EFFECTS OF FISH ATTRIBUTES ON LANDING PRICE IN SELECTED DISTRICTS ALONG LAKE VICTORIA, TANZANIA

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ABSTRACT

Studies around Lake Victoria documented various challenges hindering higher landing prices among artisanal fishers associated with varying attributes of fish. However, determination of the effects of fish attributes on landing price,

which is potential to the wellbeing of fishermen, remains undisclosed during the landing of the fish harvest to the landing sites. This paper employed cross-section data from 300 fishermen to examine the effects of fish attributes on fish prices of the selected fish species. In contrast to the approach of previous studies, the analysis in this study applied the Log-linear multiple regression model and made an auxiliary step with hedonic price function. The empirical analysis demonstrated that freshness in the Islands, onshore Island markets, preserving methods, fish size, weighted measures, and freshness of fish at Mainland were statistically significant fish attributes at $\alpha = 0.05$ level, affecting fish species landing price. These findings will contribute to filling the knowledge gap with hedonic price function approach, which is relatively unknown in view of Lake Victoria. Therefore, it is recommended that the supplies of fresh, well preserved, and large-sized fish to meet optimal price as per the demand requires the provision and availability of modern fishing vessels as well as an installed storage mechanism.

Keywords: *Fish; fish attributes; landing price; artisanal fisher; hedonic price*

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1.0   INTRODUCTION

Studies around Lake Victoria documented various challenges hindering higher landing prices among fishers associated with varying attributes of fish. These challenges include the agent's exploitation of fishers, imbalance of power in negotiation, limited access to fishing gear, buyers' choices, lack of improved fishing skills, poor handling, underuse of technology, and inadequate access to and control of storage facilities (Kambewa, 2007; Luomba, 2013). Other challenges include persistence of

unverified information about landing prices, the volume of catch, types of buyers and loans issued to fishers (Janssen *et al*., 2001; Phillips and Subasinghe, 2010). Following these challenges, the government of Tanzania has facilitated the construction of storage and other fishing facilities to prevent the harvested fish and its quality attributes from deterioration and therefore enabling artisanal fishers obtain higher paid landing prices (URT, 2014). Moreover, Chandrashekar (2014) argued that a fishers' cooperative strategy could improve fish quality attributes while attracting and sustaining higher landing prices as a solution to these challenges. Literature on the assessment of challenges hindering higher landing prices is widespread. Yet, empirical evidence on the relationship between fish attributes and landing price around Lake Victoria, Tanzania is almost non-existent. This reality, therefore motivated the present study.

 Despite the existing challenges, globally, fish remains as a prime source of food and employment in developing countries (Henson & Mitullah, 2000). Fish species are aquatic animals which are nearly 34 000 of species living in fresh and salty waters. Fish traded for consumption are recognized by having features and quality or characteristics known as fish attributes (Maciel *et al*., 2013; FishBase, 2018). A study by Nguyen (2011) demonstrated that the price theory on the relationship between price and commodity attributes is on utility bearing attributes of that commodity. However, the relationship between fish attributes and fish prices during trading have been viewed differently by scholars at the global level for years. This is the gap that motivated the present study.

The studies that viewed the relationship between fish attributes and fish prices differently include McConnell and Strand (2000),

Roheim *et al.,* (2007), Lee (2014), Hammarlund (2015) and Gobillon *et al*., (2017).For example, McConnell and Strand (2000) argue that fish species, fat content, and the type of handling are the fish attributes influencing the price. Roheim *et al.,* (2007) on the other hand cite species, brands, package size, product, and process forms as influencing attributes on the price.

Elsewhere, Hammarlund (2015) lists the size and freshness of fish as fish attributes influencing the price of fish. Besides, a study by Lee (2014) found fish size, fish freshness, trip duration, storage, and gear of fish as influencing attributes. Gobillon *et al*., (2017) analysed fish species, fish size, time, sellers, and buyers' effects as attributes influencing the price of fish. The distinction between species-specific other than species available around Lake Victoria, Tanzania part, Lee (2014) focused on Atlantic cod; Hammarlund (2015) focused on Baltic cod; and Gobillon *et al*., (2017) focused on Sole, Monkfish and other species. Although these studies were limited to different species on specific attributes and were country-specific in determining fish prices, there is no empirical information on whether the reported fish attributes or similar attributes are relevant for the selected fish species around Lake Victoria in Tanzania. With this paucity of empirical information, the present study covers this gap by exploring species specific fish attributes that influence fish landing price.

Despite availability of different species around Lake Victoria, Tanzania, the country is earning about 2.5percent of real GDP annually predominantly from the main freshwater species of commercial interest, which are Nile perch, Nile tilapia, and Sardine (FAO, 2014; URT, 2014; BOT, 2017). These species, which are largely for trade and export, form part of 85 percent of

the country's fish production from inland fisheries. Therefore, the assessment of these fish species' specific attributes is of paramount importance on fishery policy framework and strategic actions towards poverty reduction among artisanal fishers.

Empirical studies have also employed hedonic price models to assess fish attributes. such studies include McConnell and Strand (2000), Lee (2012), Hummarland (2015), and Gobillon *et al*., (2017) that focused on time series and panel data set. Alapan (2016) employed descriptive- survey approach and assessed significant effect of different factors on fish price by using ANOVA. It is known that the daily catch of fresh fish by artisanal fishers usually deteriorates with time. However, there is little information on whether the mentioned fish attributes or similar fish attributes persist around Lake Victoria, Tanzania. To address this paucity of knowledge, this paper employed cross section data of a daily paid fish price and fish attributes from the landed catches. The methodology focused on fish attributes of the selected species such as freshness, storages, market category, and the size of fish in determining landing prices at different market levels or categories as depicted by McConnell and Strand (2000), Lee (2014), and Gobillon *et al*., (2017).

