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Influence of markets on fish farming adoption: The case of Chingale in Malawi

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The challenges constraining the contribution of aquaculture to food security and household incomes have mostly been documented as low utilization of improved feed, lack of improved seed and unfriendly financing services. This study looked at the influence of markets including market information on adopting aquaculture technologies. Data were collected from 110 farmers in Zomba District, Malawi. Using a logit model, farmers' adoption of new technologies was mainly influenced by market information, level of education and number of ponds owned by a farmer. Therefore, linking rural farmers to urban markets can improve the adoption of fish farming technologies.

Key words: Adoption, aquaculture, livelihoods, marketing access.

INTRODUCTION

The productivity of artisanal and commercial fishing on major lakes and river systems in Malawi has declined by more than 37% over the period of 1974 to 2004 (World Bank, 2004) due to overfishing and poor conservation practices. This decline, coupled with rapid population growth in Malawi has reduced the per capita consumption from 16 - 18 kg/year in the 1980s (Allison, 2011) to about 8.12 kg/year in 2014, (GOM, 2015). The recommended per capita consumption by FAO is 15 kg/capita/year (FAO, 2014). With no significant gains in fish production expected from capture fisheries to sustain the current per capita fish supply, aquaculture provides a viable option. Small-scale pond aquaculture in particular can improve both productivity and cash flows with little or no external input (Sungas and Manus, 2014).

However, as technologies for aquaculture development improve, determinants of their adoption need to be investigated. In general, the adoption of agricultural innovations are determined by farm size, capacity to bear risks (Sungas and Manus, 2014), human capital, labor availability tenure systems, access to credit and commodity markets (Maina et al., 2014). Ndah et al. (2011), Farnworth et al. (2015) and Olaoye et al. (2016) found that the adoption of agricultural fish farming practices are directly linked to access to agricultural markets, gender, improvements in rural infrastructure and marketing institutions. These determinants are essential for the transformation of subsistence-oriented smallholder agriculture to commercially orientated agriculture. Particularly, improved access to agricultural input and

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output markets is important for increased productivity. Well-functioning markets transmit price signals, which allow changes in demand to be met by supply. In so doing, markets support flow of goods from areas of surplus to areas of deficit to ensure that food is efficiently distributed (Hebebrand and Wedding, 2010).

Aquaculture production in Chingale, west of Zomba in Malawi, has been facilitated and supported by several partners including Non-Governmental Organizations (NGOs) and the Malawian Department of Fisheries. Other notable organizations assisting the development of aquaculture in Chingale are World Vision and WorldFish. As such, pond aquaculture in Chingale area has grown from about 300 farmers in the 1980s to over 1000 farmers in 2009 (Nagoli et al., 2009). The main driver to this growth is the perennial water supply from the Zomba Mountain providing fish farming area of about 200 km^2, with an estimated population of 30,000 (Kambewa et al., 2009). With the water flowing by gravity, pond aquaculture is well integrated with irrigation farming through diversion canals from main streams and rivers. Water from the canals is used both for filling and refilling of fish ponds and irrigating crops. Irrigation is practiced on a wider scale with the following major crops: maize, beans and vegetables for both subsistence and commercial purposes (Kambewa et al., 2009).

Despite aquaculture's growth in numbers of ponds and area, productivity has remained low. The fish pond productivity in Chingale is about one tone per hectare accounting for an annual production of about 40 tones. Additionally, the fish produced is sold locally at about 50% of the retail price in urban and peril-urban markets. The main challenges to low production are said to be low utilization of improved feed, lack of improved seed and financing to access these inputs (Jatto et al., 2013). This study analyzed the influence of markets on the adoption of new fish farming technologies by Chingale fish farmers. The hypothesis being, farmers will adopt improved technologies when they are assured of markets and have information regarding product pricing and marketing costs.

