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DETERMINANTS OF CONSUMER WILLINGNESS TO PAY FOR THE QUALITY ATTRIBUTES OF TRANSGENIC (BT) COWPEA (Bacillus thuringiensis) IN KADUNA AND SOKOTO STATES, NIGERIA

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ABSTRACT

This study analyzed the effect of socio-economic characteristics on consumer willingness to pay for the quality attributes of transgenic (Bt) cowpea (*Bacillus thuringiensis)* in Kaduna and Sokoto states, Nigeria. A random sample of 208 consumers was drawn from the cowpea consumer population. Primary data were collected using choice experiment (CE) designed questionnaire and analyzed with mixed logit analysis and descriptive statistics. The results across the states show that majority of respondents in Kaduna state (74.58%) and in Sokoto state (78%) had low income of less than N20,000 per annum in the surveyed areas. The combined results on the effect of gender on willingness to pay (WTP) indicated that female consumers were mostly willing to pay a premium price on safety and large grain size attributes relative to male consumers in the study area. Also, the coefficient for the interaction variable of consumers' age category between 20-30 years and price had a positive sign (0.25) and was statistically significant ($p<0.01$), implying that the estimated coefficient of this interaction was significantly different from the age of individuals over 60 years. The results showed that the willingness to pay for the interaction coefficient (Price: Income) had a positive sign (₦0.04) but was not statistically significant ($p>0.05$). The positive sign on income implies that demand for cowpea attributes varies directly with income which suggests that cowpea is a normal product. The result further showed that middle income respondents having annual income between ₦ 20,000- ₦ 100,000) were more likely willing to pay as compared to low-income respondents having annual income below or equal to ₦19, 000 in the study area.

Keywords: Consumer; WTP; Bt cowpea; choice experiment; mixed Logit

INTRODUCTION

Cowpea (*Vigna unguiculata*) is the most important indigenous grain legume and one of the most valuable crops grown by farmers in northern Nigeria. The crop has high potential to contribute to food security, income, and poverty reduction in the region. Its role in the economic value is recognized as a subsidiary crop to be relied on during the "hungry" season (Abubakar *et al*., 2018). Cowpea is essential to the nutrition of the urban poor and has tremendous potential to contribute to the alleviation of malnutrition among the resource poor people. Cowpea is used in cookery as well as an ingredient to produce composite flour, biscuits and weaning food (Abubakar *et al*., 2018).

In Nigeria, the huge cowpea deficit has been a major issue in cowpea production, but cowpea is faced with many constraints such as drought, insect pest and so far, resistance to maruca pod boring insects is limited (Abubakar, 2015). To manage the cowpea pod borer problem, a new cowpea called *Bacillus thuringiensis* (Bt) cowpea is a new technology that has been developed in laboratory in Australia under public-private partnership using biotechnology and genetic engineering techniques to address insect resistance and control pod boring maruca insects in cowpea production (IAR, 2015). The Institute for Agricultural Research (IAR) has mandate for cowpea research in Nigeria, completed the confined field testing of GM cowpea in 2015and obtained approval to conduct field trials and test the release of the product. IAR is collaborating with the National Biosafety Management Agency in Nigeria to assess the role of GM products in Nigeria in the interest of farmers and consumers (Abubakar *et al*., 2018).

Genetically modified (GM) crops are popular in many regions of the world, but their deployment in Africa is hindered by safety concerns and regulatory issues, although the continent is in dire need of boosting its food production. Previous research has shown that one of the problems of introducing GM crops in some parts of the world and West /Central Africa is the principal objections to GM crops including Bt crops, and the food products made from them, concern about possible harm to human health, damage to the environment and 'unnatural' status of the technology. Consumer reaction to GM food in Africa has not been well studied and little is known of the potential consumer response to Bt cowpea in Nigeria (Abubakar, 2015). Furthermore, consumer awareness about the field of biotechnology is low and is further confronted with contradictory sources of information on GM crops while scientific facts are often mixed with social, ethical, and political considerations. This information environment could have a direct impact on consumers' perspectives and valuations or willingness to pay for GM foods in Nigeria and Africa as a whole. In addition to lack of accurate information on GM benefits to African populations, GM cowpea cultivars are likely to be introduced in a region characterized by serious consumers' perceived potential risks of ethical and health concerns about GM crops (Abubakar *et al*., 2018).