In contrast with other studies, the current study employed log-linear hedonic price function on the multiple regression analysis of cross-sectional data to provide accurate information for an outlaying variable. The model was employed to qualify the analysis of fish landing price data set collected at the time of fish selling on the landing sites. It also justifies that this study has not used time series analysis because previous paid fish landing prices were not recorded by artisanal fishers. The paper added such fish attributes as preservation methods and weighted

measures in determining fish landing prices at different market
levels or categories that were not addressed by the previous
studies.

The objective of the paper therefore, is to examine the effects of
fish attributes on landing prices. It provides empirical evidence
on whether the mentioned fish attributes or similar fish attributes
marks the distinction in relation to fish landing price on Nile
Perch, Nile Tilapia, and Sardine fish species around Lake
Victoria, Tanzania. The paper responds to two questions: (i) what
fish attributes affect landing price. And (ii) How does the change
of one attribute affect the landing price of fish? The paper is
organised into four sections. Section 1 presents the introduction.
Section 2 presents literature review. Section 3 focuses on methods
and section 4 concludes the paper.

2.0   LITERATURE REVIEW
2.1   Theoretical Review
The study was guided by the Price Theory. The theory validates
the price for any specific commodity in connection with the
quantity supply and demand. According to this theory, the price
of a commodity is obtained at a point, which utility bearing
attributes of that commodity are not only valuable to individual
buyers' demands, but also they comply with the sellers' supplies.
This is known as the optimal market price. The theory was put
forward by Nguyen (2011) in demonstrating the relationship
between prices of one-day island tours and different attributes
associated with them.

The foundation of commodity valuation for their utility-bearing
attributes and commodity prices vary with variation in the number
of attributes associated with it, dating back to the demonstration

by Rosen (1974), known as hedonic price theories. The importance of the relationship between quantities of attributes and commodity prices was also demonstrated in the studies of supply and demand for fish with specific attributes. These studies include Johnston*et al*., (2001), Kristofersson and Rickertsen (2004), and Bronnmann and Hoffmann (2018), which focused on the valuation of fish attributes that have value to the consumer by employing the demand theory. Others are supply studies, and these include Brummett (2000), McConnell and Strand (2000), and Roheim *et al*., (2007) who focused on the supply theory.

The price theory contextualizes the optimal paid price as based on supply and demand of fish, considering attributes such as species, size, freshness, methods of preservation, and weight (Alapan, 2016). The methods of preservation include freezing fresh fish, smoking fish and sun-drying fish (Matiya *et al*., 2005). To understand the impact of attributes on the prices of supplying fish at landing sites, it was important to understand how independent variables such as fish species, size, freshness, market type by the location of offshore and onshore landing sites, methods of preservation and weighted scales of measure as dependent variables influence the landing price. Therefore, it is hypothesized that fish attributes have no significant influence on the landing price.

2.2 Empirical review

Various studies have looked into several fish attributes and fish price. Examples include Gobillion *et al*., (2017), Lee (2014), Hammarlund (2015), and McConnell and Strand (2000). Many of these studies analysed data using a hedonic price function. Employing hedonic price function in relation to fish attributes, Lee (2014) and Hammarlund (2015) found that fish size,

freshness, trip duration, storage, and gear type have direct effects on the ex-vessel price for cod. Other studies, which used hedonic price function, include y McConnell and Strand (2000) and Gobillon *et al*., (2017) who confirmed the influence of attribute variables such as freshness and fish size in determining the prices of fish at different market levels. However, these studies indicated the quality attributes which are related to fishery management and resale prices.

Several hedonic studies used different functional forms such as linear, semi-log, log-log, quadratic and log-linear in transforming variables of choices when estimating hedonic price functions (Nguyen, 2011; Mangion *et al*., 2004; Carroll, 2001; Slade, 2000). Studies by Nguyen (2011) and Mangion *et al*., (2004) employed cross-sectional data in the analysis of log-linear regression model to examine the relationship between price and different attributes in terms of tourism competitiveness. According to literature, the log-linear model is the most preferred specification for analysing hedonic price determinants, and this performs better than other models do (Slade, 2000). Despite the use of similar hedonic price functions, different species were analysed in studies by Lee (2014) who focused on Atlantic cod, Hammarlund (2015) who focused on Baltic cod, and Gobillon *et al*., (2017) who focused on Sole and monkfish species. Given these findings, the log-linear form is used in the analysis of hedonic price of fish attributes of Nile perch, Nile tilapia, and Sardine fish species, which were selected in this study.

However, the cited studies explored other fish attributes but remain silent on the preservation methods and fish weighted measures, which are therefore uncovered in the present study. Similarly, other studies employed time series and panel data set

in the analysis. The present study employed log-linear hedonic multiple regression in the analysis due to the cross-section data set collected at the time of fish selling on the landing sites contrary to their availability in the previous studies.

3.0   METHODS
3.1   Data source and sampling

The study employed cross-sectional data, which were collected by enumerating sample respondents in Buchosa and Sengerema Districts in Mwanza Region. The design allowed data to be collected from the two districts at a single point in time by including multiple variables associated with similar patterns (Bryman, 2008). The two districts were selected based on ranking with a high collection of fish catches within Mwanza region, which is the region with several stop centres of fish market, seven fish processing industries, and fish trading and exporting centres (URT, 2017). The region surpasses other regions (Kagera, Geita, Simiyu, and Mara) near Lake Victoria. There are about 52,942 fishers in Mwanza Region on the shores of Lake Victoria (URT, 2014).

Purposive sampling was used to select three active sites on landing and selling of fishes with non-overlapping trading of fishes between landing sites in each district. The selected sites were Kijiweni, Nyakalilo, and Busisi in Sengerema District, and Bulyaheke, Itabagumba, and Kanyala in Buchosa District. Proportionate sampling technique was used to obtain respective sample size from each landing site and was then followed by simple random sampling using a lottery approach. Sampling frames were all fishers within the region. Pre-testing of the questionnaire was initially administered to 15 randomly selected respondents (5% of total respondents) for the purpose of

rectifying unfamiliar terms used therein, checking the clarity or ambiguity of questions, and checking the duration of interviewing one person.

