Journal of Agricultural Science; Vol. 4, No. 6; 2012
ISSN 1916-9752 E-ISSN 1916-9760
Published by Canadian Center of Science and Education

Socio-economic Determinants of the Adoption of Yam Minisett Technology in the Middle Belt Region of Nigeria

Josephine Bosede Ayoola
Institute of Food Security, University of Agriculture
P.M.B. 2373, Makurdi, Benue State, Nigeria
Tel: 234-816-494-7389 E-mail: gbayoola@yahoo.com

Received: February 16, 2012 Accepted: February 29, 2012 Online Published: April 26, 2012
doi:10.5539/jas.v4n6p215 URL: http://dx.doi.org/10.5539/jas.v4n6p215

Abstract

The paper assessed the socio-economic determinants of adoption of yam minisett technology in the middle belt region of Nigeria; where 120 farmers were sampled through multi-stage random technique from six villages in two Local Government Areas of Kogi and Benue States. Data collected by structured interview were analyzed using descriptive statistics such as frequency counts, percentages and means; and probit regression model. Results showed that 98.33 percent of farmers were aware of the technology while only 9.32 percent adopted the technology. The probit analysis indicated that age of the farmers, farm size, years of farming experience, amount of credit available and frequency of extension contacts were positively related to adoption and would probably increase adoption of the improved yam minisett technology. There is need to increase availability of credit, fertilizers and yam minisett dust, as well as improve extension services in the study area.

Keywords: Yam minisett technology, Adoption, Determinants, Middle belt, Nigeria

1. Introduction

Nigeria is said to be the greatest producer of yam in the world with annual output of about 36.72million metric tonnes (Food and Agriculture Organization, FAO, 2008), which is grown mostly in the rainforest, wood savanna and southern savanna belt (Ene and Okoli, 1995). Yam is a preferred food security crop in most Sub-Saharan African countries (International Institute for Tropical Agriculture, IITA, 1998), an important source of income to the people and a socio-cultural crop in Nigeria (Babaleye, 2003). Yam is also an export crop in West Africa and Caribbean countries to Europe and North America (Onwueme, 1998).

However, Kushwaha and Polycap (2001) reported that yam is becoming expensive in urban areas because its production has not kept pace with population growth. A fall in output percentage growth rate of yam from 42percent in 1990 to 16.3percent was reported in 2001, despite the increase in land devoted for the production of yam from 1270 million hectare to 2742 million hectares in the same period (Federal Ministry of Agriculture, FMA 2003). The cost of producing yam was also reported as being higher compared to other root crops in the country (Chikwendu et al., 1999). High cost and scarcity of seed yam were identified as major threats to yam production; reports indicating that farmers have to set aside as much as 30 percent of the harvest as planting material, and that planting material constitutes over 33- 40 percent of the cost of yam production (Iwueke et al., 1995; Madueke et al., 2000; Welch, 2005). This inhibits the size of yam farm under traditional cropping system; and constitutes the basis for introducing yam minisett technology. Among the three existing types of seed yam namely: yam minisett, milked seed yam and small whole tubers; yam minisett technique was assessed as the most promising method of seed yam in Nigeria (Asumugha et al., 2007; Okoro and Kalu, 1999).

After two decades of introducing the yam minisett technology, Madueke et al. (2000) observed that its use has not been sustained by the farmers, even though seed yam is still a major constraint to yam production. Perhaps, inefficiency in the transfer of the yam minisett technology is responsible for its low level usage. The questions that come to mind are whether the technology is sufficiently profitable to provide the incentive for its adoption, and what socio-economic factors affect its adoption in the study area. Therefore, the general objective of the study was to assess the socioeconomic determinants of yam minisett technology adoption in the middle belt region of Nigeria. The specific objectives were to: describe the socio-economic characteristics of yam farmers and evaluate their influence on yam minisett technology adoption, assess the extent to which farmers use the technology, and analyze the cost and benefits of yam minisett technique in the study area.

