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RESEARCH ARTICLE

An Assessment of the Factors Influencing Maize Farmers' Perception and Adoption of Organic Farming Practices in Niger State, Nigeria

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ABSTRACT

This study used Heckman's analytical method to evaluate the impact on corn farmers' perception and adoption of organic farming practices. A multi-stage method was used to select 222 breeders and data collected from a semi-structured survey were analyzed using descriptive statistics (such as frequency, percentage, mean) and Hackman's two-stage selection model. The results showed that farmers in the study area were mostly male (70.3%), educated (62.6%), and had an average age of 35.8 years. Additionally, the fact that the majority of farmers were in favor of organic agriculture resulted in the approval of eight (8) of the 15 agreements in the region. Practices applied are: return of straw to the field (83.8%), mixing (79.7%), mixed tillage (73.0%), hoeing/reduced tillage (66.2%), hoeing/hand weeding (61.3%) and crop rotation (61.3%). 59.9%, slash and burn plants (54.1%) and farm manure (53.2%). The results of Heckman's two-stage analysis show evidence of sample selection problems where rho is different from zero, while lambda and efficiency (Wald chi2 = 40.51) are significant at 10% and 1% respectively. From the selection model, farmers' views on the use of traditional methods are positively influenced by socio-economic factors such as age, education, agriculture, access to extension services, similar benefits and income, while gender and family size are associated with understanding. . In the outcome (adoption) model, the results showed that agricultural education and livestock production increased, with small farmers more likely to adopt organic farming than large farmers. Therefore, the culture of maize farmers in Niger is neutral and mostly influenced by the culture of the farmers. Therefore, it is recommended that agricultural suppliers provide sufficient amounts of organic material to corn producers and extension organizations that will train farmers regularly.

1. Introduction

The methods and perspectives for cultivating and promoting crops have undergone significant transformations throughout time. Pesticides and other non-biodegradable chemical substances are being used more often to improve soil fertility, which has led to a noticeable rise in diseases among consumers, primarily cancer and a decline in immunity. By contaminating groundwater and other bodies of water, the widespread use of artificial fertilizers to increase productivity is progressively transforming our environment into a dead zone for people, animals, and other living things. Local and indigenous varieties are seriously threatened by the introduction of hybrid seeds and monoculture, which could result in the permanent loss of their germplasm (3). We have chosen to decrease life spans and devastate our ecosystem in the name of producing more food to feed the population. It is difficult to ignore the repeated calls for African nations to use environmentally friendly farm management techniques in their production activities in order to avoid the tragedy of chemical pollution, particularly in the modern world where the "market" dictates what it wants and what should be grown. Nowadays, nutritional quality is given more importance than intrinsic quantity and "outer" appearance. Organic farming is the process of cultivating

without the use of synthetic fertilizers, pesticides, or plant growth stimulants. Furthermore, the technique seeks to address the varying crop requirements for fertility without unduly depleting soil nutrients (3). Therefore, in order to aid in the development of a comprehensive, environmentally friendly agricultural production system that utilizes resources that are readily available locally, African organic farmers and scientists deliberately blend the long-standing traditional farming system with contemporary farming approaches.

According to the National Organic Standard Board (NOSB), organic farming methods are "an ecological production management system that promotes and enhances biodiversity." This mitigates the negative environmental effects of pesticides and other pollutants from the agriculture sector (7). Organic farming approaches stimulate the soil's chemical and microbiological properties, increasing its microbial activity, microbial biomass, and nutrient availability (4). Collectively, these elements form a collection of delicate markers for soil quality.

In essence, one's degree of understanding about a technology strongly influences how one perceives it (7). Therefore, conventional knowledge serves as both a system for the here and now and a repository of institutional memory for the approaches that have proven most effective over time. According to (3), this kind of knowledge is like a "reservoir of adaptations" that can be drawn upon again in the event that circumstances change. Consequently, farmers who are well-versed in conventional farming methods tend to view themselves favorably and may be more inclined to implement suggested organic farming practices (3). In order to do this, this study will make an effort to respond to the following research questions: What socioeconomic traits do the study area's rural maize producers possess? What do rural maize farmers think about organic agricultural methods? What percentage of maize output uses organic agricultural methods? What aspects of organic farming practices do farmers perceive and implement differently?

