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Analysis of Demand for Fish in Urban Malawi

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ABSTRACT

The purpose of this study was to find the drivers of demand for various fish species in urban Malawi. Previous demand studies on the fisheries sector in Malawi have, mainly, treated fish as a homogenous commodity thereby making information regarding households' general consumption patterns for different fish species scanty. This study, therefore, concentrates on the disaggregated analysis of the demand for the major fish species caught and consumed in Malawi. It focuses on fish from both capture fishery and aquaculture sub-sectors namely; *Engraulicypris sardella* (usipa), *Copadichromis* spp (utaka), *Lethrinops* spp (kambuzi); *Clarias gariepinus* (mlamba); *Rhamphochromis* spp (mcheni); *Barbus paludinosus* (matemba); and Lake Malawi tilapia (chambo). It employs primary data collected from the households in Blantyre city using a multistage stratified random sampling method. Results show that the demand for usipa is influenced by a household's location in a high-density area, and has low-income levels. Utaka, on the other hand, is positively influenced by the age of the household head and the number of people employed in the household while chambo is positively influenced by the high education level of the household head, high-income levels, and the household's location in the high-density areas. The study has also found that mcheni and mlamba are positively influenced by income levels while the demand for matemba is positively the household head's state of being married but it is negatively influenced by the number of children in the household. Policy implications arising from this study are that in the course of carrying out market segmentation, the fish marketers in Malawi must concentrate on selling usipa to households in high-density areas and focus on households with low-income levels. The selling of utaka while chambo should mainly be sold to households whose heads have high education, have high-income levels, and are located in high-density areas.

Keywords: Aquaculture, Capture Fishery, Fish Species, Market Segmentation, Multivariate Probit Regression Model
JEL Classi ications: Q22

1. INTRODUCTION

Globally, the ever-increasing competition among producers which can be attributed to globalization, has led to an emergence of a general consensus that for producers to effectively provide excellent customer value they need to engage customers so as to build strong customer relationships (Kotler and Armstrong, 2018). This suggests that the producers have to search for and engage buyers, identify their needs, design good market offerings, set prices for their goods, promote their goods, and store and deliver the goods appropriately. The successful engagement of customers calls for customer-managed relationships wherein, alongside understanding how they can influence their customers, producers also need to understand how they can be influenced by their customers. An adequate understanding of consumers and the marketplace, ultimately, enables producers to adopt marketing management which allows them to choose target markets and build profitable relationships. Thus, in order to design a winning marketing strategy, marketing managers must, carefully, select the type of customers to serve, and how to best serve them.

The effective selection of the type of customers to serve requires the producers to carry out market segmentation where the market is divided into segments of customers and, later on, select the market segments they will serve. Wise producers tend to focus their efforts on meeting the distinct needs of individual market segments (Kotler and Armstrong, 2018). Market segmentation involves the use of geographic, demographic, and psychographic variables as explained in subsequent paragraphs.

Under geographic segmentation, producers divide the market into different geographical units, such as regions, states, cities, or even neighborhoods. Thereafter, the marketers may decide to operate in one or a few geographical areas or operate in all areas but pay attention to geographical differences in needs and wants. The producers can localize their products, services, advertising, promotion, and sales efforts to fit the needs of individual regions, cities, and other localities.

Just like geographic factors, demographic factors are the most common bases for segmenting customer groups due to two-fold reasons. Firstly, consumer needs, wants, and usage rates of products often vary closely with demographic variables (Kotler and Armstrong, 2018). Secondly, demographic variables are easier to measure than most other types of variables. Marketers, therefore, define segments in order to know the segment's demographic characteristics in order to assess the size of the target market and reach it efficiently. Key variables used in demographic segmentation include age, life-cycle stage, gender, income, occupation, education, religion, and ethnicity (Kotler and Armstrong, 2018; Rainbird, 2004).

With the foregoing crucial marketing concepts, seemingly in mind, and in recognition of the significant nutritional and economic value of fish, the government of Malawi has been developing various policies aimed at improving the fish value chain. One of such key policies is the National Fisheries and Aquaculture Policy (NFAP) whose main goal is to promote sustainable fisheries resource utilization and aquaculture development in order to contribute to food and nutrition security, and economic growth of the country (Malawi Government, 2016). Specifically, the NFAP aimed at increasing fish supply in the country so as to increase Malawi's per capita fish consumption from 8.12 kg in 2014 to 10 kg by 2020 (Malawi Government, 2016) something which it has, regrettably, failed to achieve because only 9.51 kg were consumed per capita in 2020 (Malawi Government, 2021). However, a close examination of the NFAP reveals that it has been focusing much on the supply side, and less, on the demand side of the fish value chain even though both the supply chain and demand chain need to be coordinated and oriented toward the customer for producers to achieve greater profitability (Esper et al. 2010). Therefore, there is a need to analyse the demand chain of the fishery sector in Malawi in order to obtain information that could provide useful insights into the fish supply chain.

