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Market Potential of Freshwater Fish Farmers in Limpopo Province

Master Maebane, Ntise Manchidi, Germinah Chiloane-Phetla
University of South Africa, South Africa
maebamm@unisa.ac.za, manchnh@unisa.ac.za, chiloge@unisa.ac.za

Abstract: O. mossambicus is one of the most cultured food fish worldwide. In sub-Saharan Africa, it is essential for meeting the need for food security, as it can be a cheap source of protein. Previous studies focused to some extent on the profitability of tilapia farmers. This study aims to make a scientific contribution by analyzing the market environment, and specifically the potential customers, of the O. mossambicus farmers who belong to small and medium enterprises in agriculture, by using a feasibility analysis framework. A mixed-methods approach was used to achieve the research objectives. Data were analyzed using the Statistical Package for the Social Sciences (SPSS), to compile descriptive and inferential statistics. The reliability and validity of the data collection instrument were measured using Chronbach's Alpha values. One-way analysis of variance (ANOVA) was the statistical method used, and the f-test was conducted to determine the statistical significance of the variables in the multivariate analysis. The overall results of the study showed that O. mossambicus farmers largely sell the fish fresh to individual consumers and informal fish traders at farm stalls. In contrast, fish traders bought the O. mossambicus frozen or smoked from other suppliers. Here, recommendations are made in respect of new entrepreneurial ventures, next steps for business consultants and other stakeholders in the O. mossambicus industry, and future research directions.

Keywords: *Freshwater fish, Market potential, O. mossambicus, SME farmers.*

1. Introduction

Globally, small and medium enterprises (SMEs) are regarded as the backbone of economies (Arokiasamy, & Ismail, 2009; Lopriore, 2009; Mutezo, 2013; Groepe, 2015; Bowmaker-Falconer & Herrington, 2020; Bosma, Hill, Ionescu-Somers, Kelley, Guerrero & Schott, 2021). In South Africa, the National Small Business Amendment Act (NSBAA) 29 of 2004 (RSA, 2004) defines a small business as "a separate and distinct business entity, together with its branches or subsidiaries, if any, including cooperative enterprises, managed by one owner or more, predominantly carried on in any sector or subsector of the economy". Although small businesses can operate in any sector, the focus of the study reported here, was on agriculture. According to Herrington and Kew (2016), cited in the Global Entrepreneurship Monitor (GEM) report, Africa (13%) and Europe (8%) had more entrepreneurs in the agricultural sector, than the less than 5% in the other three regions reported on (North America, Latin America and the Caribbean). A study conducted in South Africa by the Department of Trade and Industry (DTI, 2016) revealed that agriculture contributed only 2.3% to the gross domestic product (GDP); mining contributed 8%; manufacturing 13%; electricity 3.6%; construction 4%; trade and accommodation 15%; transport and communication 10%; finance and business services 20.9%; government services 17.4% and personal services 5.7%. Therefore, agriculture's contribution to the South African economy is the lowest of all the sectors.

Large enterprises contributed 64.5% of the total income in the agriculture sector, followed by small enterprises (20.1%), while micro- and medium-sized enterprises (MMEs) contributed 7.7% each (Statistics South Africa [Stats SA], 2017). Thus, MME contributions were lower than those of the other enterprises. In 2015, Pienaar and Traub revealed that there were approximately 35 000 white farmers in this country, regarded as the highly capitalized commercial sector, producing about 95% of agricultural output on 87% of total agricultural land, while the smallholder farming sector consisted of about four million black farmers, farming in the former homeland areas on 13% of the available agricultural land. Smallholder farmers are defined as "those who own small plots of land on which they grow subsistence crops and one or two cash crops and rely almost exclusively on family labor" (Food and Agriculture Organization [FAO], 2017a). The study by Pienaar and Traub (2015), which aimed to glean information on smallholder farmers in South Africa, emphasizes that smallholder agriculture represents a vehicle by which poverty reduction and rural development could be achieved. Smallholding in aquaculture contributes directly and indirectly to poverty reduction, especially in rural communities, by supplementing livelihoods, offering food security and reducing

poverty through such mechanisms as income generation, employment and diversified farming practices (Abdulla-al-Asif, et al., 2015; Béné, et al., 2016).

Thus, smallholder farms may assist in creating employment, particularly in South Africa, where the expanded unemployment rate increased by 1% from 37% to 38% between the fourth quarter of 2018 and the first quarter of 2019 (Stats SA, 2019). To boost employment, SMEs or smallholder farming operations need to be sustainable. The warm-water fish species considered for aquaculture in South Africa are Mozambique tilapia (Oreochromis mossambicus), Nile tilapia (Oreochromis niloticus), common carp (Cyprinus carpio) and the African sharptooth catfish (Clarias gariepinus) (Dekker, 2014; Department of Agriculture, Forestry and Fisheries [DAFF], 2014). Mozambique tilapia was selected for this study, because of legislative constraints on the other two species (Brink, Mair, Hoffman & Beardmore, 2002; Dekker, 2014; DAFF, 2018). Carp are currently blacklisted (Weyl, Ellender, Wasserman, & Woodford, 2015). It is problematic to acquire authorization for the Nile tilapia, which is commonly considered to be the most appropriate of the entire tilapia species for culturing as food fish and is the fastest grower (DAFF, 2018). In the rivers of Limpopo province, it is not yet legal to culture this species (nor is it legal in the rest of South Africa) (Dekker, 2014), which explains the selection of the slower-growing Mozambique tilapia for the larger study reported on here. The religious requirements of some consumers present some difficulty in marketing catfish (Tapela, Britz, & Rouhani, 2015), and it was therefore eliminated from the study. Tilapia is a broad name given to three genera in the Cichlidae family: Oreochromis, tilapia, and Sarotherodon.