2. Materials and Methods

Lapai, Bosso and Kontagora Local Government Areas of Niger State, Nigeria are the locations of this study. After being formed from the former Northwestern Province, Niger State gained full independence on 3 February 1976 and established its capital, Minna. Niger State is located in north-central Nigeria, between latitudes 80 201 and 110 301 degrees north of the equator and longitudes 30 301 and 70 201 degrees east of the Greenwich meridian. The three largest ethnic groups in the state are Hausa, Badji and Nupe. There are currently 25 local government areas (LGAs) in the state. However, according to the 2006 census, the state's population is more than 3,954,772. However, considering Nigeria's annual population growth of 2.5%, the Nigerian population is expected to reach 5,556,200 in 2016 (6). Farmers make up the majority of the workforce in Niger state. The state is home to more than 80% of the workforce and is the engine of the economy. Niger State also has rich vegetation that can be used for forestry, fishing and farming (6).

2.2 Sampling Techniques and Sample Size

The sample of this study was selected using the multi-stage sampling technique. In the first phase, one local government was selected from each of the three (3) agricultural zones in Niger State. In the second stage, three villages are selected from each of the important regions in the region. The third step selects the registered farmers in the selected villages as the sample of the study. A large sample of 222 respondents from 2,222 rice farmers in selected villages in the study area was selected based on the fourth stage, which required a 10% sample size.

2.3 Techniques for Analytical Methods and Data Collection

Original data was used for this survey. Data were collected between April and June 2018 using a survey developed in conjunction with scheduled interviews. The collected data were analyzed using descriptive and inferential statistics. This study includes descriptive statistics such as average, percentage and frequency distribution. and using Heckman's two-step regression analysis as inferential statistics. However, five-point and seven-point Likert scales were used to measure the differences.

2.4 Farmers' perception of Organic practices:

Using the 5-point Likert rating system, the results are as follows: Strongly Agree (SA) = 5 , Agree (A) = 4, Disagree (U) = 3, Disagree (D) = 2, Disagree (SD)) = 1. In contrast, comments about negative emotions were scored in the opposite direction. Since the reference mean of this scale is three (5 + 4 + 3 + 2 + 1 = 15 / 5 = 3), mean scores less than or equal to three are classified as negative and positive, respectively.

2.5 Level of adoption of organic practices: The following values were used to quantify this on a 7-point Likert scale: Not aware = 0, Aware = 1, Interest = 2, Evaluation = 3, Trial = 4, Adoption = 5, and Discontinuance = 0. Since the scale's reference mean ($\bar{X}$) was three (21/7=3), mean scores of ≥3 and <3 were classified as having a high and low adoption rate, respectively. However, in the Heckman outcome model, the total number of adoption scores generated was regarded as the dependent variable.

2.6 Model Specification Heckman's two-step regression model

The two models used in this study are Heckman's two-stage regression model, which combines statistical analysis and least squares. The binary variable representing the variable in the Heckman choice or probabilistic model is the farmer's preference for organic farming. The farmers' outcomes will be the regressors in the Heckman OLS (outcomes) model. The same variables were also regressed to determine which

explanations were more relevant to farmers' perceptions. This is the algebraic representation of the Heckman probabilistic choice model:

