

Wild-Caught Fish versus Aquaculture Fish Products: A Fish Marketing Concept for Aquaculture Quality Improvement, A Case Study of Nyanza Region, Kenya

Safina M Musa¹, Christopher Mulanda Aura², Rodrick Kundu³

¹Kenya Marine and Fisheries Research Institute, Kegati Aquaculture Research Station, P.O. Box 3259-40200, Kisii, Kenya

²Kenya Marine and Fisheries Research Institute, P.O. Box 81651-80100, Mombasa, Kenya
Laboratory of Marine Bioresource and Environment Sensing, Hokkaido University, Minato-cho, Hakodate, Hokkaido 041-8611, Japan

³Lake Victoria Environmental Management Project –Phase II, P. O. BOX, P.O. Box 9220-40100, Kisumu, Kenya

Running head: Consumer Preferences for Fish Products

Abstract: *This study aims to investigate Nyanza region consumers' attitude and willingness to pay for fish product attributes including farmed vs. wild-caught varieties. Nyanza region presents an interesting case study as it borders Lake Victoria and the residents are traditionally fish eaters. A total of 610 questionnaires were administered in-person to respondents in the region to gauge consumer's perception and conjoint analysis for three different fish species (tilapia, catfish and ningu) used to measure consumer willingness to pay for species-specific attributes on the market. The results indicate that fish consumption was significantly related to household size and income. Notably, fish product attributes such as taste had the greatest influence on consumer preferences with a greater proportion of respondents favoring wild caught than cultured fish primarily for taste preference. Consumers are willing to pay more for wild caught than farm-raised tilapia and catfish. The premium for wild-caught fish products suggests consumers put an irreplaceable value on the limited resources of wild fish stocks. The case study of Nyanza region confirms the unique markets for fresh fish with the degree of preference varying across species. This research can be used to better target preferred markets and facilitate policy decisions for improvement of quality and farmed fish products, management and fish industries.*

Keywords: Willingness to pay, aquaculture, consumer preference, price premiums, Nile tilapia, catfish, ningu.

1. Introduction

While the global human population continues to increase rapidly [24], the world's fishing areas have reached their maximal potential for capture fisheries production [5]. In order to maintain the current level of per capita consumption, global aquaculture production will need to reach 80 million tonnes by 2050 [5]. The decline is most pronounced in sub-Saharan Africa which is the only region in the world where fish consumption is falling. In East Africa, the gap between supply and demand is widening to such an extent that even the axial skeletons of fish (*mgongo wazi*), eaten by local people, are becoming scarce.

Recognizing aquaculture as one of the viable options for revamping the economy, the Kenya government initiated an Economic Stimulus Program (ESP) targeting fish farming in two thirds of the country and especially targeting areas with high unemployment rates [16]. Over the last ten years, fish production has increased from as low as 1,012 tonnes in 2003 to the present production of 21,487 tonnes [7]. As aquaculture production changes the supply of fish, consumers face new decisions when purchasing fish. The combined fish supply from both wild capture fisheries and aquaculture presents consumers with a variety of choices for fish products in the retail market today. Beyond the type of fish to purchase comes the decision to consume farm-raised or wild-caught fish and how much to pay for the desired product. Our research aims to identify attitudes and

perceptions among Nyanza region fish consumers and also take a multi-species approach to quantify the willingness to pay (WTP) for product attributes.

Although several studies have addressed consumer preferences for fish, particularly in the context of aquaculture [1], [6], [9], [15], [18], [23], few surveys have compared values for product attributes across different species. Furthermore, to the best of our understanding, no study has been carried out in Kenya to investigate the consumers' willingness to pay (WTP) for wild caught vs. farm-raised fish products to offer baseline information that could be compared with other regions globally. The study thus examines both consumer attitudes and willingness to pay for farm-raised and wild caught fish in Nyanza region, Kenya. Knowing the consumer preferences towards various species and their attributes could offer the understanding of aquaculture industrial development and management.

2. Materials and Methods

The survey was conducted in Nyanza region, Kenya comprising Kisumu, Bondo, Nyando, Rachuonyo, Homa-Bay, Suba, Kisii central and Migori Counties (Figure 1). The study area was selected due to the fact that Nyanza region borders Lake Victoria and the residents are traditionally fish eaters. Subsequently, random sampling was employed in the areas to select fish consumers to participate in the survey as respondents. Three species: Nile Tilapia (*Oreochromis*

niloticus), African Catfish (*Clarias gariepinus*), and *Ningu* (*Labeo victorianus*), were chosen for this study with the desire to represent both familiar, popular products (tilapia and catfish) and less familiar, emerging products (*Ningu*). Tilapia and catfish are ranked in the top ten species consumed in Kenya [7]. *Ningu* stands out as a local market fish with traditional and cultural value that was wild-caught and now being farmed.

