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Email: editorinchief@aesonnigeria.org;agricultural.extension.nigeria@gmail.com

Factors Influencing Farmers' Participation in Fish Production in Lesotho

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Rantlo, Ashby Montoeli
National University of Lesotho, Roma, Lesotho
Email: **am.rantlo@nul.ls/amontoeli@yahoo.co.uk**
Mobil: +266 59134917/58691167

Abstract

The study investigated factors influencing smallholder farmers' participation in fish farming in Lesotho. Multi-stage sampling procedure was used to select 400 farmers from whom data was collected through a semi-structured questionnaire. Percentage and binary logistic regression were used to analyse the objectives of the study. Results revealed that government support (β=2.662), lack of arable land (β=2.824) and social capital (β=2.387) enhanced participation in fish farming while membership in farmer group/association (β=1.925), path dependency (β=2.007) and culture (β=2.985) had a constraining effect on participation in fish farming in the country. Based on the results, it is concluded that institutional, technical and socioeconomic factors influence participation. In light of these, it is recommended that unobservable and informal institutional factors be taken cognisant of in the design of fish farming development policies and strategies in Lesotho. Furthermore, the formation of fish-based farmer organisations be encouraged, promoted and supported in the country.

Key words: Factors of fish farming, farmers participation in fish production.

Introduction

Fish is the cheapest source of animal protein and represents a significant proportion of animal protein in the diet of most developing countries particularly African countries. In the last decade, of the 30 countries where fish contribute more than one-third of the total animal protein supply, 22 are low Income and food deficient countries (Gatriay, 2020). Globally, fish accounts for about 17 percent of animal protein intake and 6.7 percent of all protein consumed by humans (Food and Agricultural Organisation (FAO), 2016).

Fish farming is a form of land use whereby land is used for growing or rearing selected fish species under controlled conditions in natural or artificial environment for economic and social benefits. It involves the construction of ponds, cages, tanks, reservoirs or dams and stocking them with food fish which are grown to table size (Patrick & Kagiri, 2016). Fish farming has been practised in different parts of the world, particularly East Asia, China, Europe, Canada, Africa, and developing

countries like Nigeria. It has been in practice since the ancient civilization of Egypt and China. The fisheries sector remains an important source of food, nutrition, income, and livelihoods for hundreds of millions of people around the world (Gatriay, 2020)**.**

In African countries smallholder fish farming is mainly practised under the extensive system, which is characterized by low stocking density, low production with little or no nutritional inputs and low investment cost (Shava & Gunhidzirai, 2017). Nevertheless, in the last 10 to 15 years the continent has seen the emergence of the semi-intensive culture system whereby fish is stocked at a higher stocking density than the extensive system and fed with supplementary feed to support the natural food supply and the system is characterised by moderate investment and production costs. On the other hand, there has been historically very low participation in intensive fish culture system where fishes are stocked at a high density and fed exclusively on a nutritionally-balanced diet to meet their nutrient requirements and the system has high yields and high production costs (Iruo et al., 2018).

The rapid increase in population of the world has resulted in a huge increase in the demand for animal protein including fish (which is essentially higher in quality than plant protein). This has given credence to fisheries as one of the important pillars of economic development in different countries of the developing world (Shava & Gunhidzirai, 2017). This has led to increase in investment in fish sector that has led to development and strengthening of fish supply and value chains in different countries of the world, which in turn resulted in increased participation in fish production, job creation, income, quality and supply of fish and related products (FAO, 2016).

Participation in fish farming is defined by Umunna et al. (2020) as the engagement of households in the rearing and cultivation of fish under various farming systems in order to produce food. According to Shava & Gunhidzirai (2017), in Asian countries, fish farming has been widely practiced under mainly intensive system and it contributes to about 1.3 billion USD in exports. FAO (2016) indicated that Asia has the largest fisheries and aquaculture operations in the world. Fish production is practised in both developed and developing countries and the livelihood of more than 500 million people in developing countries are directly or indirectly linked to fish production. In Africa, this activity directly supports the livelihood of more than 10 million people (Endelaw et al., 2020). Furthermore, in Africa, participation in farming has increased sharply and fish farming has gained credence as a source of employment and household income as many households engage in this enterprise. This increase has led to Africa being the second largest continent in terms of fish participation in the world (Shava & Gunhidzirai, 2017). Inland fisheries of Africa have around 5 million tons of fish and has become a major export commodity for the continent with an annual export of 2.7 billion USD (Endalew et al., 2020).

