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WILL FARMERS BUY AND APPLY AFLATOXIN BIOLOGICAL CONTROL AGENT? A WILLINGNESS-TO-PAY (WTP) APPROACH IN NORTHERN NIGERIA

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1. Introduction

Aflatoxin is among the most carcinogenic substances known in nature produced by the ubiquitous fungus, Aspergillus flavus. It is a highly toxic and is capable of colonizing and contaminating major staples like maize and groundnut at the pre-harvest, harvest and post-harvest stages of the crops rendering them unsafe for consumption. In 2004, Kenya recorded the largest aflatoxicosis occurrence in the last 20 years with 317 cases and 125 death due to consumption of contaminated maize diets with high aflatoxin levels (Lewis *et al*, 2005). A bio-control mitigating product was developed and registered under the name "AflasafeTM" in Nigeria to effectively control aflatoxin infestation of crops on the field through to storage. This was with the intent to improve public health, augment farmers' income, and enhance food safety and security. However, according to Wu and Khlangwiset (2010), a new technology to farmers always comes with new cost implication; against this backdrop, this study examined the assessment of farmers' willingness to pay for aflatoxin bio-control agent (Aflasafe) in Kaduna and Kano States of Nigeria among maize and groundnut farmers employing Contingent Valuation Methodology (CVM). The question now remains whether farmers are willing to invest in technology given the current condition in Nigeria. This study was carried out to answer the following research questions in the study areas: (i) Are farmers willing to pay for Aflasafe - the bio-control technology? (ii) What are the factors that influence farmers' willingness to pay (WTP) for aflatoxin bio-control? (iii) Identify constraints to farmers' WTP for Aflasafe.

2.0 Material and Methods

2.1 Methods

A multi-stage sampling technique was adopted for this study. The first stage involved purposive selection of five Local Government Areas (LGAs) in Kano State and two LGAs in Kaduna State where there is high concentration of maize and groundnut farmers who utilized Aflasafe as input in their farm production. The selected LGAs in Kano were exposed to aflatoxin and Aflasafe, 1 year before the survey, while the selected LGAs in Kaduna had 3 years exposure to aflatoxin and Aflasafe before the survey was conducted. The second stage involved purposive selection of 10 farming communities spread across the LGAs identified in both study area. The third stage involved purposive selection of 119 and 127 contact farmers respectively from Kano and Kaduna states, and random selection of 119 and 127 non-contact farmers respectively from Kano and Kaduna states using a sampling proportion of 6% in each farming communities identified. A total of 492 questionnaires were successfully completed and used for analysis. Contact farmers were those who had awareness about aflatoxin, received and used Aflasafe before the survey while,

Non-Contacts farmers have not used Aflasafe before, but may be aware. The data used for the study were primary data and collected from the farmers through the use of both oral interviews and structured questionnaires to elicit data about farmers' sources of information about aflatoxin and Aflasafe and their willingness to pay (WTP) among others.

2.1 Analytical Techniques

Descriptive statistics such as mean, standard deviation, graphs and frequency distributions were computed and used to compare WTP of contact and non contact farmers in the 2 States. In addition Logit model was used to determine factors influencing farmers' willingness to pay for Aflasafe if it was made available. A respondent's willingness to pay for "Aflasafe^{TM}" was represented by a dichotomous variable, where farmers willingness to pay (WTP) was represented by one (1) and those not willing to pay represented by zero (0). The model is specified below.

Logit Model *(LM)*

LM is given in its estimable form following Gujarati and Porter (2009), the model is expressed implicitly as; $LM = Ln\ (P_i /1- P_i) = Z_i = \beta_i + \beta\sum kX_{ik} + \varepsilon$ …….. (1)