In view of these problems, there is need to determine the effect of socio-economic characteristics of consumers on the willingness to pay for the quality attributes of Bt cowpea in the surveyed areas. Therefore, the objective of this study is to analyze the determinants of consumer willingness to pay for quality attributes of Bt cowpea in Kaduna and Sokoto States, Nigeria.

Available literature indicate that there are few researches on consumer willingness to pay for Bt cowpea in some parts of Northern Nigeria (Saket *et al*., 2004; Dofonsu *et al*., 2000).The few research works carried out on Bt cowpea (*Bacillus thuringiensis*) focused on effect of socio-economic characteristics of consumers on awareness of Bt cowpea and

consumer acceptance of Genetically Modified Organisms (GMO) cowpea in some parts of Northern Nigeria (Saket *et al*., 2004). Although Dofonsu *et al*., (2000) analyzed how much consumers are willing to pay for Bt cowpea, their analysis was based on the payment of premium and discounts on the Bt cowpea without due consideration for the effect of consumer socio-economic characteristics on willingness to pay for quality attributes of Bt cowpea. Hence, there is need for this research to estimate the trade-off between socio-economic characteristics of consumers and quality attributes of Bt cowpea in the surveyed areas.

METHODOLOGY

Study Area

The study was conducted in Kaduna and Sokoto states, Nigeria. The study areas are situated in northern Nigeria, an area of limited rainfall that is favorable to cowpea production (Abdulrahman, 2001). The field testing of the new Bt cowpea technology is being conducted in Zaria Local Government Area of Kaduna state at the Institute for Agricultural research (IAR) Ahmadu Bello University, Zaria.

Sampling and Sample Size

The study used multistage random sampling procedure for the selection of local government areas, urban and rural markets. In the first stage, a random selection of six (6) LGAs was made in each Agricultural Development (ADP) zone. In the second stage, a random selection of three urban and rural markets was made in each LGA. The random selection of the LGAs and the markets was carried out from the available sampling frame (a list of all people or units in the population from which a sample can be chosen) compiled by the ADPs in each state. The random samples of individuals that took part in the choice experiment session and actually participated are presented in Table 1.

Table 1: Sample size of the individual cowpea shoppers for the study

State	ADP Zones	LGAs selected	Contacted respondents	Respondents agreed to participate	Participated respondents
Kaduna	Maigana	Zaria	30	28	24
State		Giwa	20	19	18
		Sabon Gari	15	14	13
	Lere	Saminaka	30	28	20
	B/Gwari	Chikun	27	26	20
		Kaduna south			
Sokoto	Northern	Wurno	40	70	20
State	Zone	Sokoto North	30		24
		Gwadabawa	28		25
	Western	Tambuwal	70	65	20
	Zone	Sabon birni	20	18	12
		Bodinga	17	13	12
Total	5	12	327	281	208

In the random selection of primary sampling unit (individual cowpea consumers), the study follows the procedure employed by Lusk and Schroeder (2004); Naico and Lusk (2010). The procedure shows that within a location, subjects were randomly selected from several local marketplaces to ensure a representative sample of the general cowpea consumer population. The local market committee and raw cowpea traders/sellers were requested for permission to contact and interact with individuals that mostly buy cowpea for home use or personal consumption for participation in the survey. To avoid interviewing people from the same family or those that come to the market together to achieve a more spread sample, every second person entering the marketplace was systematically selected for participation in the study. Participants were informed about their rights to accept or decline the interview, and it was made known that no one would face consequences for his or her unavailability or unwillingness to participate. Each person participated only once and was assigned to only hypothetical treatment. In each market, the treatment employed was altered every 30 minutes to ensure that responses are not confounded with a location or a time-of-day effect. Both the primary and secondary sampling units were selected using random selection so that each unit in the population has a known chance of selection, to keep the sampling error (the difference of results between a sample and that of the whole population) low, and usually offer a sample which can be seen to be representative (a sample which reflects the population accurately by showing the same distribution of characteristics or variables as the whole population).

