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Analysis of the Adoption of Integrated Soil Fertility Management Technology among Farmers in Jere local Government Area of Borno State

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Abstract: *The study assessed the adoption of Integrated Soil Fertility Management (ISFM) Technology package promoted by rice farmers in Jere local government area of Borno State, Nigeria. Multi stage sampling procedure was used to select 90 respondents. Primary data was collected with questionnaire. Percentage, mean and logistic regressions were used to analyze the data. The result revealed that majority (97.8%) of the respondents were males with a mean age of 48 years, mean household size of 11 persons with a mean farming experience of 14 years. The result further showed that majority (72.2%) of the respondents are married with about 37.7% having secondary education with a mean total land area allocated for ISFM technology by the respondents was 5 ha. The logistic regression result on the factors influencing the adoption of ISFM technology revealed that age (0.034), income (0.025), gender (0.013), educational status (0.010) and farming experience (0.008) were all significant at P≤5% and P≤10% level with an R^2 (Cox and Snell) value of 0.388 and an adjusted Pseudo R^2 (Nagelkere) value of 0.295 respectively. The major constraint to the adoption of ISFM technology among rice farmers was lack of fund. It was therefore recommended that there should be deployment of more extension agents in the study area to disseminate agricultural technology information to farmers.*

Keywords: *Adoption, Experience, Constraints, Dissemination, Education, Technology*

Introduction

Soil is a natural body comprised of solids minerals and organic matter, liquid and gases that occur on the land surface. As a medium for plant growth, health soils are essential for healthy plant growth, human nutrition and water filtration. Healthy soil supports a landscape that is more resilient to the impacts of drought, flood or fire ((FAO, 2021). Soil deterioration presents a threat to food security and sustainable food production as well as posing a challenge to preservation of natural resources for smallholder farmers (Adeola, 2019). Soil fertility decline therefore, remain a major cause for the decline in per capita food availability on smallholder farms of Sub Saharan Africa (SSA). In Africa, per capita food production has been declining over the last two decades contrary to the global trend. The growth rate for cereal grain

yield in Uganda is about 1%, while population growth is about 3% (Bationo *et al.,* 2019). Land degradation is a major problem in Nigeria, with some anecdotal evidence suggesting a loss of 8.60% of its Gross Domestic Product (GDP) due to poor land management that undermines efforts to reduce household poverty (FAO, 2005 Thiombiano and Tourino-Soto, 2007). In order to address the challenges of soil nutrients depletion therefore, studies in Nigeria and other areas in Sub Saharan Africa have identified Integrated Soil Fertility Management (ISFM) as a technology that would help the poor-resource farmers mitigate problems of food insecurity and improve resilience of the soil capacity.

ISFM is a set of practices necessarily involving the use of fertilizers, organic inputs and improved germplasm combined with knowledge of how to adapt these practices to local conditions aimed at maximizing the agronomic use efficiently of applied nutrients (Wulystan, 2016). It is a strategic or technology that combines mineral fertilizers and locally available organic amendment such as grass, cow dung and dead plants and animal parts to improve soil fertility. It is increasingly seen in sub Saharan Africa as a way to improve fertilizer use efficiency and boost soil quality (Vanlauwe *et al.,* 2002; Place *et al.,* 2003). It is a set of agricultural practices adapted to local condition to maximize the nutrient and water use efficiency and improve agricultural productivity. Loevinsohn *et al.,* (2012) defines adoption as the integration of a new technology into existing practice and is usually preceded by a period of trying and some degree of adaptation. BonabanaWabbi (2002) defines adoption as a mental process an individual pass from first hearing about an innovation to final utilization of it.

Farm lands in several countries including Nigeria are characterized by widespread soil infertility which causes many crop failure and to make sufficient soil fertility replenishment, there is need to improvise the declining soil fertility. Soil nutrient balance are in deficit and the areas are also constrained by widespread soil nutrient mining which undermines the ability of many agrarian households to produce enough food for household sustenance, resulting in a rapidly expanding poverty among most rural households. With declining soil fertility and a build-up of striga hermonthica, a parasitic weed of many cereals; the net effect has been decline in land productivity and food shortages in a region which has potential to produce enough food for its increasing local population (Sadiq *et al.,* 2013). The specific objectives were to describe the socioeconomic characteristics of rice farmer's adopters of ISFM technology and to determine the factors influencing adoption of ISFM technologies among rice farmers in the study area.