The data was collected in major markets in the eight counties in Nyanza region. A two-part questionnaire was

designed to gauge Nyanza region fish consumption and willingness to pay (WTP) for fish attributes. The first section of the survey identifies the general public's attitudes and perceptions towards aquaculture, fish consumption habits and general demographics. Basic fish consumption questions investigated reasons for consuming fish, species purchased, awareness of aquaculture in the markets, environmental concerns and perceptions towards fish stocks and aquaculture.

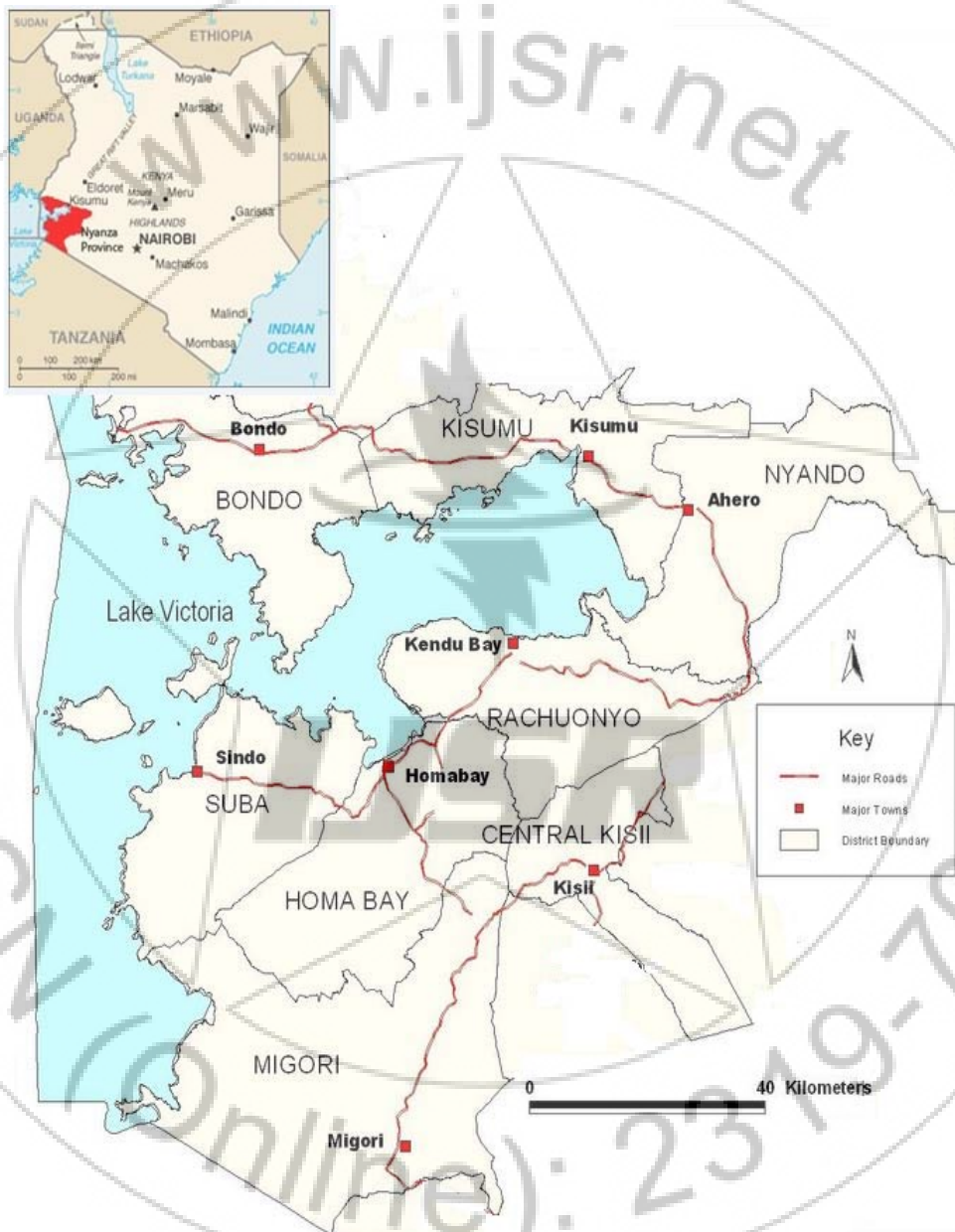


Figure 1: Location of study area in Nyanza region, Kenya (shaded in red colour) bordering Lake Victoria