T1 & T2 = (β1 x1) + e, (1)
Where:
T1 = ith farmer Area perception of organic farming.
T2 = organic farming score of the ith farmer.
X1 is the vector of explanatory variables that determine farmers' ability to view and use organic farming methods.
β1= A vector of regressor parameter estimates hypothesized to influence farmers' awareness and likelihood of adopting organic farming.
e = error term
Model Selection and Results The implicit linear specification of the model is given by:
Y1 & Y2= f (X1, X 2, X3, X4, X5, X 6, X7 X 8 , X9 X10 X11, X 12, X13, >X1 - X16 = independent variable. Of these;
X5 = Education (years spent in school)
X6 = Land owner (Owner = 1, otherwise = 0)
X7= Farming experience
X8= goal of farming (family consumption = 1, otherwise = 0)
X9 = Agricultural experience (years)
X10= Extension contact (number of visits)
e = Error term

3. Results and discussion

3.1 Socio-economic Characteristics of the Farmers

The data in Table 1 show that, with an average age of 35.82, most farmers (84.2%) were in the 21–50 age range. This implies that the farmers are still in their prime and relatively young, which makes them a readily available labor pool for growing organic maize. This supports the findings of (1), who found that young farmers have a propensity to be cosmopolitan and quick to perceive and accept agricultural innovations. In a similar vein, 70.3% of farmers were men. Male involvement in maize cultivation is likely a result of rural communities' traditional and religious beliefs, which limit women to home responsibilities, particularly in Northern Nigeria. Women are typically not permitted to own land in rural communities, and when they do, they typically assign their land's upkeep to their older male kid, brother, or spouse (8). This suggests a link between men's strong participation in maize production and men's traditional role as head of the home. This outcome is in line with the findings of (4), who discovered that men farmers dominated agricultural farming in Africa.

Table 1 also showed that the majority of respondents (62.6%) had formal education, which involved attending elementary, secondary, and university schools, while 37.4% had non-formal education, which involved training and skill development. It is anticipated that given this degree of literacy, farmers will find it easier to access information on organic methods, which may have an impact on their decision to implement organic practices. This result is consistent with research by (8), which found that education and other personal traits had a significant impact on the adoption of new technologies among rural agricultural farmers in Nigeria. In addition, Table 1 reveals that the respondents have been farming for an average of fifteen years. A farmer's practical expertise throughout time can be estimated by looking at how much experience, they have had growing maize. Because of their years of experience, the farmers may find it simpler to benefit from the use of organic inputs and production techniques when cultivating maize. This supports the findings of (4), who emphasized that possibilities to obtain high-quality agro-inputs are easily accessible to farmers with extensive farming expertise.
The majority of respondents (69.4%) owned the land they used for maize farming, indicating land tenure is not an issue in the area. However, the more than half of respondents (67.6%) had farms smaller than 2.0 hectares, with an average farmer owning 1.89 hectares of land. This suggests that farm size is relatively small. Given that the respondents appear to be small-scale farmers producing enough maize for subsistence, investing in organic farming techniques like crop rotation, mixed farming, and agroforestry may reduce the amount of land available for maize production. (5) research, which showed that farm size and land ownership encourage better agricultural techniques in crop production, lends credence to this conclusion.

3.2 Farmers' Perception of Organic Farming Practices

Farmers make the option to switch to organic agricultural practices based on their perceptions first (7). According to Table 2's data, farmers generally have a positive opinion of organic farming practices such crop rotation, mix cropping, using organic fertilizer, and growing trees on the property that enhance soil structure and stop nutrient loss. In a similar vein, farmers typically prefer methods like manual weeding that enables soil tilling while causing the least amount of structural damage. Overall, it was clear that rural maize farmers have a good understanding of and attitude toward using organic farming methods to produce maize. This might be because farmers appear to be persuaded of the advantages of using organic methods in their crops. Because organic farming procedures and traditional farming techniques are similar, this conclusion aligns with the research of (1) and (7), who similarly showed positive perceptions of organic farming practices among rural crop producers. The ease of access to resources for organic farming and its resemblance to conventional farming methods that promote sustainable agricultural production could be additional factors.