MATERIALS AND METHODS

Study design

A market study used a value chain approach. The idea for a value chain approach was to identify various channels through which fish move from producers to consumers, with the aim of identifying stakeholders, activities, costs incurred along the chain and respective returns. Data was collected using individual questionnaires which were administered to randomly selected farmers (n=110) and fish sellers (n= 80), where 53.6% were males and 46.4 % were females. The data was collected on cost of production from primary producers, transportation cost and available markets in urban centers of Zomba and Blantyre. The respondents were sampled across the various clubs under Chingale Integrated Agriculture Aquaculture Farmers Association (CIAAFA), enabling the survey to include both old (n=70) and newly (n=40) established farmers. The rule of thumb for determining sample size proposes that sample sizes larger than 30 are appropriate for most research (Hogg et al., 2015) and this justified the sample size.

Data analysis

Using logit and linear probabilities, seven independent variables that influence farmers to adopt the farming of tilapia (*Oreochromis shiranus)* and factors that influence these farmers to have more fish ponds were analyzed.

The logit model:

1. $adopt = f(sex, educn, extmkt, pondreq, age, mar\_stat,)$

The linear probability model of number of ponds required carries the following variables

2. $Pond\_reqd = (sex, educn, age, mar\_stat, adopt, farmYrs)$

Where the variables are defined as: adopt = adoption of *Oreochromis shiranus;* sex = male, female; educn = highest level of education of a respondent; pond_reqd= ability to increase the number of ponds; age = age of the respondent; mar_stat = marital status of the respondent (married or not married); farm years = number of years the farmer has been involved in fish farming
extmkt = external markets, that is, markets outside Chingale area.

From market analysis, recommendations for an optimal market channel that can increase income by reducing costs of various participants for Chingale farmers were developed.

RESULTS AND DISCUSSION

Fish farming and marketing in Chingale

Table 1 gives descriptive statistics of fish farmers in Chingale. The table shows that fish farmers in Chingale have an average age of 47 ranging from 21 to 86 years. This is also reflected with fish farming experience where the maximum number of years is 30 and minimum is 1 year, giving an indication that fish farming has been practiced in Chingale for a long time. Chingale fish farmers that have at least attained primary education were 67%. The table also indicates that 83% of the respondents were married, with 51% being males.

In a study by Oyieng et al. (2013), fish farming was dominated by male farmers (Meru, 71%: Nkubu, 79%; Mburigini, 80%). This is because most of the activities in pond making are strenuous. However, the Chingale statistics show that there is a balance between male and female participants. Apart from pond construction, fish pond management activities such as weed clearing, feeding and predation control are equally shared between

Table 1. Description of Chingale fish farmers.

Variable	Mean	Minimum	Maximum
Age	46.93	21	86
Gender*	0.508	-	-
Education*	0.667	-	-
Farming Experience	6.34	1	30
Marital Status*	0.828	-	-

For all categorical variables (*), mean is the proportion of those respondents with dummy variable 1.

Table 2. Fish farming by species.

Species	Frequency	Percentage
O. shiranus (old)	52	47.3
O. shiranus (new)	34	30.9
O. karongae	15	13.6
Tilapia rendalli	87	79.1

men and women. In fact, women dominated in the feeding of fish in ponds.

In the study, about 79% of the respondents indicated that they mostly kept *Tilapia rendalli*, 47% kept the unimproved[1] *Oreochromis shiranus*, 30% kept the new strain[2] of *O. shiranus* and 14% kept *O. karongae*, this is clearly indicated in Table 2. The two species (*T. rendalli* and *O. shiranus*) are very popular in the area mostly because they have been locally known by the farmers for a long time than the other species that were recently introduced. *T. rendalli* was mostly favoured because it mostly feed on phytoplankton with little supplementary feed.

As observed by Oyieng et al. (2013), *T. rendalli* responds well to fertilized ponds. The other perceived advantage of *T. rendalli* by farmers was that it is fleshy and grows faster than *O. shiranus*. While many farmers would want to grow *O. karongae* which is commonly known as *chambo*, the premium fish for Malawians, seed supply was the biggest challenge. It was mentioned by farmers that *O. karongae* has low fecundity and does not reproduce during cold months.

The primary objective of fish farming in Chingale is to produce fish for food. The study found that about 84% of the respondents allocated some of their harvest to home consumption and the same percentage of respondents also produced fish for sell (Figure 1). Even those that sold their fish, usually smaller fish were used for home consumption. About 64% of the respondents gave away fish for free as an enhancement to social relationships. In Chingale, about 85% of the respondents had ever sold fish after harvesting. It was found that 74% of those that sold fish had done so within the village mostly at the village markets. It was also observed that 18% of the farmers preferred selling at the pond site soon after harvesting and as low as 4% of farmers preferred urban markets.

