Comparative Analysis of the Performances of Adopters and Non-Adopters of Yam Minisett Technology in Kwara State, Nigeria

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Absract

This study compares the technical efficiency of the adopters and the non-adopters of yam minisett technology in Kwara State, Nigeria in 2011. It also describes the socio-economic characteristics of the farmers, examines their awareness about the technology and also determines the technical efficiency of the respondents. The study was conducted in Asa Local Area of the state based on the prior information obtained from the state's Agricultural Development Project (Kwara State ADP) that yam minisett technology was more practised in the area than any other part of the state. Primary data obtained from sixty-four farmers, comprising thirty-two adopters and thirty-two non-adopters of the technology was used for the study. Descriptive statistics and stochastic production frontier model were used for the analyses. The results showed that the adopters were made up of young, educated farmers who were members of farmers'cooperatives and had access to extension services. On the other hand, majority of the non-adopters were old, with less formal education and had no access to extension services and participation in cooperative societies. Analysis of the technical efficiency model revealed that the adopters and the non-adopters of the technology were 80% and 62% efficient respectively. This creates a wide gap between the adopters and the non-adopters of the innovation. Therefore, the study recommends sensitization of the farmers on the technology and its relevance to agricultural production, intensification of extension services by relevant agencies to educate the farmers on the technology, encouragement of the youths to actively participate in agriculture and apply the technology as well as formation of cooperative societies by the farmers to facilitate training and sharing of experience about the technology.

Key Words: *Yam minisett technology, technical efficiency, adoption, training.*

Introduction

Yam production is a major component of agricultural or food crop activities in West Africa which account for the 90-95% of the world yam production (Aquah, 1991; FAO, 1998). Nigeria accounted for 75% of the world yam production (Manyong *et al*; 2001). Annual production of yam in the country is estimated at 26.587 million metric tons (FAO, 2006). The annual growth rate for the same period was 6% for the yield and 10%, for the area planted.

The importance of yam in economic and socio-cultural development cannot be understated. Yam is a source of nutrition, income, employment and poverty alleviation. The crop is a major source of calories for millions of the world's tropical and subtropical populations (Degras, 1993). The average per capital consumption of yam in the major producing countries in the sub-region ranges from 193 kcabs per day in Togo to 502 in Cote d'Ivoire, and that of Nigeria is 200 Kcal/day (FAOSTAT, 2009). Although principally a starchy staple, yam also makes a substantial contribution to the supply of protein and micronutrients, such as vitamin C and high carotenoid contents (Ferede-menker, personal communication). The tuber is also a major source of income especially in coastal West Africa. It constitutes an average of 32% of the gross income derived from the crop (Orkwor, 1998). The entire production and marketing chain of yam also offers vast employment opportunities. In addition, the supply of yam offers prospects for income generation due to the number of people involved and the value attached to it. Besides, yam is important to socio-cultural life in West Africa and in the Pacific Islands (Degras, 1993). This is evident in the new yam festival celebrated at the beginning of the harvest season in those parts of the world (Onwume, 1978).

In Nigeria, yam is becoming more expensive and relatively unaffordable in urban areas, as production has not kept pace with population growth leading to demand exceeding supply (Kushwaha and Polycap, 2001). This is because increased production of yam is believed to be constrained mostly by high cost of seed yam (NRCRI, 2004), which accounts for 45% of yam production cost (Ugwu, 1990; Nweke et al, 1991; Ezeh, 1991). The high cost of seed yam is also burdened with its mediocre quality. This deprives the farmers of a good part of their production as they use tubers, which have been stored for 4-6 months and have undergone severe physiological deterioration as planting material leading to a decrease in harvest yield. In addition, fungi and other soil microorganisms resulting in low sprout emergence attack the planted yam piece.

In order to address the problems associated with yam production in Nigeria, the National Root Crop Research Institute (NRCRI) and the International Institute for Tropical Agriculture (IITA) developed the yam minisett technology (YMT) as a rapid means of multiplying yam germplasm. This technology involves the use of about 25g cut sett to produce whole tubers, which serve as yam seed. The introduction of yam minisett possesses numerous advantages. The technique is pragmatic in solving the problem of scarcity of planting materials as well as producing yams of sizes that are uniform. It helps lower the cost of production since seed yam and also reduces the cost of controlling pest and disease since it makes use of healthy mother yam from sanitized source. However, since the introduction of the technology, there is dearth of emperical studies on the performance of the adopters of the innovations. Therefore, this study compares the technical efficiencies of the farmers who have adopted yam minisett technology with those who have not. It also describes the socioeconomic characteristics of yam farmers in the study area, examines the farmers' awareness about yam minisett technology and also determines the technical efficiency of yam farmers in the study area. The results of this study would be of immense benefit towards improving agricultural production and reducing hunger in the country.