Methodology

The study was conducted in Jere Local Government Area (LGA). It lies within latitudes 11° 56.8'' North and longitudes 13° 17'' E. It occupies a total land mass of 160 square kilometers (Borno State Ministry of Land and Survey Report, 2008). Jere LGA has a projected population of 211,204 in 2015 with an annual growth rate of 2.8 %(NPC, 2006). The area is also characterized by dry and hot seasons, with minimum temperature ranging from 15-20 °c, while the maximum temperature ranges between 37-45° c and total rainfall of 500mm to 700mm per annum (Nigerian Meteorological Agency, 2008). The rainy season is usually from May to October with low relative humidity and short wet season. The topography is generally low-land plain, and the soil is generally sandy with short grasses and thorny shrubs. The soil in the study area is sometimes water logged and suitable for cultivation of cereal crops such as rice, millet, fruits such as orange, and some vegetables. However, soil fertility depletion has been described as the single most

important constraint to food security in the region. A larger proportion of the soils have low inherent fertility (Inuwa *et al.,* 2019).

Both primary data and secondary information were used for this study. Primary data was obtained from the respondents through a structured questionnaire/interview schedules administered. Secondary information was sourced from journals, textbooks, Proceedings and Reports.

A multi-stage sampling procedure involving a combination of purposive and random sampling procedure were used to draw 90 rice farmers used in the study area. The first stage involved the purposive selection of six wards while the second stage involved the selection of two villages from each ward. In the third stage, a random selection of respondents proportionately from the sampling frame was done to arrive at 90 respondents used for the study. Data was analyzed using descriptive statistics such as frequency, percentages, mean, minimum, maximum and standard deviation while logistic regression model was employed to analyze the factors influencing the adoption ISFM technology in the study area. Logistic Regression Model

The use of Logit model for analysis is consistent with the literature on adoption (Rogers, 1983; Alston et al., 1995) which describes the process of adoption as taking on a logistic nature as adoption is a binary independent variable whether adopted or otherwise. The Model's expressed as:

$Y= \beta_0+ \beta_1X_1+\beta 2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6\ldots\ldots\ldots\ldots\ldots\ldots\beta_{11}X_{12}+ e$ (i). Where;

Y = (1= Adopters of ISFM technology and 0= otherwise) β= Intercept

X_{1-12} = Independent variables

E = Error term

Results and discussion

Socio-economic Characteristics of the Respondents

The analysis of the socioeconomic characteristics of the respondents is shown in the Table 1. The result showed a mean age of 48 with a minimum and maximum age of 33 and 72 respectively, with that majority (43.3%) of the respondents fall within the age bracket of 41-48 years of age. They are strong and in their youthful age. This is also in agreement with a lot of studies which included that of Adeola (2010). The results also indicate that the mean household size of the rice farmers was 11 with a minimum and maximum age of 1 and 13. This is evident because expectedly, the more people in a family, the higher the need for opportunities, hence the greater chances of adoption. This also concurs with the findings of (Adeola, 2010). The sex distribution showed that majority (97.8%) of the respondents were males. This is because male are most saddled with family responsibilities and therefore constitute the majority. Also, the majority (72.2%) of the respondents are married while the rest were either single (13%), divorced (15%) and widowed (2%).

