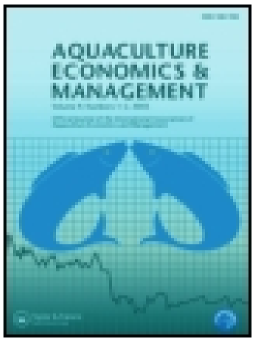

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TECHNICAL ARTICLE

Analysis of the determinants of fish consumption by households in Ghana

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ABSTRACT

A sample of 2,185 Ghanaian households from the GLSS6 was examined using a latent class model of structural heterogeneity in a linear regression framework to assess their fish consumption patterns. The results suggest that Ghanaian households fall into two consumption categories, namely "traditional" and "non-traditional" households, though there is some overlap between the two household groups. Demand for fish is price inelastic in traditional households and approximately unitary elastic in non-traditional households. In traditional households, fish is complementary to poultry but a substitute for red meat. Among non-traditional consumers, fish is complementary to poultry but a substitute for red meat and pork. While price is a major concern for traditional consumers, taste, diversity, health and nutrition are more important to non-traditional consumers. Traditional consumers are in the forest region while the non-traditional consumers are in the Savannah areas.

KEYWORDS

Ethnic affiliation; fish expenditures; Ghana; latent class; location

Introduction

Studies on consumer preference for fish relative to meat have generally concluded that economic, demographic, health and nutrition-related factors as well as taste influence consumer preferences (Lusk, Rosen & Fox, 2003; Quagrainie & Engle, 2006). In both developed and developing countries, health awareness and risks information are key factors that influence the consumption of various types of animal protein (Kaabia, Angulo & Gil, 2001; Mintert, Schroeder & Marsh, 2001). In Ghana, consumption of fish is also driven by non-economic factors such as religion and culture (Kearney, 2010). The growth of the middle-income population in Ghana has altered the demographic landscape leading to a nutrition transition, and the urbanization level is continually rising. While price is the primary concern for consumers in the rural and peri-urban areas, health and nutrition is more

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Supplemental data for this article can be accessed at publisher's website.

important for urban consumers (Heinbuch, 1994). Additionally, some government-led interventions and policies directly targeting nutrition have also influenced the consumption of fish, particularly among children.

In 2005, the government of Ghana instituted a nutrition program known as Ghana School Feeding Program (GSFP) under the context of the Comprehensive African Agricultural Development Program (CAADP) Pillar III. The program was in response to the first and second Millennium Development Goals (MDGs) on eradicating extreme poverty and hunger and achieving universal primary education. Its key objectives include promoting an increase in domestic food production and consumption, increase the incomes of poor rural households and improve the health and nutritional status of school children in Ghana. A study by Martens (2005) showed that the dietary diversity of the GSFP generally comprised of a main dish accompanied by a stew with 70% of the protein observed to be fish (mainly marine species like the herring and tuna). The GSFP is touted as one of the factors positively influencing the consumption of fish dishes among school children in several communities in Ghana (Martens, 2005).

In Ghana, fish is a cheap source of protein consumed mostly by low-income, and subsistence households. Fish contributes about 60% of animal protein consumed by Ghanaian households on average and accounts for 22% of household food expenditure (Ashitey, 2019). Even though income levels have been increasing in Ghana, in 1998/1999, the expenditure on fish as a share of the expenses on animal protein was 53% for urban households and 55 to 79% for rural households. The fifth round of the Living Standards Survey showed that fish accounted for 27% of the overall household food budget (Kassam, 2014). The per capita consumption of fish for the average Ghanaian is about 26 kg per annum, which is 12 kg higher than the Economic Community of West African States' (ECOWAS) per capita estimated consumption (Ashitey, 2019). In 2017, fish production from inland and marine sources in Ghana was 382,000 tons, but the domestic demand outweighed production by 60%, creating a significant national fish deficit, which was augmented by imports (FAO, 2019). Although the level of fish production has increased slightly since then from the contribution of cage aquaculture, fish supply from domestic sources still falls short of demand.

The demand and preference for certain animal protein are influenced by many factors. One of the major factors is changes in per capita household income. Substitution among various protein sources has also been reported. The trend of substitution, according to Mittal (2010), is stronger and more prevalent in rural areas than urban areas. Also, the amount and type of meat differ with the level of income, education, and age (Dhraief, Oueslati & Dhehibi, 2013). Meat production and consumption are influenced by consumer's preference for several types of meats. Chicken is the next most consumed animal protein after fish according to Nkegbe, Assuming-Bediako, Aikins-Wilson and Hagan (2013).

With the above information and the background exposition on the importance of fish in the Ghanaian diet, this study focuses on two main questions; (1) In addition to price and income, is the purchasing behavior of fish consumers influenced by their religion and ethnic affiliation? and (2) Can fish consumers be segmented based on their location, ethnic affiliation, and religion?