Data Collection

Data were collected from a random sample of 208 cowpea consumers using choice experiment (CE) designed questionnaire. CE is used in this study because Bt cowpea is a new product in the local marketplace (Abubakar *et al*., 2018). Primary choice data were collected by the researcher and assisted by trained enumerators. The designed questions were asked in a CE to elicit preferences of consumers on Bt and conventional cowpea. The experimental design of the CE comprises of three options, namely Bt and conventional cowpea, and "none" option. The full factorial design was initially constructed to obtain 144 possible combinations of the attributes while orthogonal fractional factorial was later designed to reduce the number of combinations to 12. In a CE, people make a series of repeated choices between different products defined by multiple attributes. In this CE, Bt cowpea was described using previous research works by key attributes such as price, safety from insecticide misuse, color, grain size, genetically modified organism, and insect damage. These attributes were described to the respondents prior to the survey. Cowpea retail prices and information on socio-economic characteristics of cowpea consumers such as age, gender, education, and income were also collected.

Analytical Techniques

Previous studies used certain Hicksian demands to estimate consumer willingness to pay (Dofonsu *et al.*, 2008; Dofonsu *et al*., 2010). The tools used for data analysis to achieve this present study include descriptive statistics, mixed logit model and willingness to pay. A method for reflecting the respondents' individual characteristics in mixed logit model is to use a new variable that multiplies the individual characteristic variable and attribute variable (such as pri:fem). Hence, this study considers various interaction terms between price

attributes and individual demographic characteristics such as age, income, gender, and education in order to determine if they have significant effect on willingness to pay.

Mixed Logit Model

Mixed logit is a fully general statistical model for examining discrete choices and a highly flexible model that can approximate any random utility model to any degree of accuracy (Caputo and Lusk, 2019). The mixed logit assumes that the parameter in the model varies over decision makers and unobserved portion of utility can be correlated over alternatives and exhibit heterogeneous preferences. Because of the concern for bias in the violations of behavioral assumptions in conditional logit (CL), it can be extended to the mixed logit (mlogit) considering respondent heterogeneity.

The mixed logit allows the parameters of attributes to vary across population and relaxes the Independence of Irrelevant Alternatives (IIA) assumption. It obviates the three limitations of standard logit by allowing random taste variation, unrestricted substitution patterns, and correlation in unobserved factors over time. It should be noted that in a logit model, each variable takes a different value in each alternative. Simulation was performed in mixed logit using one thousand random *halton* sequence draws for each sampled consumers and mean and standard deviation for each attribute were reported.

Mixed logit model can be expressed as follows:

$$P_{ni} = \int L_{ni(\beta)} f(\beta) d\beta \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where:

P_{ni}= the probabity of individual *n* choosing option *I*

$L_{ni(\beta)} = \frac{e^{V_{in(\beta)}}}{\sum_{j=1}^{J} e^{V_{in(\beta)}}}$, which is the logit probability evaluated at random parameters βs, which are different for each person (i.e, each decision maker).

f(β) = density function, which is a function of parameters βs that represent the mean b and covariance W of βs in the population. Using maximum likelihood estimation framework, the mean and covariance are considered fixed and were estimated on a sample of consumers drawn from the population.

$V_{in(\beta)}$= the observed portion of the utility, which is linear in parameters.

dβ= integration over β

n = individual consumers

i = consumer i

For the mixed logit model, the utility specification is:

$Uni = \beta_n \chi_{ni} + \varepsilon ni$ …… (2)

With

εni ~ iid extreme value. With nonzero error component, utility is correlated over alternatives giving rise to no IIA

$\beta_n \sim f(\beta_n / \theta)$

This specification is generalized by allowing β_n to be random.

Where:

Θ are the parameters of the distribution over the population, such as the mean and covariance of β_n.

β_n = random parameter and not known. It allows the slope of utility (i.e, marginal utility) to be random. The coefficient or random parameter can be decomposed into mean and standard deviation.

Willingness to Pay

Willingness to pay is the amount of money taken from income that makes a consumer indifferent. Caputo and Lusk (2019) pointed out that one of the ways in which the consumer preference can be evaluated is by acquiring the maximum amount that may be contributed by the individual to equalize a utility change. This is known as consumer's "Willingness-to-Pay".

