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Consumer preferences for organic vegetables in southwestern Nigeria: A choice experiment approach

Joseph Oluwagbenga Akinwehinmi*
Department of Agricultural and Resource Economics, The Federal University of Technology, Akure, Ondo State, Nigeria. E-mail: ayjossy@yahoo.com

Taye Timothy Amos
Department of Agricultural and Resource Economics, The Federal University of Technology, Akure, Ondo State, Nigeria. E-mail: ttamos@futa.edu.ng

Kolawole Ogundari
Education Research and Data Center, Olympia WA, USA. E-mail: ogundarikolawole@daad-alumni.de

* Corresponding author

Abstract

In sub-Saharan Africa, identifying estimates of consumers' preferences and willingness to pay (WTP) for safe food continues to receive attention in the literature. Using experimental data from Nigeria, we examined the source of heterogeneities in preference and WTP for organically produced food. The subjective valuation by consumers of certification in relation to third-party certification and the participatory guarantee system (PGS) was also investigated. A sample of 196 households subjected to a discrete choice experiment yielded 1 764 observations that were analysed using the generalised multinomial logit and mixed logit models. The results reveal a strong preference for food safety in terms of reducing chemical residue, which dominated the respondents' preference and WTP patterns. Concerning certification attributes, consumers were positively disposed to third-party certification, but showed no significant preference for the PGS form of certification. Significant heterogeneities in preference were due mainly to age and awareness of organic products. We suggest that policies should focus on consumers' understanding of organic food, third-party certification, and organic agriculture.

Key words: organic; certification; preference; willingness to pay; choice experiment

1. Introduction

Globally, the need for environmentally friendly, health-promoting and sustainable food production systems continues to motivate research on organic agriculture issues (OA) (Katt & Meixner 2020). OA pushes against the application of chemical and genetically modified (GM) materials in food production to optimise the health and productivity of interdependent communities of plants, animals and humans (Nandwani & Nwosisi 2016). Recently, the elicitation of consumers' preferences and willingness to pay (WTP) for organically produced food continues to receive attention in sub-Saharan Africa (SSA) (Coulibaly *et al*. 2011; Alphonce & Alfnes 2012; Probst *et al*. 2012; Owusu & Anifori 2013; Bruschi *et al*. 2015; Bello & Abdulai 2018; Katt & Meixner 2020), and particularly in Nigeria (Philip & Dipeolu 2010; Obayelu *et al*. 2014; Bello & Abdulai 2016b). One reason for this is that identifying estimates of consumers' preferences and willingness to pay for safe and health-promoting food may contribute significantly to sustainable food systems in the region (SSA) (Bello & Abdulai 2016b).

Despite the global increase in the trade of organically produced foods (International Federation of Organic Agriculture Movements [IFOAM] 2017), they are still more expensive to assess for consumers in Nigeria (Global Alliance for Improved Nutrition [GAIN] 2014). This may be due to the higher cost elements associated with organic agriculture than conventional food systems (Barkley 2002; GAIN 2014). Also, local markets of certified organic food are almost non-existent in the country (Barkley 2002; GAIN 2014). Thus, many farmers generally lack the economic incentive for investing in certified organic production. Even for farmers who attempt to produce organically, the absence of market mechanisms to signal consumers' trust in organic claims hampers demand (Luttikholt 2007).

A couple of studies (Philip & Dipeolu 2010; Obayelu *et al*. 2014; Bello & Abdulai 2016a, 2016b; Owoeye *et al*. 2017) have attempted to estimate precisely consumers' WTP for organically produced food in Nigeria. While Philip and Dipeolu (2010) and Bello and Abdulai (2016a, 2016b), in particular, identified different organic food attributes preferred by consumers, only Bello and Abdulai (2016a, 2016b) modelled preference heterogeneities, focusing on the northern region of the country. Meanwhile, Nigeria is highly diverse in cultural and dietary patterns (Adegboye *et al*. 2016) and heterogeneous in household wealth (World Bank 2016), such that findings from studies focusing on one region of the nation cannot be applied to the economic settings of another region.