2. BACKGROUND

In Malawi, the fisheries sector is divided into three sub-sectors namely; capture fishery, aquaculture[1], and ornamental or aquarium trade, as explained in explained in the sub-sequent paragraphs.

Further divided into artisanal and commercial production, capture fishery is practiced on Malawi's lakes and rivers such as Lake Malawi, Lake Chilwa, Lake Malombe, Lake Chiuta and Shire River. In terms of their contributions to total catch, these water bodies contributed 93.88%, 1.82%, 2.28%, 0.93%, and 1.09%, respectively, to total fish production in 2020 (Malawi Government, 2021). Lake Malawi is, particularly, significant for fish production in that it has over 800 endemic fish species, which are of both local and international scholarly importance and also act as a source of tourism. Specifically, it is the South Eastern arm of the lake which is highly productive due to the occurrence of seasonal hydrological events that result in a plentiful supply of food for the fish.

Aquaculture, on the other hand, is mainly practiced in ponds in upland locations of the country and it is, largely, practiced by smallholder farmers. The sector employs about 15,465 smallholder farmers, 61.51% of them being males and 38.49% females (Malawi Government, 2021). The farmers are loosely organized in farmer clubs such that as of 2020, the total number of recorded ponds in Malawi was 10, 000 which translated to a total pond area of 251.59 ha (Malawi Government, 2021).

Ornamental or aquarium trade concentrates on Mbuna fish which is exported live to countries such as Germany, Hong Kong, Denmark, and France (Malawi Government, 2021).

With respect to marketing, most of the high-valued fish from both aquaculture and capture fishery is sold to customers in the urban areas such as Blantyre, Lilongwe, and Mzuzu while the low-valued fish species are sold locally around the fish ponds and the other water bodies. Traders transport fish using buses, pick-ups, bicycles, and motorbikes. The fish is sold either fresh or processed so as to prevent loss of quantity and quality. The main fish processing methods used include sun-drying, smoking, and salting. Fresh fish, either frozen or chilled, is particularly commonly sold in areas close to aquaculture farms and Malawi's lakes and rivers. In terms of market outlets, fish is either sold in public markets or supermarkets or retail outlets which are, mainly, owned by aquaculture companies. In the public markets, fish is usually sold on the basis of size by piece, buckets, heaps or units while in supermarkets and retail outlets, it is sold based on weight. According to Brummett (2000), the determinants of average retail prices of fish in Malawi include the fish market factors and the fish attributes.

In terms of participation in fish marketing, fish trading is dominated by males as only a small proportion of women is engaged in fish processing and trading. Factors contributing to the lack of women's participation in fish marketing include lack of capital, and the traditional division of labour.

However, despite efforts to increase the production and consumption of fish in Malawi, there is a dearth of literature on the patterns of consumer preferences and demand for fish disaggregated based on species of fish. A study by Chikowi et al. (2020) looked at how fish attributes, market factors, and consumer characteristics affect

1 Aquaculture is the controlled farming of aquatic organisms such as shellfish, fish and even plants on land or in the open sea while capture fishery refers to the harvesting of all kinds of natural living resources in both marine and freshwater bodies.

consumer choices and demand for tilapia fish in urban Malawi, but it did not disaggregate the fish demand based on the major fish species consumed in Malawi. Another study on the demand for fish in Malawi was done by Nankwenya et al. (2017) who analysed factors that affect the demand for four fish products namely; smoked fish, dried fish, tinned fish, and fresh fish. However, just like the study by Chikowi et al. (2020), the study by Nankwenya et al. (2017) did not disaggregate the demand for fish by fish species even though prices and consumer preferences for different species of fish differ according to the species of fish and fish products (Dey, 2000). This study, therefore, fills this knowledge gap by examining the socio-economic factors that influence the consumption of fish, disaggregated by fish species, in Malawi. It addresses the following questions: (1) Which socio-economic factors positively influence the choice of the major fish species caught in Malawi? (2) Which socio-economic factors negatively influence the choice of the major fish species caught in Malawi?