Willingness- to- Pay (WTP) was computed as the ratio of each coefficient to the negative of price coefficient. The WTP provide economically meaningful information and was calculated using the following formula:

$$WTP = \frac{\beta_j}{-Price} \quad \text{..... (3)}$$

(Caputo and Lusk, 2019)

Where:

WTP = willingness to pay

β = Coefficient

j = Choice alternatives or options

P = Price coefficient

RESULTS AND DISCUSSION

Socio-economic Characteristics of Respondents

Table 1 presents the frequency distribution of respondents according to socio-economic characteristics in the study area. Results from combined data indicated that the average age was 37.88 years and the majority (30.77%) of respondents was in the age group of 28-38 years, which shows that most of the respondents are within their youthful and active age. This finding is consistent with Saket *et al*. (2004) who found that the young-aged groups accounted for the most responses on consumer acceptance of genetically modified organisms (GMO) cowpea in some parts of northern Nigeria. However, results from separate state wise dataset indicated that majority (66.67%) of the respondents in Kaduna State were in the age group of 72-82 years while most (58.33%) of the respondents in Sokoto State were in the age category of 61-71 years, respectively.

The combined result on gender distribution in the two states revealed that there was equal proportion of males (50%) and females (50%) that accounted for most of the responses in the study area. Results in Table 1 further revealed that majority (59.62%) of the respondents were females in Kaduna State while 55.77% of respondents were males in Sokoto State. This means that women accounted for most of the responses in cowpea shopping in Kaduna State possibly because of the culture and nature of the society that allow women equal opportunity with men in the surveyed area. However, men accounted for most of the responses in Sokoto State possibly because men mostly dominate marketing activities in the State.

Looking at the educational level of respondents, it is observed that many (34.62%) of the respondents had completed primary education in the study area. This implies that primary educated respondents accounted for most responses in the study area. This means that most of the respondents that accounted for the responses had the ability to read, write and communicate at the primary education level. This is followed by respondents with some secondary school (27.88%) and informal education (20.9%). The findings in this study are consistent with Saket *et al*. (2004) who reported that majority (94%) of consumers that were aware of Bt cowpea had primary education in the metropolitan towns of Gombe, Bauchi and Kano States, northern Nigeria. However, the finding is at variant with Edem *et al*. (2011) who reported a low literacy level in primary education in Nigeria. Also, the finding is not consistent with ACER (2013) who found literacy level of urban or city students to be higher than that of students in rural schools in Nigeria.

The analysis of annual income of respondents in the states showed that most (28.37%) of the respondents had annual income of less than ₦19, 999. Results across states show that majority (74.58%) of respondents in Kaduna State had annual income of less than ₦19, 999, whereas 78% of respondents in Sokoto State had annual income between ₦20, 000 and ₦ 39,999. This indicated that most of the respondents had low income in the study area. The annual income of respondents comes from different potential sources. The respondents said they had their annual income from business and civil service, farming and trading.

Table 1: Distribution of respondents according to socio-economic characteristics

Variables	Kaduna		Sokoto		Combined	
	Freq.	%	Freq.	%	Freq.	%
Age						
17-27	27	49.09	28	50.91	55	26.44
28-38	38	59.36	26	40.63	64	30.77
39-49	22	46.81	25	53.19	47	22.60
50-60	13	52	12	48	25	12.02
61-71	5	41.67	7	58.33	12	5.77
72-82	2	66.67	1	33.33	3	1.44
83-93	1	50	1	50	2	0.96
Gender						
Male	46	44.23	58	55.77	104	50
Females	62	59.62	42	40.38	104	50
Education						
Primary	39	54.17	33	45.83	72	34.62
Secondary	38	65.52	20	34.48	58	27.88
Tertiary	22	61.11	14	38.89	36	17.31
Informal school	9	21.43	33	78.57	42	20.9
Annual Income (₦)						
< 20,000	44	74.58	15	25.42	59	28.37
20,000 – 39,999	11	22	39	78	50	24.04
40,000 – 59,999	14	46.67	16	53.33	30	14.32
60,000 – 79,999	5	31.25	11	68.75	16	7.69
80,000 – 100,000	17	70.83	7	29.17	24	11.54
> 100,000	17	58.62	12	41.38	29	13.94

Effect of Socio-economic Characteristics on Consumers' Willingness to Pay (WTP)

The analysis of the effect of age on willingness to pay across the States is presented in Table 2. The combined result showed that price coefficient was statistically significant at 1% level and showed the expected negative sign. The negative sign (-0.006) for the price coefficient indicated that the level of consumers' utility decreases as the price of cowpea attributes increases.