Therefore, in the furtherance of research in this area, the present study focuses on the south-western part of Nigeria in eliciting consumers' preferences and WTP for organic food. We make two significant contributions to the literature in this area. First, the present study examined the source and shape of heterogeneities in preference and WTP for organically produced food in south-western Nigeria. Our results provide evidence of the presence of taste heterogeneities and reveal underlying drivers of these heterogeneities.

Second, information asymmetry between farmers and consumers concerning credence attributes was always a major concern to consumers in the context of organic food. This is especially important in Nigeria, where labelling and certification of direct farm produce are largely uncommon. In contrast to what previous studies have investigated, the present study estimated the subjective valuation of consumers for certification in relation to two forms of certification – third-party and the participatory guarantee system (PGS). Our results in reveal systematic differences in sensitivities towards the two different forms of food certification.

The structure of the remaining part of this paper is as follows. In the next section, we describe the theoretical and econometric framework of the study. Section 3 presents the survey design and the data used in the analysis. The empirical results are presented and discussed in the fourth section, while the conclusions are presented in the final section.

2. Theoretical and econometric framework

2.1 Theoretical framework

Consumer preferences describe (individual) tastes, measured by utility, for various bundles of goods. They allow the consumer to rank these bundles of goods according to their utility levels (Lipsey & Chrystal 1999). The random utility theory, RUT, which was postulated by McFadden (1986), assumes that, when faced with alternatives, the consumer acts rationally and chooses the alternative with the highest utility level. In other words, the individual is a utility-maximiser. In the RUT, the utility of the decision-maker comprises the deterministic and stochastic part, defined by Equation 1 below:

$$U_{in} = V_{in} + \varepsilon_{in} \quad (1)$$

U_{in} is the true but unobservable (latent) utility for alternative *i*. V*in* is the observable deterministic component of utility, and εi, the error term, is the factor unobservable to the researcher treated as stochastic (McFadden 1986).

The utility that the consumer attaches to the alternatives is latent and only observable to the researcher through the consumer's choice. Therefore, the utility function is random and probabilistic, since the researcher cannot predict the consumer's choice with certainty. Thus, the probability that the consumer will choose a particular option among alternatives is the probability that he attaches the highest utility to the possibility (Kjær 2005).

Lancaster (1966) argues that consumers make choices among alternatives conditional on their preferences, and that which consumers seek to acquire is not the goods themselves, but the characteristics the goods contain. Lancaster's approach allows us to predict how preferences will change when we change the alternatives presented to consumers, thereby allowing us to value goods that do not currently exist in the market (Fiebig *et al*. 2010). It also allows us to calculate 'implicit prices' for different attributes, without having a price for the good itself, by associating utility with the characteristics that make up the good, rather than the good itself (Lancaster 1966).

Empirically, consumer preferences can be elicited using two approaches, namely stated preference and revealed preference techniques. The revealed preference technique says that, given the choices a consumer has made under some variations of income and price, we can determine her preferences (Samuelson 1938). By relying on observations, analyses using revealed preference techniques are primarily limited to observable states of the world. Therefore, revealed preference techniques might not be suitable for quantifying preferences for which the attribute cannot be observed (Hicks 2002). Conversely, stated preference techniques use observations of actual choices made by people to measure preferences.

Two stated preference valuation methods are prominent in the literature – the contingent valuation method and the choice experiment (CE) (Boyle 2017). The contingent valuation method (CVM) values a good holistically without considering the attributes and by asking people directly about their willingness to pay (or willingness to accept). In contrast, the CE technique allows respondents to select their preferred option among hypothetically designed goods or services described in terms of their attributes.

According to Breidert *et al*. (2006), the CE design takes the reciprocal action among different product attributes into consideration. It examines the WTP of several attributes simultaneously, thus breaking the limitation wherein the CVM can only investigate one product attribute at a time. This makes the CE closer to the real buying environment.

