Consumer preference and willingness to pay for fish farmed in treated wastewater in Ghana

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Abstract

The reuse of treated wastewater for aquaculture has been practiced in several countries and has a potential to create a viable fish farming business in low income countries. However, wastewater aquaculture practices which satisfy health and hygiene guidelines and standards will not be viable if consumers are unwilling to purchase fish reared in treated wastewater. In this study we investigate consumers' preference and willingness to pay for fish farmed in treated wastewater in Ghana. A consumer survey was conducted in Kumasi. We utilize a dichotomous-choice contingent valuation methodology to estimate willingness to pay for fresh Tilapia and smoked Catfish farmed in treated wastewater and analyze factors that affect consumer choice. Consumers in the survey ranked price, size and quality of fish measured by taste and freshness as the most important product attributes influencing their decision prior to purchasing fish. Source of fish is among the least important product attributes influencing consumers' decision. Results indicate that surveyed consumers generally accept fish reared in treated wastewater if lower prices are offered. Socioeconomic factors such as household income, education and family size significantly determine consumers' willingness to pay. Furthermore, results indicate that households with children are more likely to pay for smoked Catfish compared to fresh Tilapia indicating that postharvest processing of fish might be perceived as safer and thus increases consumers' willingness to pay for smoked Catfish. The results of this study provide better understanding of fish consumers' buying behavior and their perceptions of and attitude towards fish reared in treated

wastewater. Moreover, results can contribute to identifying key product attributes that need to be targeted for improvement if sales of fish farmed in treated wastewater is to be achieved.

Key words: Wastewater aquaculture; farmed fish; dichotomous choice; willingness to pay

1. Introduction

Population growth and rapid urbanization coupled with regional freshwater scarcity in most cities of developing countries has necessitated the need for innovative solutions to effectively manage wastewater treatment plants through the reuse of wastewater for productive activities. The reuse of treated wastewater for aquaculture i.e. growing fish in treated wastewater-fed pond is a unique system that has a potential for creating a viable fish farming business in low income countries where wastewater treatment facilities are poorly managed due to lack of resources and ability to plan and implement sewage systems (Edwards and Pullin, 1990). The WHO has developed guidelines defining appropriate levels of treatment needed for different types of reuse including for aquaculture to ensure the protection of public health (WHO, 2006). The development of an integrated system of wastewater treatment plant and aquaculture is promoted by international organizations such as the UNDP and World Bank in developing countries as it represents a low-cost option for wastewater treatment and a source of food production (CEPIS, 1996). The reuse of wastewater for aquaculture, in addition to improving the sanitation in low income countries has the potential to create livelihood to surrounding communities while recovering costs for treatment facilities.

The rearing of fish in wastewater-fed ponds has been practiced in several Asian countries (Edwards and Pullin, 1990). The Calcutta wetlands in India have the largest wastewater fed aquaculture ponds in the world with production of Carp and Tilapia estimated at 18,000 ton/year sold through nearby markets in central Kolkata (Bunting, 2007; Little et al., 2002). Wastewater aquaculture is also widely practiced in Vietnam where one site is reported to produce 3,900 ton/year and in China where it is reported that in 1985 there were over 30 sites, covering an area of 8,000 ha and producing 30,000 ton of fish annually (Bunting, 2004).

In Africa, the rearing of fish in treated wastewater is not a common practice although experiments have been carried out with fish reared in secondarily treated effluent in waste stabilization ponds in Egypt, South Africa and Ghana (Tenkorang et al., 2012). Though wastewater fed aquaculture is not a common practice in most African countries, studies have been conducted to ascertain its feasibility in some countries including Ghana (Mkali et al., 2014; Tenkorang et al., 2012; Abdul-Rahaman et al., 2012). In Ghana, where the availability of reliable fresh water sources is a limiting factor for sustainable aquaculture production, especially in the arid and semi-arid regions such as the Northern part, wastewater fed aquaculture presents an opportunity to be a viable business. Wastewater reuse through aquaculture occurs predominantly in urban settings and it can offer a possible solution to the problem faced by many fish farmers where there is limited access to nutrient inputs and water resources (Bunting and Little, 2003).