Where: $Ln\ (P_i /1- P_i)$ = log odd ratio; P_i = probability that a farmer will be WTP or not WTP for Aflasafe; it ranges from 0 to 1, and is non-linearly related to Z_i ;β_i = constant term/intercept; β_k = coefficients of explanatory variables; X_{ik} = $K= 1, 2, \ldots\ldots n$ = independent variables (with ith observation) and ε = error term with zero mean' as Z_i ranges from $-\infty$ to ∞, P_i ranges from 0 to 1; thus the dependent variable *'P'* is 1 if a farmer is WTP for Aflasafe and is *'0'* if not using maximum likelihood estimation method, explanatory variables given as below for WTP's determinants. The estimated model was specified as follows:

$$WTP = \beta_0 + \beta_1 STATE + \beta_2 MSTATUS + \beta_3 EDU + \beta_4 ASSOC + \beta_5 FEXPERIENCE + \beta_6 HAPERSON + \beta_7 CREDITYN + \beta_8 TEXPENDIT + \beta_9 EXTCONT + \beta_{10} SEX + \beta_{11} TCONTACT + \varepsilon \quad \text{.....(2)}$$

The multidisciplinary independent variables shown in equation 2 above and explained in Table 3 included farmer, farm technology-related and institutional factors postulated to influence WTP.

3 RESULTS AND DISCUSSION

3.1 Socioeconomic Characteristics and the Willingness to Pay (WTP) for Aflasafe

The result in Table 1 shows light on the socioeconomic characteristics of the contact and non contact farmers from the two study states; the characteristics were similar. A significant number of the Contact farmers in Kano (80.7%) and Kaduna (89.9%) states had a willingness to pay bid value which was equal to or greater than N1, 500. This is the minimum price limit which 'Aflasafe' - the bio-control product was to be sold. In case of Non-Contact farmers only 17.6% of them in Kano state and 44.9% of them from Kaduna states were willing to pay the expected bid value (≥N1500). Table 2 shows the mean willingness to pay estimates for Aflasafe in Kano and Kaduna States among different groups: between pooled data for contact and Non-Contact farmers (POOLED), between contact and Non-Contact farmers in Kano state (KANO), between Contact and Non-Contact farmers in Kaduna state (KADUNA) among others. The average WTP value for contact farmers was generally found to be higher (N1983.74) and significant at 1% level of probability than Non-Contact (836.18). The same was applicable when compare Contact and Non-Contact farmers within Kano and Kaduna States respectively. The mean WTP values for contact farmers in Kano and Kaduna States respectively were N1, 952.1 and. N2, 013.4; these values were statistically the same and higher than the minimum price of N1500. On the other hands, values of N533.6 and N1119.7 were offered respectively by an average Non-Contact farmer in Kano and Kaduna States to acquire the product. It thus means that Non-Contact farmers were ready to pay for Aflasafe, but on the average were not willing to pay the minimum price of N1500, but something lower.

Table 1: Socio-economic characteristics of respondents of respondents

Variables	Kano state		Kaduna state	
	Contact	Non Contact	Contact	Non Contact Farmers
N	**119**	**119**	**127**	**127**
Gender distribution %				
Male	100	100	92.1	92.1
Female	-	-	7.9	7.9
Marital distribution %				
Single	2.5	17.6	1.6	18.1
Married	97.5	81.5	98.4	81.9
Widow/Widower	-	0.8	-	-
Access to credit %	36.1	16.8	83.6	29.1
Education level (Western Education) %	***62.2***	***45.3***	***56.7***	***50.4***
Extension contact %	100	69.7	100	77.2
Age distribution (Average)	49 ±10.97	40±12.87	39±12.02	36±8.69
Farm experience (Average)	25±10.98	17±11.43	18±10.28	9±6.61
Farm size (Average)	9±9.32	4±2.84	7±10.35	4±1.76
Household size (Average)	14±7.52	9±6.61	10±7.51	9±6.89
Organization member (Average)	9±5.98	7±4.11	4±3.15	6±3.93

Source: Field survey, 2015; NB: N = total number of respondents; figure after ± are standard deviations

Table 2: Average WTP values for Aflasafe by different groups of maize & groundnut's farmers (Naira/10kg)