Furthermore, with the CE, the options for the choice sets are more comfortable to express quantitatively than the respondents' direct answers, which tend to display subjective attitudes, thus reducing the answer distortion and deviation caused by individual subjective bias and understanding discrepancies (Yin *et al*. 2017). The choice experiment is a well-suited technique for the valuation of non-market goods or new products that are being developed for the market, as it focuses on the goods' attributes (Fiebig *et al*. 2010). This makes the CE suitable for this study, which is focused on the preference for attributes of certified organic food for which a potential market is being investigated.

2.2 Econometric framework

If one assumes that a consumer in a market is faced with organic and inorganic food options, and if we allocate a value of 1 if consumer i chooses an organic product n, and 0 otherwise. Then the probability that consumer i chooses organic food in such a choice settings can be represented as

$$P(y=1) = \beta_{in}X_{in} + \varepsilon_{in}. \quad (2)$$

Here, $\beta_{in}X_{in}$ is the deterministic part of the utility function in Equation (1). X_{in} represents the attributes of organic product n, while β_{in} represents the vector of utility weights the consumer attaches to X_{in}. Since we are also interested in how the preferences and choices of the consumers vary conditional on their idiosyncratic characteristics, Equation (2) can be modified to

$$P(y=1) = \beta_{in}X_{in} + \triangle_{in} Z_{in} + \varepsilon_{in}. \quad (3)$$

In Equation (3), the ($\beta_{in}X_{in} + \triangle_{in} Z_{in}$) now represents the deterministic component of Equation (1). The assumption here is that, in addition to the product's attributes, the consumers' characteristics also determine the probability of their choices (Lancaster 1966; McFadden 1986). Thus, Z_{in} can represent the vector of the socioeconomic characteristics of the consumers, while $\triangle_{in}$ represents the estimates of the coefficient of Z_{in}.

Econometrically, equations (2) and (3) can be specified in different models, depending on the assumptions the researcher decides to hold about the stochastic component of the utility function (Fiebig *et al*. 2010). Motivated by Kassie *et al.* (2017), we estimated two logit models: the generalised multinomial logit (GMNL) and the mixed logit (MIXL) models. These models' proven abilities influenced our choice to reveal heterogeneities in preference and WTP, as evidenced in other studies (McFadden & Train 2000; Fiebig *et al*. 2010).

MIXL and GMNL allow parameters to vary randomly over individuals by assuming some continuous heterogeneity distribution *a priori*, while keeping the assumption that the error term is an independently and identically distributed (iid) extreme value type 1 (McFadden & Train 2000). The individual-specific utility weight (β_i) for a given attribute in MIXL is given as

$$\beta_i = \beta + \Gamma v_i, \quad (4)$$

where β is the attribute-specific mean utility weight for the sample, β_i is the attribute-specific utility weight for individual i, Γ is a diagonal matrix that contains the standard deviation of the distribution of the individual utility weight (β_i), and v_i are the individual and choice-specific unobserved random disturbances, with mean 0 and standard deviation 1 (Fiebig *et al*. 2010; Kassie *et al*. 2017).

The GMNL is also favoured for its flexibility to accommodate different parameterisation forms to account for heterogeneities robustly. Perhaps the most attractive feature of the GMNL is its claim to recover scale heterogeneities (McFadden & Train 2000; Fiebig *et al*. 2010). The representation of heterogeneities in GMNL is given such that

$$\beta_i = \beta\sigma_i + \gamma\Gamma v_i + (1-\gamma)\sigma_i\Gamma v_i, \quad (5)$$

where β_i is the vector of utility weights for individual i, β is the vector of the mean of the estimated utility weights of the sample, and σ_i is the scaling factor, which differs across individuals but not across choices. Γ is as defined previously, and v_i is the individual and choice-specific unobserved random disturbances, v_i ~ N(0, 1). γ is a scalar distribution parameter that determines how the variance of residual taste heterogeneity, Γv_i, varies with scale. $\gamma \in [0,1]$ (Fiebig *et al*. 2010).

Different specifications of the GMNL can be obtained based on the restrictions set on σ_i , Γ and γ. When none of these parameters in Equation 5 is restricted, we have the full GMNL.

