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Research Application Summary

Factors influencing adoption of fish farming along the value chain in Kibwezi, Makueni County, Kenya

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Abstract

Communities in arid and semi-arid lands (ASALS) are confronted with a number of challenges that include limited livelihood choices, high livestock mortality during drought, poverty and malnutrition, among others. Although past studies have shown that most farmers under Edonomic Stitmulus Programme adopted fish pond farming, limited studies dealt with farmers in arid and semi-arid lands in Kenya. This study was carried out in Kibwezi to determine factors influencing adoption of fish farming along the value chain post Economic Stimullus Programme (ESP). Actors along the value chain were fish farmers, input suppliers, processors, traders, and consumers. Data were collected using semi- structured questionnaire and analyzed with SPSS software. Results of a logit regression showed that fish market access (0.001), group membership (0.012), and age (0.020) were positively significant. Education levels (0.004) and distance to input markets (0.004) were negatively significant to adoption of fish farming. Forty one percent of fish farmers were female. This was a good pointer to the needed strategy to alleviate poverty and malnutrition. Extension services were not felt as many did not have information on fisheries. This study affirmed fish farming as one of the livelihood choices that could mitigate poverty and malnutrition in Kibwezi and possibly in other similar ecosystems. This would work better with marketing information for the fish farmers.

Key words: Actors, fish farming, Kenya, Kibwezi, malnutrition, Post ESP

Résumé

Les communautés vivant dans les zones arides et semi-arides sont confrontées à un certain nombre de défis, notamment les conditions de vie limitées, une mortalité élevée du bétail pendant la sécheresse, la pauvreté et la malnutrition, entre autres. Bien que des études antérieures aient montré que la plupart des agriculteurs du programme Edonomic Stitmulus aient adopté la pisciculture en étang, des études limitées ont porté sur les agriculteurs des terres arides et semi-arides du Kenya. Cette étude a été réalisée à Kibwezi pour déterminer les facteurs influençant l'adoption de la pisciculture le long de la chaîne de valeur, après le programme de stimulation économique. Les acteurs le long de la chaîne de valeur étaient des pisciculteurs, des fournisseurs d'intrants, des transformateurs, des commerçants et des consommateurs. Les données ont été collectées à l'aide d'un questionnaire semi-structuré et analysées avec le logiciel SPSS. Les résultats d'une régression logit ont montré que l'accès au marché du poisson (0,001), l'appartenance à un groupe (0,012) et l'âge (0,020) étaient

positivement significatifs. Les niveaux d'éducation (0,004) et la distance aux marchés d'intrants (0,004) étaient négativement significatifs pour l'adoption de la pisciculture. Quarante et un pour cent (41%) des pisciculteurs étaient des femmes, un bon indicateur de la stratégie de réduction de la pauvreté et de la malnutrition. Les services de vulgarisation n'étaient pas ressentis car beaucoup n'avaient pas d'informations sur la pêche. Cette étude a confirmé la pisciculture comme l'un des choix de moyens d'existence supplémentaires qui pourraient atténuer la pauvreté et la malnutrition. Ceci fonctionnerait mieux avec des informations commerciales disponibles aux pisciculteurs.

Mots clés: Acteurs, ASALS, moyens de subsistance, malnutrition, Post ESP

Introduction

Aquaculture is the farming of aquatic organisms in inland and coastal areas, involving intervention in the rearing process to enhance production with individual or corporate ownership of the stock being cultivated (FAO, 2005). It has been over 100 years since aquaculture was introduced in Kenya, but most of the exported fish is not affordable to the majority of the local consumers. Thus there is high demand for affordable fish but limited supply. The Kenyan Government promoted aquaculture during the 2009—2012 Economic Stimulus Program (ESP) in 160 constituencies and Kibwezi constituency in Makueni County was among them. The ESP is anchored on the economic pillar of Kenya Vision 2030 (Republic of Kenya (GoK), 2007). The economic pillar has many sectors; among them is the agricultural sector where fisheries are a sub sector, which is part of the vehicle to be used to achieve a national economic growth of 10 percent annually. The World Bank (2012) estimated that 34.8 percent of the Kenyan people lived below the poverty line (proportional of people whose income is below one US. dollar a day). Goal 3 of the Millenium Development Goal was to promote gender, equality and empowerment of women had not been met by 2013.The vulnerable groups are predominantly rural and poor (GOK, 2014) especially in the Arid and Semi-Arid Lands (ASALs). Most aquaculture studies have been done in high potential areas, hence the purpose of this study was to determine factors influencing fish farming in Makueni, a county in an ASAL region.