Fish sold at the pond site and village markets often fetched lower prices than the fish that was sold at urban markets. Both pond sale and village market selling points provide less profit margins to the farmers as the customers prices haggle and take into consideration family or relations ties. However, the fact that few farmers sold at urban markets at higher prices contradicts with the conventional thinking that farmers like any other producers would respond to market demand. Ideally it was expected that more farmers would sell their fish at the urban market where prices were higher. However, a number of factors affected the choice of a market where producers would sell their fish.

The main constraining factor was limited access to the markets by the farmers because of high transport costs, lack of proper handling and storage facilities given the perishable nature of fish with respect to distance and road conditions. Transportation to various markets was mostly done on bicycles (42%), seconded by head-loading (34%). Those that have ever sold fish in urban areas transported their fish with subsidies from NGOs such as C-Fish project[3]. This finding indicates that marketing is a broader concept that should include the market infrastructure itself, transportation to markets and storage facilities.

A marketing strategy of farmed from rural smallholder farmers must be looked at keenly because the fish value chain is generally short. The current production level (40 tones) does not provide enough incentives for targeting urban markets. This production level is mostly aimed at

[1] Unimproved tilapia in this case was the wild species that had not undergone genetic improve through selective breeding.

[2] The new *O. shiranus* is an improved strain (fourth generation) from the national selective fish breeding program that has shown a 30% growth improvement over the wild strain.

[3] Captive Fisheries for Income and Strengthened Households, a USAID funded project that promoted commercialization of smallholder pond fish farming.

Table 3. Adopt and pond requirement results.

Variable	Marginal effects (dependent: adopt)		LPM (dependent: pond required)	
	dy/dx	p>|z|	Coefficient	p>|t|
Sex	0.048	0.962	0.467	0.206
Educn	-0.125	0.089*	0.081	0.854
Ext mkt	0.143	0.078*		
Pond no.	0.057	0.059*		
Age	-0.015	0.664	-0.026	0.043*
Mar_stat	0.530	0.005**	0.566	0.633
Adopt			0.101	0.077*
Farm Yrs			0.002	0.067*

*, **, *** denotes significance at 10, 5 and 1 levels, respectively.

providing cheaper animal protein. As such, only communities in Chingale benefit from aquaculture production by accessing fish at low prices. It was observed from this study that food security benefits of having fish ponds within the communities spread beyond the fish farming households but the fish farmer loses on income by selling fish at low prices within the village markets or at pond sites. This result was also found by Salau et al. (2014) and Jatto et al. (2013). However, subsistence aquaculture on one hand will neither address the poverty that impacts rural farmers nor meet the food and nutritional security needs the Malawian population. On the other hand, producing fish for markets would increase production and productivity that will increase household incomes which may result in accessibility to other protein sources apart from fish by rural poor farmers.

Furthermore, the study observed that many farmers in Chingale sold fish once a year (52%), another 28% of the respondents indicated that they sold twice a year. These results indicate that most of the fish farmers kept fish in ponds for more than the recommended time of six months (Malawi Gold Standard). The study observed that 78% of the respondents sold their fish individually without involving other farmers or consulting them. However, 6 and 3% sold fish as a group or in consultation with other farmers, respectively. This is an indication that there is no coordination in marketing of fish among the farmers in Chingale.

The lack of coordination (78.2%) means that the farmers do not gain the economies of scale of selling whereby they would present a common front of prices and supply to the market for a long time there by putting up a brand of their own.

Mode of payment for fish sales

The study showed that 84% of the farmers preferred receiving payment in cash as opposed to payment by credit (19%). This is supported by the indication that about 66% of the farmers sold fish to non-regular customers who were considered to have no ties with the sellers. On the other hand, 17% of the farmers sold to regular customers (those that the farmers knew). This figure is highly correlated to figures of those that sold on the pond site (18%) and those that sold on credit (19%). This implies that farmers that sell on pond site do not only sell at low prices but also offer their fish on credit. The lack of cash payment basis on the pond or home market may not be surprising. Even as early as in the 1990s, Brummet (1995) observed that village customers, especially during hungry seasons lack cash income to purchase food and relied on traditional or barter systems to get them through the seasons. This category of village population comprises the major part of the fish customers.