The second section of the survey used conjoint analysis methods to measure the market potential for a variety of attributes in fish preference. Conditional logit models were used to estimate the impact of the attribute variables on the decision to purchase the product in each choice situation. The sample size for each model differs because species were randomly distributed to the respondents to evaluate. Furthermore, each choice situation was treated as a unique,

individual choice independent of the other choices. Marginal values based on the estimated parameters were used to gauge consumers WTP for product attributes. Marginal values were calculated using the formula adopted from Train (2009) as follows:

$$\text{Marginal value} = -\beta_{\text{attribute}} / \beta_{\text{price}} \tag{1}$$

A total of 610 questionnaires were administered to the respondents. Data collected from the field was entered and analyzed statistically using the Statistical Package for the Social Sciences (SPSS Inc. version 20.0) and NLOGIT 4.0 software. Descriptive analysis was done by use of means, standard deviation, percentages and frequency distribution of responses. Inferential statistics was done using Chi-square (χ^2) test of goodness of fit. All data analyzed were considered significant at 0.05 level of significance.

3. Results

3.1 Profile of Surveyed Respondents

Demographics of the surveyed respondents are presented in table 1. Majority of fish consumers were between 30-39 years of ages (30% n=610) with 21% of them between 40-49 years. Notably, very few consumers were of ages 18-24 (7% n=610) and >80 years (1% n=610). Majority of the respondents were females (52% n=610) while males comprised of 48% of the respondents. Most of the respondents had attained secondary level of education (51% n=610) with very few having no formal education (2% n=610). There was no significant relationship between gender ($\chi^2 = 2.234$; $p = 0.622$); age ($\chi^2 = 3.021$; $p = 0.205$) and fish consumption. However, there was a strong significant relationship between religion ($\chi^2 = 2.121$; $p = 0.002$), household size ($\chi^2 = 1.221$; $p = 0.001$); education ($\chi^2 = 1.673$; $p = 0.003$) and income ($\chi^2 = 1.101$; $p = 0.0001$) and fish consumption.

Table 1: Demographics of fish consumers in Nyanza region, Kenya

Variable	Response	Frequency (n=610)	Percent
Religion	Christian	561	92
	Muslim	49	8
Age (Years)	18 to 24		7
	25 to 29	111	18
	30 to 39	183	30
	40 to 49	128	21
	50 to 59	61	10
	60 to 69	43	7
	70 to 79	37	6
	80 and over	6	1
Education level	None	12	2
	Primary	165	27
	Secondary	311	51
	Tertiary	122	20
Income	less than 5000	61	10
	5000-8000	189	31
	8000-10,000	317	52
	>10,000	43	7
Gender	Male	292	48
	Female	318	52
Household size	<3	31	5
	3-5	61	10
	6-8	500	82
	9-12	12	2
	>12	6	1

3.2 Fish Consumption Habits

Fish consumption habits of Nyanza region residents are shown in Table 2. Majority of the respondents eat fish at

home and restaurants (89% n = 610) followed by eating at home only (7% n = 610). The survey noted that very few respondents do not consume fish (1% n = 610) as part of their diet. A vast proportion of the respondents indicated that their fish consumption would remain the same (70% n = 610) while 22% of them predicted a slight increase in consumption in the following year. However, very few respondents (8%; n = 610) indicated that their fish consumption would increase significantly in the next year.

Table 2: Fish consumption habits among participants in Nyanza region, Kenya

Fish consumption	Number of respondents	Percent
At home only	35	7
At restaurants only	15	3
At home and restaurants	503	89
Not at all	13	1

The survey indicated that majority of the respondents prefer tilapia (80%; n = 610) while 11% of the them prefer Ningu (Figure 2). Very few respondents prefer catfish (4% n = 610). Although the survey noted ningu as the second most preferred species among the respondents (Figure 2), none of the respondents (0% n = 610) indicated that they had purchased ningu within the last 60 days. However, a vast proportion of the respondents had bought tilapia (90%, n = 610) and catfish (2% n = 610) within the last 60 days.