2. Theoretical Background and Literature Review

In this section, previous studies were reviewed to illustrate the gap filled by this research. It starts by offering some background, followed by the local and national market potential of the O. mossambicus, its export market potential, specifications for purchasing the fish, and existing studies on tilapia.

Background: The quality and quantity of freshwater tilapia in South Africa are among the reasons why the growth of the industry is slow. A related problem is that freshwater farmers do not want to increase production volumes of the O. mossambicus unless there is an available market. Previous studies indicated that it is a supply-and-demand issue (Van Rooyen, 2013; Industrial Development Corporation (IDC), 2015; Gilliland, 2017; Oyeleke, 2017) – it is, therefore, possible that a market might not be created for freshwater tilapia. Although the agricultural feasibility of O. mossambicus farmers' SMEs has been established, as have such farms, the market feasibility has not yet been fully determined (Tapela et al., 2015; Phosa, 2018). Furthermore, as confirmed by research by the FAO (2017) and the DAFF (2018), these emerging farmers lack marketing skills. The current demand for tilapia – particularly its extension to other regions of South Africa – was addressed to some extent by conducting several training courses (Brink et al., 2002).

It is thus essential to analyze the market environment more thoroughly, and specifically the potential customers of O. Mossambicus farmers, who form part of agricultural SMEs. For this article, the market environment is taken to refer to the total of all the external variables and factors which can positively (or negatively) affect the existence and growth of a business (Neethling, 2013). An organization's parameters are determined by its purpose, environment and mission statement, as well as the values and experience of its managers/leaders (Erasmus, Strydom & Rudansky-Kloppers, 2016). Thus, to provide a theoretical grounding for the study, a feasibility analysis framework was used, as suggested by Longenecker, Petty, Palich, Hoy, Radipere and Phillips (2017). This framework suggests that it is essential to consider any market on two levels: the broad macro markets, and the micro markets (fragments or niches) – in this instance, to evaluate the potential O. mossambicus customers that a farm may serve.

If a market is described as a set of consumers or potential consumers who have buying power and unfulfilled needs (Longenecker et al., 2017), that definition needs to accommodate purchasing units (individual or business entities) or consumers. In any market, consumers need to have bought power – after all, customers without money or credit do not constitute a feasible market, since no transactions can occur. Notably, consumers would not purchase goods unless they are stimulated to do so, and such stimulation may take place only when a consumer recognizes an unsatisfied need. If consumers have defined requirements that must be met, and need money to meet those needs (Cant, 2017), then their needs, wants and demands will

drive their purchases (Van Aardt & Bezuidenhout, 2014). According to Kotler, Keller, Manceau and Hemonned-Goujot (2015), 'needs' describe fundamental human requirements, which become 'wants' when they are channelled to clearly defined objects that may satisfy those needs.

Local and National Market Potential of O. Mossambicus: In 2013 the IDC (2015), which investigated the potential for the production, processing and export of tilapia for the southern African market, determined that the local demand for tilapia equalled 1 491 tons, while local production satisfied 187 tons of this demand (total production of 234 tons less 47 tons of exports), with imports satisfying 1 304 tons. This is an indication that South African tilapia production does not satisfy local demand for fish. With regard to the demands of local fish buyers, the IDC (2015) found that many of the commercial buyers, whom they interviewed, believe tilapia is an acceptable product. The Fish and Chip Co., Woolworths, I&J, PicknPay, Ocean Basket and SeaHarvest offer tilapia as a product, by customer demand, which indicates that the fish is not an unknown quantity among retailers. The common view is that, should a reasonable price be discovered, neighborhood clients would increase their demand for this fish.

Nevertheless, other retailers such as Spar and Checkers do not perceive tilapia to be a feasible product to market to South African consumers. A multitude of dominant mercantile purchasers did, nevertheless, give attention to the feasibility of trading tilapia in their supermarkets (IDC, 2015). In Gauteng, Oyeleke (2017) found that the majority of consumers (58%) consume fish each week, whilst only more than a quarter (26%) consume it more than once a week; 10% eat it once in a while, and 6% do not eat fish at all. That same study reported that 85% of retailers buy fish weekly; while 15% do so more than once a week (Oyeleke, 2017). Importantly, Oyeleke (2017) found that 60% of purchasers require tilapia more than any other fish species, which means there might be a potential market for tilapia in Gauteng province.