Quantitative data were collected by using a rectified questionnaire. The final sample size included 300 fishers who were computed by using Israel's (2013) formula, $n = N/(1 + N(e^2))$, where n is the sample size, N population size and e is the level of precision. The precision level of $\pm$ 5 percent, which is the acceptable sampling error, equivalent to 95 percent confidence level, was employed. From an estimated total population of 1200 fishers from the two districts (URT, 2014), then $n = 1200/(1 + 1200(0.05)^2) = 300$. Out of 300 fishers, 289 (a 96% response rate) completed the questionnaire and were used in the analysis. The remaining incomplete questionnaire copies were discarded. This was in line with the suggestion by Evans (1991) that a high response rate (> 80%) from a sample is preferable.

Qualitative data using Focus Groups Discussion (FGD) and Key Informant Interviews (KII) were collected to support the findings from quantitative data.. Therefore, six FGD were held, one for each landing site. The approach is useful in addressing the heterogeneity across and within groups (Novara *et al.*, 2018). Each FGD consisted of six fishers, selected to identify fishers with the ability of supplying information on fish attributes, quality of fish, landing prices, mechanism for determination of fish attributes and determination of landing price.

The KII constituted of three purposefully selected leaders from fishers, one buyer from Sengerema, one agent from Buchosa, two Beach Management Unit (BMU) leaders, two District Fishery

Officers, one representative from the Tanzania Fisheries Research Institute (TAFIRI) and two Village Executive Officials, arriving at 12 key informants.

3.2 Data analysis

Hammarlund's (2015) estimation procedure was used in this paper. Therefore, the hedonic model $p = f(x)$ was used in expressing fish attributes affecting landing price, and if expanded in the regression form, it appears as follows:

$$p_j = \beta x_i + \mu_i$$

(1) where i is the number of fish attributes x_i observed to fisher selling fish at a price p_j per kilogram, β is a coefficient of attributes, and μ_i is a random factor influencing the price of the fish. Assuming that exogeneity occurs in the supply of the fish attributes in equation (1), then the estimation of inverse attribute demand is possible:

$$\beta_t = Vq_t + \mu_t (2)$$

where β_t are the observations of prices of the fish attribute, q are the supplied quantities of different fish attributes and μ_t are unobserved factors influencing the price of the fish attribute.

It is assumed that at any time in a day, landings may occur randomly, and the price is determined by respective attributes by both sellers and buyers, and the final optimal price is paid to fishers. To consider the importance of the random arrival, Random Coefficient (RC) model was employed as suggested by Hammarlund (2015) in order to estimate the hedonic inverse demand functions.

Therefore, for each arrival in a day a, optimal prices p_{ja} are regressed on attributes x_{ia} and estimated by using Ordinary Least Square (OLS):

$$p_{ja} = \beta x_{ia} + \varepsilon_{ia} \quad (3)$$
$$\beta_t = \rho + Vq_t + \mu_t \quad (4)$$

and the two equations (3) and (4) are estimated simultaneously in equation (5) by using a random coefficient model (RC) (Hammarlund, 2015):

$$p_{ja} = \rho x_{ia} + V x_{ia} q_{ia} + x_{ia} \mu_{ia} + \varepsilon_{ia} \quad (5)$$

Therefore, the marginal implicit price for any attribute of the fish is given as $V_i = \frac{\Delta p_{ja}}{\Delta x_{ia} q_{ia}}$ (Taylor & Mesler, 2008), $x_{ia}\mu_{ia} + \varepsilon_{ia}$ is the random part of the estimated model, and $\rho x_{ia} + V x_{ia} q_{ia}$ is the interaction part of the fish attributes for the amount of catches.

With reference to price theory, all the three selected fish species are valued differently during supply and demand; hence, each has its own valid landing price. Let us say Lp_{NP_i} is Nile perch price; Lp_{NT_i} is Nile tilapia price and Lp_{SA_i} is the price of sardine, then, hedonic regression analysis at the time of landing price per specie is possible as depicted in equation (6). Each landing price per species is not comparable with another. Therefore, equation (6) is a formed multiple regression equation and transformed to natural log regression (Log-linear model). Therefore, the regressed equation was generated using the operational definitions of variables given in Table 1 as follows:

$$ln\begin{cases}Lp_{NP_i}\\Lp_{NT_i}\\Lp_{SA_i}\end{cases} = \beta_0 + \beta_1 lnIF + \beta_2 lnSF + \beta_3 PM + \beta_4 MT + \beta_5 lnFZ + \beta_6 MW + \varepsilon. \quad (6)$$

The estimated constant, β_0, represents the value of the baseline transaction, while the other βs represent the parameters of estimated coefficients, and ε is an error term. Robustic White-Huber standard errors were employed to structure heteroscedasticity following a White test for heteroscedasticity. The coefficient of each dummy variable was calculated by using $Di = (e^{Bi} - 1)100$. Since a change in the log of a variable is a relative change, 100 is a percentage change (Gujarat & Porter, 2003). Therefore, βi approximates the relative change to the landing price for dummy variables. For continuous variables, the estimated coefficient β_i is interpreted as the relative effect on the landing price due to a change in the variable.

It is important to note that OLS may violate constant correlation assumptions for data that were closer and others that were collected far apart during a day. Therefore, the RC model allows joint estimation method of a price attributes function and inverse demand function. It also solves the problem of heteroscedasticity and takes into account the constant correlation among multiple measurements.

3.3 Description of variables
The variable landing price in this paper was defined as the optimal market price determined by both supply and demand. Therefore, during data collection, it was known that, the landing price is paid by the two reasons that qualify price theory. One is the buyer's willingness to pay the utility bearing attributes of that fish landed. Another is the supplies decision made by artisanal fishers before they landed to the respective landing sites.