Methodology

The study was conducted in Kibwezi, an area prone to unpredictable rainfall patterns and drought. The area lies between latitudes 2°62 and 3° S, and longitude 37°362 and 38°302 E, and has a total area of 3,400 km^2. A majority of residents practice marginal agro-pastoralism given the climatic conditions. This includes raising livestock and cultivating grains and pulses (Nyangito *et al.,* 2009) and horticulture.

Data collection and analysis. The study used cross sectional data. Purposive sampling was used to select 146 Fish farmers statistically. A semi-structured questionnaire was used to collect data from a sample of 146 fish farmers. Independent variables (X) perceived to influence adoption (Y) of fish farming were identified.

A binary logistic regression model was used for the data analysis. A logistic regression was run to infer the factors that influence fish farming in Kibwezi, Makueni County. The choice to adoption of fish farming is a dichotomous dependent variable. The cumulative distribution function for a logistic random variable is given by Hill *et al*. (2008) as shown in Equation 1:

$$(l) = P[L \leq l] = \frac{1}{1+e^{-1}}(l) = P[L \leq l] = \frac{1}{1+e^{-1}}$$ .....Equation 1

The probability of fish farming adoption lies between 0 and 1.

$$\text{Adoption of fish farming} = \begin{cases} 1 \; If \; a \; farmer \; an \; adopter \\ 0 \; If \; a \; farmer \; is \; a \; non \; adopter \end{cases}$$

Probability that the observed value of Y takes the value of 1 given by Equation 2:

$$P_j = \frac{1}{1 - e^{-\beta_0 + \beta_i X_i}} = \frac{\exp(\beta_0 + \beta_i X_i)}{1 + \exp(\beta_0 + \beta_i X_i)}$$

.....Equation 2

Where:

P_j=Probability of fish farming adoption
β_0 = Maximum likelihood estimate of the constant term
β_i =Maximum likelihood estimates of the parameters
X_i= Explanatory variables (Age, gender, marital status, education level, fish Membership group, fund sources, extension visits, fish market places, distance to input markets).

The probability that the observed value of Y=0 is given by Equation 3:

$$1 - P_j = \frac{1}{1 + \exp(\beta_0 + \beta_i X_i)}$$

.....Equation 3

Where:

P_j=Probability of fish farming adoption
β_0 = Maximum likelihood estimate of the constant term
β_i =Maximum likelihood estimates of the parameters
X_i=Explanatory variables(Age, gender, marital status, education level, fish Membership group, fund sources, extension visits, fish market places, distance to input markets).

Logistic regression model is thus given by Equation 4

$P_j = \beta_0 + \beta_i X_i$..... Equation 4

Where:
P_j=Probability of fish farming adoption
β_0 = Maximum likelihood estimate of the constant term
β_i =Maximum likelihood estimates of the parameters
X_i=Explanatory variables (Age, gender, marital status, education level, main livelihood,fish Membership group, fund sources, extension visits, fish market places, distance to input markets).

Descriptive and quantitative analyses were done to determine factors and socio-economic characteristics of actors of the fish value chain.

Results and discussion

Fish value chain. Analysis of fish farmers' value chain provides what happens on the ground that can lead into strategies for inclusion in sustainable fish farming into the chain that could enhance production and income streams in ASALs. Consumer node provides leads to where the fish can be sold and which markets before final fish harvest. Fish farmers produce their fish within the Mtito Andei – Emali corridor that is along the paved Nairobi- Mombasa highway. Access to local markets is done by motorcycle, while those producers that sale their fish in Voi and Nairobi used pick-ups. Traders who bought fish at the farm gate were mainly retailers who deep-fried fish at the local markets within Kibwezi. Individual consumers were mainly local residents within a 4-kilometer radius. At the farm gate traders local brokers collected fish from a fish farmers but this was not a common practice in Kibwezi.

There were three levels of fish farmers, farmers who owned one pond and most of the fish produced was consumed by the family while the surplus was sold to friends and neighbors. Harvesting of fish was gradual. The second group owned a pond and harvested their fish once, and the fish was earmarked for sale to retail traders and neighbors. The third level consisted of farmers with three or more ponds that were staggered harvested. These producers were the ones who were well capitalized and sold both to local and regional market. Other participants in the fish market included boda-boda who use motor-cycles to transport retail traders from farm gate to final destination. Fish cleaners were hired by producers to clean fish to be sold to individual consumers and traders. One producer had a contract with the UN Refuge Service to supply 50-60 gram tilapia, however this arrangement was abandoned due to lack of a refrigerate van for transport. The types of fish markets were local or farm gate regional trade.

Socio-economic factors. The findings show that 71 percent of fish farmers were within the age bracket of 30-59 years. These findings collaborate studies done by Okechi (2004) and Maina *et al*. (2012.) in Kenya; Olowoegun *et al*. (2004), Olaoye *et al*. (2013) and Osondu (2014) in studies done in Nigeria that found a positive correlation between age and adoption of fish farming technologies for farmers below 50 years. The youthful age provides the manpower of operating a fishpond while mid age farmers often have the financial resources saved from their primary likelihood that can be invested into fish farming.