The estimation of a disaggregated demand for fish could help provide species-specific information which can be handy in the formulation of policy decisions aimed at improving both aquaculture and fisheries based on appropriate species (Dey, 2000). Specifically, the results of this study provide useful insights with respect to the formulation of a national fishery strategy, the choice of fish technologies to prioritize, and the management of fish. This study, therefore, contributes to the literature on fishery by providing a detailed analysis of demand for fish in Malawi disaggregated by various species since fish is a heterogeneous commodity (Westlund, 1995). Previous studies on the fisheries sector in Malawi treated fish as a homogenous commodity thereby failing to, clearly, demonstrate the species of fish preferred by different consumers in Malawi. This study concentrates on the application of the concept of demand-supply chain management (DSCM[2]) on the Malawi's fishery sector by analysing the demand for the major caught fish species in Malawi. DSCM refers to strategic coordination of the demand and supply processes within a particular firm and across the demand-supply chain, in order to provide superior customer value as cost efficiently as possible (Walters and Rainbird, 2004). Specifically, the study focuses on the analysis of demand for the following fish species: *Engraulicypris sardella* (usipa), *Copadichromis* spp (utaka), *Lethrinops* spp (kambuzi); *Clarias gariepinus* (mlamba), *Rhamphochromis* spp (mcheni), *Barbus paludinosus* (matemba) and Tilapia species of oreochromis *karongae* (chambo), hereafter referred to as usipa, utaka, kambuzi, mlamba, mcheni, chambo and matemba, respectively.

3. MATERIALS AND METHODS

3.1. Theoretical Framework

This study is based on the Neo-classical or traditional theory of consumer behaviour which posits that the overriding goal of a consumer is to maximize utility, which is defined as the level of satisfaction a consumer gets from consuming good or a service. As a result, consumers base their purchases on their assessments of a product's or service's utility. It is assumed that a rational consumer will choose a consumption bundle which yields the highest level of utility. On the basis of this assumption, a set of demand equations can be derived, the parameters of which can be used in empirical research. Once the parameters are estimated consistently, it becomes possible to describe, explain and predict the demand behaviour of the consumer. However, as pointed out by Lancaster (1966) the Neo-classical theory of consumer behaviour has one drawback in the sense that it does not consider the effect of a commodity's attributes on the quantity demanded of the commodity. This drawback led to the emergence of Lancaster's attribute theory of consumer behaviour which posits that the price of a composite good is a combination of the values of characteristics or attributes of the good. This means that the demand for any good is, necessarily, the demand for the attributes contained therein. Therefore, using the attribute theory, this study assumes that individuals get utility from the attributes of the different fish species although they directly purchase the fish species. This, again, suggests that the price of a given fish species is the sum of the values of the characteristics or the attributes of the fish species.

3.2. Empirical Literature Review

Various attempts have been made to analyse the demand for fish in both developed and developing countries even though research on the demand for fish disaggregated by species is relatively new in the developing countries (Dey, 2000). For instance, in Malawi the few empirical studies on demand for fish have focused on the demand for fish in general (Maganga et al., 2014), the determinants of the demand for various fish products (Nankwenya et al., 2017) and analysing the complementarity and trade-offs in consumer choice and demand for products of two tilapia species (Chikowi et al., 2020). A review of some literature for comparative analysis is presented in the subsequent paragraphs.

Maganga et al. (2014) used a Quadratic Almost Ideal Demand System (QUAIDS) specification to estimate a food demand system for rural Malawi which was estimated by employing third integrated household survey data. In their estimation, fish was included in the meat, fish and animal products category. Their findings indicated that the expenditure elasticity of fish was elastic thereby suggesting that fish is a luxury product for most rural Malawian households.

Nankwenya et al. (2017) analysed the demand and the factors that affect the consumption of various fish products, namely dried fish, smoked fish, tinned fish and fresh fish in Malawi. In order to analyse factors affecting consumption and demand for fish products, the study employed a Multivariate Probit Model and an Almost Ideal Demand System (AIDS), respectively. Results indicated that age, gender, education, marital status, distance to the nearest market, area of residence, occupation of the household head and household annual expenditure were the significant determinants of demand for various fish products in Malawi. Furthermore, the study found that the demand for tinned fish, dried fish, fresh fish and smoked fish was inelastic and that these fish products were substitutes. With regard to sensitivity of demand for the fish products with respect to changes in income, the study

2 This refers to strategic coordination of the demand and supply processes within a particular firm and across the demand-supply chain, in order to provide superior customer value as cost efficiently as possible (Walters and Rainbird, 2004).

found that the expenditure by households on the fish products would increase as their income increases.