Background

Ghana, like other African countries, is a multi-ethnic, multi-cultural and multi-religious country. Even though no part of Ghana is ethnically homogeneous, a dominant feature of the country's ethnic schism is the north-south divide and the dominance of the southern half in general, and by the Akan group (Asante & Gyimah-Boadi, 2004).

Ghana has about 550 kilometers of coastline and a total continental shelf to support a vibrant fishing industry. The country also has a system of rivers, lakes, and lagoons that form the basis of a thriving inland fishing industry. The marine fishery sector facilitated a production of 291,904 tons of seafood in 2017 (FAO, 2019). Fish is traded and consumed in various processed forms; fresh, dried, smoked, fermented and fried. The prices of fish vary based on the type and location. Smoked fish is the most common processed fish, and it is available in nearly every market in Ghana. Supply and consumption are highest in the areas closest to the landing sites like Lake Volta and along the coast. For households living close to these landing sites, fresh and smoked fish are the preferred forms consumed while those farther away from these landing sites prefer the smoke-dried fish (Heinbuch, 1994).

Most of the fish consumed in the capital city, Accra, originates from Tema, Chorkor (suburbs in the Greater Accra region) and Winneba (a town in the Central region). The forest and Northern Savannah areas obtain their fish supply from the coastal areas particularly the Central region (Heinbuch, 1994). Fish prices follow the fishing seasons. During the main fishing season (July to October), fresh fish prices in the inland regions vary depending on market conditions like transport and processing costs (Gordon, Pulis & Owusu-Adjei, 2011). In the off-season (November to May), fish is mainly purchased in the "smoked" and frozen forms (FAO, 2004). Processed frozen fish are mostly imported. In spite of the abundance of fish in fishing communities and its contribution to their nutrition, people living in fishing communities are generally thought to be at a high risk of malnutrition (Beveridge, et al., 2013) mainly because fish often is sold to generate income and not consumed by the household (Bandoh, Manu & Kenu, 2018). Despite an estimated annual per capita fish consumption of 26 kg, it is estimated that over 60% of children less than 6 years old have sub-clinical vitamin A deficiency, which contributes to 1 out of 3 deaths of children within that age range (Bandoh, et al., 2018).

Until recently, most efforts in Ghana to combat micronutrient malnutrition focused on vitamin supplementation through capsules, as well as meal fortification with iodized salt. More recently, there have been efforts to include a third approach based on changes in dietary habits or patterns known as food-based approaches. Food-based micronutrient strategies use a combination of production-oriented and consumption-oriented approaches to increase the consumption of foods rich in micronutrients such as fish or fish powder, especially among children and pregnant and lactating women (Simler et al., 2005). Sensitization interventions, especially in fishing communities tailored toward caregiver utilization of food sources like fish, in order to improve nutrition of the children has positively affected fish consumption patterns, reflecting in about 80% of coastal children in the Central Region of Ghana consuming fish products more than three times in a week (Bandoh et al., 2018).

Fish consumption generally varies with age and across generations. In developed countries, the older individuals generally have lower probabilities of eating fish than the younger cohorts (Gustavsen, Rickertsen & Øvrum, 2014). In much of Africa, older individuals are given preferential access to fish and other animal source foods, and there are even taboos against the consumption of protein-rich foods by children (Gittelsohn & Vastine, 2003). In Ghana, the distribution of fish during mealtimes favors the head of the household, with children generally underprivileged in access to animal source foods (Essuman, 1992).

Food-related taboos can have religious, medical, moral, psychological and emotional justifications or a combination of all of these. Interestingly, the custom of prohibiting the consumption of certain foods including fish, generally pertains to women and children (Fermon, 2013). Certain Christian sects in Ghana, abhor the consumption of certain scale-less fish which erroneously includes mackerel, a very common marine species in Ghana, because of their very small scales which are hardly visible and the velvety feel of their skins (Gadegbeku, Wayo, Ackah-Badu, Nukpe and Okai, 2013). Some rural communities in Ghana have food prohibition practices that debar women from eating any meat or fish for up to one month after childbirth (Azumah, 2010). A study by Arzoaquoi (2014) estimated the prohibition of meat and fish products was prevalent in 10.8% of pregnant and new mothers in some areas of Ghana.

Data

The data source for the study was the 2013 round six of the Ghana Living Standards Survey (GLSS 6). The GLSS 6 collected data from 16,772 households in 1,200 enumeration areas (EAs) using a two-stage stratified sampling design. The first stage included the 1,200 EAs selected to form the primary sampling units (PSUs). The PSUs were selected from all the ten regions of Ghana using probability proportional to population size. The EAs were further separated into urban and rural localities. Secondary sampling units were created using a complete set of the PSUs. The second level had 15 households from each PSU selected systematically to bring the total number of households nationwide to 18,000 (GSS, 2014).

Information was collected on living conditions and the well-being of households including demographic characteristics of households, education, health, employment, migration and tourism, housing conditions, household agriculture, household expenditure, income and their components and access to financial and credit services (GSS, 2014). This study utilized information on 2,185 seafood consuming household heads. The dependent variable is the total fish expenditure measured in US dollars.[1] The expenditure was collected at the household level through a food diary for 7 days. The independent variables included market prices[2] in US Dollars (USD) for red meat (goat meat, mutton, and beef and canned beef) and poultry (chicken), also available in the GLSS 6 dataset.

