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Assessment of the Level of Adoption of Organic Farming Technologies by Rice Farmers in Benue State, Nigeria

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ABSTRACT
The study assessed the level of adoption of organic farming technologies by rice farmers in Benue State, Nigeria. Purposive and multi-stage sampling techniques were used to select 135 rice farmers. The data for the study were collected through the use of questionnaire and were analyzed using both descriptive and inferential statistics. The results showed that majority (82.2%) of the respondents were married with household size of 6-10 persons. The organic farming technologies adopted by rice farmers were; green manuring (96.3%), crop rotation (96.3%), bush fallowing (81.5%) and shifting cultivation (80.7%). The study further showed that the farmer's perceived accessibility of sources of information on organic fertilizer were through friends/neigbours/relations ($\bar{X}$=2.75), farmer/field school ($\bar{X}$=1.35) and radio ($\bar{X}$=2.07). The study also identified the various types of organic farming technologies available; farmyard manure (96.3%), green manure (96.0%), compost manure (31.9%) and crop rotation (98.5%). The logit regression analysis on the effect of the socio-economic of the rice farmers on the adoption of organic farming technology was significant at 5% level of probability. The study concluded that farmyard manure, green manure, crop rotation, mulching and shifting cultivation were the organic farming technologies perceived to be available and adopted. Hence, the study recommended that there is need for farmers to be given skill-based training on how to make compost, farm yard manure and on the general principles of organic farming.
Key words: Adoption, Assessment, Rice farmers, Technologies

INTRODUCTION
Organic agriculture is the oldest form of agriculture on earth. Farming without the use of petroleum-based chemicals (fertilizers and pesticides) was the sole option for farmers until World War II (Delate, 2000). The war brought with it technologies that were useful to agricultural production. For example, ammonium nitrate used for munitions during World War II evolved into ammonium nitrate fertilizer, organophosphate nerve gas production led to the development of powerful insecticides. These technical advances since World War II have resulted in significant economic benefits as well as environmental and social detriments. Organic agriculture seeks to use those advances that consistently yield benefits, such as new varieties of crops, precision agricultural technologies, and more efficiently, machinery, while discarding those methods that have led to negative impacts on society and the environment, such as pesticide pollution and insect pest resistance (Delate, 2000). According to the International Federation for Organic Agricultural Movement (IFOAM) (2004) and Adeoluwa (2010), organic agriculture is a production system that sustains the health of soils, ecosystems, biodiversity and people. It relies on ecological processes and nutrient cycles adapted to local conditions, rather than the use of external inputs. Organic agriculture combines traditional knowledge, innovation and modern science to benefit the shared environment and promote fair relationships and a good quality of life for all involved. The underlying basic criterion is derived from the soil

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use/amendments that constitute the health of the soil. Olawale, Anthony, Arega and Akinyosoye (2011), stated that a healthy soil is one that is culturally managed and amended with organic fertilizers.

Adoption is regarded as a decision to make full use of an innovation or technology as the best course of action available (Rogers, 1995). Adoption of an innovation is the decision of an individual or group to use or apply an innovation (Adekoya and Tologbonse, 2011). Ekong, (1988) viewed adoption as the decision to continue full use or application of an innovation. An individual's decision on whether or not to adopt a recommended agricultural practice is recognized to occur over a period of time in stages rather than instantaneous. Rice (*Oryza sativa* L.) is an important stable food providing 66-70 body calorie intakes of the consumers. There is the need to heighten awareness of the role of rice in alleviating poverty and malnutrition (Barah and Pandy, 2005 cited in Saidu *et al.* 2012). The application of organic materials as fertilizers provides growth regulating substances and improves the physical, chemical and microbial properties of the soil (Belay *et al.*, 2001). Rice production occurs in all agro-ecological zones of the country. Global rice production has growth at an annual average of 1.0% over the past decade, reaching 486.7 million tonnes in 2017 (PWC, 2019). Most of this growth has come from Asia, accounting for 89% of global output. The global rice consumption remains strong, driven by both population and economic growth in Asia and Africa. Over the past two decades, rice demand increased at an annual average of 1.2% to reach 481.6 million tons in 2017. Africa's annual average consumption growth has average 4.8% in the last decade, outpacing the global rice consumption growth of 1.2%. Nigeria and Egypt account for most of this growth, consuming 30% of Africa's rice, but only 2% globally (PWC, 2019).

