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Demand for Fish in Urban Malawi: An Almost Ideal Estimation

Fredrick Mangwaya Banda[1]*, Abdi-Khalil Edriss[1], Wilson Wesley Jere[2], Horace Phiri[1]

[1]Department of Agricultural and Applied Economics, Lilongwe University of Agriculture and Natural Resources, Lilongwe, Malawi,
[2]Department of Aquaculture and Fisheries Science, Lilongwe University of Agriculture and Natural Resources, Lilongwe, Malawi.
*Email: fmbanda@mubas.ac.mw

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ABSTRACT

There is a general consensus, among marketers, that dealing with competition requires their engagement with customers so as to build strong customer relationships. The purpose of this study is to find factors that influence the demand for various fish species caught and consumed in Malawi. Previous studies treated fish as a homogenous commodity even though there are different species of fish. This study is, therefore, the first to provide a disaggregated analysis of the demand for fish in Malawi employing primary data collected from the households in Blantyre city using a multistage stratified random sampling procedure. Results indicate that all the fish species used in the study, except matemba (*Barbus paludinosus*), are complementary and normal goods. Policy implications arising from this study are two-fold namely; policymakers need to make sure that people have more income to buy more fish and make sure that the price of fish does not just rise anyhow.

Keywords: Almost Ideal Demand System, Aquaculture, Disaggregated Demand, Capture Fishery, Market Segmentation
JEL Classification: 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. 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 answer the following two questions: (1) What customers to serve and (2) How to serve them best?

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. Key variables used in market segmentation include age, life-cycle stage, gender, income, occupation, education, religion and ethnicity (Kotler and Armstrong, 2018).

With the foregoing 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 since 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 towards the customer for producers to achieve greater profitability (Esper et al., 2010). Therefore, there is a need to analyze 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 the 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 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. Despite there being signs of growth, Malawi's aquaculture sector is still in its nascent stage (Commercial Agriculture for Smallholders and Agribusiness, 2020). Production rose from about 800 tons in 2005 to about 7672 tons in 2016 and 9399 tons in 2020. 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 10000 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 motor bikes. 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 the public markets or supermarkets or retail outlets which are, mainly, owned by the 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.

However, despite efforts to increase the production 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 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 households' consumption of fish, disaggregated by fish species, in urban Malawi by addressing the following questions: (1) What factors influence the households' budget shares allocated to the major fish species caught in Malawi? (2) How do households adjust their consumption of the major fish species following changes in price and income 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 focusing on the aquaculture and fisheries based on appropriate species (Dey, 2000). This study, therefore, contributes to 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[2] on the Malawi's

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

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).

fishery sector by analysing the demand for the major caught fish species in Malawi. 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. Regression results indicate that all the fish species used, except matemba, are complementary goods thereby suggesting that as the price of one of these fish species rises quantity demanded of the other fish species decreases. Again, with respect to income, the study has found that all the fish species used in the study, except matemba, are normal goods implying that as consumers' income level increases consumption of these fish species increases as well.

3. MATERIALS AND METHODS

3.1. Theoretical Framework

This study is based on neo-classical (traditional) theory of consumer behaviour which assumes 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. The drawback of the neo-classical theory of consumer behaviour 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. Thus, 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 means 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. Data and their Sources

The target population for the study was the households in the city of Blantyre. The households were selected using multistage stratified 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% 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], 525 households were added to the sample thereby adjusting the sample size for the study to 1121 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 mcheni. Thereafter, quantities purchased of each fish species alongside their prices were elicited.

3.3. Estimation Methods

In order to estimate factors affecting the expenditure share of each fish species, and subsequently, calculate elasticities of demand for each species, the study employed the linear approximation (LA)/almost ideal demand system (AIDS) model which is discussed in the subsequent paragraphs.