Chikowi et al. (2020) employed Multivariate Probit and Seemingly Unrelated Regression models to analyze the correlates and complementarities and trade-offs in consumer choice and demand for smoked/dried and fresh products of two tilapia species namely, Oreochromis shiranus and Oreochromis (Nyasalapia) spp. Employing household survey data from urban Malawi, regression results indicated the existence of trade-offs in choices for the tilapia products. Also, with regard to demand, the study found the existence of complementarities in demand for the tilapia products. Furthermore, the results indicated that significant determinants of consumer choice and demand for the tilapia products were household income, access to fish price and market information, tilapia price and traits, sex and years of schooling of the food decision maker, and frequency of fish consumption.

In Bangladesh, Dey (2000) carried out an analysis of fish consumption patterns so as to find out the likely changes in the demand for fish as relative prices and income changes. The study used individual household expenditure data which was collected by the Bangladesh Bureau of Statistics in 1988/89. The study findings indicated that the estimated demand elasticities varied across income class and fish type. They also indicated that carp fish had the highest-own price elasticity of demand among the various species of fish considered while dried fish had the lowest income elasticities for the richest quartile of the population. Furthermore, the results indicated that as per capita expenditure level of households increased the income elasticities of all fish types consistently decreased, even though none of the fish types became an inferior good as the income increased thereby suggesting that fish is generally a normal good.

Dey et al. (2008) investigated demand patterns of fish in nine Asian countries. The study employed a multistage budgeting framework, so as to allow a disaggregated approach to the analysis of fish consumption, and the QUAIDS. Results indicated that, for all the fish types that were included in the study the estimated income elasticities of demand were relatively more elastic among the poorer households than the richer households. Moreover, the study findings indicated that the proportion of the budget spent on fish was bigger for consumers belonging to the higher income groups compared to the lower income groups. Similarly, the share of fish expenditure was found to be higher in the urban areas compared to the rural areas, thereby suggesting that increasing urbanization and affluence have a potential of increasing the consumption of fish and fishery products.

Mustapha et al. (2008) used the AIDS model to estimate the demand for fresh fish in Semarang, Indonesia. The estimation of the demand system involved a two-stage process, whereby in the first stage, a demand system including three commodities of meat was estimated. The second stage, on the other hand, involved the estimation of five species of fish namely; milkfish, mullet, tilapia, tuna, and other species. The study found that chicken and fish were complementary goods while fish and beef were substitutes. Furthermore, the study found that expenditure shares were inelastic for all the fish species as the mean expenditure elasticity ranged from 0.919 to 0.954 for tuna and tilapia, respectively. This implied that a% increase in the prices of the fish species would lead to a 0.9% increase in their expenditure share, suggesting that they are necessities. The study found that tilapia was an inferior good while milkfish was a complement to tuna, mullet, and other fish species.

3.3. Data and their Sources

The target population for the study was households in the city of Blantyre. The households were selected using a multistage stratified random sampling procedure. Firstly, on the basis of income levels, the city was stratified into high- and low-density strata. Secondly, using simple random sampling, clusters were selected from each stratum. Thirdly, from each cluster, households were randomly selected to form the final sample. The study targeted either household heads or other members of the household who were primarily responsible for the purchase of food in the household as respondents. To determine the sample size, the study used the formula (Zikmund et al., 2010):

$$n = \frac{Z^2 pq}{e^2} \tag{1}$$

Where: n is number of respondents (households),

p is proportion of the population of the households in the city that were interviewed which, following Chikowi et al. (2020), was equal to 46% in this study.

$q = 1–p$ is the estimated proportion of failures. It was equal to 54% in this study.

z is the statistical confidence level. This study used 95% confidence level which gave a z statistic of 1.96

e = The maximum allowance for error between the true proportion and the sampling proportion. For this study, the allowance of sampling error was not >4%age points.

Using the above information, the representative sample size for the study was calculated as follows:

$$n = \frac{1.96^2\left(0.46\right)(0.54)}{0.04^2} = 596 \tag{2}$$

However, upon factoring in the design effect[3], 414 households were added to the sample thereby adjusting the sample size for the study to 1010 households. The data was collected through face-to-face interviews using semi-structured questionnaires. Specifically, the data collected included the socio-economic and demographic factors of the respondents and households' food purchase decisions. On consumption, information collected included the types and quantities of food consumed and the food expenditures in the past 7 days. Consumers were also presented with *usipa, chambo, utaka, mlamba, kambuzi, matemba,* and

3 Design effect is a measure of how much sampling variability in a given sample differs from the sampling variability in a simple random sample.

mcheni. Thereafter, quantities purchased of each fish species alongside their prices were elicited.