The G-MNL-I is obtained when $\gamma = 1$, and is specified as:

$$\beta_i = \beta\sigma_i + \Gamma v_i \quad (6)$$

The G-MNL-II obtained when $\gamma = 0$, and is specified as

$$\beta_i = \sigma_i (\beta + \Gamma v_i) \quad (7)$$

In this study, we use four specifications of the G-MNL (full GMNL, G-MNL-I($\gamma = 1$), G-MNL-II($\gamma = 0$) and G-MNL ($\tau = 1$)). We also estimated the MIXL models. See the Appendix for the list of the characteristics of individuals associated with observed heterogeneity included in our models.

For the WTP estimation, we employed the WTP space approach specified in Fiebig *et al*. (2010) and Hess and Train (2017). Models in the WTP space reparametrise utility such that the WTP distribution is determined directly (Fiebig *et al*. 2010). In models in WTP space,

$$U_{njt} = -P_{njt} + \beta_n^p wtp'_n x_{njt}^a + \frac{1}{\beta_n^p} \varepsilon_{njt}, \quad (8)$$

where P_{njt} is price, x_{njt}^a is a vector of non-price attributes, and wtp'_n is a corresponding vector of the consumer's WTP for the non-price attributes. The standard deviation of the unobserved factors is the inverse of the random price coefficient, representing scale heterogeneity (Hess & Train 2017).

3. Method

3.1 Sampling

In the present study, we adopted a multistage sampling approach. As stated earlier, the study focused on the southwestern region of Nigeria. First, we randomly selected Ondo State, one of the six states in the region, because all the states in the southwest of Nigeria are homogenous in consumer demography and dietary patterns, mainly of the culture of the Yoruba tribe. Second, we randomly selected Akure metropolis, the capital of Ondo State, for the same reason as above. In the third stage, our identification of the households for sampling was done to stratify the households into residential districts by population density, as done in Adeoye (2016). Three major residential zones were identified: a high-density residential zone (HDRZ), a medium-density residential zone (MDRZ), and a low-density residential zone (LDRZ). The HDRZ consisted of more than 200 residents per hectare, while the LDRZ has between 60 and 100 residents per hectare (Adeoye 2016). This stratification naturally divided the households into high-, middle- and low-income groups.

The low-income group dominates the HDRZ, while the MDRZ is dominated by the middle-income group and the LDRZ by the high-income group (Adebola *et al*. 2015; Adeoye 2016). In the fourth stage, systematic random sampling was used to draw household units from each residential area in each of the residential zones, since we had no sampling frame to work with. It was challenging to follow systematic sampling due to restricted access to the residents; the respondents were randomly drawn from the Landlords' Association meeting. Household units sampled totalled 196. The statistical characteristics of the survey sample are available on request as supplementary material.

Cross-sectional data on socioeconomic information, consumers' awareness, past experience of buying preferences for organic products, and choice experiments were obtained using a structured questionnaire.

3.2 Choice experiment

In designing the choice experiment (CE) for this study, we identified the relevant attributes of the organic food product we selected. For the product, we selected a leafy vegetable (*Amaranthus hybidus*). Our selection of this was informed by the fact that the indigenous households in the study area were famous for consuming leafy vegetables (National Bureau of Statistics [NBS] 2012). Also, there is evidence that farmers use large quantities of pesticides for these products because of their high susceptibility to pests and diseases (Bello & Abdulai 2016b; Fasina 2016). Five main attributes identified from the literature that are relevant to vegetable consumers were used to design the vegetable profiles for the choice experiment (Philip & Dipeolu 2010; Coulibaly *et al*. 2011; Bello & Abdulai 2016a, 2016b; Association of Organic Agriculture Practitioners of Nigeria [NOAN] 2018). These attributes and their corresponding levels are presented in Table 1.