Introduced by Deaton and Muellbaur (1980a), the AIDS model begins with a type of preference known as the price-independent generalized logarithmic preference (PIGLOG). The PIGLOG is used to ensure that the essential and sufficient conditions for consistent consumer aggregation are met. The following equation represents the log of cost or expenditure:

$$\ln C\,(U,P) = (1-U)\ln\{a(p)\} + U\ln\{b(p)\} \tag{3}$$

Where often $0 \leq U \leq 1$. U of equal to zero represents a condition of subsistence whereas U of equal to one represents a situation of bliss. This is done to ensure that the positive linearly homogeneous functions $a(p)$ and $b(p)$ are treated as the costs of subsistence and bliss, respectively. The cost function in equation (1) gives

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.

an arbitrary first-order approximation to any demand system. Furthermore, the AIDS has some desirable characteristics, such as satisfying the choice axioms, being simple to estimate and test the true constraints of demand theory, and having a functional form that is compatible with household budget data.

Assuming specific functional forms for ln $a(p)$ and $b(p)$ ln the AIDS model is derived as follows:

Let:

$$\ln a(p) = \alpha_0 + \sum_k \alpha_k \ln P_k + 1/2 \sum_k \sum_j \gamma_{kj}^* \ln P_k \ln P_j \quad (4)$$

$$\ln b(p) = \ln a(p) + U\beta_0 \pi_k P_k^{\beta_k} \quad (5)$$

Combining (2) and (3) gives the AIDS cost function as:

$$\ln C(U,P) = \alpha_0 + \sum_k \alpha_k \ln P_k$$
$$+1/2 \sum_k \sum_j \gamma_{kj}^* lnP_k lnP_j + U\beta_0 \pi_k P_k^{\beta_k} \quad (6)$$

Equation (6) shows that $C(U, P)$ is linearly homogeneous in P, which is necessary to ensure that $C(U, P)$ becomes a valid representation of preferences. According to Shephard (1970), the price derivatives of the cost function are the quantities demanded. Hence, using equation (6), the demand functions can be derived as follows:

$$\frac{\partial C(U,P)}{\partial P_i} = q_i \quad (7)$$

Multiplying both sides of equation (6) by $\frac{P_i}{C(U,P)}$ converts to elasticity as follows:

$$\frac{\partial C(U,P)}{\partial P_i} * \frac{P_i}{C(U,P)} = \frac{\partial \ln C(U,P)}{\partial \ln P_i} = \frac{P_i q_i}{C(U,P)} = w_i \quad (8)$$

Where W_i is the budget share of good i. This means that logarithmic differentiation of equation (6) gives budget shares as a function of prices and utility as follows:

$$w_i = \alpha_i + \sum \gamma_{ij} \ln P_j + \beta_i U \beta_0 \pi_k P_k^{\beta_k} \quad (9)$$

Where $\gamma_{ij} = 1/2(\gamma_{ij}^* + \gamma_{ji}^*)$

Substituting for U, the indirect utility function, yields the AIDS model which gives the share equations in an n– good system as:

$$w_i = \alpha_i + \sum \gamma_{ij} \ln P_j + \beta_i \ln\left(\frac{X}{P}\right) \quad (10)$$

Where:
w_i is the share associated with the i^{th} good;
α_i is the constant coefficient in the i^{th} share equation;
β_j is the slope coefficient associated with the j^{th} good in the i^{th} share equation;
P_j is the price of the j^{th} good;
$X = \sum_{i=1}^n P_i q_i$ is the total expenditure on the system of goods;
P is a price index defined by:

$\ln P = \sum_{i=1}^n w_i \ln P_i + 1/2 \sum_{i=1}^n \sum_{j=1}^n \gamma_{ij} \ln P_i \ln P_j$ in the nonlinear AIDS model.