3.4. Estimation Methods

In estimating determinants of the choice of the major fish species in Malawi, there is a possibility of having some households that will not consume certain fish species during the survey period. As consequence, zero expenditures will be reported on such fish species. Estimating demand equations with zero expenditures on certain food items will result in biased estimates (Nankwenya et al., 2014). Therefore, in order to address the problem of biased estimates arising from the foregoing, the study employed the multivariate probit (MVP) regression model which has a structure similar to that of a seemingly unrelated regression (SUR) model. The MVP regression model is advantageous since it is able to overcome the endogeneity problem as it assumes that binary consumer choice decisions are jointly correlated. The MVP regression model is explained in the paragraph below:

For household *i*, 7 binary choice equations corresponding to the seven species of fish were estimated while accounting for location, market and household factors (X_{ij}) as well as unobserved factors that influence the choice of a species of fish $j = 1, 2, 3, 4, 5, 6$ and 7 denoting *usipa, utaka, chambo, mlamba, kambuzi, mcheni, and matemba*, respectively. Thus, the multivariate probit model with j dimension was expressed as:

$$y_{ij}^{*} = \beta_j^{'} X_{ij} + \varepsilon_{ij}, j = 1, \ldots, 7$$

$$y_{ij} = \begin{cases} 1 if\ y_{ij}^{*} > 0 \\ 0\, otherwise \end{cases} \tag{3}$$

Where: y_{ij}^{*} is the latent variable capturing unobserved household perception of the fish species;

ε_{ij} is the stochastic error term associated with each demand equation. It has a multivariate normal distribution with a zero mean and a variance-covariance matrix *V* with values of 1 on the principal diagonal and correlations $\rho_{jk} = \rho_{kj}$ on the off-diagonals.

$$\begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \\ \varepsilon_5 \\ \varepsilon_6 \\ \varepsilon_7 \end{pmatrix} \sim N_j \left[\begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix} \begin{pmatrix} 1 \rho_{12}\, \rho_{13}\, \rho_{14}\, \rho_{15}\, \rho_{16}\, \rho_{17} \\ \rho_{21}\, 1 \rho_{23}\, \rho_{24}\, \rho_{25}\, \rho_{26}\, \rho_{27} \\ \rho_{31}\, \rho_{32}\, 1 \rho_{34}\, \rho_{35}\, \rho_{36}\, \rho_{37} \\ \rho_{41}\, \rho_{42}\, \rho_{43}\, 1 \rho_{45}\, \rho_{46}\, \rho_{47} \\ \rho_{51}\, \rho_{52}\, \rho_{53}\, \rho_{54}\, 1 \rho_{56}\, \rho_{57} \\ \rho_{61}\, \rho_{62}\, \rho_{63}\, \rho_{64}\, \rho_{65} 1 \rho_{67} \\ \rho_{71}\, \rho_{72}\, \rho_{73}\, \rho_{74}\, \rho_{75}\, \rho_{76}\, 1 \end{pmatrix} \right] \tag{4}$$

Simulated maximum likelihood estimation was approximated by employing the Geweke-Hajivassilou-Keane algorithm as it is commonly used in the analysis of consumer behaviour (Geweke, 1996).

3.4.1. Description of variables included the multivariate probit model

This section presents a description of the variables that were used in the multivariate probit regression model. It has to be pointed out here that prices of various fish species were dropped in the model because they were highly collinear so much so that they made the system of equations used fail to achieve convergence. Table 1 presents a description of the variables used in the study alongside their expected signs.

3.4.2. Diagnostic tests for the multivariate probit model

Following Gujarati (2004), the study tested and corrected for the presence of problems of non-normality, multicollinearity, and heteroskedasticity during the estimation of the multivariate probit regression. The results of the foregoing tests are presented in the subsequent paragraphs.

A Kolmogorov-Smirnov test was used to test for the presence of normality in the data used in the study. The test gave a Chi-squared statistic with a P = of 0.0000<0.01 thereby suggesting the rejection of the null hypothesis no-normality. Additionally, in order to detect and measure the presence and the severity of the multicollinearity problem, the study employed the variance inflating factors (VIF). The results of the VIF are shown in Table 2.