Methodology

The study was carried out in Alapa in Asa Local Government Area of Kwara State, Nigeria. The selection was based on the prior information obtained from Kwara State Agricultural Development Programme that yam minisett technology is widely adopted in the area than any other part of the state. Since the study was on comparative analysis of adopters and non-adopters, it would require a reasonable number of adopters to draw a valid conclusion. In addition, only Alapa was selected as the study area in order to limit all exogenous factors that could result in error if respondents from different areas were used.

Primary data were obtained from sixty-four (64) yam farmers, comprising thirty-two (32) adopters and non-adopters of yam minisett technology each. The reason for the equality in the sample size for both groups of respondents was to ensure that differences in the technical efficiency of the two groups were not due to the different sample size. Data collected include the socio-economic characteristics and production data of the respondents.

Descriptive statistics and stochastic frontier model were the analytical tools used for the study. Descriptive statistics were used to describe the relevant socio-economic characteristics of the respondents while the stochastic frontier model was used to determine the technical efficiency of the farmers. The stochastic frontier production function model is specified in the implicit form as follows:

$$Yi = f(Xi, \beta) + (Vi - Ui)$$

Where: Y_i is the output of the $_i^{th}$ farm

X_i is a k x l vector of input quantities of the $_i^{th}$ farm

β is a vector of unknown parameters estimated

V_i are random variables which are assumed to be normally distributed $N(0,\delta_v^2)$ and independent of the U_i. It is assumed to account for measurement error and other factors not under the control of the farmer. U_i are non-negative random variables, called technical inefficiency effects (Aigner *et al.*, 1977).

A Cobb-Douglas Production form of the frontier used for this study is presented as follows:

$$lnY = \beta_0 + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3 + \beta_4 lnX_4 + \beta_5 lnX_5 + \beta_6 lnX_6 + \beta_7 lnX_7 + V_i - U_i \ldots\ldots\ldots\ldots(1)$$

Where: Y = Crop output (grain equivalent)

X_1 = Farm size (ha)

X_2 = Labour (man-day)

X_3 = Quantity of planting material (number of minisetts/yam setts)

X_4 = Fertilizer (kg)

X_5 = Herbicide (litre)

$\beta_0, \beta_1, \ldots \beta_5$ = Estimated parameters

The inefficiency model is represented by U_i which is defined as follows:

$$U_i = d_0 + d_1 z_1 + d_2 z_2 + d_3 z_3 + d_4 z_4 + d_5 z_5 + d_6 z_{n6} \ldots\ldots\ldots\ldots(2)$$

U_i = Technical inefficiency

z_1 = Age of farmer(years)

z_2 = Farming experience (years)

z_3 = Adoption of yam minisett technology (quantity of minisett used)

z_4 = Extension contact (No of visits)

z_5 = Education (years)

z_6 = Household size

$d_0, d_1, d_2, d_3, d_4, d_5, d_6$ = Estimated parameters

Since the dependent variable of the inefficiency model represents the mode of inefficiency, a positive sign of an estimated parameter implies that the associated variable has a negative effect on efficiency but positive effect on inefficiency and vice versa (Yao and Liu, 1998; Rahji, 2005).

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Respondents

The socio-economic characteristics of the respondents is presented in Table 1. All the farmers were male. This is most likely to be due to the fact that men are more capable of doing tedious work which is usually associated with farming than the female. Also, all the respondents were married, with an average of 8 members in each group. This suggests that household labour could serve as a cheap source of farm labour in the study area. The average age of the adopters and non-adopters were 34 years and 52 years respectively. This indicates that the adopters were young. This is supported by the reports of Clark and Akinbode (1998) and FAO (2001) that young farmers have more knowledge about new practices and are more willing to bear risks and more responsive to new agricultural packages.