Export Market Potential of O. Mossambicus: The distribution of consumers of this fish is not equal among, or even within, countries/regions, with differences in the volumes and per-capita consumption (FAO, 2016). The FAO (2016) reports that per-person fish consumption remained largely unchanged or even diminished in some countries in Africa (e.g., Côte d'Ivoire, Liberia, Nigeria and South Africa), while Japan experienced an increase. Since Asia has high levels of fish consumption, South Africa's tilapia export possibilities to Asia, America, Europe and the rest of Africa, needed to be investigated. In China, fish consumption per capita increased at an average annual rate of 6% from 1990–2010, to about 35.1 kg (Operation Phakisa, 2014). According to the FAO (2014), per-person fish consumption in the Asia-Pacific region is the greatest in the Pacific, followed by Southeast Asia, South Asia and North Asia. In spite of the fact that annual per-capita fish consumption in countries such as India and Pakistan is relatively low (2.85 and 0.6 kg, respectively), the great size of those populations leads to great volumes of fish being eaten – for example, India, this is equivalent to more than 3.4 million tonnes a year.

An FAO (2014) study concluded that, within countries, noticeably large geographical differences in fish consumption could be established due to particular geographic differences, notably where the populace resides near, or in the proximity of, great waterways or water bodies (e.g., the Mekong River and Cambodia's Tonle Sap). In addition, unsurprisingly, the existing data confirm a greater consumption rate of fish amongst coastal populations than amongst those who reside further inland. There was no fair divide between rural and urban areas; in 13 countries where data were available, the consumption of fish in rural areas exceeded that of urban areas, while in nine other countries, in urban areas fish consumption was higher, possibly due to the greater availability of the product in certain rural areas, and better buying power in some urban centres (FAO, 2014). In 2013, in the United States of America (USA), tilapia consumption amounted to 660 762 metric tons (mt), whereas in 2014 it was 633 759 mt (Fitzsimmons, 2017) – a decrease of about 27 003 mt. The FAO (2016) argues that despite the overall decline in tilapia consumption in the USA, the fish remains popular.

Fitzsimmons (2017) supports this conclusion, pointing out that tilapia is sometimes called aquatic chicken. A study by the Environmental Protection Agency (EPA, 2014) revealed that 86% of the fish consumed in the USA at that time was imported. The top imported species included freshwater fish, mainly tilapia (EPA, 2014). As the DAFF (2014) reports, in 2013, South Africa exported more than 86 tons of tilapia valued at approximately R1.4 million, with the top three export destinations being the United Arab Emirates, the USA and Zimbabwe. With regard to Africa, in Kenya, Charo-Karisa, Kyule and Obiero et al. (2014) found that tilapia

is the most frequently purchased fish. The study participants' diverse education levels were found to have no significant effect on their fish-buying preferences (Charo-Karisa et al., 2014). Similarly, gender grouping did not influence the purchase of fish, or consumption rates (Charo-Karisa et al., 2014). That study concluded that over 60% of Kenyan customers purchased fish chiefly from open markets, in fresh and fried forms (Charo-Karisa et al., 2014). Similarly, studies were conducted by Salehe, Luomba, Musiba, Mlaponi and Mghamba (2014) in Tanzania.

Gebrezgabher, Amewu and Amoah (2015) in Ghana, revealed that tilapia was the preferred fish. Moreover, a study by Britz, Hara, Weyl, Tapela and Rouhani (2015) revealed that, in South Africa, the Western Cape Department of Agriculture launched a project to assess the potential for semi-commercial/commercial fishing in public dams, to target the West-African expatriate market for freshwater fish. This followed a realization that an increasing number of shops are owned and run by storekeepers from a variety of African countries (amongst others, in Cape Town), that specializes in stocking food for foreigners, including frozen or dried/smoked fish (mostly tilapia) which is imported. This means that in other African countries the consumption of tilapia is much higher than in South Africa and that there is a potential market for local tilapia. In Egypt, fish is a classical and key building block of the diet, offering a fundamental root of affordable animal protein for the booming population (Operation Phakisa, 2014). Access to, and preference for, tilapia was found to be greater in communities located in Egypt's fish-manufacturing operations, than in other sectors of the population (Eltholth, Fornace, Grace, Rushton & Häsler, 2015).

In Botswana, at least 4 000 tons of fish is consumed annually (Southern African Development Community [SADC], 2016), of which only approximately 300 tons is produced in the region. Thus, there is a deficiency of 3 700 tons to be provided via imports, mostly from South Africa. However, the IDC (2015) found that, in 2013, South Africa exported only 36 tons of tilapia to Botswana, which is not enough considering that country's requirements, therefore Botswana seems to be a potential importer of tilapia from South Africa. In the Caprivi region, the consumption of freshwater fish ranked over beef, game and poultry, and has important economic value for the nation (African states bordering the Atlantic Ocean [ATFALCO], 2012). The Nordenfjeldske Development Services (NFDS, 2016) reports that, in Namibia, the yearly per-person consumption of fish is 12 kg, which constitutes 5% of overall protein intake and 14% of the overall animal protein intake. As the NFDS (2016) notes regarding Lesotho's per-person consumption, the addition of fish to overall protein intake and overall animal protein consumption is the lowest in the SADC region. There is a limited-capture fishery in Lesotho, given the country's shortage of fishery resources (FAO, 2008). The DAFF (2014a) believes South Africa could penetrate the markets of Lesotho, where there is limited consumption of tilapia.