The combined result further revealed that the coefficient for the interaction variable of consumers' Age category between 20-30 years and price had a positive sign (0.25) and was statistically significant at 1% level, implying that the estimated coefficient of this interaction was significantly different from the age of individuals over 60 years. The results also indicated that the willingness to pay estimate of ₦0.25 for the interaction variable was positive, implying that the estimated willingness to pay for respondents' age between 20 – 30 years was higher relative to the age of respondents over 60 years. This indicated that the individuals within the age of 20-30 years were more likely to value the attributes of the new Bt cowpea as compared to the respondents over 60 years of age in the study area. A possible explanation for this is that the consumers between the age of 20-30 years may have different tastes and preference patterns for cowpea attributes compared to the individuals with age of over 60 years. Another possible explanation is that the consumers in their 20-30 years were likely greater awareness and acceptance of Bt cowpea and viewed the Bt technology as novel than the individuals with over 60 years of age.

The results also revealed that age dummy variable of 20-30 years category had positive effect on willingness to pay for white colored cowpea, safety, cowpea large grain size and genetically modified organism (GMO) attributes, meaning that individual consumers within the age category of 20-30 years tend to value these attributes and more willing to pay maximum amount of money out of their income regarding white colored, safer, and large grain size cowpea attributes. However, age dummy variable of 20-30 years category had negative effect on willingness to pay for brown colored cowpea and insect damage attributes, meaning that the individuals within the age group of 20-30 years were less willing to pay for brown colored cowpea and insect damage attributes in the study area.

It can be inferred that respondents in the age category of 20 - 30 years tend to value white colored cowpea at ₦15.41 more than consumers with over 60 years of age. Also, the respondents in the age group of 20-30 years tend to value safety attribute at ₦152.98 more than consumers with over 60 years of age. Furthermore, individuals within the age category of 20-30 years tend to value cowpea large grain size at ₦76 more than respondents with over 60 years of age. This implies that respondents in the age group of 20-30 years tend to value safety and large grain size attributes more than white colored cowpea as compared to the respondents in the age group of over 60 years of age in the study area.

The results in Table 2 above further showed that respondents in the age category of 20 - 30 years tend to value brown colored cowpea at ₦ -12.33 less than respondents with over 60 years of age. Also, the respondents within 20 - 30 years of age tend to value insect damage at ₦ -35.02 less than consumers with over 60 years age in the study area. Also, when respondents in the age category of 20-30 years evaluated white versus brown colored cowpea attributes, they tend to value white color at ₦27.74 more than consumers with over 60 years of age in the study area. The results further showed that when respondents in the 20-30 years age category evaluated Bt versus conventional cowpea they tend to value Bt cowpea at ₦ -

16.15, meaning that they were willing to pay less amount of money for Bt cowpea than conventional cowpea in the study area. The respondents said they were less willing to pay for Bt cowpea because their perceived potential risks of Bt cowpea tend to outweigh their perceived potential benefit about the new Bt cowpea in the study area.

Furthermore, the effect of age on willingness to pay across states is also shown in Table 2. The price interaction with age coefficient is positive and significant for consumers in Kaduna, indicating that the willingness to pay for consumers within age category of 20-30 years was significantly higher than the willingness to pay for respondents with over 60 years age. The calculated t-value of 2.17 which was greater than 0 .84 revealed that there was no significant difference between the effects of age on willingness to pay across states and combined data.

Table 2: Effect of age on willingness to pay across states

Variables	Kaduna		Sokoto		Combined	
	Coefficient	WTP	Coefficient	WTP	Coefficient	WTP
Price	-0.011**		-0.003**		-0.006*	
White	0.305*	27.83	-0.004	-1.33	0.096	15.41
Brown	-0.098	-8.92	-0.093	-31.14	-0.007	-12.33
Safety	1.811**	165.33	0.404**	135.92	0.951**	152.98
Large size	0.658**	60.06	0.481**	161.97	0.473**	76.00
GMO	0.253**	23.09	0.030	10.25	0.143**	22.95
Insect damage	0.123	11.20	-0.504	-169.81	-0.218**	-35.02
Bt cowpea	1.622**	148.08	1.696**	571.00	1.674**	269.23
CC	2.147**	195.96	1.454**	489.48	1.775**	285.38
Price: Age	0.003*	0.24	0.001	0.33	0.002*	0.25
white vs brown		36.76		29.81		27.74
Bt vs CC		-47.88		81.51		-16.15

* = statistically significant at 1% level, ** = statistically significant at 5% level, CC = Conventional cowpea.