Demographic factors were included to provide information on the characteristics and location of the household. This study uses data on the following demographics of the household head: Years of education, marital status, monthly income (proxied with total household expenditure in $USD), and age. In addition, there are four geographic areas, coastal, forest, savannah (Sudan Savannah, Guinea Savannah, and Coastal Savannah) and the Greater Accra Metropolitan Area (GAMA).

Cultural and religious factors were added to account for belief systems, which include foods and animals produced and consumed. The major ethnic groups are Akan (49.7%), Mole-Dagbani (14.2%), Ewe, and Ga-Dangme (13.3%). About 70% of Ghanaians identify as Christian, 16.5% as Muslim, 9.2% as Traditionalist/Nativists, 7.2% as having no religion and 0.1% as other. Muslims are generally located in the Northern part of Ghana while Christians are in the southern part. The other religions are scattered all over the country.

The variable "quarter" represents the four quarters of the year starting from October 2012 to December 2013. This variable was included to capture phenomena like inflation, seasons and special occasions on the calendar (e.g. Ramadan for the Muslims, Christmas, Easter and other seasonal festivities).

Table 1. Table of description of variables.

Variables	Unit	Mean	Std. Dev.
Fish expenditure	USD/kg	6.630	7.720
Fish price	USD	0.160	0.570
Poultry price	USD	0.510	1.680
Red meat price	USD	0.660	1.570
Pork price	USD	0.210	0.770
Age	Years	38.974	16.246
Male-HH (=1)		0.714	0.452
Years of education	Years	11.286	5.574
Employed (=1)		0.567	0.496
Monthly income	USD/month	597.87	5347.860
Married (=1)		0.241	0.428
Other	Reference	0.019	0.137
Akan		0.506	0.500
Ewe		0.147	0.355
Ga		0.092	0.289
Guan		0.043	0.202
Dagomba		0.192	0.394
Nativism	Reference	0.100	0.300
Islamic		0.137	0.344
Christian		0.763	0.425
Coastal		0.181	0.385
Forest		0.475	0.499
Savannah		0.170	0.376
Greater Accra Metropolitan Area (GAMA)	Reference	0.174	0.379
1st quarter (Q1)		0.309	0.462
2nd quarter (Q2)		0.201	0.401
3rd quarter (Q3)		0.286	0.452
4th quarter (Q4)	Reference	0.203	0.402

Table 1 provides descriptive statistics. Fish is the lowest-priced animal protein sources with a mean price of USD 0.16 (Ghc 0.70)/kg. The average age of a family head in the sample is 39 years, and about 71% of family heads are male. The average years of education of the family head are around 11 years, 57% is employed with a mean month to month salary of USD 551 (Ghc 2,339), and roughly 24% are married.

Methods

Demand studies usually assume rational behavior with utility function across homogenous households (Cosaert & Demuynck, 2015). In addressing heterogeneity in our analysis, a Latent Class Model (LCM) is used. To identify diverse groups of households with similar expenditure patterns, LCM is an approach that has been used in several household studies. An advantage of the LCM is the assignment of consumers into groups (classes), which is determined through probabilities. The LCM deals with heterogeneity by assuming a discrete distribution and a specified preference-based segmentation (Wedel & Kamakura, 2000). It creates finite and identifiable groups within the population. Within these groups, tastes and preferences are assumed to be homogenous (Birol et al., 2011).

The basis of the latent class modeling procedure is random utility theory. It is assumed that households are faced with i choices of animal protein and that individuals assign random utilities to each alternative they consider and then make a choice based on the option with the highest utility. The derived utility, $U_{i,}$ obtained from consuming any of these proteins by the household includes deterministic and random components, i.e.:

$$U_i = \beta \boldsymbol{X_i} + \varepsilon_i \tag{1}$$

$$Y_i = f(X_i, S_i) \tag{2}$$

where $\boldsymbol{X}_i$ is a vector of covariates. The dependent variable, Y_i is fish expenditure, it is continuous with a normally distributed prediction error, so an ordinary least square estimation approach in a linear model was used. Equation (2) is modified to allow for heterogeneity by grouping households into c classes. This equation is expressed as:

$$ln[y_i|c] = \alpha + \vartheta_c lnp_i + \tau_c lnm_i + \beta_c \boldsymbol{X_i} + \varepsilon_i|c \tag{3}$$

where c is fish expenditure classes, $(c = 1, \ldots C,)$, β_c represents a vector of class-specific parameters to be estimated; p_i is prices for fish, chicken, pork and red meat, m_i is households monthly income and y_i is the dependent variable, fish expenditure. $ln(.)$ denotes an inverse hyperbolic transformation (IHS) which is a log-like transformation that allows the zero values in the observations. Expenditure, prices, and income are transformed as follows, $d = \ln(d_i + (d_i^2 + \theta)^{0.5})$ where $\theta = 1$, (see Bellemare, Lee & Just, 2017; Moss & Shonkwiler 1993; MacKinnon & Magee, 1990). Since the IHS is a log-like transformation, the coefficients on prices and income are interpreted as elasticities where own price elasticity for fish implied by (3) is calculated as $\vartheta_c - 1$ (Park & Capps, 1997; Cheng & Capps Jr., 1988).