However, Deaton and Muellbauer (1980) proposed a LA of the nonlinear AIDS (LA-AIDS) model by specifying a linear price index (Stones price index) given by:

$$\ln P = \sum_{i=1}^n w_i \ln P_i \quad (11)$$

In practice, the LA-AIDS model is estimated more often than the nonlinear AIDS model. The basic demand restrictions such as adding up, homogeneity, and symmetry are expressed in terms of the model's coefficients as follows:

Adding up: $\sum_{i=1}^n \alpha_i = 1; \sum_{i=1}^n \beta_i = 0; \sum_{i=1}^n \gamma_{ij} = 0;$

Homogeneity: $\sum_{i=1}^n \gamma_{ij} = 0;$

Symmetry: $\Upsilon_{ij} = \Upsilon_{ij}$

Additionally, marshallian elasticities in the AIDS model are given by:

$$\text{Price elasticity: } \varepsilon_{ij}^M = \frac{\gamma_{ij} - \beta_i \left(w_j - \beta_j \ln(\frac{X}{P}) \right)}{w_i} - \delta_{ij} \quad (12)$$

Where: $\delta_{ij} = 1$ if $i = j$
=0 otherwise.

$$\text{Income elasticity: } \eta_i = \frac{\beta_i}{w_i} + 1 \quad (13)$$

However, since the expenditure shares which happen to be the dependent variables in the LA/AIDS model sum up to one, the study deleted the share equation for kambuzi to control the problem of singularity. The parameter estimates associated with kambuzi were, then, recovered through the parameter restrictions implied by symmetry, adding up, and homogeneity. The LA/AIDS model was estimated using iterative Zellner's seemingly unrelated regression model in Stata version 15. Table 1 presents a description of the variables that have been used in the LA/AIDS model.

4. RESULTS AND DISCUSSION

4.1. Descriptive Statistics

4.1.1. Expenditure shares of different fish species

Since expenditure share of each species of fish are used as dependent variables in the LA/AIDS model, Table 2 presents the expenditure share of each fish species used in the study.

As indicated in Table 2, 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

Table 1: A description of the variables that have been used in the LA/AIDS model

Variable	Description
Dependent variables	
w-chambo	Expenditure share of chambo
w-mcheni	Expenditure share of mcheni
w-usipa	Expenditure share of usipa
w-utaka	Expenditure share of utaka
w-mlamba	Expenditure share of mlamba
w-matemba	Expenditure share of matemba
w-kambuzi	Expenditure share of kambuzi
Independent variables	
lnPC	Natural log of price of chambo
lnPN	Natural log of price of mcheni
lnPS	Natural log of price of usipa
lnPT	Natural log of price of utaka
lnPM	Natural log of price of mlamba
lnPB	Natural log of price of matemba
lnPK	Natural log of price of kambuzi
lnPX	Natural log of stones price index
IMR	Inverse mills ratio[4]

LA: Linear approximation, AIDS: Almost ideal demand system

Table 2: 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 calculation

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 3 presents pairwise correlation coefficients for the price of various fish species used in the study.

As shown by Table 3, 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 These were included in the model to control the endogeneity problem that could arise from zero purchases of some fish species by the households.

4.2.2. LA/AIDS regression results

In order to estimate factors affecting the expenditure share of each fish species and calculate elasticities of demand for each species, the study employed the LA/AIDS model. However, since the expenditure shares which happen to be the dependent variables in the LA/AIDS model sum up to one, the study deleted the share equation for kambuzi to control the problem of singularity. The parameter estimates associated with kambuzi were, then, recovered through the parameter restrictions implied by symmetry, adding up, and homogeneity. The inverse mills ration for kambuzi was dropped to control the problem of multicollinearity. Table 4 presents the results of the LA/AIDS model.

As indicated in Table 4, the inverse mills ratio for chambo and usipa are statically significant thereby suggesting that their inclusion in the LA/AIDS regression model helped control the endogeneity problem. Price of usipa, price of utaka, and price of mlamba are statistically significant positive determinants of the expenditure share of chambo. On the other hand, the statistically significant negative determinants of the expenditure share for chambo are price of mcheni, price of utaka, and the stones price index.