While wastewater aquaculture presents an opportunity to be a viable business, wastewater aquaculture practices which satisfy health and hygiene guidelines and standards will not be viable if consumers are unwilling to purchase fish reared in treated wastewater. A study by Mancy et al. (2000) on cultural implications of wastewater reuse for fish farming concluded that consumers in Egypt did not accept fish reared in wastewater although the produced fish were suitable for human consumption. To ensure that fish produced in wastewater aquaculture is acceptable to consumers, great care must be taken when introducing fish reared in treated wastewater into areas where wastewater have not been traditionally used. While studies on the supply side such as technical and food safety aspects of wastewater aquaculture have been conducted, studies on the demand side, investigating consumers' perception of and attitude toward fish farmed in treated wastewater and their willingness to purchase fish reared in treated wastewater are limited. This study assesses consumers' willingness to purchase fish farmed in treated wastewater in Ghana. Specifically, the objectives of this study are to (1) assess consumers' perception of and attitude toward fish farmed in treated wastewater; (2) investigate consumers' willingness to purchase fish farmed in treated wastewater and factors influencing consumers' fish purchasing behavior in Ghana.

The analysis considers two fish types, the Nile Tilapia (*Oreochromis niloticus)* and African Catfish (*Clarias gariepinus)* since these are the two most commonly grown fish species in wastewater fed ponds with Catfish being the preferred option in most cases due to its feeding behavior, bottom feeding habits and its ability to survive harsh aquatic environments or conditions where other cultured fish species do not survive (Mkali et al. 2014). Both fish types, Tilapia and Catfish are also the dominant fish species grown in Ghana with Tilapia accounting for over 80% of the farmed fish produced and with Catfish and other species making up the remainder 20% (Kassam, 2014). Since Catfish is mostly sold in smoked form in the market, in this study we assessed consumers' willingness to pay for smoked Catfish reared in treated wastewater.

The remainder of the paper is organized as follows: section 2 outlines the methodology followed by the data description in section 3. Results are discussed in section 4 and section 5 contains the conclusions.

2. Methodology

2.1 Dichotomous choice model

In assessing consumers' willingness to pay (WTP) for fresh Tilapia and smoked Catfish farmed in treated wastewater, a contingent valuation questionnaire was applied using a dichotomous choice model. The theoretical foundation of the dichotomous choice model lies in the random utility model (Hanemann, 1984). The choice of an alternative represents a discrete choice from a set of alternatives which in our case is consumer's willingness to pay for fish farmed in treated wastewater. In a dichotomous choice model, respondents provide a dichotomous "Yes/No" answer to a question about paying a previously determined amount referred to here as the bid, A_i that varies randomly across individuals. To analyze these dichotomous choices, separate probit models were used for fresh Tilapia and for smoked Catfish. Consumers' responses are YES if they are willing to pay at least A_i for Tilapia or smoked Catfish farmed in treated wastewater (i.e. $\mathrm{WTP_i} > \mathrm{A_i}$). Assuming a linear functional form for the WTP, the probability of observing a positive response given the values of the explanatory variables (x_i) is given by:

$$\begin{aligned} \Pr(y_i = 1|x_i) &= \Pr(y_i > A_i) \\ &= \Pr(x_i\beta + e_i > A_i) \end{aligned} \tag{1}$$

where y_i is the individual's willingness to pay, x_i is a vector of explanatory variables such as the socio-demographic characteristics of respondents and their attitude towards fish farmed in treated wastewater, β is a vector of parameters and e_i is the error term which is assumed to be normally distributed with $e_i \sim N(0, \sigma_2)$. Then we have that:

$$\Pr(y_i = 1|x_i) = \Pr\left(e_i > \frac{A_i - x_i'\beta}{\sigma}\right)$$

$$\Pr(y_i = 1|x_i) = \Phi\left(x_i'\frac{\beta}{\sigma} - A_i\frac{1}{\sigma}\right) \qquad (2)$$

where $\Phi(x)$ is the standard cumulative normal. Note that in the model presented above which is similar to probit model, the bid amount A_i is added as an explanatory variable in addition to other explanatory variables such as the socio-demographic characteristics of respondents and their attitude towards fish farmed in treated wastewater (Lopez-Feldman, 2012). Ones the parameters of the model were estimated, expected value for the willingness to pay were obtained by:

$$E(WTP) = -\frac{\alpha}{\delta} \qquad (3)$$

where $\alpha = \beta/\sigma$ and $\delta = -1/\sigma$ are respectively the vector of coefficients associated to the explanatory variables and the coefficient capturing the amount of the bid from the probit models.

2.2 Factor analysis

Attitudes of consumers toward fish farmed in treated wastewater are included as explanatory variables in the dichotomous choice model presented in section 2.1. It is hypothesized that consumers' attitude towards fish farmed in treated wastewater affects their willingness to pay. However data pertaining to consumers' attitudes toward fish farmed in treated wastewater consists of a large number of interrelated variables and thus a factor analysis was used to reorient the data and to create a few number of orthogonal variables which account for as much of the available information as possible (Jollife, 2002). The basic idea underlying factor analysis is that p observed random variables, $X=[x_1, x_2, \ldots, x_p]$ can be expressed as linear functions of m ($< p$) latent factors, $F=[f_1, f_2, \ldots, f_m]$:

$$X_j = \sum_{k=1}^{m} \lambda_{jk} f_k + e_j \quad (4)$$

where λ_{jk}, $j= 1,2, \ldots, p; k= 1,2,\ldots,m$ denote factor loadings, and e_j, $j= 1,2,\ldots, p$ are error terms or specific factors. The factors obtained from this analysis have the property that each factor is uncorrelated with all others and thus can be included as explanatory variables in the dichotomous choice model.

3. Data

3.1 Socio-demographic characteristics

Data used comes from a survey conducted in July 2014 in Kumasi, the second largest city in Ghana and the capital of the Ashanti region. In order to collect a representative sample which includes households in different income stratum, the survey was conducted in low, middle and high income residential areas. A total of 200 respondents were interviewed at home of which 154 observations were used in the final analysis due to non-response and missing observations. The survey elicited information regarding respondents' fish eating habits, fish purchasing behavior, attitudes toward and their willingness to pay for fish farmed in treated wastewater. Socio-demographic characteristics of respondents were elicited in the last part of the survey.

Table 1 presents the socio-demographic characteristics of respondents. Majority of the respondents were female (79%) and married. The high proportion of females is desirable because they are the primary food shoppers in most households. Respondent average age was 43 years and household size was 6 with average number of dependents (children) of 4 people. Mean income of the household is between GHS 500 and GHS 750 per month (1 US$ in 2014 = 3.30 GHS) and average education is senior high school. The mean monthly expense on food and on fish were respectively GHS 473 and GHS 124. Thus households in the survey on average spent 63% of their income on food.

Consumers' WTP for Tilapia and smoked Catfish farmed in treated wastewater are estimated using mean current retail prices of wild caught Tilapia and smoked Catfish as a reference. The random bids assigned to respondents ranged from GHS 11 to GHS 17 for 0.5 kg of fresh Tilapia and from GHS 6 to GHS 10 for 0.5 kg of smoked Catfish. Respondents were first asked if they are willing to pay for fish farmed in treated wastewater. Then based on the response to this i.e. if the response is "Yes" then respondents are randomly assigned to the different bids.