Effect of gender on willingness to pay across States and combined is presented in Table 3. The combined results showed that the price coefficient was statistically significant at 5% level and showed the expected negative sign. The negative sign (-0.005) for the price coefficient indicated that the level of consumers' utility decreases by 0.005 unit as the price of cowpea attributes increases by 1 unit, meaning that cowpea attributes with lower prices were more likely to be purchased by the respondents in the study area. The combined result in Table 3 further revealed that the coefficient for price: female interaction had positive sign but was not statistically significant ($p>0.05$), implying that the estimated coefficient for females was not significantly different from that of males in the study area.

The combined results in Table 3 further revealed that female consumers were mostly willing to pay a maximum amount on safety (₦174.67) and cowpea large grain size attributes (₦86.82), respectively, in the study area. This implies that female consumers tend to value safety attribute at ₦174.67 more than the male respondents. Also, it further revealed that female respondents tend to value cowpea large grain size at ₦86.82 more than the males in the study area. The effect of gender on willingness to pay across the two States showed that the coefficient for price interaction with female consumers in Sokoto State was positive and significant at 1% level, indicating that the willingness to pay for female consumers was significantly higher than the willingness to pay for male consumers.

Table 3: Effect of gender on willingness to pay across states

Variables	Kaduna		Sokoto		Combined	
	Coefficient	WTP	Coefficient	WTP	Coefficient	WTP
Price	-0.009**		-0.003**		-0.005**	
White	0.309*	34.54	-0.006	-1.88	0.097	17.79
Brown	-0.096	-10.69	-0.093	-31.63	-0.06	-13.99
Safety	1.811**	202.17	0.404**	137.27	0.952**	174.67
Large Size	0.659**	73.59	0.481**	163.50	0.473**	86.82
GMO	0.254*	28.34	0.030	10.15	0.143**	26.24
Insect damage	0.126	14.04	-0.506**	-171.85	-0.217**	-39.82
Bt cowpea	1.603**	178.95	1.702**	578.58	1.670**	306.45
CC	2.128**	237.48	1.460**	496.19	1.770**	324.89
Price: Female	0.000	0.01	0.002*	0.58	0.001	0.18
White vs Brown		45.23		29.74		27.74
Bt vs CC		-58.53		82.39		-18.43

* = significant at 1% level, ** = significant at 5% level, CC = Conventional cowpea.

The combined results in Table 4 indicated that the willingness to pay for the interaction coefficient of price: education variables had negative sign (₦ -0.02) but were not statistically significant (p>0.05), implying that the estimated coefficient of the interaction variable was not significantly different from that of consumers that had informal education. The negative sign on the estimated willingness to pay (-0.02) indicated that the willingness to pay for formally educated respondents was lower than that of informally educated consumers. This implies that formally educated respondents were less likely willing to pay maximum amount of money as compared to informally educated consumers. A likely reason may be that formally educated consumers were better able to perceive the potential risks and benefits of the Bt technology than informally educated respondents in the study area.

Table 4: Effect of education on willingness to pay across states and combined

Variables	Kaduna		Sokoto		Combined	
	Coefficient	WTP	Coefficient	WTP	Coefficient	WTP
Price	-0.010**		-0.002*		-0.005**	
White	0.310*	31.91	-0.004	-1.54	0.098	19.47
Brown	-0.096	-9.85	-0.092	-40.44	-0.076	-15.20
Safety	1.812**	186.67	0.404**	176.61	0.952**	189.92
Large Size	0.659**	67.92	0.482**	210.63	0.474**	94.49
GMO	0.254**	26.14	0.031	13.49	0.143**	28.61
Insect damage	0.126	12.97	-0.504**	-220.33	-0.216**	-43.17
Bt cowpea	1.604**	165.24	1.693**	740.27	1.667**	332.59
CC	2.128**	219.26	1.451**	634.46	1.768**	352.68
Price: Educ.	0.001	0.09	0.000	0.02	0.000	-0.02
white vs brwn		41.76		38.90		34.67
Bt vs CC		-54.02		105.82		-20.09

* = significant at 1% level, ** = significant at 5% level, CC = Conventional cowpea.

