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Factors Influencing Arable Crop Farmers' Willingness to Adopt Bio-Organic Technology in Ondo State, Nigeria

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Ikuerowo, Joseph Olubukun
Department of Agricultural Economics and Extension
Olusegun Agagu University of Science and Technology, Okitipupa
Ondo State, Nigeria
Email: ikuerowojoseph@gmail.com; Phone: +2348038430145

Tehinloju, Olanrewaju Abidemi
Department of Agricultural Economics and Extension
Olusegun Agagu University of Science and Technology, Okitipupa
Ondo State, Nigeria
Email: tehinlojulanre@gmail.com; Phone: 07065874127

Abstract

The study analysed factors influencing arable crop farmers' willingness to adopt bio-organic technology in Ondo State. Multi-stage sampling procedure was used to select 180 respondents for the study. Questionnaire was used to collect data which were analysed with percentages, 4-point likert-type scale and logit regression model. The findings revealed that the females (67.0%) dominated arable crop farming, the mean age was 41 years and 55.6% had formal education. All the respondents are aware of mixed cropping and crop rotation and less than 50% were aware of alley cropping (43.2) and biological pest control (26.6). The majority (67.6%) of the arable crop farmers had unfavourable perception of bio-organic technology. The study showed that increase in extension visit, membership of farmers' group, access to information and education positively increase the likelihood of farmers to adopt bio-organic technology. Enhanced extension services that would adequately support farmer and extended education programs geared towards broadening farmers' knowledge on bio-organic technology should be promoted.

Keywords: willingness, adoption, bio-organic technology, arable crop farmer

Introduction

Agriculture is closely related to human welfare and livelihoods in sub-Saharan Africa. It is the largest employment sector which occupies over 70% of the working population (International Labour Organization, ILO, 2018). A large percentage of the population lives in rural areas and relies on subsistence agriculture. Nigeria population is continually on the rise, currently estimated at over 170 million people making it the most populous country in Africa (International Organization for Migration, 2016). The soaring population indicated that there is pressure on the resource base. The resultant effects are the increasing in food demands by urban consumers and rural farmers, the expansion of activation areas, reduced fallow interval with lack of inputs necessary to compensate and reduced soil fertility (Mgbada, Ohajianya & Nzeh, 2016). In the face of this uncertainty in the capacity of available resources and technologies to satisfy the demands of the growing

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population for food and other agricultural commodities, bio-organic technology adoption becomes an alternative.

The practice of organic agriculture in an organized manner is still new to the country, with less than ten years of application (Ekanem & Okon, 2019). As of 2007, Nigeria had 3,154 ha under organic agriculture of which 59 ha were fully converted and managed by a few farmers and NGO's, with little government involvement. However, it was reported that in 2010, land under organic production increased to 11,979 ha (Ekanem & Okon, 2019). In recent times, global attention has shifted to organic production technologies as alternative ways of managing hazards imposed by direct exposures to extreme events towards sustainable and environment friendly food production economy. Bio-organic materials such as organic wastes, soil residues, wood wastes and other biological materials have become prominent. Organic farming is a production system that largely avoids the use of synthetically compounded fertilizers, pesticides, growth regulators and livestock feed additives (Djokoto, Owusu & Awunyo-Victor, 2016). The core objectives of organic farming include production of high quality foods in harmony with natural systems and cycles, enhancing biological cycles within the farming system which involve microorganisms, soil flora and fauna, plants and animals' wastes, maintaining long-term soil fertility, creating balance between crop production and livestock and minimizing all forms of pollution (Djokoto, *et al*., 2016).

The adoption of bio-organic nutrients by arable crop farmers will reinforce the short-term and long-term food security objectives of many developing economies including Nigeria. In the sub-Saharan Africa, environmental degradation and precarious health hazards are key threats linked to continue use of conventional production inputs. United Nations Environment Programme, UNEP, (2011) defines bio-organic agriculture as one that results in improved human well-being and social equity while significantly reducing environmental risks and ecological scarcities. Bio-organic agriculture is a related concept to low carbon, renewable energy, low-carbon transport, energy-efficient buildings, clean technologies, improved waste management, improved freshwater provision, sustainable agriculture, forestry, and fisheries. Nigeria is well-positioned in the transition to a bio-organic agriculture given her low-carbon profile and natural resources endowment. Nigerian transition to bio-organic agriculture is therefore critical to improving sustainable environment. Bio-organic technology adoption and practice could play a key role in reducing the consequences of exposure to extreme climates. Given such a context, the shift in agricultural production away from the conventional farming to organic farming would highly be a motivation for food security and sustainable food production in Nigeria-Two critical policy questions remain: Would Nigerian farmers be willing to adopt bio-organic technology? What are the factors influencing arable crop farmers' willingness to adopt bio-organic technology?