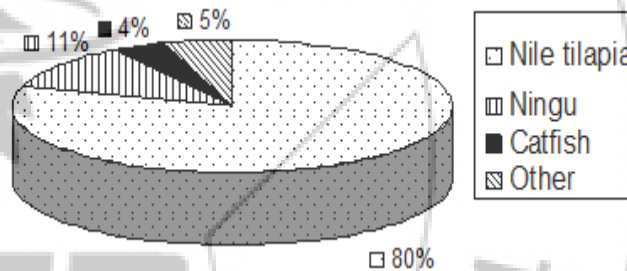


Figure 2: Fish species preference in Nyanza region, Kenya

Majority of the respondents indicated that taste was the most important reason why they consumed fish (34% n = 610), followed by those who believed that fish is healthier than other meat varieties (27% n = 610). Some popular 'other' reasons for consuming fish included variety in diet and fishing as a livelihood (Figure 3).

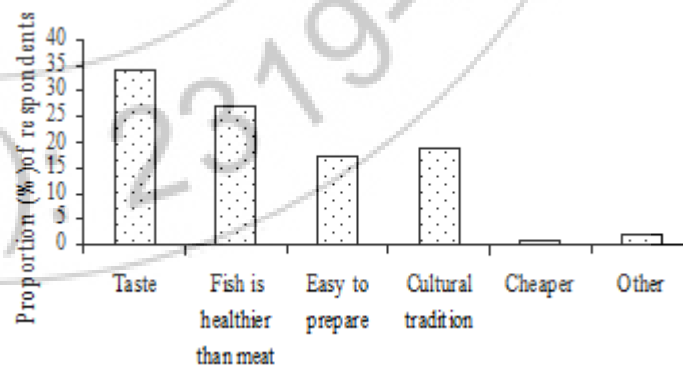


Figure 3: Trends of the most important reason participants consume fish in Nyanza region, Kenya

The survey noted that fresh fish is by far the most popular (63% n = 610) type of fish product preferred by Nyanza

region residents while previously frozen, thawed fish was the least preferred (2% n = 610) by consumers (Figure 4).

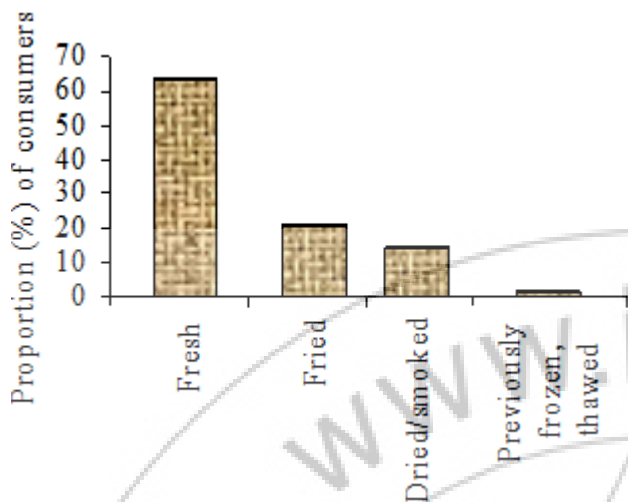


Figure 4: Forms of fish products preferred by consumers in Nyanza region, Kenya

3.3 Aquaculture vs. Wild-Caught Fish Preference

The survey noted that majority of the respondents prefer wild-caught fish (80% n = 538) while 10% prefer cultured fish. A dismal 7% of the respondents prefer both farmed and wild-caught fish while a few were unsure (3% n = 538). Table 7 identifies a cross tabulation of the reasons why consumers stated preference for each production method. The survey noted that wild caught fish is favored primarily for taste preference among Nyanza region consumers. Concern about environmental pollution, however, is a driver for some respondents who prefer cultured fish (Table 3).

Table 3: Cross-Tabulation of preferred fish production method and reason why

Production method	Reason Preferred								Total
	Concern about Env Pollution	Concern about natural resource use Nat	Taste	Food safety	Price	Habit	Other	Unsure	
Wild caught	36	55	131	42	6	47	20	5	342
Farmed	14	8	6	3	5	2	4	0	42
Unsure	2	3	11	5	9	3	12	92	137
Both	5	2	6	2	2	0	0	0	17
Total	51	74	154	52	22	52	36	97	538

A large number of participants had purchased or consumed both farm-raised and wild caught tilapia (41% n = 600) and catfish (34%; n=600). Majority of consumers have never

purchased or consumed farm raised or wild caught Ningu (47%; n=600) (Table 4).