Adoption of technologies

Using a logit model (marginal effect analysis), level of education, information on the external markets, number of ponds required, and marital status significantly affected adoption of new technologies (Table 3). Surprisingly, education was estimated to decrease probability of adoption by 13% points. This can be explained by the fact that educated people leave farming (in the village) in search of employment or other businesses in urban areas. This is unlike cases where fish farming isorganized in unions and have well established markets. The results also show that age of the respondent reduces the probability of adopting by 0.2 percent points. The older the person, the less likelihood of adopting fish farming. This is probably due to the fact that pond construction and maintenance are energy, money, and time demanding.

The limited availability of external market information

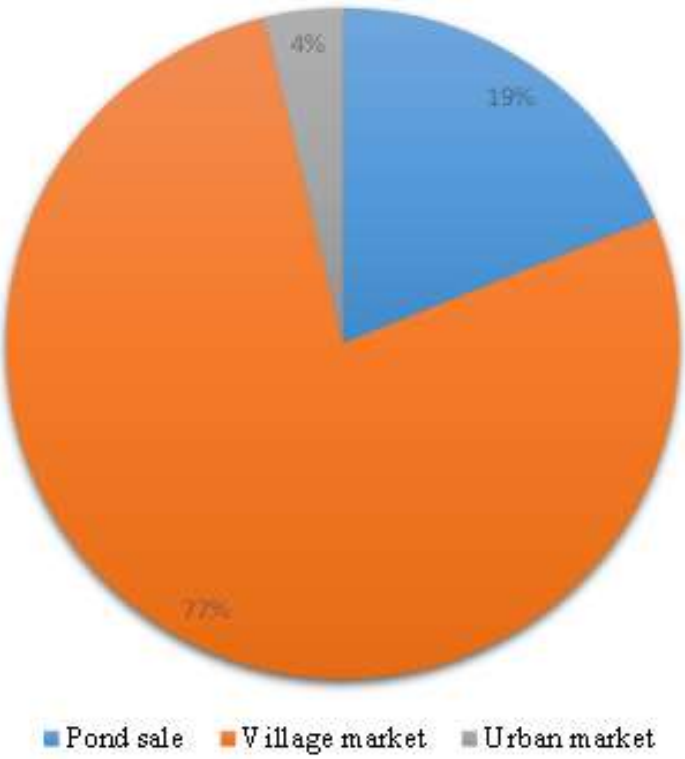

Figure 1. Chingale farmers' selling points.

reduced the probability of adoption by 14%. This makes both theoretical and practical sense. The accessibility to external markets or external market information would be an incentive for adopting the use of *O. shiranus* (Hebebrand and Wedding, 2010). The ability to increase the number of ponds increased the probability of adopting fish farming technologies by 6%. This is significant at 10% level. On the other hand, only three variables were significant under factors that influenced requirement of more ponds over time, using linear probability model (LPM). These variables are age at which one adopts; farm size; and number of years in farming fish. The more a farmer adopts new technologies, the more he/she requires more ponds because of the speculation to attain higher margins. When a farmer attains more years in fish farming, he/she is likely to attain more ponds as the need for additional capital costs decline through the use of already acquired equipment and knowledge.

Production and marketing constraints

Farmers in Chingale have shown in this study that they experienced a number of marketing problems that have been indicated in Figure 2. It has been indicated that lack of good markets which would offer higher and competitive prices was a major problem as indicated by the 73% of the respondents. Transport was another problem that was raised by 40% of the respondents. It was expensive to access outside markets in Chingale mainly because of poor road infrastructure that made transport costs high. Lack of market information (26%) was also identified as a major problem as farmers did not have information on what was required at the urban markets in terms of prices offered, fish species and sizes required. A noticeable production constraint that is cited in literature is the lack of credit (DOF, 2005). Findings in Chingale showed that Fishermen, traders and intermediaries did not have easy access to bank and microfinance operators due to too much official paperwork and collateral arrangements.