Specifications for Purchasing O. Mossambicus: Globally, the FAO (2010) found that, of the fish targeted for human consumption, fish in live or fresh form was the preferred product, with a share of 49.1%, followed by frozen fish (25.4%); prepared or preserved fish (15.0%) and cured fish (10.6%). In South Africa, the IDC (2015) and the DAFF (2018) found that both fresh and frozen tilapia were preferred for consumption. As Yongming (2013) reports, in urban China the main tilapia processed products are sold as frozen whole fish, frozen fillets, fresh fish fillets, salted and/or smoked products, and canned and roasted fish fillets, while in the provinces of China, most of the fish for the domestic market are sold live to local restaurants. In Egypt, Eltholth et al. (2015) found that most of the manufactured tilapia was carried to wholesaler outlets and marketed to customers as fresh fish, whilst small amounts were prepared by cleaning, grilling or frying them. Access to, and consumption of, volumes of tilapia were found to be greater amongst communities in production areas, and lower in other communities, where both fresh and frozen tilapia were in demand. In Tanzania, Darko, Quagrainie and Chenyambuga (2016) found that 89.29% of consumers preferred medium- and larger-sized tilapia.

In addition, the authors found that consumers who preferred medium-sized tilapia said "it tastes good" (27.78%); "it is affordable" (25.26%); "it is readily available" (21.11%); "it is fleshy" (15.56%) and "it is easy to prepare" (10.56%) (Darko et al., 2016). Similarly, Oyeleke (2017) found that, in Gauteng, 54.5% of respondents considered taste above all other factors to influence their choice when buying fish. This is a clear indication that the taste, quality and price of tilapia influence consumption patterns. Notably, a small proportion of consumers (13.89%) who preferred medium-sized tilapia stated that medium-sized fish were not merely simple to dispense amongst households, but allowed every member of the family to consume an

entire fish. Darko et al. (2016) found that those consumers who preferred large-sized tilapia said it was "fleshy" (39.02% of consumers); "easy to prepare" (21.14%); "tasty" (13.01%); relatively "cheaper" (4.89%) and "readily available" (3.25%). Moreover, 98% of consumers were willing to pay more for large-sized than small-sized tilapia, but a small proportion (10%) were willing to pay more for farmed tilapia. The study further found that many consumers (80%) preferred to buy fresh tilapia, over smoked tilapia (Darko et al., 2016).

Previous Studies on Tilapia: Asmah (2008) and Yuan, Yuan, Dai and Gong (2017) studied the profitability of fish farms in Ghana and China, respectively, with Asmah (2008) analyzing the financial viability of farms in two regions of Ghana. First, based on the cost and revenue data, statics as pointers were established to assess the feasibility of each farm, and evaluate discounted cashflows. Asmah (2008) reported that the major restrictions found to influence the profit of subsistence farms were cheap fish and lower production rates. Yuan et al. (2017), who analyzed the economic profitability of tilapia farming in China, revealed that large farms had the highest cost and profit margins, small farms had the lowest margins, while medium-sized farms fell somewhere in between. They also found that the net profit of tilapia was very flexible and subject to changes in price, feed, rent and fixed costs, of which price elasticity was the highest, followed by feed, rent and fixed costs (Yuan et al., 2017). Oyeleke (2017), who studied the productivity and supply chain of aquaculture projects in Gauteng, South Africa, reported that fish farmers operated at 36% capacity in their projects.

Although the farmers were underutilizing their production capacity, Oyeleke (2017) found a 40% excess in the profitability margin at all the farms under study. Brink et al. (2002) studied the genetic enhancement and use of indigenous tilapia in southern Africa, paying attention to farm trials involving male tilapia, and an assessment of the potential social and economic effects on farming by small-scale farmers. Brink et al. (2002) found that on-farm trials of male tilapia did not materialize, because of a failure to produce enough male tilapia by the final year of the project. This activity was substituted by initiating a series of pilot studies to examine the overall importance of using small-scale tilapia culture as part of a larger group of rural development programs, working jointly with the Western Cape Department of Agriculture (Brink et al., 2002). While scanty data were available on this activity by the project end, the results confirmed the significant potential of small-scale aquaculture to guarantee food security and offer a means of securing the necessities of life for people in poor rural communities in southern Africa (Brink et al., 2002).

As regards the assessment of the potential social and economic influence of general male tilapia culturing by small-scale farmers, since the planned project did not materialize, Brink et al. (2002) examined the maintenance of small-scale aquaculture practices, conducted under the auspices of the University of Stellenbosch-sponsored Small-Scale Aquaculture Programme, and investigated biological, economic and social sustainability issues. The results showed the economic viability of the practices, but concerns remained over the long-term profitability of some of the culture systems. Indicators clearly showed, nonetheless, that participants in the program secured important improvements to their livelihoods, skills development, increased social capital and income, and better nutrition (Brink et al., 2002). Two decades later, the current study aims to make a scientific contribution by analyzing the market environment, and specifically the potential customers, of O. Mossambicus farmers who belong to agricultural SMEs, by using a feasibility analysis framework.