Table 4: Consumption/Purchase of fish by production method and type of fish species in Nyanza region, Kenya

Product type	Tilapia		Catfish		Ningu	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Wild-Caught	215	34	150	23	203	34
Farm-Raised	113	18	91	14	22	3
Both	265	41	220	34	95	16
Neither	48	8	180	28	280	47

3.4 Conjoint Analysis

Table 5 shows the descriptive statistics for the price variables used for each species in the conjoint choices. The mean for tilapia price attribute is much higher than that for other species. Table 6 presents the estimated results and statistical significance of the variables. Also noted in Table 5 are the sample size (N), the goodness-of-fit (adjusted pseudo-R² statistics) as well as the overall parameter significant test scores (the likelihood ratio statistics) for each model. The goodness-of-fit is similar across the three estimations and the attribute variables are jointly highly significant. Notably, the wild caught variables have positive coefficients for all species, while price, following intuition, has a negative relationship. The BUYNO variable is a constant term representing the option in the choice set to buy product alternative for a species. The variable is statistically significant and has a negative coefficient across all species models. Tilapia, catfish and ningu share an attribute for

previously frozen products variables. The respective coefficients are negative and statistically significant for each model.

Table 5: Descriptive statistic for choice Experiment price variables

	Mean (SD)	Min	Max
Tilapia price (\$)	4.00±0.22	3.50	4.50
Catfish price (\$)	3.00± 1.45	2.30	3.60
Ningu price (\$)	2.50±3.22	2.00	3.00

3.5 Marginal Values

The calculated marginal values for each species' set of attributes are presented in Table 6. Each marginal value represents consumers WTP for that particular attribute under that specific fish species, while holding all else constant. With the exception of ningu, the values clearly show consumers in Nyanza region are willing to pay more for wild caught fish products than farm raised fish products.

Given our results, consumers on average would be willing to pay \$0.80/Kg, \$ 0.30/Kg and \$ 1.50/Kg more for the wild-caught tilapia, catfish and *ningu*, respectively. Similarly, consumers are willing to pay 1.50/Kg more for farm-raised *ningu*. For previously frozen tilapia, catfish and *ningu*, Nyanza province consumers are willing to pay \$ 2.00/Kg (50%), \$ 1.80/Kg (60%) and \$ 1.00/Kg (40%) less, respectively, holding other factors unchanged. The survey also indicated that consumers would be willing to pay more for fried fish products irrespective of the production method (Table 7).

NINGPFR	Previously frozen	-1.00***	-40%
NINGFR	Fried	2.00***	80%
NINGD	Dried	-0.80***	32%

** and *** represent statistical significance at the 5% and 1% levels respectively

4. Discussions

The demographic survey noted higher proportion of female (52%) consumers than male consumers (48%) in Nyanza region. Our survey achieved a good representation of the State's population in terms of age groups, education and income levels [7]. The results of the current study indicated that fish consumption was significantly related with household size, income, education and religion. Education is assumed to enlighten consumers about the health and other benefits of fish consumption hence, positively influences the generally preference of consumers [14], [17]. These results accord with previous findings that socio-demographic characteristics like income and education influence consumer's preference for fish [3], [4], [6], [9], [10], [11], [12], [13], [17], [19] [20], [23].

Most consumers consumed fish both at home and in restaurants, an indication that fish is a delicacy in the region hence served in hotels. Majority (63%) of the respondents indicated that their fish consumption is likely to stay the same in the following year with very few (7%) predicting a significant increase, suggesting a marginal increase in consumption to continue the current national trend.

The survey noted that consumers mostly preferred tilapia than any other species in Nyanza region (Figure 2). The preference for tilapia in Nyanza region could be because of religion as some religions like Sevent Day Adventist (SDA) do not eat catfish. Notably, the consumer preference of tilapia could also be influenced by availability as tilapia is the most produced species both from the wild and by culture [7]. *Ningu* consumption in Nyanza region was significantly lower probably reflecting its unfamiliarity or unavailability in the markets.

Taste is the most important reason participants consume fish, results corroborated by the findings of O'Dierno *et al.* [18]. Studies performed by Johnston and Roheim [12] also reported that species when ranked were always preferred by taste, regardless of production method. The results of the current study could be an indicator that a perception of taste is important in purchasing decision for fish in the province. Notably, fresh fish is by far the most popular (63%) type of fish product purchased in Nyanza region. These results suggest that there is a strong preference for fresh fish in Nyanza region and probably its environs. Fresh fish is a major market product in Kenya [17] [22] hence traders could ensure that consumer's demands are met. Kenyans are traditionally used to the consumption of fresh tilapia, and fresh fish in general, because of the frequent supply of fresh fish from especially Lake Victoria to open markets [22].