Nevertheless, Twumasi et al., (2021) & Endalew et al. (2020) stated that there has to be suitable and enabling environment in order to implement and realise successful participation in fish farming in both developed and developing countries. The successful cases of farmers' participation in fish farming are backed by existence of enablers in the form of government support and regulatory environment, social environment, public utilities, financial issues, physical environment, land issues, infrastructure, technology and organisational culture among farmers.

On realising the socio-economic importance of fish farming, the government of Lesotho initiated a policy shift towards improving the sector in the country (Ministry of Agriculture and Food Security (MAFS), 2020). This has seen an increase in government and donors support for the upgrading and development of the sector through projects such as Sustainable Agriculture and Natural Resources Management Project (SANREMP) and Smallholder Agriculture Development Project (SADP). However, in spite the concerted efforts from both government and development partners to support the growth of the sector, the participation of Basotho farmers in fish farming is still very low (Maduna et al., 2020; MAFS, 2020) with only 200 small-scale farmers engaging in this farm enterprise across the entire country. This situation has led to the study seeking to investigate the factors that influence participation in fish production among farmers in the entire country.

Several international studies have been conducted to assess the importance of participation in fish farming among smallholder farmers and factors that influenced decision to participate (Iruo et al., 2018; Twumasi et al., 2021). In Lesotho, several studies have assessed the importance of participation in fish farming from business and policy perspectives. A particular study, such as Raleting (2019) focused on the effects of agricultural extension service on the profits of fish farmers in Lesotho while Makalo (2019) discussed participation in fish farming as a poverty reduction strategy in Lesotho. These studies did not discuss the smallholder fish farmers' decision to participate in fish farming. To date there has not been a study conducted to assess the factors influencing participation of Basotho farmers in fish farming in the least developed nation of Lesotho.

This study analyzed the factors influencing farmers' participation in fish farming in Lesotho. Specifically, the study

1. Described farming systems under which fish farming is practiced;
2. Identified factors influencing participation of farmers in fish farming; and
3. Determined factors influencing participation in fish farming.

The topic is of importance for policy makers in Lesotho where participation in fish farming is low among farmers compared to the developed world (Makalo, 2019).

Methodology

Lesotho is situated between latitudes 28° and 31´ South of the equator and longitudes 27° and 30° East of the Greenwich. It is a geographic enclave surrounded by the Republic of South Africa. "The mountain kingdom" or "The Kingdom in the sky", as it is called by virtue of its plateaus, hills, mountains and rugged terrain, covers about 30 340 square kilometres of the highlands ranging from 1 500 metres at its lowest level to 3 300 metres at its highest level. The country has a temperate climate with cool to cold dry winters and hot wet summers (Rantlo, 2018).

The target population of the study comprised farmers who are participating in fish farming and farmers not participating in fish farming**.** Multi-stage sampling procedure was employed to draw a representative sample for the study. In the first stage, eight districts were purposely selected because they had farmers practicing fish farming

and the selected districts included Maseru, Mafeteng, Berea, Leribe, Thaba-Tseka, Butha-Buthe, Mohale's Hoek and Quthing. In the second stage, the stratified sampling technique was used to choose a sample whereby farmers were divided into strata, according to whether they are fish farmers and non-fish farmers in the eight districts. In the final stage, all 200 farmers participating in fish farming were involved through census while 200 non-participating farmers were selected using simple random sampling techniques and 25 non-participating farmers were selected from each of the 8 districts. This brought to 400 the total sample size used in the study, this included farmers who participated in fish farming and those who did not participate in fish farming.