Aim and Objective of the Research: The primary objective of the study was to analyze the market environment and potential customers of O. mossambicus farmers. The secondary objectives were, first, to identify the customers, and their demands and specifications for purchasing the fish from O. mossambicus farmer SMEs in Limpopo province, South Africa; and second, to determine which factors (poor locality, ineffective marketing, lack of market knowledge, low product demand and increased competition) reduce the volume of O. mossambicus produced by farmers.

Contributions of the Study: Here, the researcher makes suggestions to help smallholder agricultural enterprises better understand the specific constraints around O. mossambicus farming, and seeks to put forward recommendations that will effectively improve the prospects of O. mossambicus farmers in this country. New entrepreneurial ventures and other stakeholders will benefit from the findings of this study,

before engaging with O. mossambicus farmer SMEs or undertaking related activities in the aquaculture sector. Lastly, this study can be utilized by business consultants to advise emerging entrepreneurs before they start enterprises in O. mossambicus farming. The study also makes a significant contribution towards developing a viable market framework, by analyzing and determining the feasibility of the market for O. mossambicus farmers in a developing country such as South Africa.

3. Research Methodology

In this study, the convergent mixed-methods design was used – an approach that requires a researcher to collect both quantitative and qualitative data in parallel (Leedy & Ormrod, 2014). For qualitative primary data collection, a semi-structured questionnaire was used with a few open-ended questions to guide further discussions during face-to-face interviews with retailers, fresh produce market (FPM) traders, and fish traders in Limpopo province. A semi-structured questionnaire was used to obtain participants' views and perceptions of who their customers are, and what their demands and specifications are for purchasing tilapia from O. mossambicus farmers. For quantitative primary data-collection purposes, a structured questionnaire was used to collect data from 90 O. mossambicus farmers who grow these fish in agricultural SMEs, and 30 consumers who eat the fish. When using quantitative structured questionnaires, the target population answers very structured questions which are statistically analyzed, to arrive at the findings. The data obtained from the structured questionnaires were used to establish who the customers were, and what their demands and specifications were for purchasing the O. mossambicus from these fish farmers.

To that end, the contact details of the O. mossambicus farmers were provided by the Department of Agriculture in Limpopo province. Descriptive statistics were used to describe the basic characteristics of the population, and allow the researcher to summarise the data in a straightforward and understandable manner (Zikmund, Babin, Carr & Griffin, 2013). Moreover, the study used inferential statistics to evaluate the effects of various factors surveyed with the O. mossambicus farmers, since such statistics are used to make inferences, or project from a sample to an entire population (Zikmund et al., 2013). The study used a one-way analysis of variance (ANOVA), which is the statistical method used for testing the null hypothesis. The thematic analysis approach was used to derive categories and codes for the qualitative analysis. This means of analyzing qualitative data entails searching across a data set, to identify, analyze and report the findings (Creswell, 2014). It is a method for describing data, but it also involves interpretation in the process of selecting codes and constructing themes in a study. The qualitative data were analyzed manually by the researcher, with the aid of word-processing software.

4. Findings and Discussion

This section presents the findings of the study, in line with the research objectives.

Reliability and Validity: The reliability coefficient (Cronbach's Alpha) for the items measured in the Wholesalers dataset was 0.53; for the Consumers and the Farmers datasets it was 0.46 and 0.23, respectively. While these values (particularly the latter two) fall below the prescribed value of 0.70 for an acceptable reliability coefficient, the coefficients may have been influenced downwards by the relatively smaller samples of wholesalers (n=20) and consumers (n=30) who responded to this survey.

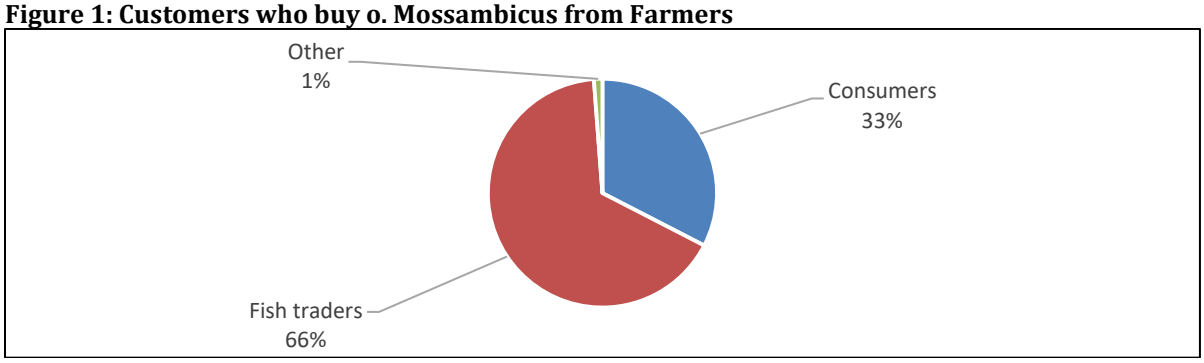
Market Potential of Buying O. Mossambicus from Farmers: The total potential market, minus the market share of competitors, is equal to the target market. The target market is referred to as that portion of the total market that a small business can reach with its products or services (Strydom, 2015). In this section, the quantities, potential customers, supply and specifications of O. mossambicus are discussed.