However, domestic rice supply in Nigeria has increased at an annual average of 3.7 million tons in previous years. The growth has been assisted by an increase in area under cultivation stretched from about 2.4 million harvested hectares in 2010 to 3.2 million harvested hectares in 2017. The supply has not been able to keep pace with demand because rice production is still primarily in the hands of resource-poor farmers with average farm size of 1-3 hectares who rely mainly on the traditional practice of cultivation, processing and storage (PWC, 2019; Daramola, 2005).

Objectives of the study were

i.) describe the socio-economic characteristics of rice farmers in the study area;
ii.) assessment of the level of adoption of organic farming technologies by rice farmers;
iii.) ascertain rice farmer' perception on accessibility of sources of information on organic fertilizers;
iv.) identify the types of organic farming technologies available to rice farmers; and
v.) Identify the constraints to adoption of organic farming technologies by rice farmers in the study area.

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Hypothesis

H_{O1}: Socio-economic characteristics of rice farmers do not significantly affect the adoption of organic farming technologies.

METHODOLOGY

The study area for this research is Benue State, Nigeria. The state is located in the middle belt region of Nigeria, which is the transition zone from the Northern and Southern ecologies, between longitude 7° 47′ and 10° 0° East and between latitudes 6° 25′ and 8° 8′ North (BNARDA, 2005). The state shares boundaries with five states; Nasarawa to the North, Taraba to the East, Cross River to the South East, Enugu to the South West and Kogi to the West. The southern part of the state is also bounded by the Republic of Cameroun. The population of the study consists of all rice farmers in Benue State. Purposive and multistage random sampling techniques were used to select 135 rice farmers. Data were collected by using a structured questionnaire and analyzed using descriptive and inferential statistics such as percentages, standard deviation, mean and the Logit Regression.

Model Specification

Logit Regression Model

The logit regression model that was used for testing hypothesis 1 is stated below:

$$Z = ln\frac{p}{1-p} = lnY = b_o + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9$$

Where Z = Probability of respondents to adopt organic farming technologies (1= adopt, 0 = did not adopt)

Bs = coefficients of explanatory changes in Z caused by changes in the independent variables.

X_1 = Age (years)
X_2 = Farm size (ha)
X_3 = Income (₦)
X_4 = Household size
X_5 = Farming experience (years)
X_6 = Contact with extension agents (no. of visit)
X_7 = Educational level of the farmers(no years spent)
X_8 = Membership of farmers' associations
X_9 = Marital status

RESULT AND DISCUSSIONS

Socio-economic characteristics of rice farmers in the study area

Table 1 shows the socio-economic characteristics of rice farmers. The results showed that 37.0% of the respondents were those within the age range of 31-40 years while the mean age of rice farmers was 39 years. This is an indication that a moderate proportion of the respondents are still active in rice farming. Majority (82.2%) of the respondents are married with household size of 6-10 persons. The educational status of the respondents was moderately high with 37.8% and 19.3% attaining secondary and tertiary school education

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respectively. The percentage of educated farmers in the area implies that the farmers could have a better understanding of agricultural information they receive. This agrees with Ajewole (2010) who reported that farmers with higher level of education were more willing to fully adopt organic farming. The annual income level indicated that moderate proportion (42.2%) of the respondents earn between ₦50, 001-100,000.

Table 1 shows the socio-economic characteristics of rice farmers.

