respondents.

Land size positively (β=0.502, P=0.002) influenced the willingness to adopt fish farming in Nyeri County (Table 4.16). This implies that the households who hold larger pieces of land were more likely to set aside small piece of land for the new innovation on trial basis without compromising their regular flow of produce from the land. These findings agree with Amsalu & de Graaff, 2007, who found that land size to be positive and significant, suggesting that farmers who hold large farms are more likely to invest in new innovations. This equally agrees with the general argument that larger farms offer operators more flexibility in their decision-making, greater access to discretionary resources, more opportunity to use new practices on a trial basis and more ability to deal with risk (Mazvimavi & Twomlow, 2009; Zhang *et al.,* 2012).

Family size positively (β=0.971, P=0.005) influenced the willingness to adopt fish farming in Nyeri County (Table 4.16). This implies that the will to adopt fish farming was high among the households whose family size was high, since fish farming is a labor-intensive agricultural practice. Therefore the larger families were more likely to meet the labour demands with ease as compared to smaller families which agrees with He *et al.* (2007). According to He *et al.* (2008)larger family size is generally associated with a greater availability of labor and may positively influence the decision towards adopting new innovations. It could also imply that higher consumption pressure faced by their family (especially if large) may influence farmers' decisions to adopt innovations that solve some of their food and nutrients demands.

Group membership positively (β=3.28, P=0.001) influenced the willingness to adopt fish farming in Nyeri County (Table 4.16). This implies that the will to adopt fish farming was high among the households whose heads belonged to groups. It could also imply that the group provides the farmers with an avenue to share their experiences and therefore learn from each other. Groups are effective in persuading members to try new technologies and encourage sharing of knowledge and experiences among the members (Macharia *et al.,* 2014). According to Mwangi *et al*., (2015) groups are known for their multiplier effect among members, and therefore many change agents work in collaboration to implement their agendas. In addition, active participation in farmers' groups should be encouraged in the efforts to boost information sharing and promoting competitive marketing of the produce (Karienye *et al*, 2020).

Frequency of households' fish consumption positively (β=0.627, P=0.014) influenced the willingness to adopt fish farming in Nyeri County (Table 4.16). This implies that the high the consumption of fish at the household level results to increased adoption of fish farming in Nyeri County. This could be explained by the local demands created at the family level resulting to families embracing these innovations to provide the necessary food demand for the family. This ends up promoting the chances of adoption of new innovations in the long run.

Training of the household heads prior to the ESP program positively influenced (β=0.087, P=0.043) adoption of fish farming in Nyeri County (Table 4.16). This implies adoption of fish farming was more likely to take place among the farmers who had earlier been trained on fish farming. This agree with (Macharia *et al.* (2014) who noted that training is an important component of instilling skills and hence builds capacity of the target group and also acts as a vehicle by which profitable and resource conserving land management is locally promoted and widely adopted. Training overcomes constraints through providing appropriate knowledge and new skills and thus providing an understanding of what a technology entails and facilitates its efficient adoption and utilization (Daudu *et al.*, 2019).

4.2. Farmers Training

Training sessions were held before and after the recruitment of farmers. Training session before recruitment were organized and held during the sensitization campaigns during chiefs *barazas* where program requirement, government support and the benefits of the program were spelt out. Training continued to the farmers who were recruited with majority of the respondents (73%) indicating that the sessions were held on weekly basis, 23% fortnightly and 4% monthly. The result reveals regular training engagement of farmers that equipped them with pond management and marketing skills. Respondents indicated that trainers employed variety of training methods; classroom model was widely used at 41%, practical and demonstration 40%, group sharing 15% while farm visit were least at 4%. This revealed that the classroom model was adapted since there were few training officer and the program had set timelines. The trainer therefore used methods that could reach more farmers at cover large content within a short time therefore lecture method in make-shift classroom set-up were employed and demonstration were done at demonstration farms as shown in Figure 1 and 2 respectively.