Quantities of O. Mossambicus Sold Per Week by the Farmers of these Fish: Only six of the 90 O. mossambicus farmers could provide data on weekly sales, and those ranged between 10 kg and 1 667 kg a week. Given this limited information, it was impossible to calculate weekly sales by weight. The reason for such uncertainty is that the farmers do not keep records –either of weight or quantity. The fact that they do not keep records is a further indication of a lack of professionalism with regard to farming with O. mossambicus. The question arises: Are they merely farming O. mossambicus for personal consumption or as

survivalists, or because they created a cooperative with a minimum of five members, and hence qualified for a grant of R350 000 as part of the Cooperatives Act, 14 of 2005 (RSA, 2005)? With regard to the number of O. mossambicus sold, only 17 respondents could provide data, but without specifying the size of the fish sold. Weekly sales of O. mossambicus ranged between 3 and 8 100 fish, while the total local weekly sales amounted to 791 440 per year (15 220 x 52 weeks). Although the mean weekly sales for the 17 respondents, in terms of the number of O. mossambicus sold, was 895 per farmer (std. deviation = 1 924.01), nearly two-thirds (64%) sold fewer than 670 fish per week, while half of them sold fewer than 125 fish per week.

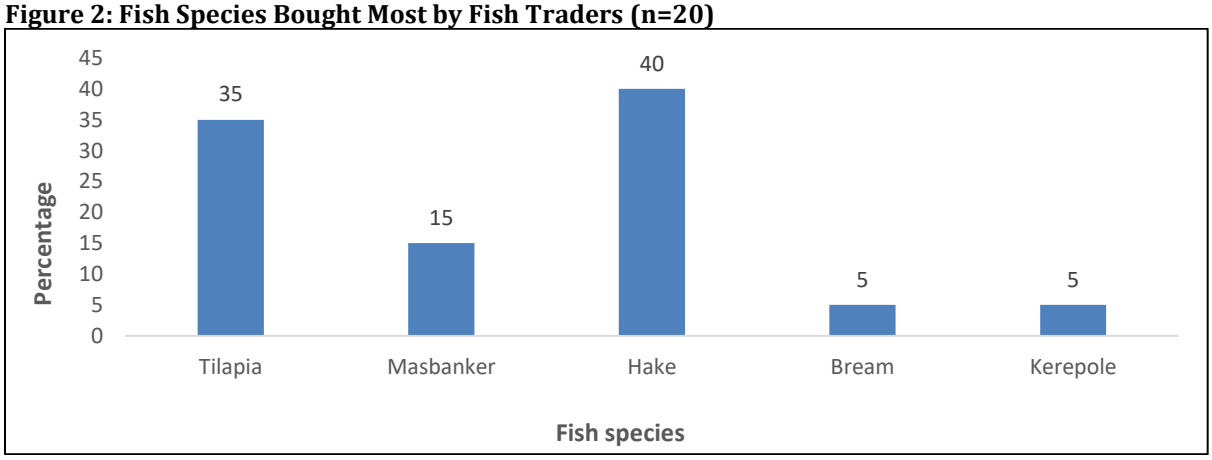
Potential Customers for o. Mossambicus, as Predicted by the Farmers of these Fish: Two-thirds of the farmers reported that the fish were bought by informal fish traders, while another third indicated that consumers bought O. mossambicus from their farms (Figure 1). The results are similar to those reported by Van Rooyen (2013) and the IDC (2015), who found that informal fish traders in local communities constitute the biggest market, as the industry's low production cannot meet the needs of the formal markets.

Figure 1: Customers who buy o. Mossambicus from Farmers



Fish Mostly Bought by the Traders: As regards the main types of fish species bought by the 20 fish traders (Figure 2), 40% bought hake while 35% bought O. mossambicus, followed by 15% who bought MAs banker. At the lower end of the spectrum of the purchase, thresholds were bream and the keepable species. It seems that fresh O. mossambicus is not a product that is well known amongst the majority of South African consumers, who are accustomed to hake (DAFF, 2018).

Figure 2: Fish Species Bought Most by Fish Traders (n=20)



Suppliers of the Fish: The results in Table 1 reveal that the fish traders mainly bought hake from other suppliers (70%), processors (15%), or farmers (10%). Only one (5%) was bought from agents.

Table 1: Suppliers of Hake and O. Mossambicus (n=20)

Item	Farmers	Agents	Processors	Other Suppliers	Total
Place you normally buy the fish (hake)	10%	5%	15%	70%	100%
Place you buy O. mossambicus	12.5%	6.3%	12.5%	68.5%	100%

Frequency with Which Traders Buy o. Mossambicus: As regards the frequency of buying O. mossambicus, 44% of traders bought it weekly; 19% daily; and 13% bought it more than once a week (Table 2). The results are similar to those reported by Oyeleke (2017), who found that 85% of retailers bought fish on a weekly basis, and 15% bought more than once a week. This implies that O. mossambicus is a commonly stocked food fish in aquaculture.