Characteristic	Freq.	Percentage	Mean ($\bar{X}$)	Min	Max
Age (years)					
≤ 30	25	18.5			
31-40	50	37.0			
41-50	40	29.6	39.26	17	63
51-60	17	12.6			
61 and above	3	2.2			
Total	135	100.0			
Marital status					
Married	111	82.2			
Single	5	3.7			
Widow/widower	19	14.1			
Total	135	100.0			
Household size (No. of persons)					
< 5	40	29.6			
6-10	59	43.9			
11-15	25	18.5	9.0	1	31
16 and above	11	8.1			
Total	135	100.0			
Formal Education (Years)					
Non-formal	29	21.5			
Primary	29	21.5			
Secondary	51	37.8	8.47	0	21
Tertiary	26	19.3			
Total	135	100.0			
Farm Size (ha)					
≤ 1.0	57	42.2			
1.1 – 2.5	53	39.3			
2.6-4.0	22	16.3	1.77	0.5	7.0
≥4.1	3	2.2			
Total	135	100.0			
Farming Experience (Years)					
≤ 5	10	10.4			
6-10	25	18.5			
11-15	20	14.8	20.50	2	50
16 and above	80	59.3			
Total	135	100.0			
Annual farm income (₦)					
≤ 50,000	24	17.8			
50,001-100,000	57	42.2			
100,001-150,000	31	23.0	131,222.22	16,000	1,200,000

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>150,000	23	17.0			
Total	135	100.0			
Annual Non-Farm Income (Naira)					
≤ 50,000	76	56.3			
50,001-100,000	38	28.1			
100,001-150,000	3	2.2	140,088.89	5,000	3,000,000
≥150,000	18	13.3			
Total	135	100.0			
No of Extension contacts in a Year					
< 5	133	98.5			
5-9	-	-			
10-14	2	1.5	0.61	0	12
≥15	-	-			
Total	135	100.0			
Membership of Farmers Association					
Yes	97	71.9			
No	38	28.1			
Total	135	100.0			

Source: field survey, 2015

Adoption of Organic Farming Technologies by the Rice Farmers

Table 2 shows the result on analysis of organic farming technologies adopted by rice farmers in the study area. The result revealed that green manuring (96.3%), crop rotation (96.3%), bush fallowing (81.5%), shifting cultivation (80.7%), mulching (31.9%), farmyard manure (22.5%), manufactured organic fertilizer (21.5%) and compost (8.1%) were the various level of adoption of organic farming technologies by rice farmers. This result implies that low adoption recorded on mulching, farmyard, compost and manufactured organic fertilizers may be due to lack of technical skills required in making them or difficulties faced in accessing such organic fertilizers. This finding agrees with Oluwale *et al.* (2011) who reported that the level of organic fertilizer use as share of the minimum requirements to take-off of organic agriculture in Nigeria is low.

Table 2: distribution of rice farmers based on adoption of organic farming technologies (n=135)

Technology	Frequency*	Percentage (%)
Green manure	129	96.3
Crop rotation	129	96.3
Bush fallowing	110	81.5
Shifting cultivation	109	80.7
Mulching	43	31.9
Farmyard manure	30	22.5
Manufactured organic fertilizer	29	21.5
Compost	11	8.1

Source: field survey, 2015
Note: *Multiple responses

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Rice Farmer' Perception on Accessibility of Sources of Information on Organic Fertilizers

The rice farmers' perceived accessibility of sources of information on organic fertilizers is presented in Table 3. The result showed that extension agents ($\bar{X}$ =1.33), contact farmers ($\bar{X}$=1.99), opinion leaders ($\bar{X}$=2.00), friends/neigbours/relations ($\bar{X}$=2.75), farmer/field school ($\bar{X}$=1.35), radio ($\bar{X}$=2.07), television ($\bar{X}$=1.49), extension bulletin/newsletter ($\bar{X}$=1.26), film shows ($\bar{X}$=1.25) posters ($\bar{X}$=1.31), handbills ($\bar{X}$=1.20), handsets ($\bar{X}$=1.78) and internet ($\bar{X}$=1.16) . These findings are supported by those of Okwu and Daudu (2011), Odhiambo and Magadini (2008) and Spink and Cole (2001) who concluded that most farmers accessed information from family and neigbours, contact farmers and opinion leaders. The result also agrees with Adepose *et al.* (2012) who reported that majority of the farmers knew about organic farming practices through friends/relatives/neighbours. The use of the radio could be as a result of its wide range of coverage, accessibility and affordability. This study corroborate with Onemolease, Okoedo-Okojie and Aphunun (2011) who discovered that radio played a significant role in adoption of improved maize practice in Edo State of Nigeria. The non-accessibility of information through some of the channels could be due to difficulties in accessing them or their non- availability.