The distributional assumption of the latent variable(s) is normal with mean $\beta' x_i$ and variance σ^2. The C will be chosen *a priori* using Akaike Information Criterion (AIC). Each household belongs to at least one class. The modified equation is specified as the probability of a household j belonging to a class:

$$P(i|c) \quad = \quad P[[y_{ic} \; |x_{ic}, c] \tag{4}$$

where each class has a specific normal density, producing the equation:

$$P(i|c) = F[y_i, \; \beta' \; x_i + \; \mu_c], \; Prob[class = c] = F_c. \tag{5}$$

The approximation further becomes:

$$P(i|c) = P[y_i, \; \beta' \; x_i + \; \mu_c' x_i], F_c = \frac{\exp(\theta_c)}{\sum_i \exp(\theta_c)}, \; with \; \theta_C \; = 0 \tag{6}$$

where θ_c are class-specific parameters to be estimated. These parameters show the impact each household's characteristics have on the probability of belonging to a class. A positive (negative) and significant parameter indicates the likelihood of a household belonging to a class increases (decreases) depending on the household characteristics (Birol et al., 2011). The formulation of equation (6) implies that each household has its vector of parameters, $\beta'_c = \beta + \mu_c$, with the assumption that all variables entering the mean are the same. The prior probability of a household belonging to a class in the presence of these household characteristics k_i is modeled as:

$$P[\text{class } c|\mathrm{k_i}] = N\left[\beta'_c\ x_i,\ \sigma^2_c\right] = F_{ic} = \frac{\exp\left(\theta'_c, k_i\ \right)}{\sum_{c=1}^{C}\exp\left(\theta'_c, k_i\ \right)},\ \theta_C\ = 0 \qquad (7)$$

According to Greene (2003), since k_i contains variables, equation (7) is normalized with a class-specific variable to zero to identify the model and bootstrap the standard errors to take care of outliers of the data and enhance asymptotic inference of the results. The variables normalized are marital status and age of the household head. Using equation (6), the hypotheses: $\beta_{location}\ = 0\ and\ \beta_{ethnicgrp} = 0$, is tested using the Wald test.

The result within each class model is a linear regression model with normally distributed error terms. The main limitation in LCM is to choose the number of classes, C. There is no theory help determine the appropriate number of groups. According to Greene (2003), a specification between two to five is appropriate to avoid estimation problems with a greater number. Multiple criteria have been used to determine a suitable number of groups including the Bayesian Information Criterion (BIC) and the Akaike Information Criterion (AIC). The AIC and BIC adjust the log-likelihood for the number of parameters in the model (Kamakura, Kim and Lee, 1996). After the estimation of the model, the posterior probabilities of households belonging to a class are computed using the parameter estimates from (7):

$$\mathrm{P}(i|c) = \tau_{ic} = \frac{F_c[\prod_{i=1}^{TI} P(i|c)]}{\sum_c F_c[\prod_{i=1}^{I} P(i|c)]} \qquad (8)$$

where τ_{ic} is the posterior probability of household i, belonging to class c.

A version of an entropy measure suggested by DeSarbo, Wedel, Vriens and Ramaswamy, (1992) is used to evaluate whether households are correctly classified using the posterior probabilities of households belonging to a class.

$$E = -\sum_i \tau_{ic}\ ln\tau_{ic} \qquad (9)$$

The value of E ranges between 0 and 1, where a value close to 0 indicates maximum entropy and some degree of overlap between classes; and a value of 1 indicates a seamless and accurate sorting of households into classes.

Table 2. Criteria for assessing fit for one and two classes.

	One Class	Two Classes
AIC	3.818	2.203
BIC	3.878	2.331
Sample size	2186	2186
Entropy index	0.00	0.592
Likelihood ratio	−4149.991	−2359.113

Table 3. Estimated class probabilities.

Class	Probability (1)	Probability (2)
Traditional households	0.721	0.591
Non- traditional households	0.279	0.409

Empirical results

The number of classes was selected using the values of the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC). The values reported in Table 2 suggest that the model with two classes is a better fit than the single class model.[3] Two sets of results are presented to test the robustness of estimates to changes in the model specification; (1) is the full regression with all covariates and (2) is a "reduced" form of (1) without suspected endogenous variables, namely price and income. The calculated entropy measure based on the posterior probability for (1) is 0.59 and 0.68 for (2). The lower the entropy index, the higher the level of overlap between classes and the less precise the class assignments process is. The overlap could result from the perspective that Ghanaians consume fish in various processed forms, in particular, fresh, frozen, smoked, dried, fried, salted, canned and other forms not captured in the data. Hence, consumption classes for fish, may not demonstrate the normal spending conduct of family units unless processed types of fish are considered.