Table 1: Socio-economic Profile of the Respondents

Variable	Adopters of YMT			Non-adopters of YMT		
	Frequency	Percentage	Mean	Frequency	Percentage	Mean
Gender						
Male	32	100.00		32	100.00	
Marital Status						
Married	32	100.00		32	100.00	
Household Size						
≤ 5	17	53.13	8	18	56.25	8
6 – 10	12	37.50		11	34.38	
> 10	3	9.38		3	9.38	
Total	32	100.00		32	100.00	
Age (years)						
≤ 45	19	59.38	34	4	12.5	52
46 – 50	7	21.88		6	18.8	
51 – 55	5	15.63		3	9.4	
≥ 56	1	3.13		19	59.4	
Total	32	100.00		32	100.0	
Educational Level						
No formal education	2	6.2		10	31.2	
Adult education	6	18.6		6	18.6	
Primary education	12	37.5		13	40.6	
Secondary education	10	31.2		3	9.4	
Tertiary education	2	6.2		0	0	
Total	32	100.0		32	100.0	
Farming experience (years)						
10 – 20	12	37.5	11	4	12.5	18
21 – 30	6	18.8		6	18.8	
31 – 40	6	18.8		3	9.4	
≥ 41	8	25.0		19	59.4	
Total	32	100		32	100.0	
Participation in Farmers' Association						
Members of associations	24	75.0		21	65.6	
Non-members	8	25.0		11	34.4	
Total	32	100.0		32	100.0	
Access to Extension Service						
Access	28	87.5		7	21.9	
No access	4	12.5		25	78.1	
Total	32	100		32	100.0	

Source: Field Survey, 2011

Education is an important driver of adoption of innovations. Analysis of the educational status of the respondents shows that 93.75% of the adopters had one form of formal education or the other, in constrast to the 67.75% in the non-adopters'group.

Distribution of the respondents according to farming experience revealed that the non-adopters had been in farming for more years than the adopters of the technology. However, the method of farming used by the non-adopters over the years could be traditional. This confirms the findings by Degras (1993) and Ennin et al (2009) that custom is a major factor affecting adoption of agricultural innovations in developing countries.

Farmers association and extension services serve as very good sources of information on new and improved farming techniques to farmers. 75% of the adopters were in one farmers association or the other compared to the 66% of the non-adopters. Also, majority of the adopters had access to extension services while majority of the non-adopters did not.

Awareness of Yam Minnisett Technology

The level of awareness of yam minisett technology by the respondents is presented in Table 2. The table shows that the level of awareness about the technology is high among the respondents, with a 100% level of awareness for adopters and 59.4% for non-adopters. 62.5% of the adopters got the information from extension agents as against 42.1% of the non-adopters who were aware of the technology. 12.5% of the adopters sourced their information from their fellow farmers as compared to 15.8% of the non-adopters. Also, 25.0% and 42.1% of the adopters and non-adopters respectively were aware of the innovation through farmers' association. These results indicate that extension services and farmers association are vital sources of information on agricultural innovations.

Table 2: Distribution of Respondents by Awareness of Yam Minisett Technology

	Adopters of YMT		Non-Adopters of YMT	
	Frequency	Percentage	Frequency	Percentage
Awareness of YMT				
Aware	32	100	19	59.4
Not aware	0	0	13	40.6
Total	32	100	32	100
Source of Information about YMT				
Extension agents	20	62.5	8	42.1
Felow farmers	4	12.5	3	15.8
Farmers' association	8	25.0	8	42.1
Total	32	100	19	100

Source: Field Survey, 2011

Maximum Likelihood Estimates and Inefficiency Estimates of the Respondents

Tables 3(a & b) show the determinants of efficiency and inefficiency of both the adopters and the non-adopters of the technology respectively. The results show that labour and quantity of minisetts used by the adopters were positively related to their efficiency. In the inefficiency model, adoption of minisett technology, extension contact and educational level of the farmers were positively related to their efficiency. Among the non-adopters of the technology, while farm size, amount of labour, adoption of minisett technology, education and extension contacts were positively related to the efficiency of the farmers, farming experience deters the farmers'efficiency. This could result from the use of old unimproved techniques of yam production by this group of farmers.