VARIABLE	MEAN_WTP	DIFFERENCE
POOLED		
Contact	1983.74±634.1	1147.56***(16.80)
Non-Contact	836.18±863.24	
STATES		
Kano	1242.86±1035.4	323.67***(3.8)
Kaduna	1566.54±834.3	
STATES & FARMERS' TYPES		
KANO		
Contact	1952.1±641.22	1418.49***(14.5)
Non-Contact	533.61±852.84	
KADUNA		
Contact	2013.39±628.35	893.70***(10.10)
Non-Contact	1119.69±774.81	
FARMERS' TYPES		
CONTACT		
Kano	1952±641.22	61.29(0.757)
Kaduna	2013.39±628.35	
NON-CONTACT		
Kano	533.61±852.84	586.07***(5.629)
Kaduna	1119.69±774.81	

Source: Data analysis, 2015; NB: Means with corresponding SDs; numbers in brackets are the t-values; *** 1%, ** 5%, * 10% level of significance of t-test

3.2 Factor influencing farmers' willingness to pay (WTP) for Aflasafe

In modeling WTP using Logit model, results showed that socio-economic, farm and farmers' specific characteristics have significant effects on their Willingness To Pay for aflatoxin bio-control (Aflasafe) in Kano and Kaduna States; seven of the independent variables were positively significant, these included ecological location/state of respondents, which was more favourably disposed to farmers from Kaduna state ($P<0.01$); level of education ($P<0.05$); farm experience ($P<0.05$); farm size per family ($P<0.10$); total expenditure made by farm family($P<0.05$); contact with extension agent($P<0.05$); and contact with the producer of Aflasafe ($P<0.01$). All these increased likelihood of willingness to pay for Aflasafe by farmers.

Table 3: Determinants of Willingness to Pay (WTP) for Aflasafe in the study area

Explanatory Variables	Coefficient	Standard error	Z-value	P > /Z /
STATE (Kaduna=1, Kano=0)	3.892	1.103	3.53	0.000***
MSTATUS(Married=1, Otherwise=0)	1.378	0.945	1.46	0.142
EDU (Educated=1, Otherwise=0)	1.43	0.598	2.39	0.017**
ASSOC(Member of association=1, Otherwise=0	-0.396	-0.624	0.63	-0.526
FEXPERIENCE (Farm experience in years)	0.062	0.029	2.17	0.030**
HAPERSON (Hectare/family size)	0.843	0.439	1.92	0.055*
CREDITYN (Credit access=1, Otherwise=0)	0.694	0.617	1.12	0.261
TEXPENDIT (Total expenditure in Naira)	0.000	0.000	1.99	0.046**
EXTCONT(Contact with extension agent=1, Otherwise=0)	3.227	1.283	2.52	0.012***
SEX (Male=1, Female=0)	1.372	2.507	0.55	0.584
CONTACT(Contact with Aflasafe producer =1, Otherwise=0)	8.478	1.281	6.62	0.000***
CONSTANT	-15.492	-3.885	-3.95	0.00
LOGLIKELIHOOD	-58.75			
CHI-SQUARE	438.43			
SIGNIFICANCE VALUE	0.00			
PSEUDO R^2	0.79			

Source: Data analysis, 2015; NB: *** 1%, ** 5%, * 10% level of significance

3.3 Constraints to WTP

Most of the Non-Contact farmers pointed out that lack of information on awareness, usage and effectiveness of Aflasafe was the major constraint (80% for Kano state and 62% for Kaduna state). The second important constraint which was general to all farmers was the cost of Aflasafe which to them was on higher side.

4.0 Conclusion and recommendation

The main conclusion of this study is that information and awareness creation are critical for use of Aflasafe. Contact with information about aflatoxin and Aflasafe enhances farmers' awareness and WTP. This knowledge, positively influence the farmers' purchase decision and translates into higher willingness to pay by the informed farmers. The study then suggests dissemination of information about aflatoxin and the relevance of Aflasafe to farmers. Adoption of Aflasafe by farmers will guarantee quality grains that enhance food safety and security. Development of markets that reward growers of aflatoxin free maize with premium prices for their product will further increase adoption of aflatoxin combating technologies such as Aflasafe.

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