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Adoption of Improved Agroforestry Technologies among Contact Farmers in Imo State, Nigeria

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Adoption of Improved Agroforestry Technologies among Contact Farmers in Imo State, Nigeria

Abstract

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The study examined the adoption of improved agroforestry technologies among farmers in Imo State. To achieve the study objectives, structured questionnaire were designed and administered to ninety farmers who were selected using a multistage random sampling technique. Data collected were analysed using descriptive statistics regression analysis and Pearson product moment correlation (PPMC). Findings shows that the farmers were mainly small scale middle aged married men with secondary education and no access to credit. The average house hold size, farming experience and annual income of the farmers were 6 person, 15.5 years and ₦ 148,255.6 respectively with two contacts with extension agents on monthly basis. The results indicated that the farmers were largely aware of *Gnetum Africana* and have adopted plantain/banana technology. The mean adoption rate of agroforestry technologies was 33.81%. The main determinants of the adoption were farmers' age, educational level, farm size, income, access to credit and extension contact as this variables were all significant. Apart from age of the farmers which was negatively related to adoption of agroforestry technologies all other variables mentioned affected the adoption rate of agroforestry technologies positively. Based on the findings, it was strongly recommended that farmers be provided with loans at concessionary interest rates to solve their financial problem of adopting innovations.

Key words: Adoption, Innovation, Agroforestry Technologies

Introduction

Adoption is a decision made by an individual or group to use an innovation in a continuous manner (Akubailo *et al.*, 2007). Adoption is regarded by Rogers (1995) as a decision to make full use of an innovation or technology as the best course of action available. According to Van den Ban and Hawkins (1996), adoption of innovation is the decision of an individual or group to use or apply an innovation. Technology is the systematic application of scientific or other organized body of knowledge to practical purposes (Akubailo *et al.*, 2007). This includes new ideas, inventions, innovations, techniques, methods and materials. Agroforestry is an agricultural approach of using the interactive benefits from combining trees and shrubs with crops and/or livestock (en.wikipedia.org/wiki/agroforestry). It combines agriculture and forestry technology to create more integrated, diverse, productive, profitable, healthy and sustainable land use system. Agroforestry incorporates several plant species into a given land area and creates a complex habitat that can support a wider variety of birds, insects and other animals (Emedi *et al.*, 1995). Agroforestry is an aspect of farm forestry that

encourages the deliberate integration of woody perennials with agricultural crops and/or animals on the same management unit, with the aim of enhancing soil fertility and increasing farmers' income through the use of economic trees (Akinbili *et al.*, 2007). The act of combining trees, crops and/or animals is as old as humanity itself, and it has been practiced since the middle ages in Europe, Asia, tropical America, and Africa (Udofia, 2001). Agroforestry addresses many of the global challenges such as deforestation, unsustainable cropping practices and hunger, poverty and malnutrition.

The issue of environmental degradation is quite critical in Imo State, where more than 80 percent of the population depends on forest products for survival, according to the Nigeria Conservation Foundation (NCF, 2000). The Forestry Monitoring, Evaluation and Coordinating Unit, has also reported an imbalance in the demand and supply of forest products (FORMECU, 1999). The improved agroforestry technologies disseminated in the state are snail rearing, apiculture, grass cutter domestication, production of *Gnetum africana*, plantain/banana production, use of vertivar grass to control erosion, and mushroom production however, the adoption of these

technologies over the years has not been encouraging. The adoption of agroforestry technologies among farmers in the state has been a subject of concern among stakeholders in agriculture. The reason for the increasing concern of stakeholders on the adoption of agroforestry technologies is due largely on the interactive benefits of agroforestry and other farming activities (Egeonu and Okoro, 2005). Sanchez (1995) reported that agroforestry is widely recognized as a branch of agricultural science that is rapidly becoming a science in its own right and that many studies have been conducted in this area of study. Most of the research studies have been studied from the biophysical perspective. However, Mercer and Miller (1998) revealed that nothing much has been done on the socioeconomic aspect especially as it affects the adoption of agroforestry technologies. This has caused a void in research.