Table 3a: Maximum Likelihood Estimates and Inefficiency Estimates of Adopters of Yam Minisett Technology

Variables	Coefficient	Standard error	t-ratio
Production function			
Constant term (β0)	5.909	2.192	2.851
Farm Size (β1)	0.390	0.326	1.195
Labour (β2)	00.875**	0.345	2.967
Qty. of Planting Material (β3)	0.699***	0.144	4.853
Qty of Fertilizer (β4)	-0.366	0.364	-1.005
Herbicide (β5)	0.015	0.040	0.385
Inefficiency function			
Intercept (δ0)	4.789	1.615	2.905
Age (δ1)	0.007	0.068	0.101
Farming Experience (δ2)	-0.153	0.122	-1.257

Adoption of YMT (δ3)	-0.298**	0.108	2.751
Extension Contact (δ4)	-0.772**	0.356	-2.181
Education (δ5)	-0.653**	0.258	-2.531
Household size (δ6)	0.230	0.187	1.232
Diagnostic statistics			
Sigma-square (δ2s)	0.4749	0.1193	3.981
Gamma (γ)	0.968	0.230	4.2135
Log (likelihood)function	26.74		
LR test	9.33		
Number of observation	32		

Source: Computed from MLE Results; **= Significant at 5% level; ***= Significant at 1% level

Table 3b: Maximum Likelihood Estimates and Inefficiency Function of Non-adopters of Yam Minisett Technology

Variables	Coefficient	Standard error	t-ratio
Production function			
Constant term (β_0)	2.694	1.094	2.462
Farm Size (β_1)	0.234**	0.084	2.785
Labour (β_2)	0.221**	0.054	4.934
Qty. Of planting materials (β_3)	0.123	0.084	1.450
Fertilizer (β_4)	-0.0101	0.045	-0.225
Herbicides (β_5)	-0.037	0.051	0.7247
Inefficiency function			
Intercept (δ_0)	-12.516	18.97	-6.597
Age (δ_1)	2.485	3.772	0.658
Farming Experience (δ_2)	1.164**	1.867	6.232
Adoption of YMT (δ_3)	-2.485**	0.585	4.250
Extension Contact (δ_4)	-1.163**	1.868	-6.233
Education (δ_5)	-1.576**	0.442	-3.563
Household size (δ_5)	1.349	1.357	0.994
Diagnostic statistics			
Sigma-square (δ^2s)	0.4375	0.060	7.292
Gamma (γ)	0.9417	0.092	10.185
Log (likelihood)function	30.24		
LR test	1.99		
Number of observation	32		

Source: Computed from MLE Results

= Significant at 5% level, *= Significant at 1% level

The technical efficiency indices of the respondents are presented in Table 4. The results showed that the technical efficiency of the sampled farmers both adopter and non-adopter of yam minisett technology were less than unity (less than 100%), implying that all the yam farmers in the study area were producing below the maximum efficiency frontier. However, the technical efficiency of most of the non-adopters was less than 60% while majority of the adopters had their technical efficiency more than 81%. The mean technical efficiency of non-adopters was 0.62(62%) as compared with 0.80(80%) of the adopters. This indicates that adopters of yam minisett are more technically efficient than non-adopters. Thus, the technical efficiency of the non-adopters could be increased by adopting yam minisett technology.

Table 4: Distribution of Technical Efficiency Indices of the Respondents

Efficiency Class Index	Adopter of YMT		Non adopter of YMT	
	Frequency	Percentage (%)	Frequency	Percentage (%)
< 0.60	0	0	18	56.25
0.61-0.70	1	3.13	16	43.75
0.71-0.80	3	9.38	0	0
>0.81	28	87.50	0	0
Total	32	100	32	100
Mean		0.80		0.62
Minimum Value		0.69		0.32
Maximum Value		0.98		0.68

Source: Computed from MLE Results

CONCLUSION AND RECOMMENDATION

The findings of this study reveal that adoption of yam minisett technology contributes positively to farmers'performance in the study area. The results also show that high level of education, good extension services and active membership of farmers'association are the major attributes of adopters of the technology and these are also positively related to efficiency of the farmers. Therefore, based on these findings, the following recommendations are suggested:

Government, non-governmental organizations and agricultural development agencies should improve their extension services among the farmers. This could be through increased extension contacts with the farmers coupled with thorough practical training on the use and importance of the innovation and other improved agricultural technologies. Besides, the farmers should form strong agricultural associations/cooperatives. This will enhance such training and also facilitate exchange of vital information on the technology and other agricultural innovations.

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