Table 1: Socio economic Characteristics of the Respondents

Variable	Frequency	Percentage	Mean	Min	Max	SD
Age(yrs)						
33-40	17	18.9	48	33	72	7.22
41-48	39	43.3				
49-56	18	20				
57-64	16	17.8				
65-72						
HHS (No)						
1-3	5	5.5	11	1	13	3.13
4-6	4	4.4				
7-9	16	17.8				
10-12	42	46.7				
>13	23	25.6				
Farming Experience						
2-6	15	16.7	14	2	22	6.92
7-11	26	28.9				
12-16	30	33.3				
17-21	15	16.7				
>22 Sex	4	4.4				
Male	88	97.8				
Female	2	2.2				
Marital Status						
Married	65	72.2				
Single	13	14.4				
Divorced	10	11.1				
Widow	2	2.4				
Level of Education						
No formal education	22	24.4				
Primary school	22	22.4				
Secondary school	34	37.7				
Post-Secondary	12	13.5				
Total Land Area (ha)			5	2	6	1.12
<2	35	38.9				
2-3.9	43	47.8				
4-5.9	11	12.2				
>6	1	1.1				
Source of Land						
Hired	67	74.4				
Personal	23	25.6				
Organization Membership (member)						
Yes	65	72.2				
No	25	27.8				
TOTAL	90	100				

Source: Field Survey, 2017

The positive skeweness to the married side is due mainly to the fact that married persons see it necessary to take care of family and hence found firmly in farming. The analysis of the distribution of the respondents according to their experiences in farming revealed that the mean experience was 14 years with a minimum and maximum experience of 2 and 22. This is because this category comprises mainly of youth who are despite having few years of farming but also strong. Concentration of agile people decreases with age. The distribution of the respondents according to their level of education reveals that the highest education level attained by most (37.7%) of them is secondary school. A great number of them (30.6%) had no formal education. This is evident by the rural characteristic of the study area. The source of land acquisition indicated that majority (74.4%) of the respondents make use of their personal land while only about (25.5%) used hired land for their cultivation. This portrays a typical characteristic of the rural people who own only small pieces of land. Table 1 also shows that majority (72.2%) of the respondents do not belong to any farmer or related organization, while the remaining are not members of farmer's organization. This however, is contrary to the findings of (Place, 2003) who opined that an additional advantage to adopt technologies is their belongingness to organizations.

Table 2: Factors Influencing Adoption of ISFM Technology

Independent Variables	B	S.E	Sig	Exp(B)
Age	0.051	0.310	0.034*	1.344
Household size	0.119	0.170	0.416^{NS}	1.233
Income	0.290	0.000	0.025*	2.000
Gender	0.122	0.049	0.013*	2.361
Educational status	1.114	0.989	0.010*	1.133
Marital status	2.011	0.183	0.293^{NS}	0.000
Farming Experience	1.034	0.000	0.008**	3.445
Constant	0.676	1.814	0.139^{NS}	0.000
$X^2 = 63.244$ d.f = 7 Pseudo $R^2 = 0.388$ (Cox and snell)				
Pseudo $R^2 = 0.295$ (Nagelkere)				
2 log likelihood= 189.259				
Adoption of ISFM technologies				

Source: Field Survey, 2017

*Significant @ 10%, ** Significant @ 5%, *** Significant @ 1%, NS= Not Significant

The logistic regression analysis was conducted to predict the socio-economic factors affecting the adoption of ISFM technology among the respondents and presented in Table 2. Out of the fourteen (7) variables analyzed, the result indicated that age, income, gender, educational status and farming experience were all significant at 5% and 10% levels of probability respectively. This show that these variables had influence on the adoption of the ISFM technology in the study area and the variables have positive contributions to the model with the values of R^2 cox and snell and R^2 Nagelkere of 0.388 (38%) and 0.295 (29%). However, house hold size and marital status had negative influence on adoption of the technology.

Conclusion

The adoption of Integrated Soil Fertility Management technology in the study area is promising and justifiable among respondents as shown from the socioeconomic variables of the respondents. Factors such as Age, Gender, farming experience, Level of education, Income, Source of land and Total land area owned strongly influenced adoption of ISFM technology among the respondents in the study area. Also Logit result also showed that variables such as Age, Income, Educational status and Farming experience were all significant and influence adoption.

Recommendations

The study therefore recommends that;

-The technology need to be simplified to a level the farmers can understand better.

- Young and agile youths should be encouraging to partake in agricultural activities as the study showed that the mean age of the farmers are all young

- The government should also provide educational programs to help increase the knowledge of the farmers (especially the women) for them to render more assistance.

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