Data were collected from 400 farmers in 8 out of 10 districts of the country where fish farming was practiced using a pre-tested semi-structured questionnaire and 20 sampling units were involved in this pre-test exercise but were not part of the main study. The questionnaire was tested before the execution of main survey to ensure content validity and internal consistency, hence reliability, which recorded a coefficient of 0.8. The instrument focused mainly on socio-economic information, agricultural production and institutional and technical support. The data collection was done between January 2020 and May 2020 and the questionnaire was given to the farmers who were requested to provide feedback within 2 months of receipt of the instrument.

Percentages and means were used to describe the systems Basotho farmers used to rear fish while binary logistic regression model was used to analyse factors that influenced participation in fish farming and their effect on participation. According to Muroiwa et al. (2018), the binary logistic regression is the best model when some of the variables are qualitative rather than quantitative or when the required assumptions for multiple regression analysis (e.g., linearity, independence, etc.) are not met. The logit model is also able to provide valid estimates, regardless of study design.

The dependent variable is the decision to participate in fish farming and participation in fish farming was coded 1, whilst non-participation in fish farming was coded 0.

In this study, the probability that a farmer participates in fish farming is Prob (Y=1) and Prob (Y=0) when not participating in fish farming. The farmer's decision to participate in fish farming is an indirect utility derived from participating in fish farming. The conceptual model for the linear function of (X) variables is as given below:

$Z_i = \beta_\circ + \sum \beta_1 \, n \; i{=}1 \; Xk_i$ (1)

$\beta_\circ$ = intercept

$\beta_1, \beta_2, \beta_3, \ldots . \beta_i$=coefficients of the independent variables.

X_1, X_2, X_3….. Xk_i = independent variables [socio-economic, institutional and technical factors and other household characteristics] that are likely to influence the individual farmer's decision to participate in fish farming namely;

X_1 = Skills and training (fish farming)
X_2 = Access to market information

X_3 = Access to arable land
X_4 = Access to marketing infrastructure
X_5 = Access to appropriate extension services

X_6 = Farmer group/association membership
X_7 = Path dependency
X_8 = Culture
X_9 = Social capital

Table I: Description of explanatory variables used in the model

Variable name	Coding of variable	Expected relationship
Skills and training (fish farming) (SKTRA)	1 if yes, 0 otherwise	+
Government support (GOVSUP)	1 if yes, 0 otherwise	+
Access to arable land (ARLAND)	1 if yes, 0 otherwise	-
Access to marketing infrastructure (INFR)	1 if yes, 0 otherwise	+
Appropriate extension services (EXT)	1 if yes, 0 otherwise	+
Farmer association membership (MEMB)	1 if yes, 0 otherwise	+
Path dependency (PADEP)	1 if influenced, 0 otherwise	-
Culture (CULT)	1 if influenced, 0 otherwise	-
Social capital (SOCAP)	1 if access, 0 otherwise	-

Given that $P_i=\frac{e^{zi}}{1+e^{z_i}}$ where *e* is the base of the natural logarithm and P_i is the probability that the farmer decides to participate in fish farming, 1- P_i is the probability that the farmer decides not to participate in fish farming. The odds of the farmer's decision to participate in fish farming (Y=1) and the odds of decision to not participate in fish farming (Y=0) is expressed as the ratio of the probability of the decision to participate in fish farming to the decision to not participate in fish farming.

The prediction equation for the individual farmer's production choice is derived from the natural logarithms as given by the equation below;

$\mathrm{Ln}\left(\frac{P_i}{1-P_i}\right)= \beta_\circ + \sum_{i=1}^{n} \beta_1 \mathrm{Xk_i} = Z_i$ (Muroiwa et al., 2018) (2)

Z_i=odds ratio of farmer's decision to participate in fish farming.