1.1 Conceptual Framework

The conceptual framework for the paper was based on the application of qualitative response models to the theories of diffusion and adoption of innovations. According to Rogers (1992), the diffusion of an innovation occurs through a five step process: awareness (knowledge), interest (persuasion), evaluation (decision), trial (implementation) and adoption (confirmation); which were defined as follows:

1) Awareness stage is that in which the individual is first exposed to an innovation but lacks information about the innovation (aware, not aware).

2) Interest stage is that in which the individual is interested in the innovation and actively seeks information about the innovation (high knowledge, low knowledge, none)

3) Evaluation stage is that in which the individual takes the concept of the innovation and weighs the advantages and disadvantages of using the innovation and decides whether to adopt or reject the innovation. Rogers (1992) notes that it is the most difficult stage to acquire empirical evidence (strongly agree/ agree/disagree/strongly disagree).

4) Trial stage is that in which the individual employs the innovation to a varying degree depending on the situation. During this stage the individual determines the usefulness of the innovation and may search for further information about it.

5) Adoption stage is that in which the individual finalizes their decision to continue using the innovation and may use the innovation to its fullest potential.

6) The rate of adoption is also defined as the relative speed with which members of a society adopt an innovation; whereby, an individual who first adopts an innovation (early adopter) requires a shorter adoption period than late adopters.

The probit model was used in analyzing relationship between discrete dependent variable (1=adoption, 0=non-adoption) and a set of non-stochastic explanatory variables (socio-economic variables) and a vector of unknown parameters. The probit model has been extensively applied to technology adoption decisions (Pindyck and Rubinfeld, 1988; Batz et al., 1999). Also, Olayemi (1998) demonstrated the use of maximum likelihood method to provide a justification for the application of ordinary least square regression technique as a generalization of the ordinary least square method.

2. Methodology

2.1 Study Area

The study was carried out in Kogi and Benue States within the middle belt region of Nigeria; which are the largest yam producing areas in Nigeria. The middle belt of Nigeria comprised six States namely Kwara, Niger, Kogi, Benue, Taraba and Nasarawa. The study area lie within Guinea Savanna agro-ecological zone, with an annual rainfall of between 1100mm – 1600mm and an average temperature of 35^0C, between latitude 14°N and 16°N and longitude 12°E and 13°E (National Population Commission, NPC 2006).

2.2 Data Sampling and Collection Methods

The sample selection method used was four-staged random sampling technique. First, two States were randomly selected from among the six States in the middle belt of Nigeria, followed by selection of one Local Government Area (LGA) from each State; then three villages were randomly selected from each of the two LGAs making a total of six villages; and finally, twenty farmers were randomly selected from the Agricultural Development Programme (ADP) contact farmers in each village to make a total number of one hundred and twenty farmers.

Structured questionnaire were used to obtain primary data about farmers' socio-economic characteristics, level of awareness of the minisett technology, farmers knowledge, attitude and practice of the technology; as well as the cost and income derived and constraints militating against the uptake of the technology. The data collected were analyzed using descriptive statistics including mean, frequency distribution and percentages; gross margin and regression methods. Probit regression model was used to estimate the factors that influence the adoption of yam minisett technology in the study area.

Gross margin Technique

$$GM = GFI - TVC$$

Where GM = Gross margin

GFI = Gross farm income and

TVC = Total variable cost

2.3 Probit Model Analysis

The maximum likelihood probit estimate used to analyze the factors that determine the adoption of yam minisett technology is expressed in its implicit form as follows:

$$Y = f(X1, X2, X3, X4, X5, X6, X7, X8, X9, X10, X11, U)$$

Where: Y = adoption index (1=adopted; 0 otherwise); X_1 = age of farmers (in years); X_2 = marital status (1 = married, 0 otherwise); X_3 = household size (number of people in household); X_4 = level of formal education (number of years spent in school); X_5 = farm size (hectares); X_6 = labour (man days); X_7 = farming experience (years); X_8 = tenancy status; X_9 = membership of cooperative/farmers' association (1 = member, 0 otherwise); X_{10} = credit received (Naira); X_{11} = number of contact with extension agents; U = error term

Maximum likelihood method had been demonstrated to provide the estimates of the coefficients (Harrel, 1986); hence, likelihood ratio test was used to evaluate whether there was relationship between the explanatory variables and the dependent variable.