Apart from production constraints, farmers faced problems in disposing their output at a higher margin. Some of these limitations were related to how urban markets were structured. A marketing study of the urban markets showed a long chain of middlemen that affected buying price. The markets were heavily controlled by unscrupulous middlemen that limited entry by producers or any new middlemen. It was also observed that urban lucrative markets especially in Zomba and Blantyre had size preference for fish. Premium prices were offered to sizes ranging from 150 to 250 g. On the contrary, the farmers' production sizes were between 40 and 75 g. The

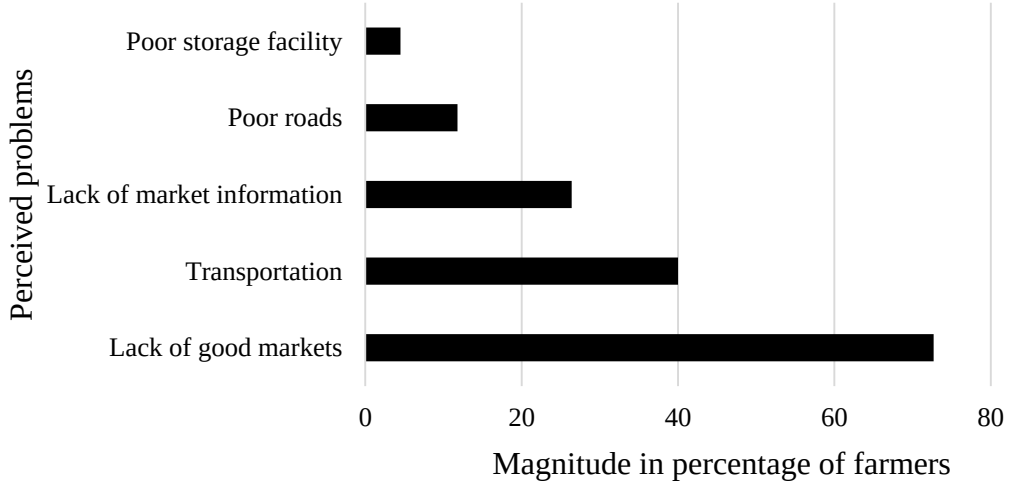

Figure 2. Problems associated with pond fish farming.

main fish marketing by the farmers in Chingale was where adverts were made before harvesting to employees from organizations in the Zomba urban. This marketing arrangement is termed “institutional arranged markets”. This market had a wide range of size preferences. It also had the highest preference for pond fish as compared to fish from natural water.

CONCLUSION AND RECOMMENDATIONS

Although, Chingale is a success story for small-scale fish farming in Malawi, its success is not built on market forces hence the low productivity. The adoption of fish farming in Chingale is supported and subsidized by NGOs and projects. This poses a serious sustainability issues once life-spans of NGO projects end. Fish production from Chingale is currently very low for urban or peri-urban markets. In the current situation where farmers do not have much to offer, marketing and production linkages need to be promoted if farmers are to be motivated by higher fish prices in urban markets. Better technologies that ensure high production and better fish sizes preferred in lucrative markets should therefore be given priority. Work on the dissemination of new *O. shiranus* strain is therefore a right step towards lucrative market breakthroughs. Similarly, the current marketing system through arranged institutional market is just ideal for the farmers. There are clubs and an association, the Chingale Integrated Aquaculture-Agriculture Farmers’ Association (CIAAFA) which can be organized to act as marketing organizations in the form of a cooperative. The CIAAFA will need to strengthen linkages between improved production practices and other institutional arrangements that link farmers and markets in appropriate market chains.

As much as the study indicates that most farmers sold/harvested once a year, it would be recommended that farmers produce at least twice a year to take advantage of the availability of peri-urban market. Furthermore, individual marketing of fish should be discouraged for group marketing in order to enjoy economies of scale especially on transport (Salau et al, 2014). In this case, farmers ought to work in groups where fish stocking and harvesting are done at the same time within a group. The group stocking and harvesting should then be spread across the year to ensure uniform supply. Different groups would stock at different times to avoid flooding the fish market which result in low prices when the demand is low. However, poor land transport links and means of transportation between Chingale and urban markets as a result of poor road infrastructure is currently the major impediment to aquaculture growth in Chingale. It is therefore recommended that government and non-governmental organizations should play an active role in the improvement of both the vertical and horizontal dimensions of the fish marketing chain in Chingale for profitable fish farming.