Many of the known conventional farming practices such as use of synthetic fertilizers, pesticides application, fossil fuels and frequent planting of single crops are ecologically unfriendly to the natural environment and soil fertility. Sustainable

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agricultural practices are intricately linked with ecological sustainability which includes improved soil fertility; increased ability of the topsoil to retain organic matter; reducing use of hazardous chemical fertilizers; improving green cover to conserve soil; and increase carbon sequestration (Tugrul, 2019). Sustainable agriculture offers a more holistic approach to farming than conventional in that it relies on ecosystem services and is typically much less detrimental to the surrounding landscape.

Despite the considerable interest in organic farming as an important aspect of green economy, the Nigerian bio-organic sector still remains underdeveloped. Therefore, to rally support for the sector, it is important to understand the perception of farmers about bio-organic technology and the willingness to accept same. The adoption of bio-organic technology by arable crop farmers is driven by a variety of reasons which range from socioeconomic, structural and institutional factors (Ullah, Khan, Zheng & Ali, 2018). However, access to information and extension services (Mwangi & Kariuki, 2015) and farmers' attitudes (Ghosh, Sohel, Ara, Sahara, Nur & Hassan, 2019) are also crucial in adoption decisions. There is a very low interest in bio-organic production among Nigerian farmers (Atungwu, Agbonlahor, Aiyelaagbe & Olowe, 2016). It is therefore essential to examine level of awareness and knowledge of bio-organic production technologies as management practice over conventional systems. The study determined arable crop farmers' level of awareness on bio-organic technology; examine arable crop farmers' perception on the use of bio-organic technology and analyse the factors influencing arable crop farmers' willingness to adopt bio-organic technology in the area.

Methodology

The study was conducted in Ondo State, Nigeria. Ondo State lies between Latitudes 5º 45´ and 8º 15´ north of the equator and Longitude 4º 30´ and 6º 60´ east of the Greenwich Meridian. Ondo State has eighteen (18) Local Government Areas with an estimated population of about 3.4 million inhabitants (National Population Commission [NPC], 2006).

The data was collected with the aid of structured questionnaire administered on arable crop farmers. Multi-stage sampling procedure was used to select respondents for the study. The first stage involved purposive selection of one LGA (Okitipupa, Akure North and Owo) from each of the three senatorial districts in Ondo State. This selection is to ensure representative sample. The second stage involved random selection of two communities (Okitipupa-Aye and Ilutitun, Akure North-Ogbese and Iju, Owo-Iyere and Uso) each from the selected LGAs. In the third stage, thirty (30) arable crops farmers were randomly selected from each of the selected community, making a sample size of one hundred and eighty (180).

Percentages and mean were used to analyse the economic characteristics of the respondents. Logit regression model was used to analyse factors influencing arable crop farmers' willingness to adopt bio-organic technology. The logit regression model is a unit or multivariate technique which allows for estimating the probability that an event occurs or not by predicting a binary dependent outcome from a set of independent variables. The logit model is based on cumulative logistic probability

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function and it is computationally tractable. According to Gujarati and Porter (2009), it is expressed as:

$P_i = \mathrm{E}\,(\mathrm{Y} = 1 \mid \mathrm{X_i}) = \beta_0 + \beta_i X_i$

For ease of estimation, the equation was further expressed as;

$P_i = \frac{1}{1+e^{-z_i}} = \frac{e^{Z_i}}{1+e^{Z_i}}$

Where:

P_i = Probability of an event occurring

$Z_i = \beta_0 + \beta_i X_i$ (i=1, 2, 3, -- ----------8)

The empirical model of the logistic regression used for this study assumed that the probability of arable crop farmers' willingness to adopt bio-organic technology is expressed as:

$$P_i = \frac{e^{\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+\beta_8X_8}}{1+e^{\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+\beta_8X_8}}$$