Regarding mcheni, Table 4 shows that price of chambo, and the stones price index are statistically significant positive determinants of the expenditure share of mcheni. Price of utaka is the only statistically significant negative determinant of the expenditure share of mcheni. As for usipa, Table 4 shows that the statistically significant negative determinants of the expenditure share of chambo include its own price and the stones price index. The price of utaka, on the other hand, is the only statistically significant positive determinant of the expenditure share of usipa. Table 4 further indicates that the price of mcheni and the price of utaka are the statistically significant positive determinants of the expenditure share of mlamba while the price of usipa and the stones price index are the statistically significant negative determinants of mlamba's expenditure share.

In terms of utaka, the statistically significant negative determinants of expenditure share include the price of mcheni, its own price, the price of mlamba, the price of matemba, and the stones price index. The only statistically significant positive determinant of utaka's expenditure share is the price of usipa. Similarly, kambuzi's expenditure share has three statistically significant negative determinants namely; the price of chambo, the price of utaka, and the stones price index. The price of matemba is the only statistically significant positive determinant of the expenditure share of kambuzi.

Lastly, with respect to matemba, the statistically significant positive determinants of expenditure share include its own price and the price of utaka. The price of chambo, price of mcheni, price of utaka, and stones price index are statistically significant determinants of matemba's expenditure share.

4.3. Marshallian Price and Expenditure Elasticities

Since economists are often interested in elasticities, after determining the parameter estimates of the LA/AIDS model, the study proceeded to calculate the price and expenditure elasticities of each species of fish. By definition, price elasticity is the percentage change in quantity demand for some good with respect to a 1% change in the price of the good (own price elasticity) or of another good (cross price elasticity). Expenditure elasticity, on the other hand, is the percentage change in quantity demanded for some good due to the change in expenditure level. Table 5 presents marshallian price and expenditure elasticies of the fish species used in the study. The marshallian price and expenditure elasticities have been calculated using equations (12) and (13), respectively.

As indicated by Table 5, all species of fish used in the study, except matemba, had neg ative own-price elasticities of demand suggesting that they are normal goods. The positive own-price elasticity of matemba could be attributed to the fact that matemba a Giffen inferior good[5] . In particular, among the species with the

5 With Giffen goods, the negative income effect, associated with inferior goods, outweighs the always positive substitution effect, thereby leading to an upward-sloping demand curve.

Table 3: 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*** (0.0020)	1.0000					
Price of chambo	−0.1067*** (0.0004)	0.0537* (0.0737)	1.0000				
Price of kambuzi	0.0048 (0.8720)	0.0823*** (0.0061)	−0.0264 (0.3794)	1.0000			
Price of mcheni	−0.0404 (0.1782)	0.1506*** (0.0000)	0.1727*** (0.0000)	0.0389 (0.1957)	1.0000		
Price of mlamba	−0.0524* (0.0809)	0.0300 (0.3175)	0.2321*** (0.0000)	−0.0289 (0.3355)	0.071** (0.0178)	1.0000	
Price of matemba	0.2335*** (0.0000)	0.0596** (0.0469)	0.0716** (0.0170)	0.0840*** (0.0051)	0.0270 (0.3691)	0.0370 (0.2186)	1.0000

