(RESEARCH ARTICLE)

Effect of adoption of sustainable agricultural practices among plantain farmers in Yenagoa agricultural zone of Bayelsa State, Nigeria

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Abstract

The study analyzed adoption of sustainable agricultural practices among plantain farmers in Yenagoa agricultural zone of Bayelsa State, Nigeria. Purposive and multi-stage random sampling techniques were used to select 100 plantain farmers from ten communities in the study area. Data were collected using structured questionnaire and were analyzed using descriptive and inferential statistics such as (ANOVA) and multiple regression analysis. The findings showed that plantain farmers had a mean age of 39 years, 54.0% of plantain farmers were females while 46.0% were females. The result shows that planting time (82.0%), spacing (79.0%), pruning (65.0%) and new varieties (53.0%) were the various sustainable agricultural practices provided by extension in the study area. The study further shows that sucker multiplication ($\bar{x}$ = 2.76), post-harvest ($\bar{x}$ =2.60) and types of suckers ($\bar{x}$ = 2.28) were the sustainable agricultural practices adopted by plantain farmers. Plantain farmers were aware of the following sustainable agricultural practices provided by extension: spacing (100%), pruning (99%), planting time (97%), mulching (77.0%) and staking (61.0%). The study also shows that extension was effective in result demonstration ($\bar{x}$ =3.32), agricultural extension visit ($\bar{x}$ = 3.05), number of trainings ($\bar{x}$ =2.99), method demonstration ($\bar{x}$ =2.81), research extension linkage ($\bar{x}$ =2.77) and number of meetings scheduled that held ($\bar{x}$ =2.61). The ANOVA result showed that there was significant difference in the effectiveness of extension in sustainable agricultural practices dissemination among plantain farmers in the study area at 5% level of significance. The multiple regression analysis revealed that age (3.626***) and household size (4.165***) influenced the adoption of sustainable agricultural practices at 1% level of significance while marital status (2.578**), income (2.519**) and farm size (2.641**) influenced the adoption of sustainable agricultural practices at 5% level of significance. The study concluded that there was high level of adoption of sustainable agricultural practices by plantain farmers in the study area. Hence, it recommends that extension should vigorously promote the adoption of sustainable agricultural practices for increased plantain production.

Keywords: Adoption; Sustainable; Agriculture; Plantain and practice

1. Introduction

Nigerian is known for its vast oil and gas resource, however, agriculture had always been the main stay of Nigeria's economy, and accounted for most of its gross domestic product, until recent years (Hamadina and Hamadina, 2015). They further submitted that agriculture is mostly practiced in Nigeria (Bayelsa State inclusive) at subsistence level with little or no mechanization and the farm size is usually less than one hectare. The adoption of sustainable agricultural

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practices has the potential to improve agricultural sustainability through reduction in agricultural input and less waste generation from the resource (Mwalupso, Korotoumou, Eshetie, Alavo and Tiian, 2019).

Agricultural policies instigated in Nigeria in the last decade, such as the E-wallet programme and Fadama, have brought increased production and improvement in the livelihood and standard of living of the rural population specially in Bayelsa State, thereby stimulating great potential for adoption of sustainable agricultural practices (Apata and Saliu, 2016).

Sustainable agricultural practice is precarious to food security, rural income and employment generation, and economic growth in any given agro-economy. Adoption of various sustainable agricultural practices in reducing poverty in Bayelsa has received huge attention, it remains under-researched (Agbarevo and Okringbo, 2020).

It is very obvious that the yield per hectare in plantain production took a down-ward trend due to low level of adoption of sustainable agricultural practices developed by research for almost a decade (Food and Agricultural Organization, 2011 cited in Kainga, 2013). Effect of adoption of sustainable agricultural practices among plantain farmers in Yenagoa agricultural zone of Bayelsa State, Nigeria are about this is yet to be ascertained. There is no empirical evidence to indicate that a study of the nature has been conducted. It was against this backdrop that this paper seeks to examine the effect of adoption of sustainable agricultural practices among plantain farmers in Yenagoa agricultural zone of Bayelsa State, Nigeria, to fill the gap in knowledge.