In this study, the binary logistic regression model for the farmer's decision to participate in fish farming is as expressed below:

$P_i\ 1-P_i = \beta_1 SKTRA + \beta_2\, GOVSUP + \beta_3\, ARLAND + \beta_4\, INFR + \beta_5\, EXT + \beta_6\, MEMB + \beta_7\, PADEP + \beta_8\, CULT + \beta_9\, SOCAP$

Results and Discussion

Socio-Economics Characteristics

The results in Table 2 reveal that, in terms of variables such as household size, monthly income and education level, there was no variation between the two categories of Basotho smallholder farmers. There was no significant relationship

between these three variables and participation in any type of farming in the kingdom of Lesotho. There was variation in terms of age as the mean age of farmers in fish farming was 50 years while the farmers in non-fish farming had a mean of 35 years. However, the significance tests revealed no significant relationship between age and participation in farming.

Around 95% of fish farmers practised extensive system while the remaining fish farmers engaged in the intensive system. All farmers under intensive farming used fibre and cage for fish farming, kept large numbers and also practised exclusive feeding of nutritionally balanced diet to their stock. In addition, they acquired their fingerlings from hatcheries in the neighbouring Republic of South Africa. They mainly sold carp, yellow fish and tilapia breeds to the international markets on contractual basis. The fish farmers who practised extensive farming were characterised by low stocking density, used poultry droppings as the only nutritional inputs and they acquired their fingerlings from the rivers and streams and they produced only catfish and yellow fish and they sold to individual local consumers at public places. This situation implies that in Lesotho, fish farming is still underdeveloped, hence limited returns attained by fish farming communities. This agrees with Makara (2018) that in Lesotho's agriculture, some sectors are underdeveloped and as a result farmers receive very little incomes, and that discourages many Basotho from participating in such activities.

All respondents indicated that they have never received appropriate extension services from the public extension services and the explanation could be that there is shortage of expertise in the area of aquaculture. About 5% of the farmers claimed to have received various forms of support from government and donor funded projects. This group of farmers had access to the necessary infrastructure such as storage, processing and transportation which probably helped their fish farming. In addition, this group owned technologies such as fibre and cages and had access to nutritionally balanced feedstuffs. About 45% of the farmers indicated that they had access to social networks which helped and influenced their farming enterprises.

Table 2: Demographic characteristics of farmers

Variable	Fish farming	Non-fish farming
Age	50	35
Education level	8	9
Household size	7	7
Monthly income	900	950

Around 65% of the farmers claimed to have received training in fish farming only once while the remaining 35% never received such training. About 50% of the respondents cited limited size of arable land as a factor that influenced their farming decisions while the other half's decisions were path dependent as they only practised what their fore fathers used to do. In addition, 58% of the respondents indicated that

they practised farming according to the traditions and culture of Basotho. Around 55% of the farmers held membership in farmer groups/ farmer associations/ cooperatives and they all stated that this variable influenced their farming decisions and performance. The explanation could be that the collective action reduced the transaction and business costs for these farmers.

Factors Influencing Participation in Fish Farming

Government support: the results in Table 3 reveal that government support has a positive influence on participation in fish farming as it recorded a correlation coefficient of 2.662. This correlation coefficient implies that there is enough evidence to support that an increase in farmers' access to government support leads to an increase in participation in fish farming among smallholder farmers in Lesotho. This agrees with the study's a priori expectation that institutional support enhances participation in targeted farm enterprises. This is consistent with Mafura (2020) who stated that government or donor support such as equipment and inputs enabled smallholder farmers to participate in targeted and new farming enterprises such as bee keeping.

Arable land: the results revealed that lack of arable land positively influences participation in fish farming as it recorded a correlation coefficient of 2.824. The results imply that there is enough evidence to support that an increase in the lack of arable land leads to an increase in participation in fish farming. This agrees with the study's expectation that lack or limited arable land enhances participation in fish farming. The explanation for this could be that fish farming does not necessarily have to be practised on huge acreage compared to most other farming enterprises. The study is supported by Marake (2019) when stating that farmers with limited or no arable land mostly resort to less land intensive enterprises such as bee farming.