Source: Own calculations

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

Table 4: Parameter estimates of the LA/AIDS regression model

	Dependent variable: Expenditure share						
Variable	Chambo	Mcheni	Usipa	Mlamba	Utaka	Kambuzi	MATEMBA
Constant	1.4301***	−2.3230***	0.3366***	0.6994***	0.1277***	0.1299***	0.6794***
	(0.1678)	(0.1214)	(0.0751)	(0.1166)	(0.0367)	(0.0370)	(0.0663)
Chambo	0.0173	0.0630***	−0.0350***	−0.0001	−0.0025	−0.009***	−0.0353***
	(0.0126)	(0.0091)	(0.0056)	(0.0088)	(0.0028)	(0.0028)	(0.0050)
Mcheni	−0.022***	0.0012	−0.0023	0.0339***	−0.0034**	−0.0001	−0.0079***
	(0.0075)	(0.0054)	(0.0034)	(0.0052)	(0.0016)	(0.0017)	(0.0030)
Usipa	0.0066	0.0010	−0.0067*	−0.0100*	0.0077***	0.0033*	−0.0011
	(0.0079)	(0.0057)	(0.0035)	(0.0055)	(0.0017)	(0.0017)	(0.0031)
Mlamba	0.035***	−0.0072	−0.0020	0.0208***	−0.030***	−0.0042**	−0.0105***
	(0.0087)	(0.0063)	(0.0039)	(0.0061)	(0.0020)	(0.0019)	(0.0034)
Utaka	0.065***	−0.0022	−0.0015	−0.034***	−0.0073**	−0.0029	−0.0154**
	(0.016)	(0.0115)	(0.0071)	(0.0111)	(0.0035)	(0.0035)	(0.0063)
Matemba	−0.0237	0.0019	−0.0029	−0.0023	−0.0073*	0.0070*	0.0273***
	(0.0198)	(0.0143)	(0.0088)	(0.0138)	(0.0043)	(0.0044)	(0.0078)
Kambuzi	−0.078***	−0.0577***	0.0504***	−0.0085	0.0305	0.0056	0.0429***
	(0.0268)	(0.0193)	(0.0120)	(0.0186)	(0.0247)	(0.0059)	(0.0105)
Expenditure	−0.092***	0.2435***	−0.0251***	−0.049***	−0.011***	−0.011***	−0.0569***
	(0.0164)	(0.0119)	(0.0073)	(0.0115	(0.0036)	(0.0036)	(0.0065)
IMR	−0.074***	0.0200	−0.0850***	0.0021	−0.0119		−0.0133
	(0.0223)	(0.0174)	(0.0154)	(0.0134)	(0.0138)		(0.0103)

Source: Own calculations

Asterisks represent level of statistical significance: *(10% significance), **(5% significance), ***(1% significance). Figures in parentheses are standard errors. LA: Linear approximation, AIDS: Almost ideal demand system

Table 5: Marshallian price and expenditure elasticities

Variable	Chambo	Mcheni	Usipa	Mlamba	Utaka	Kambuzi	Matemba
Chambo	**−0.8626**	−0.9024	−0.9283	-0.9239	−0.9439	−0.9265	−0.9524
Mcheni	−1.4238	**−1.238**	−1.1170	−1.1373	−1.0438	−0.9884	−1.0044
Usipa	−0.9305	−1.0118	**−1.037**	−1.0324	−1.0574	−1.0348	−1.0597
Mlamba	−1.1206	−1.1843	−1.2258	**−1.218**	−1.2642	−1.2229	−1.2645
Utaka	−1.6015	−1.6417	−1.6679	−1.6635	**−1.684**	−0.2748	−1.6923
Kambuzi	−0.9148	−0.9308	−0.9412	−0.9272	−0.9475	**−0.9405**	−0.9509
Matemba	4.5697	3.5033	2.8097	2.9260	2.3900	2.8587	**2.1635**
Expenditure	0.7584	2.1288	0.7689	0.6128	0.7556	0.9027	−5.4749

Source: Own calculations

The values in bold are own price elasticities. The rest are cross price and expenditure elasticities negative own-price elasticity of demand, utaka had the highest own-price elasticity of demand of 1.68 and it is followed by mcheni and mlamba with own-price elasticities of 1.24 and 1.22, respectively. On the other hand, chambo has the lowest own-price elasticity of demand and it is price inelastic. This suggests that a large percentage increase in the price of chambo will lead to a small percentage change in the quantity demanded for chambo. A further probe into this finding using a qualitative research tool of depth interview [6] it became clear that, despite it being expensive than other fish species, consumers still prefer chambo to the other fish species because it is very tasty and has more flesh. This, then makes its demand become price inelastic.