Objectives

This study specifically aimed to:

- Describe the economic characteristics of the respondents in the study area.
- Ascertain sustainable agricultural practices provided by extension.
- Ascertain the level of awareness of plantain farmers on sustainable agricultural mine.
- Examine the effectiveness of extension in sustainable agricultural practice dissemination among plantain farmers.

1.1. Hypotheses

1.1.1. HO_1

There is no significant difference in the effectiveness of extension in sustainable agricultural practices dissemination among plantain farmers in the study area.

1.1.2. HO_2

Socio-economic characteristics of plantain farmers do not significantly influence their level of adoption of sustainable agricultural practices in study area.

2. Material and methods

The study was conducted in Yenagoa Local Government Area of Bayelsa State. The study area lies along latitudes between 4° 48' 00'' North and 5° 24' 10''East; and longitudes between 6° 12' 00''E and 6° 39' 30''E. Yenagoa Local Government area share boundary with Rivers State on the North and East, Delta State on the North West and West, Ogbia LGA on the South East and Southern Ijaw on the South west. Yenagoa Local Government Area had a population of 352, 285 by 1996 estimate (National Bureau of Statistics, 2006). Purposive sampling technique was used to selection of Yenagoa Agricultural Zone, which is the host to Agricultural Development Programmes (ADP). Stratified sampling was used in the selection of the sample size of 100. In the first stage, two extension blocks were randomly selected from the Zone, while in the second stage, 2sub-circle were selected from each block, giving a total of 5 sub-circles. In the third stage, ten farmers were randomly selected from each sub-circle, giving a sample size of one hundred farmers. Data collected through structured questionnaire were analyzed with descriptive statistic, such as mean, while ANOVA and multiple regression was used to test the hypotheses. The questionnaire was a 3-point rating scale of Always adopted, Adopted and not adopted to which numerical values 3, 2 and 1 were assigned respectively. The scores up 6, and gives a mean of 2.0 when divided by 3. Hence, the cut-off point of 2.0 as the upper limit was used to determine the adoption categories.

2.1. Model specification

$$Yi = bo + b1X1 + b2X2 + b3X3 + b4X4 + b5X5 + ei$$

Where;

Y =level of Adoption (measured on a 4-point rating scale)
X_1 = Age (measured in years)
X_2 = Sex (male = 1, female =0)
X_3 =Household size (number of persons eating in the same pot)
X_4 = Income (Naira)
X_5 = Marital Status (1= married, 0 otherwise)
X_6 = Farm size (Ha)
e_i = error term
ANOVA as used as Okringbo *et al.* (2019) is given by the formula:

$$F - statistics = \frac{\text{Between groups mean square (BGMS)}}{\text{Within groups mean square (WGMS)}} \ldots\ldots\ldots (1)$$