Table 1 Summary statistics for socio-demographic variables (N = 154)

Variable	Description (coding)	Mean	Standard deviation
Age	Age of respondent in years	43	12.68
Gender	1= female, 0= otherwise	0.79	0.33
Educ	Education level of respondent 1= None 2=Primary 3= Senior high school 4= Tertiary	2.95	0.70
Mstatus	Marital status 1= Married 2= Single 3= Divorced 4= Widow/er	1.67	1.08
HHsize	Household size	6	2.38
Dependent	Number of dependents	4	2.31
HHincome	Household income 1= <100 2= 100-250 3=251-500 4=501-750 5=751-1000 6= >1000	4.40	1.39
Expfood	Monthly expense on food	472.63	368.47
Expfish	Monthly expense on fish	124.15	94.77

3.2 Consumers' fish consumption habits

Table 2 presents consumers' fish consumption habits described by where fish is consumed, how frequently fish is consumed and where fish is purchased. Majority of respondents consume fish at home and chop bars with 68% of respondents having a consumption rate of more than 8 times a month. The mean household size is 6 and on average households spending on fish is GHS 124 per month, which is 26% of mean monthly expenditure on food of GHS 473 (Table 1). The latest Ghana Living Standard Survey (GLSS 5) indicates that the food budget share of fish is the highest among all the household food items recording a share of 28% and 27% for urban and rural households respectively, which gives an indication of the relative importance of fish in the consumption expenditure of Ghanaian households (Ghana Statistical Service, 2008). Furthermore, respondents indicated that they purchase fish from the market and cold stores.

Table 2 Consumers' fish consumption habits

Fish consumption	Percent
Fish consumption (place):	
At home	45%
At chop bar	4%
At home and chop bar	51%
Monthly fish consumption (frequency):	
1 to 2 times	6%
3 to 5 times	12%
6 to 8 times	14%
More than 8 times	68%
Fish purchasing (place):	
Road side	1%
Market	48%
Cold store	25%
Farm gate	2%
Market and cold store	22%
Market and road size	2%

3.3 Consumers' fish purchasing behavior

The questionnaire also touched on the set of product attributes that were likely to have an influence on consumers' choice. To determine the most important factors that influence consumers' choice, consumers were asked to rate 7 product attributes – price, freshness, size, taste, type, source and safety. These product attributes were rated based on their level of importance prior to purchasing fish using a Likert scale ranging from 1 indicating strongly disagree to 5 indicating strongly agree. Product attributes were then ranked for their level of importance based on the number of consumers giving high scores (4-5) to each attribute.