Table 3 presents the estimated probabilities of family units within the two classes, which are subsequently referred to as "traditional" and "non-traditional" in view of the outcomes in Table 4. Table 3 indicates class participation for the unrestricted (1) and restricted (2) regressions controlled by age and employment. The distinction between regressions 1 and 2 is the inclusion and exclusion of price and income in regressions 1 and 2 respectively. The likelihood of a family in the sample belonging to the traditional class ranges from 59.10 to 72.10% while the probability of being a non-traditional family unit range from 27.90 to 40.10% (Table 3).

From Table 4 we can surmise that traditional family units represent the average fish consumers among Ghanaian families. As per Heinbuch (1994), shoppers in the urban regions consume fish for wellbeing and nutritional reasons while rural families choose fish for economic reasons. Southern

Table 4. Estimated parameters of the latent class linear model.[a]

Variables	Traditional (1)	Traditional (2)	Non- traditional (1)	Non- traditional (2)
Fish price	−0.922** (0.037)		−0.998*** (0.000)	
Poultry price	−0.053*** (0.024)		−0.001*** (0.000)	
Red meat price	0.107** (0.023)		0.001*** (0.000)	
Pork price	−0.053 (0.033)		0.001*** (0.000)	
Akan	0.118** (0.054)	0.207*** (0.071)	0.007*** (0.001)	0.136 (0.157)
Ewe	0.067 (0.071)	0.338*** (0.094)	0.013*** (0.001)	−0.465** (0.199)
Ga	−0.110 (0.086)	−0.118 (0.101)	0.002 (0.001)	0.187 (0.189)
Guan	−0.035 (0.077)	0.055 (0.115)	−0.029*** (0.002)	−0.440* (0.246)
Dagomba	−0.168** (0.084)	−0.020 (0.102)	0.003*** (0.001)	0.137 (0.237)
Islamic	−0.060 (0.061)	0.268*** (0.092)	0.000 (0.001)	0.121 (0.161)
Christian	0.039 (0.046)	0.081 (0.065)	0.001* (0.000)	0.155 (0.113)
Coastal	−0.049 (0.055)	−0.105 (0.069)	0.001* (0.000)	0.354*** (0.133)
Forest	0.173*** (0.041)	0.163*** (0.052)	−0.003*** (0.000)	−0.135 (0.110)
Savannah	0.182*** (0.058)	0.150*** (0.069)	0.003*** (0.001)	0.037 (0.155)
Education	−0.016*** (0.005)	0.033*** (0.007)	0.000** (0.000)	0.069*** (0.013)
Monthly income	0.126*** (0.021)		−0.001*** (0.000)	
Married	−0.040 (0.031)	0.114** (0.046)	0.002*** (0.000)	0.332*** (0.074)
Male	0.010 (0.030)	0.013 (0.039)	−0.004*** (0.001)	0.074 (0.074)
1st quarter (Q1)	−0.129*** (0.042)	−0.046 (0.051)	−0.006*** (0.000)	−0.132 (0.100)
2nd quarter (Q2)	0.026 (0.051)	−0.005 (0.060)	−0.001* (0.000)	0.117 (0.118)
3rd quarter (Q3)	0.137*** (0.042)	−0.151*** (0.054)	0.003*** (0.001)	0.021 (0.103)
Constant	2.959*** (0.170)	7.130*** (0.101)	0.008*** (0.002)	6.356*** (0.196)
Fixed parameters				
Constant	−0.509***	4.335***		
Age	0.038***	−0.101***		
Employed	−0.122**	−0.216		
R^2	0.202	0.113		
F test	23.375***	15.546***		
N	2185	1965	2185	1965

Note: *$p < 0.1$, **$p < 0.05$, ***$p < 0.01$

[a]BSE: Bootstrapped standard errors in parenthesis with 100 replications

Ghana has the most noteworthy portion of family units situated in both urban and rural zones in the nation.

Demand for fish is price inelastic among traditional families but moderately elastic among non- traditional family units, which is roughly unitary. When the price of fish increases by 1%, the demand of fish diminishes by 0.92% among traditional family units and about 1% among non-traditional families, *ceteris paribus* (Table 4). Similar elasticity effects are reported by Dalhatu and Ala (2010) for Nigerian family units, and by Ackah and Appleton (2007) among Ghanaian families.

For traditional families, fish is complementary to chicken but a substitute for red meat. Non-traditional families also think of poultry as a supplement to fish, yet red meat and pork are the substitutes. Potential explanations behind the substitutability of fish over other animal proteins may be economical, wellbeing and nutrition-related factors and taste (Heinbuch, 1994). Cost is an important consideration for consumers in the rural and peri-urban regions, who tend to be traditional family units while taste, decent variety, wellbeing and nourishment concerns relate to urban shoppers, who tend to be more non-traditional.