Figure 2: Fish Farmers Training Session at Kaiyaba Mathira West Sub-County

Figure 3: Fish Farmers Training on Predator Control at a Demonstration Pond at Kaiyaba Mathira West Sub-County

Most (90%) of the respondents were trained on fish pond construction for example ponds depth and lining, 95% on identification of types fish, 91% on fish harvesting and 97% fish marketing and preparation (Table 4.6). Only 36% of the respondents were trained on fish diseases, parasites and predator's control. Farmers were trained adequately on pond construction, types of fish since it was done practically during the pond construction and stocking. Indeed, training on harvesting and fish marketing was emphasized to elicit farmers' interest to adopt fish farming.

Fish Farming Areas/ Training Condition	Pond Construction		Identifying of Fish Types		Fish Feeding		Fish Diseases, Parasites and Predators		Fish Harvesting		Fish Marketing and Preparation	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Trained	220	99	211	95	191	86	79	36	201	91	216	97
Not trained	2	1	11	5	31	14	143	64	21	9	6	3
Total	222	100	222	100	222	100	222	100	222	100	222	100

Table 4: Frequencies of Training on Specific Fish Farming Activities
Source: Own Data, 2020

4.2.1 Challenges of Fish Farmers Training

Majority (41%) of the respondent cited training methods to be the major training constraint, 23% the language used during training sessions hindered effective delivery of the content, 21% cited that fund to reimburse their fares and lunch, 10% and 5% cited lack of follow up farm trainings and training materials respectively (Table 4.7).

Challenges	Frequency	Percentage
Ineffective training methods	91	41
Insufficient training funds	47	21
Training language barrier	51	23
Inadequate follow up trainings	22	10
Inadequate training materials	11	5
Total	222	100

Table 5: Challenges of Fish Farmers Training
Source: Own Data, 2020

Methods of training were the major challenge cited during training because of the time constraints and few numbers of trainers. This was followed by language barrier since some trainers were from other ethnic communities and used the technical language during the training sessions. Also, there were limited follow up trainings in the farms to clarify and demonstrate training areas that were ambiguous. Further, training material like brochures were limited and farmers lacked reference materials in case of any problem. Data from key informants indicated that training sessions were hurried, follow up training were limited and inadequate of training material. This confirmed that there were shortcomings on methods of training, timeframe of farmers training and the number of training personnel. This made the training sessions to be hurried and adopt a classroom scenario with chalk board and manila displays. Further, they rated the attendance for the sessions to be good despite some complaints on reimbursement of fare and lunch which were given to participants in cash after the training sessions (KII, KIII and KIV interviewed, April, 2020).

4.2.3 Association between Training and Adoption of Fish Farming Activity

The training offered to the farmers through the ESP was significantly associated with adoption of fish farming by the farmers (χ^2 = 98.571, P=0.001). This indicated that the training offered to farmers on pond construction, pond management, harvesting and marketing of fish influenced farmers to adopt the fish farming. This is because farmers found fish farming to be simple after pond construction which was funded by the program, flexible with high yields in six months.

5. Conclusion

The study found that farmers awareness campaign by local administration (chiefs) and the fisheries department officers, government supported farmers training, capital to construct fish ponds, initial fingerings and fish feed resulted to adoption of new agricultural activity (fish farming) in Nyeri county by creating farmers appetite to increase their income, and produce nutritious food (fish) in their household and sale. Therefore, it concluded that effective communication and accessibility of packaged information, and provision of prerequisite farm inputs (resources) enabled adoption of fish farming in an alien community that had negative cultural orientation about fishing.

Further the study concludes the socio-demographic factors; age of the household head, family size, membership to farmers group, consumption of fish at household level and marital status had a positive influence on adoption of fish farming in Nyeri County. However, education level of the household head negatively influenced the adoption of fish farming in Nyeri County. Therefore, practical oriented agricultural activities are likely to be adopted with ease by farmers who have the will, supported with inputs and given proper and training despite their level's education.

The study recommends the following;

- Always to consider farmers socio-economic and demographic characteristics when introducing a new agricultural innovation.

- Invest more on farmers training to inform and equip them with prerequisite skills and knowledge on new agricultural innovation to arouse adoption.

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