There is a growing awareness that agroforestry technologies are not reaching poor farmers. The main reason is the poor linkages between research organization and extension (Aboh and Akpabio, 2008). However, Alimba and Mgbada, (2003) found that inappropriateness of the innovation is responsible for non-adoption by the farmers while, Asiabaka *et al* (1994) had a contrary view and concluded that farmers fail to adopt because they are wise and not because they are ignorant, and rationally weigh the changes in incomes and risks associated with agroforestry technologies under their socio-economic circumstance. This however, made the adoption of agroforestry technologies among farmers in the State unsatisfactory.

Previous studies on the adoption of agroforestry technologies (Kuntash *et al.*, 2002; Ajayi *et al.*, 2006) focused more on the linkage between research organizations and extension, with neglect to the linkage between extension and farmers, and farmers are central to adoption of innovations as they are the supposed users of the technologies (Aboh and Akpabio, 2008). According to them, ineffective linkage between extension and farmers is responsible for low adoption of agroforestry technologies by farmers.

It is against this background that the study addressed the following research questions:

1. What are the socioeconomic characteristics of farmers involved in Agroforestry?
2. What is the farmers' awareness level of the agroforestry technologies disseminated in the area?
3. What is the extent of adoption of agroforestry technologies in the area?
4. What are the factors affecting the adoption of agroforestry technologies by farmers in the area?

Hypotheses

The following null hypotheses were tested

- i. There is no significant relationship between adoption of agroforestry technologies and farmers socio-economic characteristics.
- ii. There is no significant relationship between adoption of agroforestry technologies and the farmers' awareness level.

Methodology

The study was carried out in Imo State, Nigeria. The State is located in Southeast of Nigeria and shares common boundaries with Abia State on the east and northeast, Rivers State on the south, and Anambra State on the west and northwest. The State lies between latitudes 5 °45'N and 6 °35'N of the equator and longitudes 6 °35' E and 7 °35' E of the Greenwich Meridian (ISMLSUP, 1999). The State has an average annual temperature of 28 °C, an average annual relative humidity of 80%, average annual rainfall of 1800-2500mm and an altitude of about 100m above sea level (Imo ADP, 1990). The state experiences two major seasons: dry and rainy seasons. The dry season starts by November and lasts to early march while the rainy season starts from April to October with a short dry spell in August called the "August Break". The state is in the tropical rainforest zone of Nigeria which makes her vegetation habitable for many forest species and livestock species. Many farmers in the state practice agroforestry because of the vegetation of the area. The State is divided into three agricultural zones: Owerri, Okigwe, and Orlu because of administrative and extension services but not with any agro-ecological reason. The population of the state is 3,934,899 persons with many subsisting in farming (NBS, 2007).

Sampling Procedure and Sample Size

The multistage random sampling technique was adopted for this study. Firstly, the three agricultural zones were selected. In each agricultural zone, two local government areas (LGAs) were randomly selected. In each selected LGA, five communities were randomly selected. Lastly, three farmers involved in agroforestry were randomly selected from the list of contact farmers in the communities (sample frame). In all, three agricultural zones, six local government areas, thirty communities, and ninety farmers were used for the survey. This brought the sample size of the study to ninety farmers (Respondents).

Data Analysis

Descriptive statistical tools such as frequency counts, percentages and means were used to describe the data collected, while inferential statistical tools were used to test hypotheses, using Pearson Product Moment Correlation (PPMC) and linear regression. The rate of adoption is calculated as the number of technologies adopted divided by the total number of technologies

transferred and expressed in percentage (Kuntash *et al.*, 2002; Ajayi *et al.*, 2006). The implicit model of the regression is as follows: $Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, e)$.

Where; Y=Adoption Rate of Agroforestry Technologies (%)

X_1 = Farmers Age (years)

X_2 = Farmers Educational level (years)

X_3 = Household Size of Farmers (Number of Persons)

X_4 = Farming Experience of Farmers (Years)

X_5 = Farm Size of Farmers (Hectares)

X_6 = Farmers Income (₦)

X_7 = Farmers access to credit (Dummy variable, Yes =1, No = 0)

X_8 = Farmers contact with extension agents (Monthly).