The literature has, for the most part, reported some health advantages of eating fish (Wurtz et al., 2016; Sui, Raubenheimer, Cunningham & Rangan, 2016), which may explain the observed shifts from red meat to fish. Kaabia et al. (2001) and Mintert et al. (2001) reported that urban tenants are reducing their meat consumption for health reasons. Despite the health advantages of fish, goat meat, beef and pork are well known among Ghanaian families and are eaten in small amounts in rural areas (Heinbuch, 1994). Pork and chicken are prominent in family units in urban regions. Changes in the populace and income levels are bringing about dietary variety in the urban territories of Accra, Kumasi, Sekondi-Takoradi and Cape Coast in Ghana (Osei-Asare & Eghan, 2014).

Ethnic allegiance and geographical location influence the family unit's consumption of fish in both traditional and non-traditional families. Among traditional family units, the Akan ethnic group is 12% to 21% likely to increase fish consumption. Results from the restricted regression additionally recognize a positive relationship of 34% between being Ewe and fish consumption. A family unit situated in the forest locale is likely to increase fish consumption by 17% and by 18% for Savannah residents. Among non-traditional family units, fish demand increases with being Akan (0.70%) or Dagomba (0.30%). An alliance with the Ewe ethnic group has a blended relationship with fish demand. Demand is negative (−46.50%) in the restricted model yet positive (1.3%) in the unrestricted model.

Fish consumption and location are significantly related for a nontraditional family in the coastal (35.40%) and Savannah (0.30%) regions. Religion and fish consumption among non-traditional families has a positive relationship at the 10% level. Under the limited model, a connection to Islamic religion is related with a 26.80% expansion in fish consumption in nativist family units. In general, the relative impact of ethnicity and location of families is more established among the traditional than the nontraditional family units (Table 4).

Education is a fundamental component in the family unit's fish consumption, yet more so among non-traditional than traditional households. Household income has dissimilar roles in traditional and non-traditional households. A 1% increase in the household's income is correlated with a 0.13% rise in the demand for fish in traditional households (Table 4). Because the expenditure on fish is higher, fish is assumed to be a normal good in traditional households but an inferior good in non-traditional households. Marital status and gender of household head are associated with fish consumption in non-traditional households but not among the traditional households, especially when the household head is a married woman (Table 4). The results from the restricted model indicate that families with married female heads have a positive association with fish consumption. The correlation is stronger among non-traditional relative to traditional households.

Fish demand is seasonal, and this contributes to price differentials. Both traditional and non-traditional households decrease their fish consumption in the first quarter (January to March) but increase their fish consumption in the third quarter relative to the fourth quarter.

The results also indicate the importance of income and price, as shown by the F tests in Table 4. The hypotheses that location and ethnic affiliation have no effects on fish consumption was tested using the Wald test of linear restrictions. The chi-squared value for ethnic affiliation is 10.29 under the unrestricted model, and statistically significant at 1% while under the restricted model, the chi-square value is 0.12 and not statistically significant. The chi-squared value for geographic location is 11.31 for the unrestricted model and statistically significant at 1% while under the unrestricted model, the chi-square is 4.20 and statically significant at 5%. The outcome of the Wald tests illustrates that location and ethnic affiliation are relevant factors necessary for market segmentation and consumer targeting for fish marketing in Ghana.

Conclusions

A sample of 2,185 Ghanaian households from the round 6 of the Ghana Living Standards Survey (GLSS6) was examined for their fish consumption using a latent class model of structural heterogeneity in a linear regression framework. The results suggest that there are two classes of households with respect to expenditures on fish, which are termed traditional and non- traditional. In traditional households, fish is complementary to poultry but a substitute for red meat. Among non- traditional consumers, fish is complementary to poultry but a substitute for red meat and pork.

There is some overlap between the two classes of households. Demand for fish is price inelastic in traditional households and approximately unitary elastic in non-traditional households.

The null hypotheses that location and ethnic affiliation do not affect fish consumption were rejected. Based on the results, producers are encouraged to take advantage of the lifestyles and belief systems to improve marketing of fish in Ghana by adopting consumer targeting, market segmentation, and positioning strategies in marketing their fish. The results could also inform international donors particularly the World Bank, which is collaborating with the Ghana government to improve the fisheries sector in Ghana through improvements in the fish value chain.

Disclosure statement

The authors confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

Notes

1. 1 Ghana cedi = $US = 0.22
2. Prices were collected from markets in enumeration areas. There were 1200 EAs
3. The posterior probabilities for the three-class model were 0.01, 0.02 and 0.97.

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References

Ackah, C., & Appleton, S. (2007). *Food price changes and consumer welfare in Ghana in the 1990s.* Centre for Research in Economic Development and International Trade, School of Economics, University of Nottingham: Credit Research Paper 07/03, Nottingham, UK.

Arzoaquoi, S.A. (2014). *Common food taboos and beliefs during pregnancy in Yilo Krobo district* (Master Thesis). University of Ghana, Ghana.