P_i ranged between zero and one and it is non-linearly related to Z_i. Z_i is the stimulus index which ranged from minus to plus infinity and it is expressed as:

$$Z_i = \left(Ln\frac{P_i}{1-P_i} \right) =$$

$$\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \mu \ldots\ldots$$

To obtain the value of Z_i the likelihood of observing the sample was formed by introducing a dichotomous response variable. The explicit Logit model is expressed as:

$$Y_i^* = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \mu$$

Where;

Y_i^*= dichotomous response variable (1= willing to adopt bio-organic technolgy; 0= otherwise).The X variables used were:

β_o = Intercept

β_1 - - - - β_8 = estimated parameters

X_1 - - - - X_8 = set of independent variables

X_1 = Age (years)

X_2 = Year of Education (number of years spent in school)

X_3= Farming experience (years)

X_4 = Membership of Farmers group (dummy yes 1, 0 if no)

X_5= Extension contact (number of visit)

X_6 = Access to information on bio-organic technology (dummy yes1, no 0)

X_7 = household size

X_8 = farm size

The perception of respondents to bio-organic technology was assessed using 10-statements on a 4-point scale of Strongly agree (4) agrees (3), disagrees (2) and strongly disagrees (1) and a cut-off point of 2.5 was used to ascertain respondents' perception. With a calculated grand mean of 2.69, respondents' perception was

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classified as favourable and unfavourable (Ighoro, Alakpa, Kayenikan & Awhereno, 2019)

Results and Discussion

Characteristics of Arable Crop Farmers

About 59% of the farmers belong to one farmer's group and the other. Involvement in association/groups is one of the determinants of innovation adoption as it gives the farmers opportunity to share information on innovation. Member of farmer organizations have better access to specific knowledge and information about new practices and technologies (Liu, Bruins, & Heberling, 2018). About 41% and 31% of the farmers indicated once and twice extension visit per year, respectively. It could be hypothesized that extension services in the study area was generally low. Only about 39% of the farmer had access to information on bio-organic technology. This implied that limited access to information by respondents could impede on the willingness to adopt bio-organic technology in the study

Table 1: Respondents' characteristics

Variable	Percentage (%)
Membership of farmers' group	
Yes	41.6
Extension contact (number of visit in a year)	
Once	40.6
Twice	31.1
Three times	11.7
Four times	16.7

Source: Field Survey, 2019

Arable Farmers' Level of Awareness of Bio-organic Technology

Table 2 shows that all the respondents were aware of mixed cropping as well as organic manure. The proportion of the respondents that were aware of mulching and green manure was 79.2 percent apiece. Also, they were aware of animal maure (83.7%), minimum tillage (71.0) and cover cropping (65.5%). The result further reveals that the proportion of the respondents aware of alley cropping (43.2%) and biological pest (26.6%). This result is consistent with the findings Ekanem & Okon, (2019) that arable crop farmers are aware of organic practices.

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Table 2: L**evel of awareness of bio-organic technology**

Bio-organic technology	**Aware Percentage (%)**
Crop rotation	100.0
Mulching	79.2
Biological pest control	26.6
Mixed cropping	100.0
Alley cropping	43.2
Animal manure	83.7
Green manure	79.2
Cover cropping	65.5
Minimum tillage	71.0

Source: Field Survey, 2019

Perception of Respondents to Bio-Organic Technology

Table 3 indicates the perception of respondents on the use of bio-organic technology. Respondents agreed that the cost involved in bio-organic technology is high compared to synthetic fertilizers ($\bar{X}$= 2.74) but that bio-organic technology results in safe and healthy products ($\bar{X}$ =2.74) with bio-organic technology being strenuous and more time is expended ($\bar{X}$ =2.84). Also, the respondents agreed that low awareness of bio-organic technology ($\bar{X}$ =2.96 and asserted that bio-organic products had low market demand ($\bar{X}$ = 2.64).

The findings indicate that 67.6% of respondents had unfavourable perception and 32.39% had favourable perception. This implied that the majority of the arable crop farmers still practice conventional farming despite the perceived benefits inherent in bio-organic technology. This result is similar to the findings of Oladeji, Ajadi, Oyesola & Sangotegbe, (2015), Ighoro et. al., (2019) that most vegetables farmers have unfavourable perception of organic farming practices.