Table 1: Attributes and Attribute levels of Vegetables used in the choice experiment

Variable	Description	Levels	Reference level
Price	Price of 1 kg of leafy vegetable in naira	N50, N100, N150[1]	N50
Chemical reduction (CHR) in %	Level of chemical reduction while growing the vegetable	0, 25, 80, 100	0
Certification	The organic certification scheme used	No certification, NAFDAC[2], NOAN[3]	No certification
Freshness	Describes the extent to which the vegetables appear fresh	Completely fresh (CFR), Partially fresh (PFR), Not fresh at all	Not fresh at all
Taste	Describes the level of the natural tastiness of the vegetables	Naturally tasty, Not naturally tasty	Not naturally tasty

Source: Authors' compilation (2018)

First, we included chemical reduction as an important attribute, since Fasina (2016) and the Federal Ministry of Agriculture and Rural Development ([FMARD] 2017) reported that farmers in the study area continued to use inorganic fertiliser in large quantities. This attribute had three levels (see Table 1). Second, we included certification labels as an attribute to test the households' sensitivity to information asymmetry in the context of farmers' claims regarding organic produce. This is currently a debate among stakeholders in organic agriculture in Nigeria (NOAN 2018). In light of this, the present study included a certification label as one of the attributes of the choice experiment. The levels included for this attribute included NAFDAC and NOAN. Although organic agriculture certification was not within the curricula of NAFDAC at the time of this study, it made an effort to collaborate with the NOAN to become the statutory regulatory body in charge of the certification of organic agriculture in Nigeria (NOAN 2018).

The price attribute was included in the estimation of WTP. The price levels we used for the price attribute reflect the current prices of organic vegetables in Ibadan, Oyo State, which was the only known market for certified organic vegetables at the time of this study (NOAN 2018). Two other attributes that were identified as important for consumers as far as vegetable consumption is concerned included freshness and taste. Freshness has always been a cue for quality when consumers purchase vegetables (Bonti-Ankomah & Yiridoe 2006). As far as taste is concerned, Probst *et al*. (2012) and Philip and Dipeolu (2010) found it to be a strong predictor of vegetable choice.

In designing the CE, we followed the approach of Kassie *et al*. (2017). An efficient D-optimal design was developed using the "gen_design" function of the "skpr" R package of Morgan-Wall and Khoury

[1] N represents naira, the Nigerian currency. N365 = 1 USD at the time of this study
[2] NAFDAC is the abbreviation for National Agency for Food and Drug Administration and Control
[3] NOAN is the abbreviation for Nigerian Organic Agriculture Network

(2018) within the R Software environment. The D-efficiency of the design was 99.9%. The design generated 18 profiles. The 18 profiles were divided into nine choice sets, with two alternatives. A status quo alternative that represented a vegetable product with unknown organic status was added to each choice set. Hence, the first two alternatives in each choice set were hypothetical organic vegetables, while the third alternative was the conventional vegetable with no organic claim. A preliminary pilot testing of the questionnaire was carried out. In the choice experiment, each respondent undertook nine choice tasks. With 196 households sampled, a total sample of 1 764 observations was obtained.

Stated preference methods, including the CE, have often been criticised for hypothetical bias (HB), which tends to overstate their willingness to pay for hypothetical goods (Kjaer 2005). This study combines a certainty follow-up mitigation strategy (Jerrod & Wuyang 2018) with the traditional cheap talk script (Cummings & Taylor 1999) to mitigate the HB. Finally, CE data were analysed using the G-MNL R package, developed by Sarrias and Daziano (2017).

4. Results

4.1 Preferences of consumers for organic vegetables

Estimates of consumers' mean preferences for organic vegetable-based attributes on four specifications of the G-MNL models are presented in Table 2. The full G-MNL is preferred most by the Akaike information criteria (AIC) and the log likelihood (LL), while G-MNL ($\tau = 1$) is selected most by the Bayesian information criteria (BIC). In all of the G-MNL formulations for organic amaranth, price, chemical reduction, taste, freshness and NAFDAC-certified attributes were consistently significant at the 1% level and carried the expected signs. Only the mean preference for the NOAN-certified attribute was not statistically different from zero, even at 10% in the best-fit G-MNL model specification. The standard deviations of the taste parameters, as well as standard errors for mean preference estimates, are presented in Table 3. The estimates showed that variations in mean estimates for all of the attributes were significant at 1%, implying strong heterogeneities in the consumers' evaluation of all of the attributes of the vegetable.