E= Error term.

Results and Discussion

As shown in table 1, majority (44.40%) of the respondents fall within the age bracket of 41-50 years. About 25.00% of the respondents are between 51 and 60 years while the young farmers (below 40 years) who should constitute the major labour force in agriculture were 8.9%. The retired age of 61-70 years had a percentage of 18.90 while the remaining 2.20% of the respondents were older farmers (71 years and above). The respondents' mean age was 51.6 years. This implies that the respondents are mainly of the middle age indicating that the middle age farmers could adopt agroforestry technologies more than any other group.

The majority (57.80%) of the respondents were male. This implies that the contact farmers are more of male. Thus, male headed households engage in agroforestry more than female headed households. This could be due to the socio-cultural milieu of the area which gives males the access to production resources like land where agroforestry is practised more than females. Marital status indicates that the majority of the respondents (94.44%) were married. This may be as a result of high labour requirement in agricultural production in which they use members of their family as labour force (Okoye, 1999) and partly due to the expected benefits derived in feeding members of their family from what they produce. About 3.33% of the respondents were single. The youths are involved here. This implies that many youths shy away from farming.

The analysis shows that majority of the respondents (57.80%) had household sizes of 5-8 persons. The mean household size of the respondents was 6 persons. This is in line with the findings of Okoye, (1999) that large household is advantageous to farming as labour may be derived from the members.

Table 1 also reveals that the majority (36.67%) of the respondents had secondary education, 34.44% had primary education while 22.22% had tertiary education. About 6.67% of the respondents had no formal education constituting the illiterate class of the respondents. The mean educational level of the respondents was 8 years. Following this result, respondents could be said to be mainly literates. This literate proportion of the respondents implies that adoption of innovations like agroforestry will be favoured as education affects adoption of new technologies positively.

The analysis shows that the majority (48.90%) of the respondents had farm sizes of 1-3 ha, 40.00% had farm sizes of less than 1 ha. The mean farm size of the respondents was 1.5 ha. This implies that the respondents are mainly smallholder farmers. This small landholding is not really favourable for adoption of agroforestry technologies. However, agroforestry practice may not be greatly influenced by farm size since farmers with fragmented farm land often try to make maximum use of their plots.

The mean farming experience of the respondents is 15.5 years. This is an indication that the respondents have been in farming for a long period of time. The implication is that they are capable of adopting agroforestry technologies since many may have been practicing it for a long time. The analysis on income show that majority of the respondents (48.90%) realized between ₦20, 000 and ₦100, 000 per annum from agriculture. About 20.00% and 17.80% of the respondents had farm annual incomes of ₦100, 001- ₦180, 000. The mean annual farm income of the respondents was ₦148, 255.60. With this result, it is likely that the adoption of agroforestry technologies will be favourable because income is very important in adoption process. Access to credit shows that majority of the respondents (68.90%) had no access to agricultural credit while the remaining 31.10% had access to credit. Accessibility to farm credit induces adoption of innovation. Lack of collateral could be the reason why farmers' accessibility to credit is poor. Therefore removal of complex lending conditions is necessary for increased accessibility to credit to farmers to aid adoption of agricultural innovations.

The majority of the respondents (38.89%) had contact with extension agents twice in a month, 21.11% had no contact with extension agents. Regular contact with extension agents motivates and exposes the farmers to innovations and gives them information how to use the technologies. With persuasion and conviction from the extension agents, adoption of agroforestry technologies is likely to increase.

Farmers' Awareness of Agroforestry Technologies

As shown in Table 2 many agroforestry technologies have been transferred to end-users. The technologies as agreed by respondents include- *Gnetum africana* (Okazi) (84.40%), Snail rearing (83.30%), Plantain/Banana

production (82.20%). Others are Bee keeping (57.80%), Mushroom production (30.00%), Grass cutter domestication (24.40%), and Vertivar Grass production (17.80%). This result shows that majority of the respondents are aware of *Gnetum africana* followed by Snail rearing and Plantain/Banana production. With the level of awareness of these agroforestry technologies, there is likely to be high adoption rate of these technologies, since farmers should be aware of a given technology before adoption.