3. Results and discussion

The result in Table 1 showed that 42.0% of plantain farmers were within the age bracket of 34-41 years old while 29.0% of the farmers were within the age bracket of 26-33 years. The mean age of the plantain farmers was 39 years old. This implies that most of the plantain farmers in the study area were still in their productive stage in life and would be energetic enough to participate actively in farming activities. More so, it can be inferred that this group of young and energetic farmers would be willing to adopt sustainable agricultural practices that will lead to increased yield. This finding is in conformity with that of Ominikari (2021) who reported a mean age of 39.8 years among sampled rural farmers in Bayelsa State. This finding also agrees with those of Kalu, Nwachukwu and Apu (2021) who reported a mean age of 39.8 years among sampled farmers in Ebonyi State. The result further showed that 66.0% of the plantain farmers were married while 33.3% were single. This implies that married individuals dominated among the sampled farmers in the study area. Marital status is an important predisposing factor to enhance income and improve food production. This finding is in tandem with that of Ayoko (2019) which reported that the majority (66.11%) of sampled rice farmers in Ebonyi State were married. Majority 60.0% of the plantain farmers had a household size of between 4 and 6 persons per household while 40.0% of them had a household size of between 7 and 9 persons. The mean household size of the plantain farmers was 6 persons per household. This implies that the plantain farmers in the study area had relatively large household sizes. This implies that there would be added responsibilities of providing for these large families which could be aided by the adoption of sustainable agricultural practices for enhanced agricultural production. Similarly, married farmers would likely have access to production variables such as land and labour which would reduce the cost of hired labour and enhance their agricultural production. This finding is similar to that of Ajunwa (2019) who reported a mean house hold size of 6 persons among sampled farmers in Imo State. The result still revealed that 71.0% of farmers in the study area had farming experience of between 1-10 years.

Table 2 shows the frequency distribution according to the various sustainable agricultural practices provided by extension in the study area. The result shows that planting time (82.0%), spacing (79.0%), type of sucker (75.0%), mulching (72.0%), staking (68.0%), pruning (65.0%), conventional agricultural practice (64.0%) and sucker multiplication (61.0%) were the various sustainable agricultural practices provided by extension in the study area. This implies that sustainable practices such as planting time, spacing, type of sucker, mulching, staking, pruning, conventional agricultural practice, sucker multiplication and new varieties were the various sustainable agricultural practices provided by extension in the study area.

Table 3 shows the mean scores distribution according to the adoption level of sustainable agricultural practices among plantain farmers in Yenagoa Agricultural Zone of Bayelsa State. The result shows that spacing ($\bar{x}$ = 3.00) planting time ($\bar{x}$ = 2.91), mulching ($\bar{x}$ = 2.78), sucker multiplication ($\bar{x}$ = 2.76), pruning ($\bar{x}$ = 2.70), post-harvest ($\bar{x}$ = 2.60) and types of suckers ($\bar{x}$ = 2.28) were the sustainable agricultural practices adopted by plantain farmers in the study area. These mean ratings were above the bench mark mean score of 2.05. This might be attributed to the fact that the plantain farmers perceived these agricultural practices to be relevant to increased crop yield. This is in contrary to the findings of Mgbada, Ohajianya and Nzeh (2016) who reported low level of use of sustainable agricultural practices among sampled cassava farmers in Ebonyi State.

Table 1 Distribution of plantain farmers by their socio-economic characteristics

Variables	Frequency (n=100)	Percentage (%)	Mean
Age (years)			
18- 25	2	2.0	
26- 33	20	29.0	
34- 41	42	42.0	
42 and above	36	27.0	39 years
Sex			
Male	46	46.0	
Female	54	54.0	
Marital status			
Single	33	33.0	
Married	66	66.0	
Divorced	1	1.0	
Household size			
1 – 3	-	-	
4 – 6	60	60.0	
7 – 9	40	40.0	6 persons
Educational qualification			
No formal education	29	29.0	
Primary education	68	68.0	
Secondary education	3	3.0	
Tertiary education	-	-	
Farming experience (years)			
1 - 10	71	71.0	
11 – 20	16	16.0	
21 and above	13	13.0	10 years
Farm size (hectares)			
0.1 – 0.5	33	33.0	
0.6 - 1.0	34	34.0	
1.1 – 1.5	33	33.0	0.9 hectare
Estimated monthly income (₦)			
18,000 - 30,000	30	34.0	
31,000 - 43,000	64	64.0	
44,000 - 57,000	6	6.0	
58,000 and above	-	-	₦33,880.00

Source: Field survey data, 2021

Table 2 Distribution according to the various sustainable agricultural practices provided by extension in the study area