The variable freshness is one of the attributes correlating with landing price fluctuation (Lee, 2014). In this paper, due to challenges in measuring nautical miles travelled, the freshness of the fish is measured in terms of distance in hours spent to reach either offshore islands or onshore mainland landing sites, termed as "trip duration" (Lee, 2014). The island freshness variable applies to fish sold on islands, while the mainland freshness variable applies to fish originally sold at mainland landing sites. Landing sites have different structures, conduct, and performance that cause variance in fish landed price. Market type is included as an attribute variable to account for the landing price received at offshore landing sites, onshore landing sites, or local markets, during the analysis. Table 1 shows a summary of the variables used in this paper.

Local market places are inland locations near the sea with easy access for fishers where additional commodities are sold. Another variable is the method of preservation included to consider quality of fish in different forms of preservation. In addition, fish size was included to account for various sizes of fish.

Table 1: Variable description and meaning

S/N	Variable Description	Variable Name	Type of Variable	Meaning of Variable
1	Landing Price	LP	Continuous	Price per kg of a fish in TZS at the on-spot market
2	Island Freshness	SF	Continuous	Distance in hours spent to reach the island.
3	Mainland Freshness	IF	Continuous	Distance in hours spent to reach mainland from the catch.
4	Market Type	MT	Categorical	Equal to 1 if offshore island (OFI); 2 if onshore mainland (ONL); 3 if local markets.

5	Preserved Methods	PM	Dummy	Equal to 1 if fish preserved in freezer storage and 0 otherwise
6	Fish Size	FZ	Continuous	The quantity of fish in Kg, per fishers
7	Weighted Measured	WM	Dummy	Equal to 1 if weighted scale results are acceptable and 0 otherwise

4.0 FINDINGS AND DISCUSSION
4.1 Demographic features of selected fish species

The study established demographic features of the selected fish species, which are Nile Perch, Nile Tilapia, and Sardines in terms of price of fish species per kilogram, quantity of fish per kilogram, and the size in length in centimetres of the fish species landed. The descriptive statistics analysis of data shows that the average landing price was TZS 3 225 per kilogram for Nile perch, TZS 2 780 per kilogram for Nile tilapia, and TZS 324 per kilogram for Sardines. The average quantities of fish catches landed by fishers were 16 kilograms of Nile perch, 23 kilograms of Nile tilapia, and 18 kilograms of sardines. It was difficult to establish the length of all species per catch, but the largest Nile perch fish had a maximum length of 90 centimetres, and the largest Nile tilapia fish had a maximum length of 43 centimetres. Further details are shown in Table 2.

Table 2: Demographic features of selected fish species

Variables	Sub-Variables	Mean	Std Deviation	Min.	Max
Nile perch	Landing price per kg	3225	553.7	2800	7500
	Quantity in kg per fishers	16	6	12	34
	Size in centimetres per fish	-	-	30	90
Nile tilapia	Landing price per kg	2780	423.4	2500	6500
	Quantity in kg per fishers	23	4	21	48
	Size in Centimetres per fish	-	-	13	43
Sardine	Landing price per kg	324	43	300	450
	Quantity in kg per fishers	18	2.7	15	25

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Size in centimetre per fish	-	-	-	-

4.2 Fish attributes affecting landing price

The effect of fish attributes on fish landing price was established by computing fish attributes, which were considered by fishers as useful for better-received landing price. Inferential analysis results were obtained by regressing landing price of each fish species on the independent variables that were selected. The findings on Table 3 indicate that about 84 percent of the fishers respondents considered fish size measured in kilograms as one of the criteria preferred by middlemen and fishmongers. This aligns with the observable existing situation; fish species of larger size are the ones that are highly valuable and are preferred for inter-trade at regional markets. These findings concur with the assumption that market changes for example in terms of increasingly purchasing of fish with certain attributes, create higher demand, and cause price increase in accordance with the price theory. The findings concur with the observation by Abila (2015) that smaller fish are sold locally within Mwanza region, leaving other regional markets and retailers in Tanzania to trade mostly in larger species like Nile Perch and Tilapia.

Availability of these species and others, as reported by 67 percent of fishers is one of the attributes preferred by buyers. Consumers' willingness to pay depends on preferences and choices pertaining to the available species and sizes, thus affecting the price of these fish. Descriptive statistics indicate further that about 68.9 and 70.8 percent of the respondents reported that the number of days spent on onshore and offshore landing sites do not influence landing prices. Days spent storing fish between harvest and landing influence fish deterioration, implying that artisanal fishers do not spend more than a day

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between harvest, and landing. This finding concurs with the observations made during focus group discussions that fishers are not spending more than a day because of inadequate fishing storage vessels, which prevent them from reaching deeper waters (FGD, at Itabagumba, April 2017).

Table 3: Fish attributes affecting landing price (n = 289)

Fish Attributes Criteria		Per cent	
	No	Yes	Total
Fish size	15.3	83.7	100
Fish days spent onshore	68.9	31.1	100
Fish days spent offshore	70.8	29.2	100
Availability of different species	33.0	67.0	100
Fish stored for many days before reaching landing centres	64.5	35.5	100
Fish stored in a boat freezer before landing	48.0	52.0	100

Looking at the effects of fish attributes on landing price, three hedonic regression analyses were run to capture the effect of landing price of Nile perch, Nile tilapia, and Sardine as dependent variable., The findings are presented in Tables 4, 5 and 6. The results of multiple regression analysis of the landing price of Nile perch are in Table 4. The coefficient(s) results of the OLS and RC models in Table 4 show a similar change of landing price in TZS per kilogram. However, it should be noted that the log-linear from the models affect the actual change of landing price in TZS per kilogram as shown in Table 8.