Table 2: Traders' Frequency of Buying O. Mossambicus (n=16)

Item	Daily	More than once a Week	Weekly	More than once a Month	Monthly	Once in a while	Total
Frequency of buying O mossambicus	18.8%	12.5%	43.8%	0%	18.8%	6.3%	100%

Specifications for Purchasing O. Mossambicus: Of the 20 fish traders participating in the study, 55% bought O. mossambicus frozen/smoked; 10% bought it fresh; 5% bought it live and a further 5% bought it salted (Table 3). Of the fish traders, 25% bought it in 'another' form but did not specify. The majority of fish traders are situated in urban areas, and the IDC (2015) reported that tilapia is gutted and frozen for transport to markets or wholesalers.

Table 3: Specifications for Purchasing O. Mossambicus (n=20)

Form in which Available for Purchase	Live	Fresh	Frozen/Smoked	Salted	Other	Total
O. mossambicus	5%	10%	55%	5%	25%	100%

Sizes which O. Mossambicus Traders Buy: Of the 20 fish traders, 66.7% bought medium-sized (300 grams) O. mossambicus; 26.7% bought the large size and 6.7% bought the small size. As the FAO (2017) reports, size-related preferences for tilapia are influenced by a market segmentation of consumers, driven by the specific use of the fish. The size of the O. mossambicus being sold plays a major role in the profitability of an operation. While plate-sized fish are generally more popular amongst general consumers, growing tilapia to larger weights (i.e., 300 grams or more) is less profitable than selling them at smaller sizes (DAFF, 2018). This could explain why fish traders prefer buying medium-sized O. mossambicus.

Table 4: Fish Species Preferred by Consumers who eat o. Mossambicus

Species	Most Preferred	Preferred	Less Preferred	Not Preferred	Total	Mean
Hake	33.3%	37.5%	16.7%	12.5%	100%	2.92
Sole	0%	0%	8.7%	91.3%	100%	1.09
Tilapia	60%	20%	13.3%	6.7%	100%	3.33
Catfish	17.4%	13.0%	4.3%	65.2%	100%	1.83
Trout	0%	0%	6.7%	90.5%	100%	1.10
Carp	**4.3%**	**17.4%**	**26.1%**	**52.2%**	**100%**	**1.74**

On a four-point scale of 1 = not preferred and 4 = most preferred, the most preferred type of fish was O. mossambicus (weighted mean index = 3.33 out of 4), followed by hake (weighted mean index = 2.92 out of 5) and catfish (weighted mean index = 1.83 out of 5) (Table 4). The least preferred type was sole (weighted mean index of 1.09 out of 4). These results are similar to those reported by Oyeleke (2017), who found that 60% of buyers demanded tilapia more than any other fish species.

Factors that Reduce the Volumes of o. Mossambicus from Farmers: Overall, the main factor cited as having the potential to reduce the volumes of O. mossambicus was 'low product demand' (weighted mean index = 3.39 out of 5; SD = 1.088); closely followed by 'lack of market knowledge' (weighted mean index = 3.26 out of 5; SD = 1.241) and 'ineffective marketing' (weighted mean index of 3.13 out of 5; SD = 1.334). The lowest-ranked factor was 'increased competition' (weighted mean index = 2.73 out of 5; SD = 1.339). Low product demand can be linked to responses that revealed a lack of market knowledge and ineffective marketing. These results align with those of Baloyi (2010), who found that 76% of farmers in two districts (Capricorn and Vhembe) indicated that they did not have access to market information, especially in respect of market prices and the products that were in high demand by markets during certain periods.

Table 5: Factors that Reduce the Volumes of O. Mossambicus (n=90)

Factor	Strongly Disagreed	Disagree	Unsure	Agree	Strongly Agree	Total %	Mean	Std. Deviation
Poor Locality	21.3%	10.1%	25.8%	31.5%	11.2%	100	3.02	1.315
Ineffective Marketing	8.9%	34.4%	12.2%	23.3%	21.1%	100	3.13	1.334
Lack of Market knowledge	10.1%	18.0%	21.3%	34.8%	15.7%	100	3.26	1.241
Low Product Demand	4.5%	19.1%	18.0%	47.2%	11.2%	100	3.39	1.088
Increased Competition	17.0%	34.1%	19.3%	13.6%	15.9%	100	2.73	1.339

Relationship between Factors Contributing to Reducing Volumes of O. Mossambicus: A Kruskal-Wallis one-way ANOVA test was conducted to determine the homogeneity of the sampled farmers concerning their responses to the factors that reduce the volume of O. mossambicus. The results of the ANOVA are reported in Table 6. The F-statistic and the corresponding p-value were used to determine whether or not the differences were significant. The statistical significance of the variables in the multivariate analysis was tested at levels of $p \leq 0.05$.