Sustainable agricultural practices	Frequency	Percentage
New varieties	77	77.0
Planting time	82	82.0
Spacing	79	79.0
Pruning	65	65.0
Mulching	72	72.0
Sucker multiplication	61	61.0
Staking	68	68.0
Conventional agricultural practice	64	64.0
Type of sucker	75	75.0

Source: Field survey, 2021

Table 3 Distribution according to the adoption level of sustainable agricultural practices among plantain farmers

Sustainable agricultural practices	Always adopted 3	Adopted 2	Not adopted 1	Score $\sum F\overline{x}$	Mean $\overline{x}$	Remarks
New varieties	0(0)	100(200)	0(0)	200	2.00	Not adopted
Planting time	94(282)	3(6)`	3(3)	291	2.91	Adopted
Types of suckers	29(87)	70(140)	1(1)	228	2.28	Adopted
Hot water treatment	1(1)	2(4)	97(97)	102	1.02	Not adopted
Spacing	100(300)	0(0)	0(0)	300	3.00	Adopted
Pruning	70(210)	30(60)	0(0)	270	2.70	Adopted
Mulching	79(237)	20(40)	1(1)	278	2.78	Adopted
Fertilizer	27(81)	4(8)	69(69)	158	1.58	Not adopted
Post-harvest	69(207)	22(44)	9(9)	260	2.60	Adopted
Sucker multiplication	76(228)	24(48)	0(0)	276	2.76	Adopted
Debudding	26(78)	25(50)	49(49)	177	1.77	Not adopted
Herbicide	26(78)	5(10)	69(69)	157	1.57	Not adopted
Staking	2(6)	68(136)	30(30)	172	1.72	Not adopted
Grand mean score					2.21	Adopted

Source: Field survey, 2021; Decision: ≥ 2.05 = adopted; < 2.05 = not adopted

Table 4 shows the frequency distribution according to the level of awareness of plantain farmers on sustainable agricultural practices in the study area. The result shows that farmers were aware of the following sustainable agricultural practices provided by extension: spacing (100%), type of sucker (99.0%), pruning (99.0%), planting time (97.0%), non-renewable resources (79.0%), mulching (77.0%), staking (61.0%), sucker multiplication (53.0%), new varieties (52.0%) and conventional agricultural practice (50.0%). This implies that sustainable practices such as spacing, type of sucker, pruning, planting time, non-renewable resources, mulching, staking, sucker multiplication, new varieties and conventional agricultural practice were provided by extension in the study area. Awareness of sustainable agricultural practices is significant in predisposing farmers to adopting them for their agricultural activities. This finding is in agreement with those of Ikuerowo and Tehinloju (2021) who reported that arable crop farmers in Ondo State were of bio-organic technologies such as crop rotation (100%), mixed cropping (100%) and mulching (79.2%).

Table 4 Distribution according to the level of awareness of plantain farmers on sustainable agricultural practices in the study area

Sustainable agricultural practices provided by extension	Aware	Not aware
New varieties	52(52.0)	48(48.0)
Planting time	97(97.0)	3(3.0)
Type of sucker	99(99.0)	1(1.0)
Spacing	100(100.0)	0(0.0)
Pruning	99(99.0)	1(1.0)
Mulching	77(77.0)	23(23.0)
Sucker multiplication	53(53.0)	47(47.0)
Staking	61(61.0)	39(39.0)
Integrated pest management	35(35.0)	65(65.0)
Conservation tillage practices to control erosion	6(6.0)	94(94.0)
Conventional agricultural practice	50(50.0)	50(50.0)
Non-renewable resources	79(79.0)	21(21.0)

Source: Field survey, 2021

Table 5 Effectiveness of extension in sustainable agricultural practice dissemination among plantain farmers