Table 2: Estimates of mean preferences for organic amaranths

	Full G-MNL	**G-MNL-I ($\gamma = 1$)**	**G-MNL-II ($\gamma = 0$)**	**G-MNL ($\tau = 1$)**
Taste	**Coeff (std error)**	**Coeff (std error)**	**Coeff (std error)**	**Coeff (std error)**
ASC1	1.9883*** (0.283)	0.604 (0.603)	1.521** (0.604)	0.426 (0.466)
ASC2	2.1840*** (0.304)	0.880 (0.611)	1.800*** (0.609)	0.714 (0.455)
Price	-0.074*** (0.008)	-0.033*** (0.005)	-0.044*** (0.007)	-0.037*** (0.005)
CHR	0.133*** (0.009)	0.046*** (0.006)	0.062*** (0.009)	0.069*** (0.009)
Taste	5.061*** (0.547)	1.862*** (0.302)	2.220*** (0.379)	2.681*** (0.435)
CFR	4.7862*** (0.624)	1.881*** (0.448)	2.248*** (0.550)	2.406*** (0.536)
PF	4.3503*** (0.761)	2.141*** (0.452)	2.712*** (0.620)	2.665*** (0.523)
NOAN	1.1433 (0.936)	0.800** (0.391)	1.172** (0.507)	0.581 (0.486)
NAFDAC	7.477*** (1.016)	3.031*** (0.565	3.883*** (0.745)	3.567*** (0.620)
Tau	1.892*** (0.207)	1.791*** (0.330)	1.427*** (0.220)	
Gamma*	-6.217 (11.948)			-13.347*** (384.547)
Model fit criteria				
AIC	2 166.64	2 195.470	2 174.528	2 169.619
BIC	2 423.344	2 447.179	2 426.237	2 421.328
LL	-1 036.082	-1 051.735	-1 041.264	-1 038.809
N	1 758	1 758	1 758	1 758
AIC/N	1.23	1.25	1.24	1.23

Significance: *** = 1%; ** = 5%; * = 10%

In modelling preference heterogeneity, the MIXL model performed best compared to all the G-MNL specifications in terms of the AIC, BIC and plausibility of estimates. Therefore, the discussion of observed heterogeneity is based on the MIXL model estimates presented in Table 3. The results show that interaction variables NAFDAC*awareness and chemical reduction*age were found to be positive and significant at 5%. Furthermore, the interaction of taste*gender was positive and significant at a 10% level of significance.

Table 3: Estimates of observed heterogeneity in the MIXL model for organic vegetables

Taste parameters	Coefficient (std error)
Price	-0.016*** (0.002)
CHR	0.020** (0.012)
Taste	1.141*** (0.290)
CFR	0.880** (0.291)
PFR	1.369 *** (0.222)
NOAN	0.039 (0.267)
NAFDAC	1.397*** (0.361)
Observed heterogeneity	
CHR*Age	0.003** (0.001)
CHR*Aware	0.008 (0.005)
CHR*Checkup always	-0.011 (0.010)
CHR*Radio	-0.005 (0.006)
CHR*Household size	-0.001 (0.005)
CHR*Own farm	0.007 (0.005)
CHR* % spouse income contribution	0.014 (0.009)
Taste*Special diet	0.068 (0.232)
Taste*Vegetarian	-0.626 (0.478)
Taste*Gender	1.234** (0.619)
Taste*Ownfarm	-0.124 (0.263)
NAFDAC*Aware	0.727** (0.337)
NAFDAC*Radio	0.059 (0.331)

Significance: *** = 1%; ** = 5%; * = 10%

4.3 Willingness-to-pay estimates for organic vegetables

For the WTP, two models were estimated, and the results are presented in Table 4. Comparing both WTP models, the WTP space model produced more realistic WTP estimates based on the current market price (200N) for 1 kg of organic amaranth in Ibadan, Nigeria. Respondents were willing to pay 1.31N more to have a 1% decrease in chemical residue compared to conventional amaranth with no reduction in the chemical residue. This is followed in value by NAFDAC certification, for which they were willing to pay a premium of 89.98N relative to amaranth that was not certified organic by NAFDAC. In terms of taste, the respondents were willing to pay 44.03N more for amaranth that was naturally tasty over one that was not naturally tasty. They were also willing to pay 75.20N more for partial freshness and 42.26N more for complete freshness. Regarding heterogeneity, significant variations in willingness to pay for a reduction in chemical use, improvement in taste, complete freshness, and NAFDAC certification was evident at 1%.