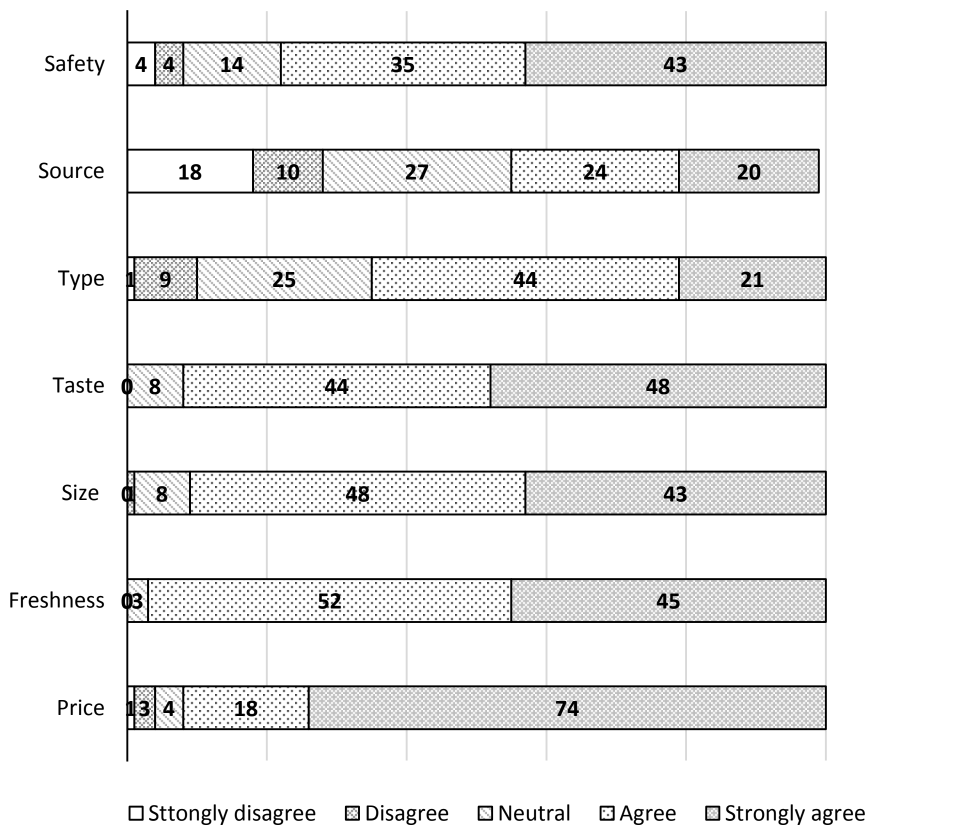

Figure 1 Factors influencing consumers' fish purchasing behavior (%)

Results show that on average freshness of the fish (97%), price (92%), taste (92%) and size (91%) are the four product attributes ranked the highest followed by the safety attribute (78%). The importance of knowing the source of fish ranks as one of the least important attributes (Figure 1). Looking at the number of respondents giving the highest score (5) to a product attribute, price is the most important attribute as 74% of respondents indicated that price is the most important attribute influencing fish purchasing decisions followed by taste, freshness and size. This indicates that price of fish, size and quality of fish (measured by taste and freshness) are the most important product attributes influencing consumers' decision prior to purchasing fish. Only 20% of respondents put source of fish as the most important attribute. This reflects obliviousness among consumers of fish in Kumasi, whose purchasing decisions are not based on the source of fish.

4. Results and discussion

4.1 Consumers' attitude toward fish farmed in treated wastewater

The survey collected information on consumers' perception of and attitude toward fish farmed in treated wastewater. These information were collected to investigate the effect of consumers' attitude on their willingness to pay for fish farmed in treated wastewater. To investigate the underlying structure of the attitude variables, we conducted a factor analysis. The factor analysis resulted in 3 factors that, henceforth, will be referred to as *Food safety*, *Product attribute* and *Substitute* based on the factor loadings of the variables on the extracted factors (Table 3). Table 3 presents the factor loadings of attitude variables (in bold) on the extracted factors after varimax orthogonal rotation. Examining the factor loadings provides information on the extent to which each of the attitude variables contributes to the meaning of each of the factors. Each of the three factors has an eigenvalue greater than 1. The total variance accounted for is 57% with factor 1 accounting for 25%, factor 2 for 17% and factor 3 for 15%. Cronbach's alpha coefficients were computed to examine the internal consistency of each factor. Values were found to be moderate to high (0.57-0.80), indicating that the attitude variables loading on each of the factors measure the same underlying construct.