Table 4: Effects of fish attributes on the landing price of Nile perch (n =289)

Variables	OLS Coefficients	OLS Std. Error	OLS P-Value	RC model	RC Std. Error	RC p-value
(Constant)	0.049	0.542	0.928	0.069	0.671	0.918

Island freshness	0.013	0.001	0.000*	0.017	0.006	0.005*
Mainland freshness	-0.065	0.005	0.000*	-0.048	0.022	0.030*
Preserved Methods	0.109	0.044	0.014*	0.171	0.064	0.007*
Market Type (base = Local market)						
Offshore island	0.047	0.029	0.105	0.066	0.018	0.000*
Onshore mainland	-0.067	0.042	0.120	-0.051	0.023	0.027*
Fish size	0.150	0.047	0.001*	0.173	0.029	0.000*
Weighted Measure	-0.125	0.099	0.213	-0.109	0.09	0.226

OLS R-squared = 0.911
RC   R-squared 0.893
* means significant at the 5% level of significant

The explanatory power of the model is also shown by R^2 range between 0.911 and 0.893 respectively, giving a good model fit. This is above 80 percent of the total variation in the dependent variable, which is explained by the explanatory variables. As indicated in Table 4, at the 5 percent level of significance, island freshness, preserved methods, offshore island, and the size of fish had significant and positive coefficients. Mainland freshness of fish and onshore mainland markets are other attributes, which had significant, but negative coefficients.

Table 5 reveals the findings of hedonic regression such that the coefficient of Nile tilapia, island freshness, fish size, preserved methods, and offshore islands were found positive and significant at the 5 percent level of significance. mainland freshness and onshore mainland markets were other attributes found negative and significant at the 5 percent level of significance. The unit change in each of coefficient also indicates a change of landing price in TZS per kilogram of Nile Tilapia. The model's level of significance was 5 percent, and for the OLS and RC models, the R^2 ranged from 0.894 to 0.807 respectively, giving a good model fit. In summary, Nile tilapia fish attributes were found to have

similar effects as Nile perch fish attributes, although the difference was on the units of change of each coefficient, thus confirming the differences in landing prices of the two species.

Table 5: Effects of fish attributes on the landing price of Nile tilapia (n = 289)

Variables	OLS Coefficients	OLS Std. Error	OLS p-value	RC model	RC Std. Error	RC p-Value
(Constant)	0.0401	0.3371	0.905	0.046	0.5795	0.936
Island freshness	0.0041	0.0016	0.0109*	0.0035	0.0015	0.0203*
Mainland freshness	-0.0739	0.023	0.0014*	-0.071	0.0105	0.00001*
Preserved methods	0.1001	0.067	0.136	0.141	0.0713	0.0489*
Market Type (base = Local market)						
Offshore island	0.0381	0.009	0.000*	0.037	0.0013	0.00001*
Onshore mainland	-0.0759	0.032	0.018*	-0.08	-0.112	0.475
Fish size	0.1411	0.017	0.001*	0.143	-0.106	0.178
Weighted Measure	-0.1339	0.053	0.012	-0.138	-0.045	0.0023

OLS R-squared 0.894

RC R-squared 0.807

* mean significant at 5% level of significant

Table 6 presents the results on hedonic price regression indicating that the coefficients of island freshness, weighted measure, and onshore mainland market, and mainland freshness were negative and significant for sardine fish species. The model coefficient results of sardines are different from the coefficients of fish attributes of Nile perch and Nile tilapia, which are shown in Tables 4 and 5 respectively.

Table 6: Effects of fish attributes on the landing price of Sardine (n = 289)

Variables	OLS Coefficients	OLS Std. Error	OLS P-Value	RC model	RC Std. Error	RC p-value
(Constant)	0.011	0.495	0.982	0.0195	0.671	0.976

Mainland freshness	-0.025	0.011	0.024*	0.032	0.016	0.046*
Island freshness	-0.103	0.014	0.000*	-0.019	0.007	0.007*
Preserved methods	0.073	0.054	0.177	0.093	0.064	0.147
Market Type (base = Local market)						
Offshore island	0.009	0.015	0.548	0.039	0.021	0.064
Onshore mainland	-0.103	0.02	0.000*	-0.081	0.013	0.000*
Fish size	0.112	0.073	0.126	0.133	0.081	0.101
Weighted Measure	-0.147	0.086	0.088	-0.096	0.037	0.009*

OLS R-squared 0.912

RC R-squared 0.865

* means significant at the 5% level of significant

The difference was in the coefficients of fish attribute(s); preservation methods, offshore island, and fish size, which had insignificant influence on the landing price of sardines, but had significant influence on the landing price of Nile perch and Tilapia. The model's level of significance was 5 percent for the OLS and RC models with R^2 ranging from 0.912 to 0.865 respectively, giving a good model fit.

Therefore, island freshness of fish was found to increase fish landing price by TZS 0.013per kg of Nile perch and by TZS 0.0041per kg of Nile tilapia. This implies that the increase in price was caused by buyers arriving at the island from the mainland to get freshness qualities. This reduced the distance in hours to the mainland that could lead to deterioration of freshness of fish and therefore leading to low paid landing price. Moreover, other buyers are communities living around and nearby islands who have a traditional preference for consuming fresh quality fish; this causes an increase of the demands of fresh fish in the islands. This was clarified during a FGD, that hours spent transporting fish to the mainland with a lack of quality storage facilities expose them to the risk of spoilage leading to a decrease of landing price paid. Sometimes buyers at mainland would collude with other dealers

for low price settings (FGD, Kanyala Ward, April 2017). It is because of this observation that fishers expect higher price on the islands.

The negative coefficients for sardine fish attributes (island freshness, weighted measure, and onshore mainland market type and mainland freshness) were mainly due to the demand driven by buyers' quality preference of sardine that were sun-dried. It was reported during focus group discussions that,

> *".... if fishers want to be paid better for sardine catches, sun drying on the grass is most preferred by buyers than fresh catches during landing, and because sardines can also be dried on the sand, unfortunately, most of the fishers don't have time to wait for the sardines sun drying process…" (FGD, Bulyaheke,* April-2017).

In general, availability of dried catches of sardines at islands paired with on-site buyers could positively influence landing prices paid in the first hand to fishers than the landed freshness of this species.