5. Discussion

In the literature, two main attributes are usually considered to define a certified organic product – complete abstinence from inorganic substances during production, and an organic status claim by the producer that is usually proxied using a certification label (IFOAM 2017). In this study, the strong preference for reducing chemical residue in food underscores the importance of food safety-related attributes in consumers' choice of food in the study area. Concerning certification attributes, the findings of this study generally align with Bello and Abdulai (2016a, 2016b). These authors found that certification attributes and reduced chemical residue contributed positively to consumers' likelihood of choosing organic vegetables. A new finding here is that, while consumers are entirely disposed to NAFDAC, NOAN seems not to be as widely accepted by consumers as NAFDAC, which implies a preference for third-party certification over the PGS form of certification. Moreover, the NOAN certification attribute was revealed to have the highest heterogeneity in all the estimated model specifications. This was not unexpected, as the PGS form of certification was relatively unknown in the study area.

Table 4: WTP estimates for attributes of organic vegetables

	Preference space model	**WTP space model**
	Coeff (std error)	**Coeff (std error)**
CHR	1.78*** (-0.196)	1.31*** (0.25)
Taste	68.02*** (8.615)	44.03*** (6.22)
PFR	58.46*** (11.02)	75.20*** (5.76)
CFR	64.32*** (11.373)	42.26*** (9.18)
NOAN	-15.92 (11.438)	16.74 (23.63)
NAFDAC	100.47*** (8.742)	89.98*** (13.04)
het.(Intercept)		235.32*** (32.07)
Unobserved heterogeneity		
CHR	1.24499 (0.14473)	1.45*** (0.26)
Taste	38.91135 (4.46051)	61.75*** (7.92)
PFR	11.62119 (4.4924)	96.16 (NA)
CFR	13.50967 (10.37286)	53.72*** (12.24)
NOAN	-1.64966 (4.86266)	55.48 (34.1)
NAFDAC	14.86036 (4.27232)	134.11*** (31.85)
Tau	25.42064	169.05*** (18.14)
Gamma		18.08* (10.05)
LL		-1 105.5
AIC		2 266.204
N		1 758

Significance: *** = 1%; ** = 5%; * = 10%

Furthermore, there was evidence of heterogeneities in consumers' valuation of the attributes of organic farm products, especially for reducing chemical residues and for certification schemes. The results presented in Table 4 imply that sensitivity to the chemical reduction attribute was higher among older respondents. Studies (Philip & Dipeolu 2010; Nocell & Kennedy 2012) have similarly associated ageing with increasing consciousness of healthy eating. Concerning the interaction between NAFDAC certification and consumers' awareness of organic products, the results show that the respondents who were aware of organic products valued NAFDAC certification as a positive inducement to choosing organic vegetables. This was also expected, as an increasing level of awareness makes consumers understand the objective risk associated with chemical-dense food and, as such, desire certified organic practices in food production (IFOAM 2017).

Concerning welfare measures, the respondents were willing to pay a premium of up to 120% for a NAFDAC-certified organic vegetable if an organic vegetable is considered to be one with no trace of chemical residue. Compared to the price of a PGS-certified organic vegetable in Oyo State, which was the only state with an emerging organic market in the southwestern region (NOAN 2018), the premium estimated in this study is only slightly higher by 20%. The WTP estimates here prove to be intuitive, because it was mentioned earlier that the respondents mainly preferred a third-party certification to the PGS form of certificate. Moreover, the results here compare favourably with findings in similar studies (Philip & Dipeolu 2010; Bello & Abdulai 2016a, 2016b).