Social capital: the social networks among smallholder farmers positively influences participation in fish farming with a correlation coefficient of 2.387. The statistics imply that there is enough evidence to suggest that an increase in social capital results in an increase in participation in fish farming among Basotho farmers. These informal institutions facilitate information sharing between fish farmers in Lesotho and one of the outcomes of this exchange is knowledge about production methods and techniques, opportunities and benefits of fish farming. This is consistent with Adepoju (2019) that social capital plays a critical role in production and marketing decisions among smallholder farmers

Farmer group membership: this variable significantly and positively influences participation in non-fish farming with a correlation coefficient of 1.925. The result indicates that there is adequate evidence to support that an increase in participation in farmer group/association leads to an increase in participation in non-fish farming. The explanation could be that there is no fish farming based group and all farmer groups or association are based on non-fish commodities hence, non-participation in fish farming. This is supported by Twumasi et al. (2021) who stated that farmer groups and associations enhance participation in the production of the commodity of interest or focus.

Table 3: Factors determining fish farming and non-fish farming participants

	Fish farmers			Non-fish farmers		
Variable	**Coefficient β**	**Std. Error**	**Odds Ratio**	**Coefficient β**	**Std. Error**	**Odds Ratio**
Skills & Training	1.721	0.908	0.319	-1.480	0.758	1.892
Government	2.662	1.210	10.160	1.386	1.902	1.975
support*	2.824	1.353	12.920	-0.640	-1.871	0.994
Arable Land*	1.753	0.700	11.219	0.722	0.390	0.760
Market	-1.910	0.376	0.370	1.805	-1.206	1.909
Infrastructure	1.983	0.670	1.032	1.925	2.338	12.414
Extension Services	2.712	0.671	0.370	2.007	2.851	10.119
Group	-0.975	0.874	0.231	2.985	1.790	11.210
membership*	2.387	1.731	13.320	1.049	1.308	0.567
Path Dependency*						
Culture*						
Social Capital*						

Number of observations = 400 LR chi2 (40) = 53.33 Prob > Chi2 = 0.0773 Pseudo R2 = 0.2547 Log likelihood = -78.00965

***P ≤0.05**

Path dependency: this variable has a significant and positive influence on farmers' participation in non-fish farming with a correlation coefficient of 2.007. This correlation coefficient implies that there is enough evidence to claim that an increase in the level of path dependency results in an increase in farming other than fish farming. These farmers decision making is influenced by their forefathers as they only venture into enterprises that were pursued by their forefathers which fish farming was not part of. The findings agree with those of Rantlo et al. (2020) that path dependency is among the main factors that influence production and marketing decisions among smallholder farmers in the least developed countries such as Lesotho.

Culture: the results revealed that tradition significantly and positively influences farmers to participate in farm enterprises other than fish farming with a correlation coefficient of 2.985. The result implies that there is enough evidence to support that an increase in the level of rooting in culture leads to an increase in other types of farming except fish farming. The explanation is that in Lesotho, fish has not been a traditional dish and it would have been irrational to invest in the production of a commodity with a relatively limited demand. This is supported by Lenka (2017) when stating that one of the features of Basotho farmers is the production of mainly commodities that are part of traditional dishes.

Conclusion and Recommendations

Most Basotho fish farmers practiced fish farming under extensive system while the minority practiced fish farming under a more advanced intensive system in the Mountain Kingdom of Lesotho.

Support from government in the form of subsidised inputs and technologies have rendered the environment conducive for Basotho farmers to participate in fish production. Limited availability and size of arable land has made Basotho farmers to opt for the less land intensive agricultural enterprise of fish farming in the country. Participation in this agribusiness of fish farming is further consolidated by social capital that is centred on the exchange of information and ideas about fish farming in Lesotho.

Constraint to participation in fish farming include group membership, culture and path dependent decision making as they promote non-fish-based production systems, hence more participation of Basotho farmers in sectors other than fish production. Collectively, these factors have restricted and made the environment unconducive for Basotho farmers to participate in fish farming enterprise, hence low participation in fish farming among Basotho farmers in the country.

These are critical to the participation of farmers in the enterprise of fish farming in the country. In addition, formation of fish-based farmer organisations/groups should be encouraged and supported as this institutional innovation is a critical factor to the participation of farmers in the production of most commodities in Lesotho.

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