Table 3: Perception of respondents to organic vegetable farming

Perception statement	**Mean**	**SD**
Cost involved in is high compared to sythetic fertilizers	2.74	1.06
Bio-organic technology practices help to suppresses weed	1.77	0.59
There is low market demand for bio-organic products	2.64	1.06
Bio-organic technology results in safe and healthy crops	2.74	0.84
There is low awareness of bio-organic technology	2.96	0.99
It guarantees increased productivity	3.04	1.05
It could promote the growth of pathogens and diseases	2.44	0.81
Bio-organic technology allows natural production of nutrients in the soil	1.86	0.62
It is strenuous and more time is expended	2.84	1.02
Bio-organic technology is friendly to the environment	2.86	1.04

Source: Field Survey, 2019

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Factors Influencing Arable Crop Farmers' Willingness to Adopt Bio-Organic Technology

Table 4 present factors influencing arable crop farmers' willingness to adopt bio-organic technology- (log likelihood = -67.165 and Chi^2 =189.01 and P≤ 0.05). The pseudo R^2 value of 0.64, indicates that the overall is significant and good fit. The explanatory variables included in the model are collectively explaining the decision of the farmers to adopt bio-organic technology. Out of the eight variables included in the model, extension contact, membership of farmers' group, access to information and education were the significant factors that influences willingness to adopt bio-organic technology.

Table 4 reveal that extension contact was found to be positive with marginal value of 0.02 (P≤0.05) and significantly related to arable crop farmers decision to adopt bio-organic technology in the study area. This implies that respondents with high number of extension contact have greater chance of adopting the technology. Altalb, Filipek & Skowron (2015) indicated that agricultural extension is responsible for the transfer of agricultural technologies to farmers and convince farmers to adopt modern agricultural techniques. Extension agents are expected to provide farmers with useful information on production technologies, efficient input combinations and market information, all aimed at enhancing farm productivity and incomes (Nyuor, Donkor, Aidoo, Buah, Naob, Nutsugah, Bayala & Zougmore, 2016). The result is consistent with the findings of Gelgo, Mshenga & Zemelu, (2017), Ali, Awuni, and Danso- Abbeam , (2018) that extension contact influences adoption of technology.

Access to information on bio-organic technology also positively and significantly influences farmers' willingness to adopt bio-organic technology. The result shows that the willingness to adopt bio-organic technology increased by 1.2% as the farmers gained more access to information on bio-organic technology. This result suggests that arable crop farmers who have more information about the benefits inherent in bio-organic technology are more likely to adopt it on their farms.
The coefficient of education was significant level and had positive influence on willingness to adopt bio-organic technology. The marginal value of 0.015 indicated that one percent increase in education will bring about 1.5% in the probability of adopting bio-organic technology. By implication, it means that as the arable crop farmers gained one year of education the willingness to adopt bio-organic technology would increase by 1.5%. This result is similar to the findings of Nwaiwu, (2015) that education enhances access to a number of economic activities and enables the farmers to understand and adopt conservation measures.

Membership of farmers' group had positive and significant effect on willingness to adopt bio-organic technology. The marginal value of 0.043 implied that being a member of farmers' group would increase the probability of adopting bio-organic technology by 4.3%. Belonging to a farmer's association promotes access to information about innovation through other member (Wossen, Alidoulaye, Alene, Haile, Faleke, Olanrewaju & Manyong, 2017).

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Table 4: Factors influencing arable crop farmers' willingness to adopt bio-organic technology

Variable	Coeffient	Std Error	Marginal effect
Age	0.027	0.029	0.263
Education	2.508**	1.050	0.015
Household size	0.090	0.083	0.087
Farm size	0.221	0.379	0.041
Access to Information	0.063**	0.029	0.012
Extension contact	0.446**	0.142	0.020
Membership of Framers' group	0.223**	0.103	0.043
Farming Experience	0.060	0.052	0.363
Loglikelihood= -67.165			
Pseudo R^2= 23.63			
Chi^2Value = 189.01			
Observations= 180			

Field Data 2019 (P≤ 0.05)**

Conclusion and Recommendations

Arable crop farmers in the study area were aware of bio-organic technology but the majority had unfavourable perceptions about the technology. Extension contact, information access, education and membership of farmers' group are the significant factors that influence willingness to adopt bio-organic technology.

Enhanced extension services that would adequately support farmer and extended education programs geared towards broadening farmers' knowledge on benefits inherent in bio-organic technology should be promoted. Also, formation of farmers' group should be encouraged as it enhances information sharing about bio-organic technology, hence favouring the ease of adoption of bio-organic technology.

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