For the other attributes included, the strong positive preference for tastiness underscores the importance of the taste of food for the respondents when purchasing food. Related studies (Philip & Dipeolu 2010; Probst *et al*. 2012) also reported taste to be a significant predictor of organic food choice, particularly in relation to vegetables. Consumers' valuations of the two freshness attributes (completely fresh and partially fresh) were positive and highly significant. The results were expected, since freshness, among other physical attributes, remains a significant source of information signalling food quality and additional credence attributes to consumers (Bonti-Ankomah & Yiridoe 2006; Yue & Tong 2009; Probst *et al*. 2012; Alphonce & Alfnes 2017). The insignificance of the variation in WTP for partial freshness shows that the respondents did not differ significantly in their valuation of partial freshness as an indicator of organic amaranth. Regarding price attributes, our findings reveal that the more expensive the vegetables for an average consumer in our study, the less likely they would prefer it, holding other factors constant. This is consistent with economic theory and findings in similar studies (Philip & Dipeolu 2010; Probst *et al*. 2012; Bello & Abdulai 2016).

6. Conclusions

This study elicited consumers' preferences and WTP for the relevant attributes of organic vegetables in southwestern Nigeria using the CE approach. The drivers of heterogeneities in consumers' valuations were modelled, and we came to the following conclusions.

On average, preference for food safety, in terms of a reduction in the use of chemicals, dominated the preference and WTP patterns of the respondents regarding organic food. In terms of factors driving this behaviour, age and awareness of the concept of organic agriculture were very strong. The acceptability of organic certification may depend strongly on the familiarity of consumers with the certification body and their awareness of organic products. A relatively unknown certification scheme or a PGS form of certification may not quickly gain consumers' trust in organic claims to the extent that a known third-party certification like NAFDAC would do.

Given the strong preference for food safety, as was evident in this study, a long overdue policy framework should be promoted urgently to ensure adherence to safe food production standards in Nigeria in a holistic manner. In developing and implementing such policies, the empirical evidence of the respondents' preferences and WTP for specific attributes of organic vegetables provided by this study should be taken into account. Such policies should also focus efforts on ensuring that a larger proportion of the population is aware of the health and environmental benefits of organic food, since an unprecedented proportion of the population still is not fully aware of the concept of organic food. For future research in this direction, there is a need to understand the drivers of farmers' uptake of certified organic food production in Nigeria to strengthen policy on safe and sustainable food production.

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Appendix

List of socio-economic characteristics explaining taste heterogeneity

Variable	Measurement
Gender	(Dummy, 1 = male, 0 = female)
Age	Years
Education	(Years of formal education)
Frequency of purchase	(Dummy, 1 = frequently, 0 = not frequently)
Education	Years of formal education of the household head (years)
Household size	Numeric
Household monthly income	Naira (Nigerian currency)
Awareness of organic product	(Dummy, 1 = aware, 0 = not aware)
Special diet	If the respondent is on any special diet (dummy, 1 = yes, 0 = no)
Food disease incidence	Incidence of food-related disease (dummy, 1 = yes, 0 = no)
Vegetable farm ownership	Dummy, 1 = own, 0 = do not own
Vegetarian	Dummy, 1 = yes, 0 = no
Medical check-up	Dummy, 1 = always or most of the time, 0 = occasionally or never
Proportion of wives' income	Contribution of wives' income to total household income for male-headed households in percentage

Sample socio-demographics

Variables	Description	Mean	SD	Min	Max
Age	Age of the household head in years	47.64	13.74	17	82
Male	Dummy (1 = if household head is male, 0 otherwise	0.71	0.45	0	1
Education	Years of formal education of the household head	13.79	3.47	0	18
Income	Average monthly income of household in Naira (N '000)	72.22	109.63	5	1 000
Household size	Number of members in the household	4	2	0	11
LDRZ	Dummy (1 = if household is resident in low-density residential area, 0 = otherwise	0.26	0.44	0	1
Awareness	Dummy (1 = if previously aware of organic products, 0 otherwise)	0.38	0.48	0	1
Special diet	Dummy (1 = household head is on special diet, 0 otherwise)	0.15	0.36	0	1