The survey found out that consumers prefer wild-caught to farm raised fish. Wild caught fish is favored primarily for taste preferences among consumers in Nyanza region. The results of the present study concur with those of several

Table 6: Conditional Logit Model Estimation Results

Variable	Description	Coefficient	Std. Error
Tilapia			
BUYNO	choice to buy	-1.824***	0.122
TILWC	Wild caught	0.898***	0.022
TILF	Farm-raised	-0.661***	0.162
TILPFR	Previously frozen	-0.122***	0.235
TILFR	Fried	0.723***	0.178
TILD	Dried	-0.652***	0.164
TILPRICE	Price	-0.112***	0.093
N=300 ; adj. Pseudo-R ² =0.054; LR=107.68			
Catfish			
BUYNO	choice to buy neither		0.201
CATWC	Wild caught	0.591***	0.120
CATF	Farm-raised	-0.412***	0.100
CATPFR	Previously frozen	-0.221***	0.116
CATFR	Fried	0.673***	0.010
CATD	Dried	-0.872***	0.016
CATPRICE	Price	-0.054***	0.203
N=299; adj. Pseudo-R ² =0.032; LR=87.77			
Ningu			
BUYNO	choice to buy neither		0.152
NINGWC	Wild caught	0.721***	0.059
NINGF	Farm-raised	-0.652***	0.070
NINGPFR	Previously frozen	-0.451***	0.103
NINGFR	Fried	0.899***	0.016
NINGD	Dried	-0.451***	0.201
NINGPRICE	Price	-0.189***	0.162
N=285; adj. Pseudo-R ² =0.055; LR=228.86			

** and *** represent statistical significance at the 5% and 1% levels respectively

Table 7: Marginal values for species-specific attributes calculated from conditional logit

Variable	Description	Coefficient	Percent of Avg. price
Tilapia			
BUYNO	choice to buy neither	-3.80***	
TILWC	Wild caught	0.80***	20%
TILF	Farm-raised	-1.00***	-25%
TILPFR	Previously frozen	-2.00***	-50%
TILFR	Fried	1.00***	25%
TILD	Dried	-1.50***	-38%
Catfish			
BUYNO	choice to buy neither	-2.50***	
CATWC	Wild caught	0.30***	10%
CATF	Farm-raised	-0.50***	-17%
CATPFR	Previously frozen	-1.80***	-60%
CATFR	Fried	0.60***	20%
CATD	Dried	-0.20***	-7%
Ningu			
BUYNO	choice to buy neither	-1.524**	
NINGWC	Wild caught	1.50***	60%
NINGF	Farm-raised	1.50***	60%

other studies, which indicate that wild caught fish is the most preferred due to taste [2], [3], [22].

Although in a non-linear environment such as the conditional logit model, the magnitude of the coefficients themselves cannot be readily interpreted, evaluating the coefficient signs and statistical significance may help draw comparison across the three species models. The wild caught variables have positive coefficients for all species, suggesting that consumers are more likely to chose the fish product if it is wild-caught. Price following intuition has a negative relationship; an indication that consumers are less likely to purchase higher priced fish products of any species. The results are in line with the findings of other authors who have indicated that price is an important attribute that determine utility values for aquatic food [8], [11], [12], [20], [21], [26]. The BUYNO variable is statistically significant and has a negative coefficient across all species model. The negative relationship can be interpreted as a decrease in consumer utility if the consumers do not choose this species in a choice situation due to the lack of appeal for the product alternatives. The respective coefficients for all species were negative for previously frozen products suggesting that consumers are less likely to purchase fish products that were previously frozen.