3. Results and Discussion

3.1 Socio-economic Characteristics of Yam Farmers

The results on table 1 revealed that majority of the farmers were in their productive age; about 78 percent were middle-aged between 41 and 60 years, while about 18 percent were below 40 years and about 14 percent were above 60 years. This implies that given the right resources for production, the farmers have the required vigour to produce large output of yam in the area. About 89 percent of the farmers were married, with modal family size between 4 and 6; indicating the presence of substantial intra-household demand for yam for food and income security, as well as availability of family labour as an input for yam production. High cost of labour was found to be a major constraint to adoption of yam minisett technology in Abia State of Nigeria (Anyaegbunam et al, 2009). Therefore, the availability of substantial family labour may reduce the cost of labour, thereby increasing the chances of the adoption of yam minisett technology in the study area. About 44 percent of the farmers had no formal education, while about 43 percent had primary education; indicating that low literacy rate might hinder adoption of yam minisett, since farmers' level of education has been reported to influence the level of technology adoption (Chinaka et al, 1995). Results also indicated very low farm income in the area, with implication for resource-poverty, small scale production and low adoption of new technology; 55 percent of farmers earned less than 100 000 naira and only 2.5 percent earned above 200 000 naira annually. Results also showed that more than 88 percent of the farmers cultivated less than 2ha of yam farm. This relative small farm size may be a limiting factor to adoption of yam minisett technology because previous studies have shown that farmers with greater farm size more readily adopted new crop technologies. Specifically, Udoh (2010) found that farm size showed a significant positive relationship with adoption of cassava biotechnology by Nigerian farmers.

3.2 Farmers' Awareness and Practice of Seed Yam Technology

Results on Table 2 indicated that about 98 percent of the respondents were aware of yam minisett technology, while less than 2 percent were not aware. The major sources of information about the yam minisett technology were agricultural extension agents as well as family and friends, indicated by 96.67 percent and 30.83 percent respectively. Also, majority of the farmers sourced their seed yam from previous harvest and open market; about 62 percent and 77 percent respectively. This confirmed the findings of Iwueke (1991) that majority of the farmers became aware of yam minisett technology through the extension agents following its introduction by the Agricultural Development Programmes in 1986. About 69 percent of the farmers that were aware have watched the demonstration, but less than 26 percent have tried and only about 9 percent sustained the practice (Figure 1). Table 2 also indicated that about 55 percent and 36 percent of those that tried the yam minisett technology have between 1-2 hectares and less than 1hectare of yam farm respectively.

3.3 Costs and Benefits of Yam Minisett Technology

Table 3 showed the gross margin analysis of yam minisett technology on per hectare basis. The total costs of labour and capital inputs were ₦15 200 and ₦22 500; being 40.32 percent and 59.68 percent respectively of total variable cost of ₦37 700 naira. The labour cost covered the expenses incurred on labour for land clearing, tillage, planting, mulching, stalking, weeding, pesticide application, fertilizer application, and harvesting; while the capital inputs included the expenses on seedlings, fertilizer, pesticides, and transportation. The total value of yam minisett output per hectare was ₦52 000; and gross margin per hectare was ₦14 300. The benefit-cost ratio was

1.38; implying that it might be worthwhile for farmers to practice yam minisett technology either as an enterprise option or a preferred source of seed yam, since every naira invested in yam minisett production would generate a revenue of N1.38. The yam minisett technology had demonstrated the potential to add value; each moderate sized yam tuber of about N80 worth was multiplied to produce about 9 yam minisetts of about N40 each, amounting to about N360 and added value of about N280. A total of 1 300 yam minisetts were produced per hectare at a unit cost of about N29, while the unit price was about N40, implying a potential saving of about N11 from each sett that was produced by the farmer as an alternative to buying seed yam directly from the market. Saving some of the cost of seedlings through the yam minisett technology would likely increase the profitability of yam enterprise, and should serve as an incentive for the adoption of yam minisett technology.