Extent of Adoption of Agroforestry Adoption Frequency

The results in Table 3 reveal that majority of the respondents (74.40%) have adopted Plantain/Banana production, 70.00% have adopted *Gnetum africana*, 65.60% have adopted Snail rearing while 16.70% have adopted Mushroom production. About 8.90%, 7.80%, and 3.30% have adopted Bee keeping, Vertivar Grass production and Grass cutter domestication respectively. This means that the respondents adopted mainly Plantain/Banana production. This could be because Plantain/Banana has for long been planted by farmers making it almost an indigenous crop in the area. *Gnetum*

africana followed Plantain/Banana production in the adopted technologies by the respondents. This could also be because *Gnetum africana* does not require much cost for domestication. Even at that adoption level of Plantain/Banana and *Gnetum africana*, it does not still satisfy the ADP target of 91.00% adoption of each of the packages (Egeonu and Okoro, 2005). Also the high adoption of Plantain/Banana and *Gnetum africana* is in minority considering the number of technologies to be adopted.

Extent of Adoption of Agroforestry Technologies

The distribution in table 4 shows farmers' extent of adoption of agroforestry technologies. The Table reveals that about 6.67%, 15.56%, 18.89%, and 27.78% of the farmers adopted 5, 4, 3, and 2 agroforestry technologies respectively. The majority (31.11%) of the farmers adopted 1 agroforestry technology. The average number of technologies adopted by the farmers is 2.389 (approximately 2) while the average rate of adoption of agroforestry technologies is 34.12% implying that adoption of the technologies is not satisfactory. This could be due to poor delivery system of the extension agents and high cost of adopting the technologies.

Table 1. Respondents Socioeconomic Characteristics (n=90)

Variables	Frequency	Percentage
Age (years)		
31-40	8	8.90
41-50	40	44.40
51-60	23	25.60
61-70	17	18.90
71 and above	2	2.20
Mean age=51.6		
Sex		
Male	52	57.80
Female	38	42.20
Marital Status		
Married	85	94.44
Single	3	3.33
Divorced	2	2.22
Household size		
1-4	24	26.70
5-8	52	57.80
9-12	14	15.60
Educational Level		
No Formal Education	6	6.67
Primary Education	31	34.44
Secondary Education	33	36.67
Tertiary Education	20	22.22
Farm Size (ha)		
< 1	36	40.00
1-3	44	48.90
4-6	10	11.10
Mean farm size = 1.5 ha		

Farming Experience (yrs)		
1-10	40	44.44
11-20	22	24.44
21-30	18	20.00
31-40	8	8.89
41-50	2	2.22
Annual Farm Income (₦)		
20, 000-100, 000	44	48.90
100, 001-180, 000	18	20.00
180, 001-260, 000	16	17.80
260, 001-340, 000	7	7.80
340, 001-740,000	5	5.56
Mean Annual Farm Income N 148,255.60		
Access to Credit		
Yes	28	31.10
No	62	68.90
Extension Contact		
No Contact	19	21.11
Once in a month	16	17.78
Twice in a month	35	38.89
Thrice in a month	6	6.67
Four times in a month	14	15.56

Source: Field Survey, 2010

Table 2 Distribution of Respondents' Responses on Awareness of Agroforestry Technologies

Transferred Technologies	Frequency	Percentage	Rank
<i>Gnetum Africana</i> (Okazi)	76	84.40	1
Snail Rearing	75	83.30	2
Plantain/Banana Production	74	82.20	3
Bee Keeping	52	57.80	4
Mushroom Production	27	30.00	5
Grass cutter Domestication	22	24.40	6
Vertivar Grass Production	16	17.80	7

Note: Multiple responses

Source: Field Survey, 2010

Table 3 Distribution of Respondents' Responses on Adoption of Agroforestry Technologies