Marginal values clearly show consumers are willing to pay more for wild caught fish products than farm raised fish products for tilapia and catfish. Comparing in terms of percent of average price, consumers are willing to pay more for cultured *ningu* than wild caught catfish and tilapia. Tilapia and catfish are both already farmed species, while farm-raised *ningu* in Kenya markets is still on the horizon. This comparison suggests that the magnitude of price premiums may decrease as consumers become more familiar with the cultured species. Notably, consumers are willing to pay more for fried fish of any species regardless of production method. This is a niche that aquaculture producers in Nyanza region need to tap to add value to their products as farmed fish is inferior to wild-caught fish in Nyanza province. By value addition through frying, aquaculture farmers could increase their profit margin and at the same time ensuring that products reaching consumers in the market are of the required form. The higher absolute WTP for wild caught tilapia compared to catfish is reflective of the higher average unit price of tilapia (Table 4). The conditional logit estimation by Jaffry *et al.* [11] generated similar parameters for product form and sources. Other analyses concluded price premiums of similar magnitude for product attribute [2], [13]. Because wild-caught tilapia is a high value, high quality product, it is not surprising that WTP for wild-caught tilapia is much higher than the other species in our study. Tilapia is caught locally and sold fresh in fish markets; this also explains the low WTP for previously frozen tilapia.

5. Conclusions and Recommendations

The results of this study show that there is a strong preference for wild-caught fish in Nyanza region, primarily due to taste and the preference varies by species. Consumers are willing to pay more for wild caught than farm-raised tilapia and catfish. However, consumers have equal

preference for both wild caught and farm-raised *ningu* with equal price premiums. The case study of Nyanza region confirms the unique markets for fresh fish and that consumers are marginally increasing their fish consumption based on taste and health interests. The result of this study suggest that *ningu* culture is a niche that fish farmers need to venture into since there is a strong demand for *ningu* in Nyanza region yet wild-caught *ningu* is negligible. As researchers strive to substitute fish meal and fish oil in cultured fish, there is need to emphasize on the optimum levels where the taste of cultured fish is not compromised. Notably, value added fish products like fried fish is on high demand and hence this product can be developed into a niche marketing strategy by fish farmers. Findings from consumer market studies can strengthen the relationship between fisheries and aquaculture management.

A caveat of this study includes the potential for hypothetical bias in the conjoint analysis which relies on stated preferences rather than actual purchases observed in real market data. Notably, the design of choice experiments varies by study, including the range of prices used to cover the potential WTP. Further research from this study may include an investigation of varying preferences among consumers based on their different characteristics. Also, an examination of survey methodologies can be performed since mixed models were used for this study. More flexible choice models may also be applied to reveal consumer heterogeneity. Finally, it may not be a big surprise to see that the study reported that the conjoint analysis identifies price premiums for wild-caught fish, as the survey was conducted in regions that boarder L. Victoria. It would be interesting to compare the results from Nyanza region with similar preference studies conducted in different geographical locations with other species to provide a robust global perspective.

6. Acknowledgements

Kenya Marine and Fisheries Research Institute (KMFRI) provided the necessary funds and materials required during the study.

References

- [1] C. H. Batzios, D. K. Moutopoulos, G. Arampatzis, G. Siardos, "Understanding consumer's attitude on fish quality and marketing aspects in the greek market," *Agricultural Economics Review*, 6(1), pp 18-30, 2006.
- [2] S. Dasgupta, J. Eaton, A. Caporelli, "Consumer perceptions of freshwater prawns: Results from a Kentucky farmers' market," *Journal of Shellfish Research*, 29(1), pp 19-23, 2010.
- [3] S. L Drake, M. A. Drake, H. V. Daniels, M. D. Yates, "Sensory properties of wild and aquacultured Southern Flounder," *Journal of Sensory Studies*, 21, pp 218-227, 2006.
- [4] C. R. Engle, J. P. Kouka, "Potential consumer acceptance of canned bighead carp: A structural model analysis," *Marine Resource Economics*, 10(1), pp 101-116, 1995.