Table 1: **Socio-economic characteristics of the farmers (n=222)**

Variables	Frequency	Percentage (%)	Mean
Age(years)			
20years and below	19	8.6	36
21-30years	50	22.5	
31-40years	88	39.6	
41-50years	49	22.1	
51years and above	16	7.2	
Sex			
Male	156	70.3	
Female	66	29.7	
Household size			
5 and below	106	47.7	6
6-10people	91	41.0	
11-15people	24	10.8	
16 and above	1	0.5	
Formal education			
Non-formal	83	37.4	
Primary	31	14.0	7
Secondary	60	27.0	
Tertiary	48	21.6	
Farming experience			
10years and below	87	39.2	15
11-20years	83	37.4	
21-30years	36	16.2	
31years and above	16	7.2	
Land ownership			
Self	154	69.4	
Otherwise	68	30.6	
Farm size			
Less than 2Ha	150	67.6	1.89
2Ha and Above	72	32.4	

Source: field survey, 2018

Table 2: Farmers' perception of organic farming practices

Farmers' Perception of OFP	SA	A	NS	D	SD	WM	R
Crop rotation in the long run improves soil fertility	81(36.5)	66(29.7)	46(20.7)	29(13.1)	0(0)	3.90	**6th**
Mix cropping reduces pest and disease infestation	183(82.4)	27(12.2)	0(0)	8(3.6)	4(1.8)	4.70	**2nd**
Mix farming provides manure that increases soil fertility	42(18.9)	39(17.6)	91(43.5)	17(7.7)	27(12.2)	3.23	**9th**
Slash-burn/flame weeding suppresses weed growth	19(8.6)	39(17.6)	105(47.3)	22(9.9)	37(16.7)	2.91	**11th**
Zero/hoe tillage prevents erosion and disturbance in soil structure	86(38.7)	22(9.9)	51(23.0)	18(8.1)	45(20.3)	3.39	**8th**
Production of green manure takes much time and resources	2(0.9)	58(26.1)	65(29.3)	86(38.7)	11(5.0)	2.79	**13th**
Compost manure are slow in releasing nutrient to the soil	16(7.2)	17(7.7)	118(53.2)	48(21.6)	23(10.4)	2.80	**12th**
Hand picking of insects are less efficient pest control measure	38(17.1)	180(81.1)	4(1.8)	0(0)	0(0)	4.15	**5th**
Organic pesticide protect water from harmful chemicals	101(45.5)	113(50.9)	5(2.3)	0(0)	3(1.4)	4.39	**3rd**

Bio pest control are safe to human health	8(3.6)	34(15.3)	137(61.7)	18(8.1)	25(11.3)	2.92	**10th**
Hand weeding and Hoe tillage labour demanding practices	52(23.4)	57(25.7)	89(40.1)	17(7.7)	7(3.2)	3.59	**7th**
Organic fertilizer delays harvest	176(79.3)	41(18.5)	0(0)	5(2.3)	0(0)	4.75	**1st**
Use of Farm Yard Manure decreases maize yield	2(0.9)	58(26.1)	65(29.3)	86(38.7)	11(5.0)	2.79	**13th**
Planting trees reduces size of land for maize production	98(44.1)	91(41.0)	19(8.6)	14(6.3)	0(0)	4.23	**4th**
Incorporating plant residues exposes the soil to erosion	2(0.9)	58(26.1)	65(29.3)	86(38.7)	11(5.0)	2.79	**13th**

Source: field survey, 2018,

SA=strongly agree, A=agree, U=undecided, D=disagree, SD= strongly disagree, WM= Weighted Mean, % in parenthesis, R= remark, A= agree, D= disagree, OFP=Organic farming practices,

Table 3: Distribution of respondents by farm Practices

*Multiple responses

Table 3**: Levels of adoption of organic farming practices among maize farmers (n=222)**