Table 3: Mean distribution of rice farmers based on perceived accessibility of sources of information on organic fertilizers (n=135)

Source	Mean ($\bar{X}$)	Std Deviation
Extension agents	1.33*	0.560
Contact farmers	1.99*	0.637
Opinion leaders	2.00**	0.531
Friends/neigbours/relations	2.75**	0.500
Farmer/field school	1.35*	0.615
Radio	2.07**	0.581
Television	1.49*	0.572
Extension bulletin/newsletter	1.26*	0.441
Film shows	1.25*	0.432
Posters	1.31*	0.509
Handbills	1.20*	0.403
Handsets	1.78*	0.654
Internet	1.16*	0.421

Source: field survey, 2015

Note: ** Accessed, *Never accessed

Types of Organic Farming Technologies Available to the Rice Farmers

Result of analysis on the types of organic farming technologies available to rice farmers in the study area is presented in Table 4. The result showed farmyard manure (96.3%), green manure (96.0%), compost manure (31.9%), manufactured organic fertilizer (48.9%), crop rotation (98.5%) mulching (88.0%) shifting cultivation (91.1%) and bush fallowing (93.3%). The availability of these organic farming technologies could be attributed to ease of accessing the materials needed for their preparation as well as the culture of passing on the age-long traditional practices of improving soil fertility.

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Table 4: Types of organic farming technologies available to the rice farmers (n= 135)

Technologies	Frequencies*	Percentage (%)
Farmyard manure	130	96.3
Green manure	129	96.0
Compost manure	43	31.9
Manufactured organic fertilizer	66	48.9
Crop rotation	133	98.5
Mulching	120	88.0
Shifting cultivation	123	91.1
Bush fallowing	126	93.3

Source: field survey, 2015
Note: *Multiple responses

Perceived Constraints to Adoption of Organic Farming Technologies by the Rice Farmer

The constraints to adoption of organic farming technologies as perceived by the rice farmers in the study area are presented in Table 5. The result showed that major constraints to adoption of organic fertilizers include labour intensive nature of organic fertilizers ($\bar{X}$ = 2.75), lack of extension personnel ($\bar{X}$ = 2.73), lack of funds ($\bar{X}$ = 2.72), lack of political will/commitment on the part of government ($\bar{X}$ = 2.72), non- availability of manufactured organic fertilizers ($\bar{X}$ = 2.67), lack of access to information ($\bar{X}$ = 2.54), lack of storage facilities ($\bar{X}$ = 2.41), high transportation cost ($\bar{X}$ = 2.37), among others. The standard deviations for the constraints to adoption of organic farming technologies by rice farmers were all less than 1. This shows uniformity in responses of the respondents. This also indicates that the adoption of organic fertilizers in the study area is faced with a lot of obstacles. The level of perceived constraints could be due to the inherent characteristics of organic fertilizers which include bulkiness, slow decomposition, slow nutrient release, offensive smell, etc. This result agrees with the findings of Svotwa *el al.* (2008); Nyamanagara *et al.* (2001) and Odhiamba (2008) who showed that constraints faced in adopting organic farming include labour intensive nature of organic manure, low organic matter decomposition, bulky nature of organic manure, high transportation cost, non-availability of organic fertilizers sources and lack of extension personnel.

Table 4: Mean distribution of perceived constraints to adoption of organic farming technologies by rice farmers (n=135)

Constraints	Mean	Std. Deviation
Labour intensive nature of Organic fertilizers	2.75**	0.484
Bulkiness	2.16**	0.742
Slow decomposition	2.03**	0.585
Low nutrient content	2.11**	0.619
Low quality organic matter	2.09**	0.674
Offensive smell	2.19**	0.682
Shortage of organic Fertilizer source	2.11**	0.843
High transport cost	2.37**	0.789
Lack of extension personnel	2.73**	0.589
Lack of access to information	2.54**	0.751
Lack of funds	2.72**	0.582
Lack of storage facilities	2.41**	0.716