Contrary to the island freshness, the mainland freshness of fish was found to demonstrate a decrease of fish landing price to the selected species relative to the other fish attributes. This concurs with the findings in a study by Matiya (2005), and by implication, fishers around Lake Victoria have inadequate storage facilities and best preservation techniques, factors that may contribute to the spoiling of transported fish. This is an indication that artisanal fishers still have inadequate storage facilities to maintain freshness of fish from the harvesting area on the mainland. Likewise, as the fish grading procedures are built on the freshness quality of fish on the mainland, there is a likelihood that

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unpreserved fish could be graded as of low quality during landing due to lack of cold storage facilities and therefore negatively affecting the price paid during the selling.

 Meanwhile the preserved fish was found to fetch an increase of landing price by TZS 0.109 per kg and TZS 0.0713 per kg for Nile perch and tilapia respectively. These findings concur with those the findings in study by Alapan (2016). By implication, the findings mean that, since fishes are perishable, if they are to be sold in good condition they must be taken to market within the shortest possible time or they must be preserved. This was supported by a observation from a BMU leader who said, "Most of fishers' canoes do not have storage facilities; that is why the fishers are likely to be paid low for landed fish which is not well preserved" (Busisi Ward Office, April 2017). They are forced to bear the costs during a contractual arrangement, which also lowers landing prices. Henceforth, if low-cost preservation facilities can be provided with improved technologies, they could reduce spoiling and increase the landing price for fresh fish supplied on the mainland.

With the influence of market type, this study found that fish price increased by TZS 0.00656 per kg of Nile perch and by 0.038TZS per kg of tilapia when they are landed on offshore islands. Landing price also decreased by TZS 0.051 per kg and TZS 0.0759 per kg for Nile perch and Nile tilapia respectively when landed on onshore mainland. By implication, trading of fish offshore in various islands is an advantage to artisanal fishers. This is not only because they are likely to suffer from dominance behaviour associated with grading procedures in the mainland and in other local markets, but also because fishes are the

perishable commodities that could lead to a better-paid landing price if sold fresh at the nearby landing sites.

furthermore, fishers who took advanced loans through agreements with buyers, , have to compensate for the loans acquired via paid landing price and other costs incurred by fish vessel sponsors when they arrived on the mainland. Therefore, using offshore islands for trading fish as a market base for fishers is better than using onshore mainland or local market prices.

Fish size is another attribute, when it increases it it leads to an increase of fish price by approximately TZS 0.141 per kg and TZS 0.150 per kg of Nile perch and Nile tilapia respectively, both at offshore islands. Brummett (2000) and Lokina (2014) stated that the accepted legal-size of fish fetches a better price to fishers. During a KII with the fishers' leader of Itabagumba ward, different fish pieces of various sizes were sold/bought at different prices. However, most of the fishers focused on large size of fish, which led to higher earning paid as landing price (Itabagumba, April 2017). This indicates that the probability of catching fish of large size could influence landing price at landing sites. This is because buyers are willing to pay for large-sized fish as foretold by the utility theory (Hammarlund, 2015). In addition, the Government of Tanzania has set legal parameters of defining the accepted legal size of fish for sale. The parameters include 25 centimetres in length for Nile tilapia and 50 to 85 centimetres for Nile perch (Sengerema Fishery Officer, April 2017). Fishers who violate these criteria opt for selling their fish catches outside the markets and end up with lower paid landing prices. The findings support the assumptions of the price theory. Mainly during the supply of the harvested fish at legally acceptable sizes result in a

better optimal paid landing price by the buyers than small fish sizes, given that the demand is constant.

In view of the author of this paper, fishers have poor fish landing price negotiation skills on fish attributes. As a result, they accept any given landing price even if it is 'low pay,' by always hoping that fishes are plenty to be harvested on the next day. These findings are an indication as to why poverty persists among fishers (Luomba, 2013; Daw & Gabrielsson, 2016; NBS, 2019). Low income due to low pay can be mitigated by improving market structure, conduct, and performance which seem to be reinforced by imperfect competition (middlemen monopoly) and relatively low investment of the fishery economy by the government as depicted by the structural theory and poverty (Bradshaw, 2007).

4.3 Variation of fish landing price caused by the change of fish attribute

The marginal effect findings in Table 7 indicate that an increase in the quantities of Nile perch, Nile tilapia, and sardines led to an increase in the prices of freshness of fish at offshore landing sites on the islands. However, for a positive action taken to adjust preserved methods, when the quantities of Nile Perch increased, the marginal effect increased by TZS 0.051 per kg. With respect to increasing the quantity of sardines, the increase had a negative marginal effect of 0.054 when landed on the mainland. This indicates that, despite the small changes in fish attributes as shown in Table 7 the changes of fish attributes are paramount to the variation in landing prices.

The marginal effect of the variable weighted measure and onshore mainland for a fish-landing centre were found to have a negative effect. This implies that any increase in the quantities of fish landed, it negatively affects the scales of weighted measure, which tends to lower the price of fish. This finding was reported in the FGD where fishers agreed with the observation made by one member that measurement weighted scale used by buyers, provide wrong weighted results, usually less than the actual amount of the catch landed (FGD, Kanyala, April 2017). The findings support the assumption of price theory that when the supplies of quantities of fishes exceed the demand, the price of that commodity is lowered. Thus, the weighted scales measurement of fish is essential attribute to fish landing price.