The combined result further revealed that when respondents evaluated cowpea white color versus brown color attributes, the formally educated respondents tend to value cowpea white color attribute at ₦ 34.67 more than informally educated consumers in the study area. The result in Table 4 also indicated that when consumers evaluated Bt cowpea versus

conventional cowpea, the formally educated respondents tend to value Bt cowpea at ₦ -20.09 less than informally educated respondents. The result further showed that formally educated respondents tend to value safety attribute at ₦189.02 more than the informally educated consumers. The result in Table 4 also showed that the formally educated consumers tend to value cowpea large grain size at ₦94.49 more than the informally educated individuals in the study area. The effect of education on the willingness to pay across states is also shown in Table 4. Results revealed that the coefficient for price interaction with education was positive in Kaduna State (0.09) and Sokoto State (0.02), but not statistically significant, respectively. This implies that the willingness to pay for formally educated consumers was not significantly different from the willingness to pay of informally educated consumers across the States.

The analysis of the effect of income on consumers' willingness to pay is presented in Table 5. The results showed that the willingness to pay for the interaction coefficient (Price: Income) had a positive sign (₦0.04) but was not statistically significant. The positive sign on income implies that demand for cowpea attributes varies directly with income which suggests that cowpea is a normal product. The result further showed middle income respondents having annual income between ₦ 20,000- ₦ 100,000) were more likely willing to pay as compared to respondents having annual income below or equal to ₦19, 000 in the study area. This finding is not in agreement with Hashem *et al*. (2023) that income of Thai consumers had significant effect on willingness to accept genetically modified corn oil. The effect of income on the willingness to pay across states is also presented in Table 5. The coefficients for price interaction with income in mixed logit model were positive and not statistically significant, indicating that the willingness to pay for consumers with lower income was not significantly different from the willingness to pay for consumers with middle income.

Table 5: Effect of income on willingness to pay across states and combined

Variables	Kaduna		Sokoto		Combined	
	Coefficient	WTP	Coefficient	WTP	Coefficient	WTP
Price	-0.010**		-0.002*		-0.005**	
White	0.308*	29.45	-0.003	-1.41	0.098	18.65
Brown	-0.096	-9.18	-0.092	-37.39	-0.076	-14.32
Safety	1.811**	173.04	0.404**	163.49	0.952**	181.76
Large Size	0.658**	62.88	0.482**	194.89	0.473**	90.40
GMO	0.253**	24.19	0.031	12.42	0.143**	27.37
Insect damage	0.124	11.88	-0.504**	-203.94	-0.216**	-41.32
Bt cowpea	1.608**	153.58	1.694**	685.40	1.667**	318.29
CC	2.132**	203.70	1.452**	587.45	1.768**	337.51
Price: Income	0.002	0.16	0.001	0.20	0.000	0.04
White versus Brown		38.64		35.98		-196.2
Bt vs CC		-50.12		97.95		-19.22

* = significant at 1% level, ** = significant at 5% level, CC = Conventional cowpea.

CONCLUSION

The study concluded that consumers within the age range of 20-30 years of were more likely willing to pay for Bt cowpea compared to cowpea consumers of over 60 years of age. In addition, the study concluded that consumers in the study area were willing to pay

significantly more for safer Bt cowpea varieties, and for cowpea large grain size attributes. Also, they were willing to pay significantly more for genetically modified (GM) cowpea.

The study revealed that both in Kaduna and Sokoto States consumers placed a relatively high willingness to pay on safety attribute of Bt cowpea and thus, there is the need to incorporate a few regulatory steps on safety into the regulatory approval as well as assess the safety of Bt cowpea to be introduced in the markets for general consumption. The study also revealed that cowpea large grain size and safety attributes were the most valued by consumers in the study area. Therefore, there is a need for crop breeders to keep improve cowpea large grain size when introducing new varieties of Bt cowpea in the study area.

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