As indicated in Table 2, the VIF values for all the explanatory variables used in the multivariate probit model was 1.52 thereby confirming that there was virtually no multicollinearity problem in the variables used in the multivariate regression model since all the regressors had VIF values far <10. Also, in order to surmount the heteroscedasticity problem in the study, robust standard errors were used during the estimation of the multivariate regression model.

4. RESULTS AND THEIR DISCUSSION

4.1. Descriptive Statistics

4.1.1. Expenditure shares of different fish species

Table 3 presents the expenditure share of each fish species used in the study.

As indicated in Table 3, chambo fish has the highest expenditure share of about 38%. The highest expenditure share of chambo can be attributed to the fact that it is the most expensive fish as consumers feel it is very tasty. Chambo is followed by mcheni which has the second largest expenditure share of about 22%. Following mcheni is mlamba which has an expenditure share of about 13%. Matemba has the lowest expenditure share of about 0.88%. The lowest expenditure share of matemba is attributed to the fact that it is very cheap and considered an inferior good so much so that it is mostly purchased by people with low incomes who, mostly, reside in high-density areas.

4.2. Inferential Statistics

4.2.1. Correlation of prices of various fish species used in the study

By definition, correlation is the analysis of the co-variation of two or more variables. Table 4 presents pairwise correlation coefficients for the price of various fish species used in the study.

Table 1: A description of the variables that were used in the multivariate probit model

Variable	Description	
Dependent		
Dusipa	Decision to purchase usipa (−1 if a household purchases usipa, 0-otherwise)	
Dutaka	Decision to purchase utaka (−1 if a household purchases utaka, 0-otherwise)	
Dchambo	Decision to purchase chambo (−1 if a household purchases chambo, 0-otherwise)	
Dmlamba	Decision to purchase mlamba (−1 if a household purchases mlamba, 0-otherwise)	
Dmcheni	Decision to purchase mcheni (−1 if a household purchases mcheni, 0-otherwise)	
Dkambuzi	Decision to purchase kambuzi (−1 if a household purchases kambuzi, 0-otherwise)	
Dmatemba	Decision to purchase matemba (−1 if a household purchases matemba, 0-otherwise)	
Independent		**Expected sign**
Age	Age of household head	±
Years	Years of formal education by the household head	±
Hhsize	Household size	±
Children	Number of children<7 years in a household	±
Adults	Number of adults more than 13 years in a household	±
Employed	Number of people employed in a household	+
Lnincome	Natural log of the income level of a household	+
Peggs	Price of eggs	±
Pveg	Price of vegetables	±
Pchicken	Price of chicken	±
Female	Dummy (−1 if household head is female, 0-otherwise)	±
Married	Dummy (−1 if household head is married, 0-otherwise)	±
High	Dummy (−1 if the household is located in high-density area, 0- otherwise)	±

Source: Own compilations

Table 2: Results of the multicollinearity test

Variable	VIF	Tolerance
Age	1.37	0.7319
Years	1.82	0.5503
Hhsize	2.74	0.3645
Children	1.30	0.7698
Adults	2.60	0.3850
Employed	1.33	0.7510
Lnincome	1.86	0.5362
Pegs	1.06	0.9412
Pveg	1.04	0.9655
Pchicken	1.17	0.8547
Female	1.10	0.9100
Married	1.19	0.8411
High	1.13	0.8819
Mean VIF	1.52	

Source: Own calculations

Table 3: Expenditure share of different fish species

Fish species	Observations	Expenditure share	Cumulative expenditure share
Chambo	1104	0.3804038	0.3804038
Mcheni	1104	0.215719	0.596123
Usipa	1104	0.108596	0.704719
Mlamba	1104	0.1265572	0.831276
Utaka	1104	0.043774	0.87505
Kambuzi	1104	0.1161622	0.991212
Matemba	1104	0.0087878	1.000000

Source: Own calculations

As shown by Table 4, variables that are positively linearly associated with the price of usipa include the price of utaka ($P < 0.01$) and the price of matemba ($P < 0.01$) while price of utaka is positively linearly associated with the price of chambo ($P < 0.1$), price of kambuzi ($P < 0.01$), price of utaka and price of mcheni ($P < 0.01$). Additionally, Table 3 shows that the price of chambo is positively linearly associated with price of mcheni ($P < 0.01$), price of mlamba ($P < 0.01$), and price of matemba ($P < 0.05$). Other positively linearly associated variables include the price of kambuzi and the price of matemba ($P < 0.01$), and the price of mcheni and price of mlamba ($P < 0.05$). It is, also, worth noting that the price of usipa is negatively correlated with the price of chambo, and the price of mlamba ($P < 0.01$ and $P < 0.1$, respectively).