Table 6: Test of Homogeneity (ANOVA) of O. Mossambicus Production Factors (n=90)

Factors that Reduce Production Volumes of O. Mossambicus		Sum of Squares	DF	Mean Squares	F-Statistics	Sig
Poor locality (farm location)	Between groups	0.456	2	0.228	0.129	0.879
	Within groups	153.500	87	1.764		
	Total	153.956	89			
Ineffective Marketing (farm location)	Between groups	2.248	2	1.124	0.626	0.537
	Within groups	156.152	87	1.795		
	Total	158.400	89			
Market knowledge (farm location)	Between groups	2.323	2	1.162	0.750	0.475
	Within groups	134.799	87	1.549		
	Total	137.122	89			
Low Product Demand (farm location)	Between groups	0.127	2	0.063	0.052	0.949
	Within groups	105.262	87	1.210		
	Total	105.389	89			
Increased Competition (farm location)	Between groups	5.161	2	2.580	1.454	0.239
	Within groups	154.439	87	1.775		
	Total	**159.600**	**89**			

*$p \leq 0.05$

It is evident from the test of the homogeneity of farmers of O. mossambicus (see Table 6), that there were no significant differences within and between groups in respect of the factors that reduce the volumes of O. mossambicus, such as poor locality (F-statistic = 0.129; p = >001); ineffective marketing (F-statistic = 0.626; p = >001); lack of market knowledge (F-statistic = 0.750; p = >001); low product demand (F-statistic = 0.052; p = >001) and increased competition (F-statistic = 1.454; p = >001).

5. Conclusion and Recommendations

What emerged from the demand analysis of O. mossambicus is the indication that the fish is in demand in South Africa, as shown by the broad knowledge of the participating fish traders and consumers. The results indicate that O. mossambicus farmers sell those fish fresh to informal fish traders and consumers. Farmed fresh, the O. mossambicus is generally marketed at farm stalls at a weight of less than two kilograms per fish. Fresh O. mossambicus is therefore sold in local markets, rather than via retail or formal outlets. Since fish traders buy and sell frozen O. mossambicus, it appears that efforts should be directed at taking a different approach to traditional frozen fish, if O. mossambicus farmers want to position themselves more competitively. O. mossambicus can also be exported to foreign markets due to the product being frozen, allowing for long-distance transportation. The results indicate that 58.4% of respondents agreed that low product demand (a mean of 3.39 out of 5) reduced the volumes of O. mossambicus – this can be linked to the responses that revealed both a lack of market knowledge and ineffective marketing. An ANOVA test showed the volumes of O. mossambicus were not determined by poor locality, ineffective marketing, a lack of market knowledge, low product demand or increased competition, thus the null research hypothesis – that there is no significant difference within and between groups, in respect of the factors that reduce the volumes of O. mossambicus – is accepted.

Practical Implications: The study was based on the premise that fish farmers should first understand the culture of O. mossambicus consumption in South African society if access to the market is to be achieved and strengthened. Second, they should understand that formal markets prefer frozen O. mossambicus, as that directly affects customers and their demands and specifications for purchasing the fish, while there is the local, national and export market potential for raw and processed products, which in turn affects the volumes of the product. The Department of Agriculture should educate O. mossambicus farmers about consumption cultures in South Africa. It became evident that O. mossambicus farmers would increase the volumes of fresh fish production if they were confident that a buyers' market was available, to sell to. Fresh O. mossambicus is the reason why formal fish traders do not buy from O. mossambicus farmers. More effort should be directed at selling O. mossambicus frozen if a market exists. Increased volumes of frozen O. mossambicus may play a significant role in securing the formal market (local, national and export), and growing the informal market.

Therefore, connecting O. mossambicus farmers with formal markets would improve the volumes of frozen O. mossambicus, enhancing growth and sustainability. This can be done by involving intermediaries, who are often able to perform marketing functions better than the producer of a product can. A producer can perform his/her own distribution function (including delivery) if the geographic area of the market is small, customers' needs are specialized and risk levels are low. However, intermediaries generally provide more efficient means of distribution, if customers are widely dispersed, or if special packaging and storage are needed (Longenecker et al., 2017). It is therefore recommended that local agents or brokers (middlemen) be used by O. mossambicus farmers, as that will assist them in selling to wholesalers and retailers, as well as to the national and export market. In addition, O. mossambicus farmers and stakeholders should improve communication by using social media platforms and should form marketing groups to sell their fish – that will allow improved market access and raise product awareness.

As a single brand could be developed to market each farmer's product. They can then sell the product to consumers or secondary intermediaries, such as processors. The findings of the study reported here indicated that 58.4% of respondents agreed that low product demand reduced the volumes of O. mossambicus being produced. It is therefore recommended that low product demand should be considered in any local policy aimed at improving freshwater aquaculture. Moreover, an O. mossambicus aquaculture forum should ideally be established, to include aquaculture stakeholders (O. mossambicus farmers, fish traders, fish consumers, the DAFF and the Agricultural Research Council). This will assist in developing primary legislation governing freshwater aquaculture. Moreover, the government should identify well-established O. mossambicus farmers, and match them with farmers in Limpopo for mentorship and coaching, which will develop in them the skills and confidence needed to manage and expand their farms and enterprises.

Future Research Directions: The study recommends that future research investigate the financial literacy of O. mossambicus farmers. In addition, accurate audits should be conducted on O. mossambicus farms, to determine the true production capacity and supply in different parts of South Africa and other countries.

Ethical Compliance: The College of Economic and Management Sciences (CEMS) provided ethical clearance for the larger study on 13 July 2018, ethical clearance certificate no. 2018 CEMS ESTTL 007. This paper is part of a thesis entitled: 'A sustainable marketing framework for small business Mozambique Tilapia (Oreochromis mossambicus) farmers in Limpopo province'.

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