Regarding the cross-price elasticity of demand, all the fish species used in the study, except matemba, indicated a complementary relationship as they had negative elasticities. Even though this finding appears somehow odd, it can be explained by that fact that households may prefer more than one species of fish thereby making them purchase more than one species at once so that the other species could be used at a later date. Matemba, exhibited a substitutive relationship with the other fish species as it had a positive and elastic cross-price elasticity of demand with the other fish species. In particular, the highest substitutive relationship was between matemba and chambo, and it is seconded by matemba and mcheni.

Table 5, further shows that the calculated expenditure elasticities are positive except for matemba which had a negative and elastic cross-price elasticity of demand. This, further confirms that all fish species used in the study except for matemba were normal goods. This result conforms to the finding by Dey (2000) who found that fish, in general, is a normal good. The result, also, shows that matemba is an inferior good so much so that consumers buy more of matemba when their income levels decrease.

A closer look at the calculated expenditure elasticities shows that mcheni is a luxury while chambo, usipa, mlamba, utaka, and kambuzi are necessities as they have positive expenditure elasticities which are less than one suggesting inelastic expenditure elasticies. This means that a large percentage change in consumers' income will result in a small percentage change in the quantity demanded of these fish species.

5. CONCLUSION AND POLICY IMPLICATIONS

This study aimed at determining factors that influence the households' budget shares allocated to the major fish species in urban Malawi, and to find out how households adjust their consumption of the major fish species following changes in price and income levels in Malawi. It has found that price of usipa, price of utaka, and price of mlamba are positive determinants of the expenditure share of chambo while the negative determinants of the expenditure share for chambo are price of mcheni, price of utaka, and the stones price index.

6 This is a one-on-one interview between a researcher and a respondent. The advantage of depth interview is that it enables a researcher to gain more insight from each respondent.

The study has, also, found that price of chambo, and the stones price index are positive determinants of the expenditure share of mcheni while price of utaka is the only negative determinant of the expenditure share of mcheni. In terms of usipa, the study has found that negative determinants of the expenditure share of usipa include its own price and the stones price index. The price of utaka, on the other hand, is the only positive determinant of the expenditure share of usipa while the price of mcheni and the price of utaka are the positive determinants of the expenditure share of mlamba. Lastly, the price of usipa and the stones price index are the negative determinants of mlamba's expenditure share.

With respect to utaka, the study has found that negative determinants of expenditure share utaka include the price of mcheni, its own price, the price of mlamba, the price of matemba, and the stones price index. The only statistically significant positive determinant of utaka's expenditure share is the price of usipa. Similarly, kambuzi's expenditure share has three negative determinants namely; the price of chambo, the price of utaka, and the stones price index. The price of matemba is the only positive determinant of the expenditure share of kambuzi.

Elasticities were then computed to give a clear picture of the foregoing finding and it turn out that all the fish species used in the study, except for matemba, are complementary. This suggests that as the price of fish species, except matemba, rises quantity demanded of the other fish species decreases. Again, with respect to income, the study has found that all the fish species used in the study, except matemba, are normal goods implying that as consumers' income level increases consumption of these fish species increases as well. This finding conforms to the finding by Dey et al. (2008) who found that fish is generally a normal good in Bangladesh.

Policy implications arising from this study are two-fold namely, (1) policymakers need to make sure that people residing in urban areas have a lot of income generating activities which can enable them buy more fish so as to get the essential nutrients found in fish, and (2) there is a need to make sure that prices of different fish species do not just rise anyhow. Particularly, in order to make sure that the price of do not rise anyhow, policy makers could make sure that the price of inputs, such feeds, used in the aquaculture sub-sector are low. Alternatively, can ensure the availability of good and efficient transport infrastructure from the fish producing areas to the markets thereby helping minimize transport costs. Ultimately, the reduction of transportation costs will result in the lowering of fish prices since the marketers would be facing low transportation costs.

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