Transferred Technologies	Frequency	Percentage	Rank
Plantain/Banana Production	67	74.40	1
<i>Gnetum Africana</i> (Okazi)	63	70.00	2
Snail Rearing	59	65.60	3
Mushroom Production	15	16.70	4
Bee Keeping	8	8.90	5
Vertivar Grass Production	7	7.80	6
Grass cutter Domestication	3	3.30	7

Note: Multiple responses

Source: Field Survey, 2010

Table 4 Distribution of Respondents' According to Number of Agroforestry Technologies Adopted

Number of Technologies adopted	Frequency	Percentage
1	28	31.11
2	25	27.78
3	17	18.89
4	14	15.56
5	6	6.67
Total	90	100.00

Average number of technologies adopted = 2.389

Average Rate of Adoption = 34.12%

Source: Field Survey, 2010

4.4 Factors affecting Adoption Rate of Agroforestry Technologies

In order to determine the factors affecting the adoption rate of agroforestry technologies, a multiple regression analysis was done. The regression was subjected to four functional forms (linear, semi log, double log and exponential forms). The linear form was chosen as the lead function for further discussion because of the following reasons:

-It has the highest coefficient of multiple determination (R^2) value (0.791)

-It has the highest F-calculated value (5.477)

-It has the highest number of significant independent variables (X_1 , X_2 , X_5 , X_6 , X_7 , and X_8).

The coefficient of multiple determination (R^2) has a value of 0.791 (79.10%) indicating that the independent variables (X_1 , X_2 ,..... X_8) jointly explained 79.1% of the variation in the dependent variable (Y). Consequently the interpretation of the regression result indicates the following: Farmers' age (X_1) is negatively related to adoption of agroforestry technologies, meaning that younger farmers adopted the technologies more than the older farmers. This relationship is significant at the 5% level of probability as the t-calculated value (2.005) is greater than the t-tabulated value (1.98). Farmers' educational level (X_2) has a positive relationship with adoption rate of agroforestry technologies implying that the more educated farmers adopted agroforestry technologies more than the less educated farmers. The relationship is significant at the 1% level of probability as the t-calculated value (3.206) is greater than the t-tabulated value (2.617). Farmers' household size (X_3) is positively related to adoption rate of agroforestry technologies indicating that farmers having larger households adopted the technologies more than their counterparts having smaller households. The effect is however insignificant at the 10% level of probability as the t-calculated value (0.121) is less than the t-tabulated value (1.658). Farmers' experience (X_4) has a positive effect on adoption rate of agroforestry technologies showing that the more experienced farmers adopted the packages more than the less experienced farmers. The

effect is not significant at the 10% level of probability due to the value of t-calculated (0.427) being less than the t-tabulated value (1.658). Farm size of farmers (X_5) is positively related to adoption rate of agroforestry technologies implying that as the farmers' farm sizes increase they adopt more of agroforestry technologies, and vice versa. This effect is however significant at the 5% level of probability as the t-calculated value (2.325) is greater than the t-tabulated value (1.98). Farmers' income (X_6) is positively related to adoption of agroforestry technologies meaning that the richer farmers adopted the technologies more than the poorer farmers. The effect is significant at the 1% level of probability as the t-calculated value (3.206) is greater than the t-tabulated value (2.617). Farmers' access to credit (X_7) has a positive effect on adoption of agroforestry technologies indicating that farmers with access to credit adopted the technologies more than those without access to credit. This effect is statistically significant at the 10% level of probability as the t-calculated value (1.968) is greater than the t-tabulated value (1.658). Farmers' contact with extension agents (X_8) is positively related to the adoption rate of agroforestry technologies showing that farmers with higher number of contacts with extension agents adopted the agroforestry technologies more than farmers with less contact with extension agents. This relationship is statistically significant at the 1% level of probability as the t-calculated value (4.250) is greater than the t-tabulated value (2.617).