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Incidence of pest	2.23**	0.819
Lack of access to organic certification	2.29**	0.845
Heavy weed infestation	2.33**	0.810
Lack of subsidy	2.32**	0.843
Lack of political will/Commitment on part of Govt.	2.72**	0.607
In availability of manufactured organic fertilizer	2.67**	0.658
Lack of sound national organic framework	2.32**	0.843

Source: field survey, 2015

Note: ** = High constraint, * = Low constraint

Effect of Socio-Economic Characteristics of Rice Farmers on Adoption of Organic Farming Technologies

Result of logit regression analysis that was used to test the effect of the socio-economic of the rice farmers on the adoption of organic farming technology is presented in Table 6. From the result, R^2 was 0.640, implying that the factors in the model accounted for only 64.0% of the variations in the probability to adopt organic farming technologies. There are, therefore, other variables that affect the respondents' probability to adopt organic fertilizers that were not captured in the regression model. The Chi-square statistics (25.694) is however, significant (0.012) at 5% level of probability, indicating that the variables significantly affected respondents' adoption of organic fertilizers.From the result of the analysis age had a negative coefficient (-0.688) and was significant at (0.076) 10 level of probability. This implies that while controlling the other variables, increase in age decreases the likelihood of adopting organic fertilizers by a factor of 0.502 (EXP (B) = 0.502). This result agrees with the findings of Odendo *et al.* (2009) who discovered that age of household heads was negatively associated with the adoption of innovations. The findings also revealed that farming experience had a positive coefficient (0.822) and was significant at (0.095) 10% level of probability. This implies that increase in farming experience increases the likelihood of adoption of organic fertilizers by a factor 2.276 (EXP (B) = 2.276). This result however, disagrees with the findings of Bamire et al. (2002) who concluded that farming experience is negatively related to adoption of innovations. This shows that older and more experienced farmers are more willing to bear risk of adoption of organic farming technologies. Membership of social organizations was found to have a negative coefficient (-12.363) and was significant at (0.100)10% level of probability. This means that being a member of social organization(s) decreases the likelihood of adopting organic fertilizers and organic practices by a factor of 0.100 (EXP (B) = 0.100). The finding is contrary to that of Agwu (2006) who reported that membership of social organizations positively influenced adoption of technology. The deviation from the apriori expectation could be due to lack of presence of extension agents who are expected to pass information on new technologies through social organisations.

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Table 6: logistic regression of determinants of adoption of organic farming technologies by rice farmers

Variable	B	S.E	Wald	Sign.	Exp(B)
Age	-0.688	0.399	3.139	0.076***	0.502
Sex	0.49	2.298	0.049	0.828	1.647
Marital status	-2.310	2.285	1.021	0.312	0.099
Household size	-0.019	0.249	0.006	0.938	0.981
Years of education	0.368	0.290	1.606	0.205	1.444
Farm size	-0.629	0.426	2.176	0.140	0.533
Farming experience	0.822	0.492	2.794	0.095***	2.276
Annual farm income	0.000	0.000	0.000	0.984	1.000
No. of extension Contacts	4.527	2.906	2.428	0.119	92.501
Member of social organization	-12.363	7.506	2.713	0.100***	0.100
Constant	23.565	12.778	3.401	0.065	1.7E10
Chi square = 25.694					
Prob > $\chi 2$ = 0.012					
Nagelkerke R2 = 0.640					

Source: field survey, 2015

Note: * ** * t-ratio significant at 1%, 5% and 10% levels respectively**

CONCLUSION AND RECOMMENDATIONS

The study concluded that farmyard manure, green manure, crop rotation, mulching, shifting cultivation and bush fallowing were the organic farming technologies perceived to be available and adopted by rice farmers the study area. The perceived constraints were attributed to the inherent characteristics of organic fertilizers which include bulkiness, slow decomposition, slow nutrient release and offensive smell. Based on the finding of the study, the following recommendation were made:

i. There is need for farmers to be given skill-based training on how to make compost, farm yard manure and on the general principles of organic farming
ii. Organic fertilizer plants should be established in Benue State to ensure availability of manufactured organic fertilizers to farmers and reduce the problem of bulkiness.
iii. Extension organizations, especially Agricultural Development Programmes' (ADPs) staff should ensure regular contacts with farmers to keep them abreast of available innovations on organic fertilizers that are available.

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