Table 3 Results of factor analysis

No.	Perception statements	Factor loadings		
		Factor 1	Factor 2	Factor 3
1	Fish farmed in treated wastewater is a good substitute to wild caught fish	0.36	0.09	**0.42**
2	I would purchase fish grown in treated wastewater-fed pond if it is cheaper than wild caught fish	0.28	**0.67**	0.27
3	I would buy fish grown in treated wastewater-fed pond no matter the price	0.17	0.19	**0.71**
4	All fish types, fish reared in wastewater-fed pond or wildly caught, are the same	0.14	-0.07	**0.79**
5	Fish farmed in treated wastewater-fed pond is hygienic	**0.79**	0.10	0.27
6	Consuming fish farmed in treated wastewater-fed pond is healthy	**0.75**	0.20	0.28
7	I would buy fish grown in treated wastewater-fed pond only if it is approved by health authorities	**0.50**	0.33	0.36
8	Fish farmed in treated wastewater-fed pond is bigger than wildly caught fish	0.001	**0.79**	0.10
9	Fish farmed in treated wastewater-fed pond is always available	0.03	**0.70**	-0.23
10	Fish farmed in treated wastewater-fed pond contains chemical residues	**-0.53**	0.10	-0.003
11	Fish farming in treated wastewater will give me options and choices to buy my fish	**0.54**	0.49	0.05
12	As a consumer, fish farmed in treated wastewater will be beneficial to consumers	**0.72**	-0.03	-0.20
	Variance explained (%)	25	17	15
	Cronbach alpha coefficient	0.80	0.62	0.57
	Suggested interpretation	*Food safety*	*Product attribute*	*Substitute*

Factor 1, *Food safety*, had high loadings on variables related to the health, hygiene and approval by health authority of fish farmed in treated wastewater. This factor captures consumers' tendency to buy fish farmed in treated wastewater based on its health and safety aspects. In addition to these variables, other variables reflecting the perceived benefit of fish farmed in treated wastewater such as its potential to give consumers options and choices load positively on this factor. While health aspects of fish farmed in treated wastewater have positive factor loadings, the variable related to consumers' concern regarding the existence of chemical residue has a negative factor loading (-0.53). This indicates that when a consumer believes that fish farmed in treated wastewater contains chemical residue, the consumer's tendency to consider fish farmed in treated wastewater as healthy and safe is reduced. The second factor, *Product attribute*, has high loading of variables related to potential benefits of fish farmed in treated wastewater. This factor captures the tendency of consumers to buy fish farmed in treated wastewater based on its perceived potential benefits such as price, size and availability. The third factor, *Substitute*, had high loading on statements that reflect the belief that fish reared in wastewater has a potential to be a substitute for wild caught fish. This factor also load on statements that reflect the belief that all fish regardless of where they are reared are the same. Factor scores for each factor were obtained for each household, which were then used as one of the explanatory variables in the dichotomous choice model to assess consumers' WTP for fresh Tilapia and smoked Catfish farmed in treated wastewater.

4.2 Econometric results

A set of common explanatory variables was used to explain consumers' decision, which enabled comparison of results between the two models. In addition to socio-demographic characteristics of the respondent and the random amount the consumer was asked to pay (*Bid*), explanatory variables include attitude variables obtained from factor analysis. The differences in the attitudes of consumers involved in buying fish are likely to be related to the socio-demographic characteristics of the consumer (Burton et al., 2003). This poses an endogeneity problem as attitudes are partly determined by socio-demographic characteristics of consumers. To overcome the endogeniety problem, before estimating the probit models, the factors obtained from the factor analysis were regressed on the socio-demographic characteristics of consumers as a system of linear equations by using seemingly unrelated regression estimation (SURE). SURE is used when a subset of right-hand side variables are the same (Zellner, 1962). Results of the SURE model indicated that the models were not significant and that the attitude variables were not endogenous. Thus attitude variables could be considered as exogenous explanatory variables.

Tables 4 presents the results of the probit model for fresh Tilapia and smoked Catfish farmed in treated wastewater. As expected, the *Bid* variable is statistically significant in both models and that as the bid goes up the probability of a positive answer goes down. Thus, the higher the amount requested to pay, the lower the probability a consumer would be willing to pay. Furthermore, it implied that the respondent was more likely to choose fish farmed in treated wastewater if it was less expensive than the widely caught fish counterpart. Examining the results of the socio-demographic characteristics of respondents revealed that some of the socio-demographic characteristics which had a positive and significant effect on consumers' willingness to pay for smoked Catfish have a negative impact on the probability of consumers' willingness to pay for fresh Tilapia. We also observe that some variables were significant for one product but not for the other.