Asante, R., & Gyimah-Boadi, E. (2004). *Ethnic structure, inequality and governance of the public sector of Ghana.* Geneva, Switzerland: United Nations Research Institute for Social Development.

Ashitey, E. (2019). *Fish and seafood report. Global agricultural information network.* Retrieved from http://agriexchange.apeda.gov.in/MarketReport/Reports/Fish_and_Seafood_Report_Accra_Ghana_3-8-2019.pdf.

Azumah, D. A. (2010). *The effects of pre-pregnancy and post-partum food/nutrition taboos and traditions on women's reproductive health in Ghana: A case study of the Kumasi Metropolitan Area.* Penn-ICOWH 18th Congress. Cities and Women's Health: Global Perspective, 7–10th April 2010, Philadelphia, USA

Bandoh, D. A., Manu, A., & Kenu, E. (2018). Lacking in abundance: Undernutrition in a peri-urban fishing community in coastal Ghana. *BMC Nutrition*, *4*(1), 20. Available at 10.1186/s40795-018-0229-8

Bellemare, F., Lee, Y. N., & Just, D. R. (2017). *Producer attitudes to output price risk: Evidence from the lab and from the field*. Retrieved from https://aede.osu.edu/events/producer-attitudes-output-price-risk-evidence-lab-and-field.

Beveridge, M. C. M., Thilsted, S. H., Phillips, M. J., Metian, M., Troell, M., & Hall, S. J. (2013). Meeting the food and nutrition needs of the poor: The role of fish and the opportunities and challenges emerging from the rise of aquaculture. *Journal of Fish Biology*, *83*, 1067–1084. doi:10.1111/jfb.12187

Birol, E., Asare-Marfo, D., Karandikar, B., & Roy, D. (2011). *A latent class approach to investigating farmer demand for biofortified staple food crops in developing countries: The case of high-iron pearl millet in Maharashtra, India*. HarvestPlus Working Paper. HarvestPlus, International Food Policy Research Institute, Washington, DC., USA.

Cheng, H., & Capps, O. Jr.(1988). Demand analysis of fresh and frozen finfish and shellfish in the United States. *American Journal of Agricultural Economics*, *70*(3), 533–542. doi:10.2307/1241491

Cosaert, S., & Demuynck, T. (2015). *Nonparametric welfare and demand analysis with unobserved individual heterogeneity*. The Netherlands: Maastricht University School of Business and Economics. Retrieved from https://cris.maastrichtuniversity.nl/portal/files/1492871/content.

Dalhatu, M., & Ala, A. L. (2010). Analysis of fish demand in Sokoto Metropolis, Sokoto State, Nigeria. *Nigerian Journal of Basic and Applied Science*, *18*(2), 154–159. doi: http://ajol.info/index.php/njbas/index.

DeSarbo, W. S., Wedel, M., Vriens, M., & Ramaswamy, V. (1992). Latent class metric conjoint analysis. *Marketing Letters*, *3*(3), 273–288. doi:10.1007/BF00994135

Dhraief, M. Z., Oueslati, M., & Dhehibi, B. (2013). Income, education and age effects on meat and fish demand in Tunisia. *International Journal of Food and Agricultural Economics*. *1* (2), 1–12.

Essuman, K.M. (1992). The role of inland fish in food consumption in West Africa: A review. In F. Teutscher (Ed.), *Post-harvest Fish Technology*, (pp. 122–140). Rome: Food and Agriculture Organization (CIFA Technical Paper CIFA/T19).

Food and Agriculture Organization (FAO). (2019). *FAO yearbook of fishery and aquaculture statistics*. Rome: FAO. Retrieved from http://www.fao.org/fishery/statistics/global-capture-production/en. Accessed: 03/01/2020.

Food and Agriculture Organization (FAO). (2004). *FAO fishery country profile – The Republic of Ghana: General economic data – March 2004*. Rome: The Food and Agricultural Organization of the United Nations. Retrieved from http://www.fao.org/fi/oldsite/FCP/en/GHA/profile.htm.

Fermon, Y. (2013). *Subsistence fish farming in Africa: A technical manual*. AGF International. Retrieved from https://www.actionagainsthunger.org/sites/default/files/publications/Subsistence_fish_farming_in_Africa_A_technical_manual_10.2013_3.pdf.

Gadegbeku, C., Wayo, R., Ackah- Badu, G., Nukpe, E., & Okai, A. (2013). Food Taboos among Residents at Ashongman - Accra, Ghana. *Food Science and Quality Management*, *15*, 21–30.

Gittelsohn, J., & Vastine, A.E. (2003). Sociocultural and household factors impacting on the selection, allocation and consumption of animal source foods: Current knowledge and application. *The Journal of Nutrition*, *133*(11), 4036S–4041S. doi:10.1093/jn/133.11.4036S

Gordon, A., Pulis, A., & Owusu-Adjei, E. (2011). *Smoked marine fish from western region, Ghana: A value chain assessment* (pp. 46). Ghana: WorldFish Center, USAID Integrated Coastal and Fisheries Governance Initiative for the Western Region.