4.2.2. Results from the multivariate probit regression model

This section presents a discussion of the socio-economic determinants of the choice of different fish species used in the study. The results are presented in Table 5.

Table 5 indicates that the Chi-squared value generated by the Wald test is 1590.86 with an associated $P = 0.0000 < 0.01$. This suggests that the null hypothesis of insignificance should be rejected thereby implying that the coefficients used in the multivariate probit regression are not simultaneously equal to zero. Going by individual fish species, Table 5 shows that number of people employed negatively affects the choice of usipa while a household's location in a high-density area has a positive effect on the choice of usipa. Furthermore, Table 5 indicates that the statistically significant negative determinants of the choice of utaka are age of the household head, number of people employed in the household, and price of eggs.

In terms of chambo, Table 5 shows that the statistically significant positive determinants of the choice for chambo include the years of schooling, household's income level, and the price of chicken. Household's location in a high-density area is a statistically significant negative determinant of the choice for chambo. Table 5 also shows that household's income level is the statistically significant positive determinant of the choice for mlamba. With

Table 4: Pairwise correlation coefficients for the price of various fish species

Variable	Price of usipa	Price of utaka	Price of chambo	Price of kambuzi	Price of mcheni	Price of mlamba	Price of matemba
Price of usipa	1.0000						
price of utaka	0.0929***	1.0000					
	(0.0020)						
Price of chambo	−0.1067***	0.0537*	1.0000				
	(0.0004)	(0.0737)					
Price of kambuzi	0.0048	0.0823***	−0.0264	1.0000			
	(0.8720)	(0.0061)	(0.3794)				
Price of mcheni	−0.0404	0.1506***	0.1727***	0.0389	1.0000		
	(0.1782)	(0.0000)	(0.0000)	(0.1957)			
Price of mlamba	−0.0524*	0.0300	0.2321***	−0.0289	0.071**	1.0000	
	(0.0809)	(0.3175)	(0.0000)	(0.3355)	(0.0178)		
Price of matemba	0.2335***	0.0596**	0.0716**	0.0840***	0.0270	0.0370	1.0000
	(0.0000)	(0.0469)	(0.0170)	(0.0051)	(0.3691)	(0.2186)	

Source: own calculations. Note: *P* values in parentheses. Asterisks represent the level of statistical significance: *(10% significance), **(5% significance), ***(1% significance)

Table 5: Parameter estimates of the multivariate probit model

Variable	Choice						
	Usipa	Utaka	Chambo	mlamba	kambuzi	Mcheni	Matemba
Constant	3.1677***	3.2253***	−3.3754**	−2.2495**	−12.77***	3.0186**	3.1824**
	(1.1940)	(1.0494)	(1.6529)	(1.0237)	(1.806)	(1.3776)	(1.5659)
Age	0.0099	0.0183**	0.0045	0.0051	0.0223*	−0.0035	0.0112
	(0.0096)	(0.0082)	(0.0114)	(0.0076)	(0.0125)	(0.0086)	(0.0121)
Years	−0.0624	−0.0309	0.0683*	0.0047	−0.0394	0.0501	−0.0822
	(0.0435)	(0.0290)	(0.0406)	(0.0275)	(0.0571)	(0.0322)	(0.0562)
Hhsize	0.0114	−0.366***	−0.1495	−0.1099	−0.2654*	−0.0599	0.0097
	(0.0964)	(0.046)	(0.1201)	(0.0797)	(0.1601)	(0.0865)	(0.1177)
Children	0.0489	0.1199	0.0334	0.0086	0.1972	−0.1113	−0.62***
	(0.2764)	(0.1833)	(0.2276)	(0.1793)	(0.3466)	(0.1888)	(0.2311)
Adults	0.0524	0.3575***	0.0830	0.0682	0.0763	0.0818	0.2647
	(0.1146)	(0.0978)	(0.1396)	(0.0923)	(0.1868)	(0.1027)	(0.1732)
Employed	−0.3555**	0.3853***	0.2126	0.0148	0.4061**	0.0744	0.1588
	(0.1420)	(0.1257)	(0.2032)	(0.1221)	(0.2068)	(0.1374)	(0.1875)
Lnincome	−.1444	−0.225***	0.5655***	0.1804**	0.2140	−0.232**	−0.1928
	(0.1038)	(0.0859)	(0.1373)	(0.0845)	(0.1383)	(0.1063)	(0.1432)
Peggs	−0.0001	0.0003**	−0.00001	0.0001	0.0002**	0.00011	0.00005
	(0.00008)	(0.0001)	(0.0.001)	(0.00008)	(0.0001)	(0.0001)	(0.0001)
Pveg	0.0000	0.0001	−0.00003	−0.0001	−0.0004	−0.0004**	−0.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0002)
Pchicken	−0.00001	−0.0001***	0.0001	−.00002	0.00005	0.000001	0.0001
	(0.00007)	(0.00005)	(0.0001)	(0.0001)	(0.0001)	(0.00005)	(0.0001)
Female	0.0607	−0.0383	−.1582	−0.0574	−0.1466	0.1129	0.1328
	(0.1405)	(0.1184)	(0.1883)	(0.1177)	(0.2299)	(0.1336)	(0.1763)
Married	0.1320	0.1038	−0.0766	0.1834	3.719***	0.0557	0.5457**
	(0.2087)	(0.1971)	(0.2928)	(0.1876)	(0.9341)	(0.2230)	(0.2480)
High	0.5988***	−0.0217	−3.9742***	−0.016	4.181***	0.2160	0.2234
	(0.2009)	(0.1891)	(0.2617)	(0.1933)	(0.2394)	(0.2056)	(0.2522)