The F-ratio which determines the overall significance of a regression is statistically significant at the 1% level of probability because the F-calculated value (5.477) is greater than the F-tabulated value (2.82). This implies that the independent variables jointly exerted great influence on the adoption rate of agroforestry technologies. This compels us to rejecting the first null hypothesis of the study which states that, "there is no significant relationship between farmers' socio-economic characteristics and the adoption rate of agroforestry technologies". We now conclude that farmers' socio-economic characteristics are significantly related to the adoption rate of agroforestry technologies.

Table 5 Multiple Regression Estimates of Factors Affecting Farmers' Adoption Rate of Agroforestry Technologies

Independent Variables	Linear Form		Exponential Form		Semi Log Form		Double log Form	
	Coefficient	t- ratio	Coefficient	t- ratio	Coefficient	t- ratio	Coefficient	t- ratio
Intercept	2.08	0.181	5.6E+28	0.103	-15.29		2.373	1.544
X ₁	-0.403	-2.005 ^{xx}	-7.89E-07	-0.02	-5.383		-0.294	-0.751
X ₂	1.273	3.265 ^{xxx}	-1.6E+22	-0.536	-2.519		-0.048	-0.321
X ₃	0.096	0.121	-2.2E+23	-0.028	1.619		0.133	0.895
X ₄	0.081	0.427	-4.6E+08	-0.010	-0.231		0.008	0.070
X ₅	3.305	2.325 ^{xx}	2.2E+28	4.374 ^{xxx}	6.118		0.174	1.933 ^{xx}
X ₆	5.322	3.206 ^{xxx}	0.001	0.0001	5.198		0.141	1.703 ^x
X ₇	5.727	1.968 ^x	-7.0E+28	-0.639	8.123		0.271	1.464
X ₈	5.463	4.250 ^{xxx}	1.3E+28	2.781 ^{xxx}	10.546		0.295	2.778 ^{xxx}
R ²	0.791		0.297		0.335		0.284	
☑ ²	0.777		0.228		0.262		0.208	
F-Ratio	5.477 ^{xxx}		4.286 ^{xxx}		4.722 ^{xxx}		3.723 ^{xxx}	

^{xxx} Significant at 1% level

^{xx} Significant at 5% level

^x Significant at 10% level

Source: Computer printout of field survey 2010.

Table 6 Relationship between Adoption and Awareness Level of Agroforestry Technologies

Variable	r	P-Value	Decision
Awareness level vs adoption level of improved Agroforestry technologies	0.33	0.001	significant

r = correlation coefficient, p- probability level of significance p<0.05(significant)

Source: field survey, 2010

Table 6 reveals that there is a significant though low relationship (33%) between the awareness level and the adoption level of improved agroforestry technologies. The null hypothesis is rejected because the P-value is < than 0.05

Conclusion

Although the study was limited to Imo State and farmers in Imo State constituted the sample of the study, certain reasonable conclusions have been made from the results of the study. The farmers are mostly middle aged married men with farm size of 1.5ha. This definitely confines them to practice agroforestry farming on a small scale. Out of the seven agroforestry technologies available, the farmers were mostly aware of *Gnetum Africana* and they adopted Plantain/Banana production more than others. The innovation on Plantain/Banana is almost same with the existing native practice by the resource poor farmers which shows that the technology on plantain/banana production is not difficult to practice. The significance of age, educational level, farm size, income, access to credit, and extension contact means that they exerted greater influence on adoption of agroforestry technologies. This implies that adoption of agroforestry technologies require mainly young, educated, large scale and rich farmers with access to credit and higher contact with extension agents.

Recommendation

The results of this study lead us to make these recommendations. Access to credit is very important for adoption of innovations. Our findings support this assertion. Therefore farmers should be provided with loans preferably at market interest rates to solve farmers' problem of inadequate finance. The loans should be supervised to see that they are not diverted to wrong hands and ensure equally judicious utilization of such loans by farmers. Inputs like planting and starting stocks should be subsidized so that the poor rural farmers will easily adopt the technologies by affording to buy the inputs. Agricultural Development Programme should be intensified to sensitize and motivate farmers towards enlisting in farmers' co-operative societies. Farmers' socio-economic factors should be considered fundamental in designing extension intervention strategies.

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