Greene, W. H. (2003). *Econometric Analysis* (5th ed.). Englewood Cliffs, NJ, USA: Prentice Hall.

Ghana Statistical Service (GSS). (2014). *Ghana living standards survey round 6 (GLSS 6)*. Main Report. Accra, Ghana: Government of Ghana.

Gustavsen, G. W., Rickertsen, K., & Øvrum, A. (2014). Fish consumption across generations –a life cycle approach. *Økonomisk Fiskeriforskning Årgang*, *24*(1), 18–25.

Heinbuch, U. (1994). *Animal protein sources for rural and urban populations in Ghana*. Programme for Integrated Development of Artisanal Fisheries in West Africa. Technical Report No. 58, Accra, Ghana.

Kaabia, M. B., Angulo, A. M., & Gil, J. M. (2001). Health information and the demand for meat in Spain. *European Review of Agriculture Economics*, *28*(4), 499–517. doi:10.1093/erae/28.4.499

Kamakura, W. A., Kim, B. D., & Lee, J. (1996). Modelling preference and structural heterogeneity in consumer choice. *Marketing Science*, *15*(2), 152–172. doi:10.1287/mksc.15.2.152

Kassam, L. (2014). *Aquaculture and food security, poverty alleviation and nutrition in Ghana: Case study prepared for the aquaculture for food security, poverty alleviation, and nutrition project.* WorldFish Centre. Retrieved from http://pubs.iclarm.net/resource_centre/2014-48.pdf.

Kearney, J. (2010). Food consumption. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *365*(1554), 2793–2807. doi: https://www.10.1098/rstb.2010.0149.

Lusk, J. L., Rosen, J., & Fox, J. A. (2003). *Consumer valuation of beef Ribeye steak attributes.* A Paper Presented at the American Annual Economist Meeting Annual Meeting, Tampa, Florida. August 2000.

MacKinnon, J. G., & Magee, L. (1990). Transforming the dependent variable in regression models. *International Economic Review*, *31*(2), 315–339. doi:10.2307/2526842

Martens, T. (2005). *Impact of the Ghana School Feeding Programme in 4 districts in central region* (Master Thesis). Wageningen University, Ghana.

Mintert, J., Schroeder, T., & Marsh, T. (2001). *Factors affecting beef demand.* Cattlemen's Day 2001. Retrieved from http://krex.k-state.edu/dspace/bitstream/handle/2097/4544/cattle01pg20-22.pdf?sequence=1.

Mittal, S. (2010). Application of the QUAIDS model to the food sector in India. *Journal of Quantitative Economics*, *8*(1), 42–54. Retrieved from http://www.jqe.co.in/journals/JQE_v8_n1_2010_p2.pdf.

Moss, C. B., & Shonkwiler, J. S. (1993). Estimating yield distributions with a stochastic trend and non-normal errors. *American Journal of Agricultural Economics*, *75*(4), 1056–1062. doi: http://www.jstor.org/stable/1243993.

Nkegbe, E., Assuming-Bediako, N., Aikins-Wilson, S., & Hagan, A. (2013). Meat consumption trends in some selected households in Accra Ghana. *Asian Journal of Agriculture and Food Sciences*, *01*(04), 151–157.

Osei-Asare, Y. B., & Eghan, M. (2014). Meat consumption in Ghana, evidence from household micro-data. *The Empirical Economic Letters*, *13*(2), 141–153.

Park, J. L., & Capps, O. (1997). Demand for prepared meals by U.S. households. *American Journal of Agricultural Economics*, *79*(3), 814–824. doi: http://www.jstor.org/stable/1244423.

Quagrainie, K., & Engle, C. E. (2006). A latent class model for analyzing preferences for catfish. *Aquaculture Economics and Management*, *10*(1), 1–14. doi:10.1080/13657300500234300

Simler, K. R., Jacobs, K. L., Mensah-Homiah, J., Randriamamonjy, J., Wiesmann, D., & Abdul-Razak, A. (2005). *Food-based approaches to reducing micronutrient malnutrition an impact evaluation of the UNICEF ICBD program in the Savelugu-Nanton district of Northern Ghana*. Washington DC: International Food Policy Research Institute.

Sui, Z., Raubenheimer, D., Cunningham, J., & Rangan, A. (2016). Changes in meat/poultry/fish consumption in Australia: From 1995 to 2011–2012. *Nutrients*, *8*(12), 753. doi:10.3390/nu8120753

Wedel, M., & Kamakura, W. (2000). *Market segmentation: Conceptual and methodological foundations*. Boston, USA: Kluwer Academic Publishers.

Wurtz, A. M. L., Hansen, M. D., Tjonneland, A., Rimm, E. B., Schmidt, E. B., Overad, K., & Jakobsen, M. U. (2016). Substitutions of red meat, poultry and fish and risk of myocardial infarction. *British Journal of Nutrition*, *115*, 1571–1578. doi:10.1017/S0007114516000507