Effectiveness indicators	Fortnightly 4	Quarterly 3	Monthly 2	Annually 1	Score $\sum F\overline{x}$	Mean $\overline{x}$	Remarks
Agricultural extension visit	45(180)	30(90)	10(20)	15(15)	305	3.05	Effective
Fields meeting	16(64)	21(63)	23(46)	40(40)	213	2.13	Not effective
Number of meetings scheduled that held	31(124)	24(72)	20(40)	25(25)	261	2.61	Effective
Method demonstration	43(172)	17(51)	18(36)	22(22)	281	2.81	Effective
Result demonstration	55(220)	28(84)	11(22)	6(6)	332	3.32	Effective
Number of trainings	47(188)	25(75)	8(16)	20(20)	299	2.99	Effective
Field workshop	16(64)	18(54)	20(40)	46(46)	204	2.04	Not effective
Research extension linkage	29(116)	34(102)	22(44)	15(15)	277	2.77	Effective
Grand mean score						2.72	Effective

Source**:** Field survey, 2021; Decision: ≥ 2.55 = effective; < 2.55 = not effective

Table 5 shows the mean scores distribution according to the effectiveness of extension in sustainable agricultural practice dissemination among plantain farmers. The result shows that extension was effective in sustainable agricultural practice dissemination through the following ways: result demonstration ($\overline{x}$ = 3.32), agricultural extension visit ($\overline{x}$ = 3.05), number of trainings ($\overline{x}$ = 2.99), method demonstration ($\overline{x}$ = 2.81), research extension linkage ($\overline{x}$ = 2.77) and number of meetings scheduled that held ($\overline{x}$ = 2.61). These mean ratings were above the bench mark mean score of 2.55. This implies that result demonstration, agricultural extension visit, number of trainings, method demonstration, research extension linkage and number of meetings scheduled that held were the methods employed by extension in

sustainable agricultural practice dissemination among plantain farmers in the study area. This finding is similar to those of Agbarevo and Okringbo (2020); Agbarevo and Nwogu (2016) who reported that extension agents in Abia State were very effective in the organization of research-extension-farmer input linkage.

Table 6 Analysis of variance results showing difference in the effectiveness of extension in sustainable agricultural practices dissemination among plantain farmers in the study area

Variable		Sum of Squares	Df	Mean Square	F-cal	F-tab
Effectiveness	Between Groups	105.134	9	11.682	689.402	3.04
	Within Groups	1.525	90	0.017		
	Total	106.659	99			

Source: Field survey data, 2021; Ho_1: rejected at 5% level

The result of the Analysis of Variance (ANOVA) f-test used to test for significant difference in the effectiveness of extension in sustainable agricultural practices dissemination among plantain farmers is presented in Table 6. The result in Table 6 shows that the calculated Anova f-value of 689.402 was significantly higher than the tabulated ANOVA f-value of 3.04 at $P \leq 0.05$, suggesting that there was significant difference in the effectiveness of extension in sustainable agricultural practices dissemination among plantain farmers in the study area. This further implies that the effectiveness of extension in sustainable agricultural practices dissemination among plantain farmers differed significantly across sampled communities in the study area. This might be attributed to factors such as the effectiveness of extension personnel and socio-economic attributes of plantain farmers that may affect the dissemination of sustainable agricultural practices in the study area.

Given that the computed ANOVA f-value of 689.402 is less than the critical ANOVA f-value of 3.04 at 5% level of significance, the study therefore concludes that there is significant difference in the effectiveness of extension in sustainable agricultural practices dissemination among plantain farmers in the study area.

Table 7 Ordinary Least Square (OLS) multiple regression result of the influence of socio-economic characteristics of plantain farmers on their level of adoption of sustainable agricultural practices in the study area