Wald Chi-square 1590.86. Prob>Chi-square 0.0000. Source: own calculations. Note: Asterisks represent level of statistical significance: *(10% significance), **(5% significance), ***(1% significance). Figures in parentheses are robust standard errors

respect to kambuzi, the statistically significant positive determinants of its choice include age of the household head, number of people employed in the household, price of eggs, the household head's state of being married, and the household's state of being located in the high-density area. As for mcheni, statistically significant determinants of the choice for mcheni are the income level of household and the price of vegetables. Lastly, Table 5 indicates that the statistically significant positive determinant of the choice for matemba is the household head's state of being married while number of children in the household is the statistically significant negative determinant of the choice for this species of fish.

5. CONCLUSION AND POLICY IMPLICATIONS

This study aimed at determining the socioeconomic factors that influence the households' choice of the major fish species in Malawi. It has been found that the choice of usipa is negatively affected by the number of people employed in a household thereby suggesting that the more the number of people employed in the household the less the choice for usipa. This finding is consistent with the fact that usipa is an inferior fish species such that when people's capability to get money, through employment increases, their consumption of usipa decreases. Again, finding that the choice of usipa is affected by a household's location in a high-density area conforms to what obtains in the literature that usipa is a cheaper fish species whose demand is higher in the high-density areas because they have low income levels.

The study has also found that the choice of utaka is positively influenced by the age of the household head, number of people employed in the household, and price of eggs. In particular, it shows that as the age of the household increases, the choice of utaka also increases. An in-depth analysis of this finding revealed that utaka has many fins which makes it difficult to consume by the young ones, hence being liked by the adults who, usually, consume it with pepper.

As regards chambo, the study has found that its choice is positively determined by the years of schooling, household's income level, and the price of chicken. Household's location in a high-density area is a statistically significant negative determinant of the choice for chambo, confirming that chambo is, indeed, a commercially high-valued species of fish in Malawi. Therefore, due to the high price, it only those households with higher incomes either from business activities or through employment obtained as a result of getting higher education, that can afford chambo. People in the high-density areas do not purchase chambo because they cannot afford it as their income levels are low. Furthermore, the study has found that household's income level is the positive determinant of the choice for mlamba, whereas with respect to kambuzi, the positive determinants of its choice include age of the household head, number of people employed in the household, price of eggs, the household head's state of being married, and the household's state of being located in the high-density area. As for mcheni, its choice is positively influenced by the income level of household and the price of vegetables. Lastly, the choice for matemba is positively influenced by the household head's state of being married, and it is negatively influenced by the number of children in the household.

Policy implications arising from this study are that in the course of carrying out market segmentation, the fish marketers in Malawi must concentrate selling usipa to households located in the high-density areas and focus on households with low income levels. The selling of utaka, on the other hand, should be concentrated to household's with old household heads and a large number of employed people but the marketing of chambo should be concentrated in households whose heads have high education, have high income levels, and are located in the high-density areas. Furthermore, the marketing of mcheni and mlamba should mainly be concentrated in households with high income levels. Lastly, matemba should mainly be marked to household whose heads are married but have a small number of children. The successful implementation of the foregoing will enable the marketers build profitable relationships and succeed in their marketing endeavours.

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