Table 4 Probit estimates for WTP: Tilapia and smoked Catfish farmed in treated wastewater

Variable	Fresh Tilapia		Smoked Catfish	
	Coefficient	Z-value	Coefficient	Z-value
Bid	-0.284	-3.15**	-0.333	-1.73*
Age	0.003	0.24	-0.025	-1.89**
Female	-0.335	-1.01	-0.224	-0.51
Education	-0.371	-1.73*	-0.123	-0.44
Dependent	-0.160	-1.66*	0.296	1.81*
HHsize	0.125	1.38	-0.265	-1.79*
HHincome	0.256	2.57**	0.222	2.04**
Food safety	0.115	0.82	-0.092	-0.59
Product attribute	0.569	3.93**	0.137	0.86
Substitute	0.377	2.53**	0.226	1.39
Constant	3.597	2.51**	4.826	2.18**
Log Likelihood	-77.55		-44.14	
LR Chi^2	38.93		17.74	
Prob > Chi^2	0.000		0.005	
Pseudo R^2	0.20		0.17	

*Significant at 0.10 level
**Significant at 0.05 level

The presence of children (*Dependent*) in the household has a negative and significant impact on the likelihood of consumer's willingness to pay for fresh Tilapia while it has a positive and significant impact on consumer's willingness to pay for smoked Catfish. This indicates that consumers with dependents are more likely to pay for smoked Catfish than for Tilapia farmed in treated wastewater. We expected that the presence of children might increase consumers' consciousness towards food safety. This is confirmed by the fact that consumers are less likely to pay for fresh Tilapia farmed in treated wastewater but are more likely to pay for smoked Catfish. The positive sign for *Dependent* variable indicates that postharvest processing of fish might be perceived as safer and thus increases the likelihood of consumers' willingness to pay for smoked Catfish. Furthermore, household size has a significant negative effect on the probability of consumers' willingness to pay for smoked Catfish but is weakly significant (at 16%) in the case of fresh Tilapia. Although family size and the presence of dependents are correlated, inclusion of both variables provided more information. Consumers with large family size are more likely to seek less expensive food items to economize. Household income has a significant and positive effect on the probability of consumers' willingness to pay for both products. Age of respondent has a significant negative effect on the likelihood of consumers' willingness to pay for smoked Catfish but has no significant effect on consumers' willingness to pay for fresh Tilapia. This indicates that young consumers are more likely to be willing to pay for smoked Catfish. While age doesn't have a significant impact on consumers' WTP for fresh Tilapia, education has a negative significant impact on consumers' WTP for fresh Tilapia indicating that consumers with higher level of education are less likely to be willing to pay for fresh Tilapia farmed in treated wastewater.

Examining model results pertaining to attitude variables revealed that the parameters for *product attribute* and *substitute* are significant at 5% critical level for fresh Tilapia but only substitute variable is weakly significant (16% level) for smoked Catfish. Product attribute and Substitute both have a positive effect on the probability of consumers' WTP for fresh Tilapia indicating that consumers with a positive attitude towards the different attributes of the product are more likely to pay for fresh Tilapia reared in treated wastewater. In contrast, attitude variables do not have a significant impact on consumers' willingness to pay for smoked Catfish.

Table 5 presents the estimated marginal effects of the explanatory variables on the likelihood of consumers' WTP. Statistical significance of these variables corresponds to their significance in the probit models and only those variables which were significant for at least one product were included in Table 5. The marginal effects indicate, for example, that if the bid amount goes up by GHS 1, the probability of the respondent paying for fresh Tilapia decreases by 0.088 and by 0.053 for smoked Catfish. Thus the impact of increasing the price on consumers' WTP is larger for fresh Tilapia. The marginal effect also indicate that an increment on one level of income increases, on average, the probability of WTP by 0.079 for fresh Tilapia and 0.036 for smoked Catfish. The *Dependent* variable has about equal magnitude but opposite marginal effect on consumers' WTP for the products. The marginal effect associated with Dependent variable is positive and significant for smoked Catfish, while it is negative and significant for fresh Tilapia. The *Age* variable has a negative and statistically significant marginal effect only for the smoked Catfish while *Education* has a negative and statistically significant marginal effect on only fresh Tilapia. An increment of one level of Education decreases, on average, the probability of consumers' WTP for fresh Tilapia by 0.115. The marginal effects also show that a higher score in the attitude variables, P*roduct attribute* and *substitute*, increases the likelihood of consumers' WTP for fresh Tilapia.