Variables	+Linear	Exponential	Semi-log	Cobb douglas
Constant	16.821(5.067)***	2.438 (19.345)***	1.352 (4.213)***	2.170 (6.342)***
Age	1.566 (3.626)***	0.063 (3.715)***	1.538 (3.474)***	0.062 (3.463)***
Sex	0.284 (1.639)	0.011 (1.579)	4.399 (1.649)	0.173 (1.632)
Marital status	-0.213 (2.578)**	-0.011 (-0.669)	0.024 (1.261)	-0.002 (0.134)
Income	4.295E-5(2.519)**	1.817E-6 (2.204)**	0.861 (1.883)*	0.038 (1.836)*
Household size	0.141 (4.165)***	0.005 (3.893)***	0.677 (2.620)**	0.026 (2.459)**
Farm size	0.183 (2.641)**	0.007 (2.195)**	1.124 (3.160)***	0.044 (3.048)***
R-square	0.885	0.874	0.868	0.856
Adjusted R^2	0.642	0.632	0.625	0.614
F-statistic	8.311***	8.067***	7.728***	7.246***

Source: Field survey data, 2021; NB: ***, ** and * represents 1%, 5%, and 10% significance levels respectively. Figures in brackets are t-values and + means lead equation.

The result of the ordinary least square multiple regression analysis used to test the hypothesis that socio-economic characteristics of plantain farmers do not significantly influence their level of adoption of sustainable agricultural practices is presented in Table 7. The result shows that the linear model was selected as the lead model based on the magnitude of the coefficient of multiple determinations (R^2), the signs of the regression coefficients as they conform to *a priori* expectation and the number of significant variables. The model shows that the explanatory variables included in the model explained about 88.5% of the observed variation in respondents' livelihoods indicating goodness of fit of the regression model. Age, marital status, household size, income and farm size were the significant variables that

influenced adoption of sustainable agricultural practices among plantain farmers in the study area. The coefficient of age (3.626***) was positively related to the adoption of sustainable agricultural practices at 1% significance level, an indication that a direct relationship exists between the age of farmers and their adoption of sustainable agricultural practices in the study area. This finding is in agreement with Mgbada *et al.* (2016) who reported that age had significant relationship with the use of sustainable agricultural practices among cassava farmers in Southeast Nigeria. The coefficient of marital status (2.578**) was positively related to the adoption of sustainable agricultural practices at 5% significance level, implying that a direct relationship exists between the marital status of farmers and their adoption of sustainable agricultural practices in the study area. The coefficient of income (2.519**) was positively related to the adoption of sustainable agricultural practices at 5% significance level, an indication that a direct relationship exists between the income of farmers and their adoption of sustainable agricultural practices in the study area. The regression analysis shows that the computed F-statistic value of 8.311 was significantly higher than the tabulated F- value of 2.56 at 1% level of significance and 1.96 at 5% level of significance, therefore the null hypothesis that "socio-economic characteristics of plantain farmers do not significantly influence their level of adoption of sustainable agricultural practices" was rejected and the alternate accepted. The study concluded that adoption of sustainable agricultural practices was dependent on socio-economic characteristics of plantain farmers such as age, marital status, household size, and income and farm size.

4. Conclusion

The study concluded that farmers were aware of most sustainable agricultural practices such as spacing, type of sucker, pruning, planting time, non-renewable resources, mulching and staking provided by extension. There was also high level of adoption of these sustainable agricultural practices by plantain and extension was effective in result demonstration, agricultural extension visit, number of trainings, method demonstration, research extension linkage and number of meetings scheduled that held.

Recommendations

Based on the findings, the following recommendations were made:

- There is the need to vigorously promote the adoption of sustainable agricultural practices provided by extension since there was high adoption level among plantain farmers in the study area.
- This can be achieved through intensifying efforts in the area of awareness creation of such practices.
- There is need for the Agricultural Development Programme (ADP) and other extension agencies to encourage farmers on the continuous adoption of sustainable agricultural practices by sensitizing them on the inherent benefits associated with the use of more internal inputs in food production.
- Attention of extension agencies should be directed towards field meetings and field workshops, which were discovered to be the weak links in the activities of sustainable agricultural practice dissemination. In the study area.

Compliance with ethical standards

Disclosure of conflict of interest

There was no conflict of interest.

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