Organic practices	**NA %**	**AW %**	**I %**	**E %**	**T %**	**A %**	**D %**	**Mean**	Scores	**Rank**
Crop rotation	10.4	21.6	2.7	9	2.7	59.9	1.8	3.4*	755	8th
Mixed cropping	1.8	7.7	5.0	0	5.9	79.7	0	4.40*	976	1st
Mixed farming	5.0	9.9	1.8	8.1	0	73.0	2.3	4.0*	894	3rd
Slash-burn/flame weeding	6.8	9.0	6.3	1.4	13.1	61.3	2.3	3.80*	853	6th
Zero/hoe Tillage	2.7	21.2	8.1	5.0	9.0	54.1	0	3.60*	796	7th
Green manure	31.5	31.5	18.5	12.6	6.3	0	0	1.31	292	14th
Composting	25.2	33.3	27.9	8.1	5.4	0	0	1.35	300	13th
Hand picking of insects	25.7	31.1	20.7	3.6	3.6	13.1	2.7	1.63	362	12th
Organic pesticide	12.2	29.7	11.3	6.3	20.7	18.9	0	2.50	552	11th
Bio pest control	42.8	38.7	5.0	5.4	3.6	14.5	0	1.02	226	15th
Hoeing/hand weeding	5.0	9.9	2.7	6.3	5.9	66.2	4.1	3.90*	863	4th
Use of organic fertilizer	2.3	31.6	5.9	0	5.4	47.7	6.8	2.99	664	9th
Farmyard manure	0	15.8	9.0	2.7	19.4	53.2	2.3	3.85*	855	5th
Planting trees/hedges	0	21.6	6.8	8.6	12.6	36.5	14	2.94	652	10th
Residues incorporation	4.1	12.2	0	0	0	83.8	0	4.31*	957	2nd

Source: Field Survey, 2018

NA= Not Aware, A=Awareness, I= interest, E= Evaluation, T= Trial, A=Adoption, D=Discontinuance, Decision rule: $\bar{X} \geq 3$= High adoption level and $\bar{X} < 3$ = Low adoption level (*=High Adoption Level).

3.4 Levels of Adoption of Organic Farming Practices among Maize Farmers

The degree to which maize producers in the study area have adopted organic farming practices is indicated by the result in Table 3. These results show that two main organic farming approaches in the area, mix cropping (79.7%) and crop residue integration (83.8%), have been successfully adopted by the majority of farmers, indicating a progressive trend in their farming practices. In addition, the farmers have used crop rotation (59.9%), flame weeding (61.3%), mix farming (73.0%), farmyard waste (53.2%), and zero/hoe tillage (54.1%). Eight (8) of the fifteen (15) farmers who reported employing organic agriculture practices had actually accepted them, according to the findings, for a 53.33% adoption rate. This implies that the adoption of organic farming methods is happening gradually. (1) discovered that Owerri has a poor acceptance rate for organic farming methods, with farmers utilizing only five (5) of the recommended fourteen (14) stated practices. This finding, however, is different from theirs.

3.5 Result of the Heckman Two-step Selection Model

In the study, Heckman's two-step method model was utilized to ascertain the elements impacting rural maize farmers' perspectives and adoption of organic farming practices. To avoid sample selection bias, the model makes an effort to estimate study parameters. First, the reliance error components in the selection and outcome equations was evaluated in order to determine the suitability of the model for the study. The findings showed evidence of a sample selection problem since rho was significantly different from zero and lambda was

statistically significant at 10%. It made appropriate, then, to use the Heckman 2-step selection model. Additionally, the likelihood function (Wald chi2=40.51) was found to be statistically significant at 1%, suggesting that the model possesses a strong capacity for explanation.

The findings of the selection model demonstrated a positive and significant correlation between rural farmers' perceptions in organic farming practices in maize production and the following variables: farm income, age of household heads, formal education, farming objective, extension services, and the relative benefits of organic practices. Implying that, rise in any of these elements boosts the chance of farmers' view in organic farming practices in maize production. On the other hand, the perception of farmers was inversely correlated with sex and household size. It is implied that organic farming methods are more preferred by female farmers who have a low dependency ratio on family members when producing corn. The outcome is in line with studies by (7) and (2), which found that rural farmers' perceptions of and likelihood of implementing agricultural technologies in crop production are influenced by their socioeconomic position.