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Table 7: Random coefficient model results of the quantity effect of one attribute on the landing price of fish for other attributes (n = 289)

	IS	WM	IF	PM	OFI	ONL
Quantity of Nile Perch	0.021*	-0.157	-0.189	0.051**	0.001***	-0.091
Quantity of Nile Tilapia	0.192*	-0.162	-0.036	0.028**	0.0291**	-0.171
Quantity of Sardine	0.049**	-0.094**	-0.028	1.327	0.000**	-0.054**

*Indicates statistically significant at 90%, ** Indicates statistically significant at 95%

*** Indicates statistically significant at 99%

- The inferential analysis findings in Table 7 were also supported by the findings in Tables 8 Table 9. The findings in Table 8 indicate that fish species were found to have different prices per scale, measured by an increase in the length and weight. The variation of these fish attributes was also observed to benefit first-hand buyers when compared to artisanal fishers. This affirms that there are neither common criteria for evaluation of fish attributes nor pricing regulations procedures existing for attributes specificity for price allocation supervised by the responsible authority.

Table 8: Variation of fish species in size and respective prices

Type of Specie	Size (cm)	Size (kg)	Landing Price (TZS)	Agents/Middlemen/Retailers selling price (TZS)
Nile Perch	Smaller than 50	Less than 1	3 000	Between 4 000-4 500 per piece
	Greater than 50	Between 1 and 4	Between 4 000 – 4 500	Between 10 000-12 000/Kg
		Greater than 5	Between 6 000 – 7 000	
		Greater than 10	Greater than 7 000	
Nile Tilapia		Greater than 1	Between 5 000-6 200	Between 8 000-10 000/Kg
	Smaller than 50	Less than 1	3 000	Between 4 000-4 500 per piece

Preserving methods are empirically shown in Table 9. The findings reveal that one 20-litre bucket of sardines could be purchased at a landing price of between TZS 6 000 - 9 000 in 2016. Some of the preserving methods listed during focus group discussions include sun-drying, smoking, salting and frying in oil. Frying in oil is done at home for consumption purposes. These methods vary, and, as a result, affect fish prices (FGD, Nyakalilo, April 2017).

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Table 9: Fish Price by Storage Mechanism and Preservations Techniques

Species	Methods of Preserving	Unit of Measurement	Landing Price (TZS)	Agents/Middlemen/Retailers Selling Price (TZS)
Sardine				
	Sun-sand Drying	1 Bucket of 20lt	Between 6 000 – 9 000	Not below 7 000
	Wire mesh Drying			Between 15 000-18 000
	Smoking			Between 15 000-18 000
	Dried but affected with rainfall			Not below 9 000
Nile Perch				
	Smoking	Under 50 cm	3 000	Between 4, 000 - 4 500
	Freezer	Equal or greater than 50cm	5 000-6 200	Between 10 000-12 000
Nile Tilapia				
	Smoking	Under 50 cm	3 000	Between 4 000-4 500
	Freezer	Equal or greater than 50cm	5 000-6 200	Between 10, 000-12 000

5.0   CONCLUSIONS

The fish attributes that influence the landing price around Lake Victoria for Nile perch, Nile Tilapia, and Sardines fish species are island freshness, onshore island market, fish preservation methods, fish size, and freshness of fish. The coefficients were found statistically significant ($p < 0.05$). Therefore, the null hypothesis that fish attributes had no significant influence on the landing price was rejected; it is evident that the mentioned fish attributes influence the landing price.

However, the preservation methods and weighted measures were unique fish attributes found influencing fish landing price in this study. The weighted measure scales accelerate the lower price when there is an increase in the quantities of fish landed.

Therefore, this study indicated that, under the condition of monopolistic tendency, buyers might collude with other dealers to manipulate the weighted measure scales of a commodity lowering its price regardless of the quantities demanded. It is recommended that fishers should sell their fish at the nearest market place immediately to avoid the cost of preservation and fish deterioration, which would negatively influence the price.

Furthermore, the marginal effect provides evidence that the change of one attribute influence the landing price of fish. In this respect, it is paramount to consider the influence of each attribute identified in this study for strategic interventions on landing price determination. Therefore, it is recommended that the supplies of fresh, well preserved, and large-sized fish to meet optimal price as per the demand that require the provision and availability of modern fishing vessels as well as an installed storage mechanism. In addition, fishers need to participate in contractual agreements to ensure artisanal fishers with well-equipped fish preservation methods to enable buyers purchase the harvests at better and agreeable landing prices.

Furthermore, it is recommended that further research needs to incorporate other factors such as taste, nutritional value, fish processing, grading, branding, packaging, marketing and other fish species that were out of the scope of this study.

REFERENCES

Abila, R. (2015). Fish trade and food security: Are they reconcilable in Lake Victoria. Retrieved from http:// www. fao.org.Site visited on 11/10/2017.

Alapan, M.P., Arpilleda, E.L., Altizo, K. J., Frias, G.K. & Ravelo, J.D. (2016). Factors Affecting the Market Price of Fish in the Northern Part of Surigao Del Sur, Philippines. *Journal of Environment and Ecology.* 7(2):34-41.doi.org/10.5296 /jee.v7i2.10469.

BOT (2017). Bank of Tanzania Annual Report 2015/16. [https://www.bot.go.tz/Publications/EconomicAndOperati onsAnnualReports/

BOT%20ANNUAL%20REPORT%202015-16.pdf] site visited on 07/03/2018.

Bradshaw, T. K. (2007). Theories of poverty and anti-poverty programs in community development. *Community Development.* 38(1): 7-25.

Bronnmann, J.& Hoffmann, J. (2018). Consumer preferences for farmed and ecolabeled turbot: A North German perspective. *Aquaculture Economics & Management.* 22(3): 342-361. doi:10.1080/13657305.2018.1398788

Brummett, R. E. (2000). Factors influencing fish prices in Southern Malawi. *International Journal of Aquaculture.* 186 (3–4):243–251.

Bryman, A. (2008). *Social Research Methods*, Oxford University Press, New York. 784 pp.

Carroll, M.T., Anderson, J. L. and Martinez-Garmendia, J. (2001). Pricing U.S. North Atlantic Bluefin tuna and implications for management. *Agribusiness*.17(2):243-253. doi.org/10.1002/agr.1014

Chandrashekar, B.S. (2014). Fishery co-operative societies in India: Problems and prospects. *Global Journal for Research Analysis*. 3 (7): 2277-8160.