Females represented 41 percent of fish farmers in the study area. The high representation of women fish farmers in Kibwezi mirrors findings by Mutambuki *et al*. (2014) where 31percent of fish farmers were female in a study done in Kitui, an area with almost similar socio-economic and ecological characteristics. Secondly, when ownership of key protein sources is by a mother, there is a high probability that household members will be fed appropriately.

Over 58.4 percent of fish farmer had attained at least secondary level of education as shown in Table 1. These educational levels are consistent with studies done in Trans Nzoia County, Kenya by Kiumbua *et al*. (2013) where farmers with over 12 years of education had a positive influence on fish farming. In Kibwezi, more years of education should increase the adoption rate of fish farming as noted in the logistic regression results. These results contrast with studies done by Asmah (2008) in Ghana and Njagi *et al*. (2013) in Meru that found 44 and 56 percent of fish farmers, respectively, had only primary education. In Ghana, fish farmers had been fish rearing for ten years. Thus lower levels of education are compensated by longer years of farming experiences in the adoption of fish farming.

The fish farmers' predominant livelihood choices were either business (34.8%) or a salaried profession and (36.2%). This confirms other Kenyan studies done by Ngugi *et al*. (2000). The ability to have extra income from other sources should have influenced adoption of fish farming positively but from the logistic model it was negative. This could imply that farmers were risk aversive.

Membership group. A majority of fish farmer (92.5%) were not members of farmers' society, hence only 7.5 % were members. This variable had a positive influence on adoption at significant level of 1 % implying that farmers may not be aware of advantages of group dynamics or they belong to non-farming clubs. Fish farmers who have membership in fish farming associations/ cooperatives tend to be successful fish farmers (Akinbile, 1998). This is because of accrued benefits derived from group membership, which a loner farmer cannot attain. Also in the same study, it was noted that membership of fish farming associations/ cooperatives was a positive influencing factor in the adoption of modern fisheries technology and poverty alleviation. The organized farmers groups consists of self-help groups, CBO, farmers associations. A majority of farmers were ESP recipients and 54% were involved in farmers association and societies. Only 13 non-ESP members were enrolled in farmers' organizations.

Most of the farmers reported limited access to credit in Kibwezi, perhaps many people fear getting credit or loans especially where collateral security is required.

Extension contacts. The 146 fish farmers sampled had at least three contacts with the fisheries extension officers during the fish production cycle (8 months). This study found out that extension contacts had a positive influence on adoption, although it was insignificant. Most likely, the extension contacts did not provide information on fish farming alone. The result of the study was simillar to FAO (2000) report that extension contact had a positive impact on fish production in high potential areas of Kenya.

Fish and input markets. The fish was sold either in Local (markets in Kibwezi) or in Regional, Markets outside Kibwezi. Eighty one percent of the fish was sold in the local market while 18.7 percent was sold in the regional market.

The distance to fish markets is crucial for fish farmers because of marketing cost and sale price differentials. Local markets were preferred over regional markets to maximize gross margins by reducing freight cost. Regional markets had better prices and hence were more profitable but only 18.7% of farmers used them. Three reasons for local market popularity were: low output per farmer, regional markets require huge quantities that can be accomplished only by large scale farmers or use of brokers who can assemble them. Fish farmers were not organize to provide a steady supply of fish over a given period.

Seventy one percent of fingerlings were sourced over 168 kilometers from farmers homestead. INPUTMKT (0.004) was negatively correlated and significant at α=0.01. This was a major handicap to pond stocking because advanced plans needed to be organized in the procurement of fingerlings. This was significant and inversely related to adoption of fish farming. The reason being that when inputs are scarce and not easily available, the probability of farmers to adopt up fish farming is low.

Fish market places influenced the adoption of fish farming positively. This was expected given that when farmers have readily available and accessible markets, this promotes fish trade. Fish farming thrives where there is a clear/potential market and infrastructure in place like in the case of Uganda's small-scale fish farmers near Kampala and Jinja (Jagger *et al*., 2001).

Regression analysis. A logistic equation was used to assess the factors influencing adoption of fish farming. The dependent variable was adoption of fish farming that can be characterized as binary, taking on the value of 1 or 0. The dependent takes the value of 1 when fish farming is adopted and 0 for non-adoption. The regress and in these situations was the decision to adopt fish farming a vis the decision not to adopt. The regression analysis results for fish farming adoption in Kibwezi showed that Tolerance and VIF were more than 0.1 and less than 10, respectively for all variables, therefore multicollinearity was ruled out. According to Pallant (2011) Tolerance of more than 0.1 and VIF of less than 10 respectively indicated no multicollinearity in a multiple regression analysis.