Table 5 Marginal effects

Variable	Fresh Tilapia	Smoked Catfish
	Coefficient	Coefficient
Bid	-0.088**	-0.053*
Age	0.001	-0.004**
Education	-0.115*	-0.019
Dependent	-0.05*	0.048*
HHsize	0.039	-0.043*
HHincome	0.079**	0.036**
Product attribute	0.177**	0.022
Substitute	0.117**	0.037

Willingness to pay estimates

The mean WTP for the two products are presented in Table 6. The mean WTP estimates are statistically different from zero implying that consumers in this sample are receptive to fish reared in treated wastewater. The mean WTP, using the average of the explanatory variables, for fresh Tilapia is 12.61 GHS/0.5 kg while the mean WTP for smoked Catfish is 12.03 GHS/0.5 kg. These prices are comparable to the mean price of wildly caught or farmed fresh Tilapia and smoked Catfish in the market.

Table 6 Mean WTP for fresh Tilapia and smoked Catfish

Fish type	Mean WTP	95% Confidence Interval
Fresh Tilapia	12.61 GHS/0.5 kg	(11.73, 13.49)
Smoked Catfish	12.03 GHS/0.5 kg	(7.43, 16.62)

5. Conclusion

This study investigated consumers' perception of and willingness to pay for fish reared in treated wastewater. The results of this study provide better understanding of fish consumers' buying behavior and their perceptions of and attitude towards fish reared in treated wastewater. Such knowledge is useful for fish producers or marketers in identifying what determines the decision-making behavior of fish consumers and in identifying and targeting those consumers who are likely to pay for fish farmed in treated wastewater in the future. Moreover, it can contribute to identifying key product attributes that need to be targeted for improvement if sales of fish farmed in treated wastewater is to be achieved in Ghana.

A consumer survey was conducted in Kumasi in 2014. Majority of respondents in the survey (82%) consume fish more than 6 times a month and spend 26% of their mean monthly food expenditure on fish which gives an indication of the relative importance of fish in the consumption expenditure of consumers. Examining product attributes that influence consumers' decisions revealed that price, size and quality of fish measured by taste and freshness are the most important product attributes influencing consumers' decision prior to purchasing fish. Source of fish is among the least important product attributes influencing consumers' decision.

Results of the probit model revealed that consumers of fish in Kumasi are generally accepting fish reared in treated wastewater if sufficient lower prices are offered. Consumers are more likely to choose fish farmed in treated wastewater if it was less expensive than the widely caught fish counterpart. Moreover, the fact that the two fish products are not only different in terms of their type but also the form in which they were offered to the consumers had an impact on consumers' willingness to pay. While wealthier households are more likely to pay for both products, households with children are more likely to pay for smoked Catfish compared to fresh Tilapia which suggests that postharvest processing of fish might be perceived as safer and thus increases the likelihood of consumers' willingness to pay for smoked Catfish. Furthermore, our results revealed that young consumers with small family size are more likely to pay for smoked Catfish. While age doesn't have a significant impact on consumers' WTP for fresh Tilapia, consumers with higher level of education are less likely to pay for fresh Tilapia. Furthermore, consumers' attitudes towards fish farmed in treated wastewater are important determinants of consumers' willingness to pay for fresh Tilapia but are not relevant in determining consumers' willingness to pay for smoked Catfish.

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