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CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest.

REFERENCES

Allison EH (2011). Fisheries, aquaculture, poverty and food security. OECD Food, Agriculture and Fisheries Working Papers. OECD Publishing, Paris.

Brummet RE (1995). The context of smallholding integrated aquaculture in Malawi: a case study for sub-Saharan Africa. Naga, the ICLARM Q. 18(4):8-10.

DOF (2005). National Fisheries Fortnight. Department of Fisheries Government of the People's Republic of Bangladesh, Dhaka.

Farnworth C, Sultana N, Kantor P, Choudhury A (2015). Gender integration in aquaculture research and technology adoption processes: Lessons learned in Bangladesh. WorldFish, Penang, Malaysia. Working Paper 17.

FAO (Food and Agriculture Organization of the United Nations) 2014. The state of world fisheries and aquaculture 2014. Rome, Italy.

Government of Malawi (GOM) (2015). Annual Economic Report 2015. Ministry of Finance, Economic Planning and Development, Lilongwe.

Hebebrand C, Wedding K (2010). "The Role of Markets and Trade in Food Security. A Report of the CSIS Global Food Security Project", Center for Strategic and International Studies, Washington, D.C.

Hogg AM, Meredith MP, Chambers DP, Abrahamsen EP, Hughes CW, Morrison AK (2015). Recent trends in the Southern Ocean eddy field. Journal of Geophysical Research: Oceans 120:257-267.

Jatto NA, Alkali U, Galadima ZI, Sheu Shagari UI, Maikasuwa MA (2013). Estimating The Factors Influencing Cat Fish Farmers' Interest In Fish Production In Ilorin, Kwara State. European Scientific Journal 9(13):1857-7431.

Kambewa PS, Chaweza RD, Gawani C (2009). "Aquaculture for improved rural livelihoods: Development and promotion of market linkages for increased adoption of improved technology package and incomes: Chin gale Baseline Report". Unpublished Report. WorldFish Center.

Malawi Gold Standard. Fish farmers handbook for pond aquaculture, COMPASS II, USAID Malawi.

Maina JG, Mbuthia PG, Ngugi J, Omolo B, Orina P, Wangia SM, Karuri EG, Maitho T, Owiti GO (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 26:36.

Nagoli J, Phiri EM, Kambewa E, Jamu D (2009). Adapting Integrated Agriculture Aquaculture for HIV and AIDS-Affected Households: The case of Malawi. The WorldFish Center Working Paper 1957. The WorldFish Center, Penang, Malaysia.

Ndah HT, Knierim A, Ndambi OA (2011). Fish pond aquaculture in Cameroon: a field survey of determinants for farmers' adoption behaviour. The Journal of Agricultural Education and Extension 17:309-323.

Oyieng EP, Charo HK, Kahi AK, Ojango JMK (2013). Characterization of fish production and marketing practices under small-holder fish farming systems of eastern Kenya. Livestock Research for Rural Development 25(2):32.

Olaoye OJ, Ezeri G, Akegbejo-Samsons Y, Awotunde J, Ojebiyi W (2016). Dynamics of the adoption of improved aquaculture technologies among fish farmers in Lagos State, Nigeria. Croatian Journal of Fisheries 74:56-70.

Salau E, Lawe A, Luka G, Bello D (2014). Adoption of improved Fisheries Technology by Fish Farmers in Southern Agricultural Zone of nasarawa State, Nigeria. Journal of Agricultural Extension and Rural Development 6(11):339-346.

Sungas S, Manus P (2014). Factors influencing adoption of Pond fish farming innovations in Poultry of Morobe provinces, Papua New Guinea. Universal Journal of Agricultural Research 2(6):191-197.

World Bank (2004). Institutionalizing Traditional Community-Based Natural Resources Management. http://www.worldbank.org/afr/ik/iknt64.pdf.