According to the results of the adoption model, the two main factors that increase the likelihood that rural maize farmers will embrace organic farming practices are an increase in the quantity of animals they possess and an increase in the amount of formal education held by farmers. Higher education is anticipated to boost farmers' ability to acquire, decipher, and comprehend information necessary to making innovative decisions on their farms, therefore this result is in keeping with the study's apriori expectation. While having livestock increases the likelihood that farmers will embrace other organic farming techniques like mixed farming, composting, bio weeding, and bio pest management, it also gives them convenient access to animal waste, or manure, which is a vital component of soil fertilization. Many studies supported these findings, including (4) and (2), which found that formal education is essential to farmers' technological decision-making processes and that animals not only contribute to the synergistic crop-animal production interaction, particularly with the supply of manure, but can also provide the farmer with draft power in the form of cattle and oxen. However, the study discovered a negative relationship between the size of the farm and the adoption of organic agricultural practices. It is suggested that farmers who grow maize for subsistence are more likely to employ organic agriculture methods than large-scale producers of the crop. This is probably because organic farming techniques are labor-intensive and strenuous, as they usually avoid the use of huge farming equipment that may have minimized the need for human work. (8), who discovered that small-scale African farmers were more productive than larger farms, confirmed this.

4. Conclusion and Recommendations

According to the findings, the majority of male smallholder farmers in the study area had finished a high level of formal education and were of a productive age in the study area, which may have contributed to their positive opinion of the employment of organic farming techniques in the production of maize. Consequently, eight (8) of the fifteen (15) suggested organic practices were adopted by farmers in the region. Thus, it can be claimed that the adoption rate of organic agriculture practices by rural Niger State maize producers is moderate. The attitudes and adoption levels of farmers were influenced by many factors such as the age of the household heads, formal education, farming goals, farm size, accessibility to extension services, and the comparative advantages of organic farming practices. Therefore, it was recommended that;

i. Agricultural input providers should offer enough organic-related inputs for maize production, as farmers have a positive opinion of organic farming methods.
ii. Extension agents should be encouraged to train farmers on organic methods on a regular basis.
iii. Financial institutions should make financing more easily accessible in order to increase farmers' income from growing maize.

Table 4: Results of Heckman two-step selection mode

	PERCEPTION	**MODEL**	**ADOPTION**	**MODEL**
Explanatory Variables	Coefficient	z-value	Coefficient	z-value
Age	0.0130225	2.54***	-0.0317764	-1.22
Sex	-0.286413	-2.55***	0.4497057	0.89
Marital status	0.1031431	1.27	-0.4644598	-1.14
House size	-0.0423981	-2.11**	0.1325769	1.48
Formal education	0.0116248	1.81*	0.0485356	1.66*
Land ownership	-0.043121	-1.17	0.3573102	1.36
Farm size	-0.1071906	1.27	-0.7635057	-1.76*
Goal of farming	0.141353	1.71*	-0.5919234	-1.46

Farm Experience	-0.0026364	-0.48	0.0335595	1.08
Access to Extension services	0.0431772	1.69*	-0.1451188	-1.11
Farm income	3.07e-07	1.24	1.84e-06	1.67*
Cost of organic farm inputs	2.5e-07	0.84	1.83e-07	0.12
Relative Advantage	0.0493295	2.36**	-0.050647	-0.54
Compatibility	-0.5227403	-1.27	0.026673	0.01
Complexity	0.000016	0.65	0.0001182	1.08
Livestock ownership	-0.4696909	-1.18	4.035116	6.63***
Cons	0.724459	1.52	-0.0680437	-0.04
Diagnostics				
Lambda	-0.3850948	-1.67*		
Wald chi2	40.51			
Prob>chi2	0.0007***			
Number of obs	222			
Censored obs	82			
Uncensored 0bs	140			

Source: Field Survey, 2018

Note: *= significant at 10%, **= significant at 5% and ***=significant at 1%

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