Daw, T.& Gabrielsson, I. (2016). What has wellbeing got to do with the price of fish: a focus on fishers' income might miss opportunities for sustainable poverty alleviation. ESPA 2016 Annual Science Conference.

Evans, S.J. (1991). Good surveys guide. BMJ. 302(6772):302–303. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/ articles/PMC1669002/pdf/bmj00112-0008.pdf.

FAO, (2014). The state of world fisheries and aquaculture; Opportunities and Challenges. [www.fao.org/3/a-i3720e.pdf] site visited on 20/04/2016.

FishBase (2018). Retrieved rom http://www.fishbase.org/ search.php. Site visited on 13/01/2019.

Gobillon, L., Wolff F.C. and Guillotreau P. (2017). The effect of buyers and sellers on fish market prices. *European Review of Agricultural Economics*. 44(1): 149-176.

Hammarlund, C (2015). The big, the bad, and the average: hedonic prices and inverse demand for Baltic cod. *Marine Resource Economics*. 30(2): 157-177.

Henson, S., and Mitullah, W (2000). Food Safety Requirements and Food Exports from Developing Countries: The Case of Fish Exports from Kenya to the European Union. *American Journal of Agricultural Economics.* 82(5): 1159-1169.

Israel, D G. (2013). *Determining Sample Size*. Institute of Food and Agricultural Sciences (IFAS), University of Florida, PEOD-6: 1-5.Retrieved from http://www.gjimt.ac.in /web/wp-content/uploads/2017/10/2_Glenn-D.-Israel_Determining-Sample-Size.pdf. Site visited on 27/05/2016.

Janssen, C,. Zhou, J,. Bo Söderberg (2001). Robust estimation of hedonic models of price and income for investment property. *Journal of Property Investment & Finance*. 19(4): 342– 360. doi.org/10.1108/EUM0000000005789.

Johnston, R.J., Wessells, C.R., Donath, H. & Asche, F. (2001). A contingent choice analysis of ecolabeled Seafood: Comparing consumer preferences in the United States and Norway. *Journal of Agricultural and Resource Economics*. 26(1):20–39.

Kambewa, E.V. (2007). *Balancing the people, profit and planet dimensions in international marketing channels*. A study on coordinating mechanisms in the Nile perch channel from Lake Victoria. Wageningen University: Netherland. 45pp.

Kristofersson, D. and Rickertsen, K. (2004). Efficient estimation of hedonic inverse input demand systems. *American Journal of Agricultural Economics*. 86 (4):1127- 1137. doi.org/10.1111/j.0002-9092.2004.00658.x

Lee, M. (2014).Hedonic pricing of Atlantic cod: Effects of size, freshness, and gear. *Marine Resource Economics.* 29(3): 259-277.

Lokina, R.B. (2014). Fishing business arrangements and sustainability around Lake Victoria fishing. *African Journal of Economic Review.* 2(2): 71-94.

Luomba, J. (2013). Dagaa fishery the unknown wealth of Lake Victoria. *IIFET 2012   Tanzania Proceedings*,20th July 2012. Dar es salaam, Tanzania. 10pp.

Maciel, E., Savay-da-Silva, L., Vasconcelos, J., Sonati, J., Galvão, J.,Leandro De Lima, K.,Oetterer, M. (2013). Relationship between the price of fish and its quality attributes: A study within a community at the University of São Paulo, Brazil. *Food Science Technology (Campinas)*. 33(3): 451-456.

Mangion, M.L., Durbarry, R. and Sinclair, M.T. (2005). Tourism competitiveness: price and quality. *Tourism Economics*. 11(1): 45-68.

Matiya, G., Wakabayashi, Y. & Takenouchi, N. (2010). Factors influencing prices of fish in central region of Malawi and its implications on the development of aquaculture. *Journal of Applied Sciences.* 5(8): 1424-1429.

McConnell, K. & Strand, I. (2000). Hedonic prices for fish: Tuna prices in Hawaii. *American Journal of Agricultural Economics*. 82(1):133-144. doi.org/10.1111/0002-9092.00011

NBS (2019). National Bureau of Statistics. Dar es Salaam.

Nguyen, T.T., (2011). Implicit price of mussel characteristics in the auction market. *Aquaculture International*. 20(4):605–618.

Novara, C., Lavanco,G., Mannino, G., & Serio, C. (2018) Management and human factors: exploratory research with focus groups. *World Futures*. 74(5):343-354. doi: 10.1080/02604027.2018.1492294

Phillips, M and Subasinghe, R. (2010). Small-scale shrimp farmers and global market –trends,future prospects and adaptation. In V. Alday-Sanzy(Eds.) *The Shrimp Book.* Nottingham University Press: Nottingham. 10 pp.

Roangead (2013). *Tanzanian Nile perch value chain baseline study.* Burgun Cedric: International Trade and Sustainable Development. Retrieved from http://www.Roangead.org/IMG/pdf/Roangead_Rapport_Final.pdf. Site visited on 02/08/2015.

Roheim, C. A., Gardiner L., and Asche F. (2007). Value of brands and other attributes: of retail frozen fish in the UK. *Marine Resource Economics*. 22(3):239-253.

Rosen, S (1974). Hedonic prices and implicit markets: Product differentiation in pure competition. *Journal of Political Economy*. 82(1): 34-55.

Slade, B.A. (2000). Office rent determinants during market decline and recovery. *Journal of Real Estate Research*. 20(3):357-380.

URT (2014). *Report on Lake Victoria Fishery Frame Survey Results.*Government Printer., Dar es Salaam, Tanzania. 162 pp.

URT (2016). *Tanzania Fisheries Sector: Challenges and Opportunities. Ministry of Agricultura, Livestock and Fisheries*. Government Printer., Dar es Salaam, Tanzania. 40 pp.

URT (2017). *Mwanza Region Investment Guide*. Government Printer., Dar es Salaam, Tanzania. 80p