- [5] FAO, "The state of world fisheries and aquaculture 2011". FAO, Rome (In press), 2014.
- [6] C. M. Gempeasaw II, R Bacon, C. R. Wessel, A. Manalo, "Consumer perceptions of aquaculture products," American Journal of Agricultural Economics, 77(5), pp 1306-1312, 1995.
- [7] C. K. Halbrendt, F. F. Wirth, G. F. Vaughn, "Conjoint analysis of the mid-atlantic food-fish market for farm raised hybrid striped bass," Southern Journal of Agricultural Economics, 23, pp 155-164, 1991
- [8] G. D. Hanson, R. O. Herrmann, J. W. Dunn, "Determinants of seafood purchase behaviour: consumers, restaurants and groceries stores," American Journal of Agricultural Economics, 77(5), pp 1301-1305, 1995.
- [9] R. Harrison, W.T. Stringer, W. Prinyawiwatkul, "An analysis of consumer preferences for value-added seafood products derived from crawfish," Agricultural and Resource Economics Review, 31(2), pp 157-170, 2002.
- [10] S. Jaffry, H. Pickering, Y. Ghulam, D. Whitmarsh, P. Wattage, "Consumer choices for quality and sustainability labeled seafood products in the UK," Food Policy, 29, pp 215-228, 2004.
- [11] R. J. Johnston, C. A. Roheim, "A battle of taste environmental convictions for ecolabeled seafood: A contingent ranking experiment," Journal of Agricultural and Resource Economics, 31(2), pp 283-300, 2006.
- [12] R. J. Johnston, C. R. Wessel, H. Donath, F. Asche, "Measuring consumer preferences for ecolabeled seafood: An international comparison," Journal of Agricultural and Resource Economics, 26(1), pp 20-39, 2001.
- [13] H. Kinnucan, R. Nelson, J. Hiariey "Preferences for fish and seafood: An evoked set analysis," Mar Resour Econ, 8, pp 273-91, 1993.
- [14] G. Kumar, K. Quagraine, C. Engle, "Factors that influence frequency of catfish by U.S. households in selected cities," Aquaculture Economics and Management, 12(4), pp 252-267, 2008.
- [15] K. O. Obiero, M. A Opiyo, J. M Munguti, P. S Orina, D. Kyule, E. Yongo, C. M. Githukia, H. Charo-Karisa, "Consumer preference and marketing of farmed Nile Tilapia (*Oreochromis niloticus*) and African Catfish (*Clarias gariepinus*) in Kenya: Case Study of Kirinyaga and Vihiga Counties," International Journal of Fisheries and Aquatic Studies, 1(5), pp 67-76, 2014.
- [16] L. O'Dierno, R. Gaavindasamy, V. Puduri, J. J. Myers, S. Islam, "Consumer perception and preferences for organic aquatic products: Results from the telephone survey. New Jersey agricultural experiment station, Rutgers University Department of Agricultural," Food and Resource Economics, pp 1-58, 2006.
- [17] K. K. Quagraine, J. Unterschultz, M. Veeman, "Effects of product origin and selected demographics on consumer choice of red meats," Can J Agr Econ, 46(2), pp 201-219, 1998.
- [18] K. K. Quagraine, "IQF catfish retail pack: A study of consumers' willingness to pay," International Food and Agribusiness Management Review, 9(2), 75-87, 2006.
- [19] K. K. Quagraine, C. Ngugi, S. Amisah, "Analysis of the use of credit facilities by small-scale fish farmers in Kenya," Aquacult Int., 18, pp 393-402, 2009.
- [20] K. K. Quagraine, J. Dennis, J. Coulibaly, C. Ngugi, S. Amisah, "Developing supply chain and group marketing systems for fish Farmers in Ghana and Kenya," Aqua Fish Collaborative Research Support Program Technical Reports, Oregon State University, Investigations 2007-2009, 2pp 198-210, 2010.
- [21] K. Train "Discrete choice methods with simulation," Cambridge University Press, Cambridge, UK, 2009.
- [22] United Nations "World population prospects: the 2004 revision," Population Newsletter, 79, pp 1-5, 2005.
- [23] D. Whitmarsh, M. G. Palmieri, "Social acceptability of marine aquaculture: The use of survey based methods for eliciting public and stakeholder preferences," Marine Policy, 33, pp 452-457, 2009.
- [24] F. F. Wirth, K. J. Davis, "Shrimp purchasing behaviour and preferences of seafood dealers," Paper presented at the Southern Agricultural Economics Association Annual Meeting, Mobile, Alabama, February 1-5, 2003.

Author Profile



Safina Musa received the MSc and Bsc in Aquatic Sciences and Fisheries and Aquatic Sciences from Moi University in 2007 and 2010 respectively. She is currently employed at Kenya Marine and Fisheries Research Institute (KMFRI), Kenya as a research Scientist in aquaculture



Mr. Christopher Mulanda Aura is a Kenyan male under a PhD program in Marine Bio-resource Measurement and Environment Sensing in Hakodate Campus, Hokkaido University, Japan. But he is currently employed at Kenya Marine and Fisheries Research Institute (KMFRI), Mombasa, Kenya.



Mr. Rodrick Kundu holds a Bachelors degree in Biological Sciences from the University of Nairobi (Kenya) and a Masters in Fisheries Management from Moi University (Kenya). He is employed by Kenya Ministry of Agriculture, Livestock and Fisheries (State Department of Fisheries) and currently deployed to the World Bank funded - Lake Victoria Environmental