Logistic regression results. The results of a logistic regression analysis for fish farming adoption in Kibwezi are shown in Table 1. Various tests were used to determine the significance and relevance of the model. The results indicated that the variables used were weakly correlated with values less than 0.5. The variance Inflation Factor (VIF) was used to find out the severity of multicollinearity among the independent variables. The Wald statistic was used to test the significant of individual variables, which indicate educational level, market access and distance to input suppliers were significant at 1% level. Membership of groups and age were significance of 5%. The variable with most influence on the model was fish Market places followed by distance to input markets.

Table 1. Maximum Likelihood Estimates for Fish Farming Adoption Model

Variable	Beta	SE	Wald	Exp (B)	P-value
CONSTANT	-5.703	2.919	3.829	0.003	0.0500
AGE	0.023	0.018	1.633	1.023	0.020**
GENDER	-0.186	0.436	0.181	0.831	0.671
MSTATUS	-0.307	0.236	1.693	0.736	0.193
EDUC	-o.488	0.171	8.163	0.614	0.004***
MLIHOOD	-0.020	0.131	0.024	0.984	0.878
MEMSP	2.555	1.021	6.263	12.874	0.012**
CREDIT	0.408	0.356	1.307	1.503	0.253
EXTVT	0.189	0.386	0.222	1.206	0.637
-+/7410FISHMKT	0.730	0.229	10.185	2.076	0.001***
INPUTMKT	-0.014	0.005	8.234	0.983	0.004***

** Significant at a=0.05, *** Significant at a=0.01. Source: Author (2015)

It was concluded that five variables, i.e., Fish markets (0.001), Education (0.004), Distance to input markets (0.004), Membership to a group (0.012), and Age (0.020) were the most influential factors affecting adoption of fish farming. Gender, marital status, other livelihood fund sources, and extension were not statistically significant.

Conclusion

The overwhelming majority of farmers practiced small scale fish farming in post Economic Stimulus Programme area studied (Kibwezi). The average number of ponds were three and mostly earthen. Hence very few farmers had many ponds. This study sought to determine factors influencing fish farming. Fish markets, education levels, distance to input markets, membership group and age were found to be significant factors. Markets were the driving force behind the decision to adopt fish farming. Distance to

input markets had a negative effect, indicating that when input suppliers were far away farmers could not access fingerlings and feed. Water was a key input in fish farming, so the farmers near the river shores were more adoptive. Fish products market was available on the highway to Mombasa, but prices were low and value addition limited.

The study recommends that farmers invest in storage facilities to enhance fish shelf life, which protect them from selling their products at throw way prices. Subsidies could be given by the county government to businessmen willing to invest in local input supplies and processing. This would promote fish farming in Kibwezi.

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References

Ataga, R. 2015. Makueni County. Ministry of Agriculture, Livestock, Fisheries, Kenya.

Brummett, R.E., Youaleu, J.L.N., Tiani, A.M. and Kenmegne. 2010. Women's traditional fishery and alternative aquatic resource livelihood strategies in the southern Cameroonian Rainforest. *Fisheries Management and Ecology* 17:221 – 230.

Food and Agriculture Organization (FAO). 2013. Aquaculture production: Frame survey in Western Kenya. Food and Agriculture Organization of the United Nations, Rome, Italy.

Government of Kenya (GOK). 2014. Annual National Statistics: Kenya National Bureau of Statistics Nairobi: Government Printer.

Hellin, J. and Meijer, M. 2006. Guidelines for value chain analysis. FAO, Rome, Italy.

Hill, R.C., Griffith, W.E. and Lim, C.G. 2008. Principles of Econometrics. 4th ed. John Wiley & Sons New York, USA.

Maina, J.G., Mbuthia, P.G., Ngugi, C., Omolo, B., Orina, P., Wangia, S.W., Karuri, E.G., Maitho, T. and Owiti, G.O. 2014. 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): 1-9.

Okechi, J.K. and Jensson, P. 2004. Profitability assessment: A case study of African catfish farming in the Lake Victoria Basin, Kenya. University of Iceland, Reykjavik.

Olaoye, O.J., Ashley-Dejo, S.S., Fakoya, E.O., Ikeweinwe, N.B., Alegbeleye, W.O., Ashaolu, F.O. and Adelaja, O.A., 2013. Assessment of socio-economic analysis of fish farming in Oyo State, Nigeria. *Global Journal of Science Frontier Research Agriculture and Veterinary* 13 (9): 45-55.

Olowosegun, T., Sanni, A.O., Sule, A.M. and Bwala, R.L. 2004. Contribution of women to fisheries development in Kainji Lake Basin. pp. 91-97. In: 2004 FISON Conference Proceeedings.