3.4 Determinants of Yam Minisett Technology Adoption

Results on Table 4 indicate that age of the farmers and farm size were positive and significant at 1percent level, implying that as the age of the farmers and their farm size increase, the tendency of farmers to adopt the yam minisett technology also increases. These suggest that older farmers might have more experience in yam farming and that bigger farmers would be more profit oriented; and will be more interested in adopting technologies that promote their profitability. Agwu (2004) had similar findings in respect of adoption of improved cowpea technology in Nigeria. The amount of credit available to farmers and number of extension contacts were also positive and significant at 5percent and 10percent respectively, while membership of farmers' organization was negative and significant at 5percent level. These results confirmed the findings of Onemolease and Alakpa (2009) that the frequency of extension contacts promotes the adoption of improved technologies; and Anyaegbunam et al (2009) that farm size, education level and credit availability increased adoption of yam minisett technology significantly in the South East zone of Nigeria. Results also indicated that the major problems hindering the adoption of yam minisett technology included scarcity of treatment chemicals, scarcity of mother seed yam and inability to understand the highly technical procedure, others included tediousness of the practice, lack of substantial increase in harvest, small size of tubers, and poor compatibility to farming system (Table 5). In comparison, Anyaegbunam et al (2009) found that major problems hindering adoption of improved technologies were high cost of input, unavailability of credit, inadequate access to land and insufficient extension services.

4. Conclusion and Recommendations

Despite the high potential of the yam minisett technology to reduce cost and increase profitability of yam enterprise, as well as the high rate of awareness of the technology; its adoption in the middle belt zone of Nigeria is still low. High inputs requirement, including mother seed yam and treatment chemicals, as well as the highly technical procedure; were identified as major constraints to the adoption of the technology. Farm size, age of farmers, farming experience, amount of credit available and frequency of extension contacts with farmers were positively related to adoption and will increase the probability of adoption of the technology. Hence, increased farmers' organization, extension contacts and inputs availability, especially fertilizer, minisett dust and credit; would most likely promote the adoption of yam minisett technology in the middle belt zone of Nigeria.

References

Agwu, A. E. (2004). Factors Influencing the Adoption of Improved Cowpea Technology in Nigeria. *Journal of International Agriculture and Extension Education, 11*(1).

Anyaegbunam, H. N., Eze, C. I., Ogbonna, M. C., & Korieocha, D. S. (2009). Evaluation of factors driving the adoption of yam minisett technology by farmers in Abia State, Nigeria. *The Nigerian Agricultural Journal*, *40*(1), 169-174.

Asumugha, G. N., Ugwu, B. O., Aniedu, O. C., Orkwor, G. C., & Amegbeto, K. (2007). Minisett technique of seed yam production in two major yam producing states of Nigeria: a function of input availability and production objective. In N.M. Mahungu and V.M. Mayong (eds.) *Advances in Root and Tuber Crops technologies for sustainable food security, improved nutrition, wealth creation and environmental conservation in Africa*. Proceedings of the 9th Triennial Symposium of the International Society for Tropical Root Crops – African Branch (ISTRC-AB), Mombasa, Kenya, 1-5 November, 2004. Pp 209-214. Central Bank of Nigeria (Statistical Bulletin) Vol. 14, December 2003.

Babaleye, T. (2003). West Africa: Improving yam production technology. ANB-BIA *Supplement Issues/Edition, 463*, 56-59.

Batz F. J., Peters, K. J., & Jansen, W. (1999). The Influence of Technology Characteristics on Rate and Speed of Adoption. *Agricultural Economics, 21*(2), 121-130. http://dx.doi.org/10.1016/S0169-5150(99)00026-2

Chikwendu, D. O., Chinaka, C. C., & Omotayo, A. M. (1995). Adoption of minisett technique of seed yams production by farmers in eastern forest zone of Nigeria. *Discovery and innovation, 7*, 367-375.

Chinaka, C. C., Chikwendu, D. O., & Asumugha, G. N. (1995). A socio-economic study of the adoption and sustainability of improved cassava varieties among resource poor farmers in outh-east zone of Nigeria. In *Root crops and poverty alleviation.* International Society for Tropical Crops African Branch, Malawi, 333-336.

Ene, L. S. O., & Okoli, O. O. (1995). Yam improvement, genetic consideration and problems. In Osuji G. (ed.). *Advance in Yam Research*, Frontline Publishers, Enugu, Nigeria, 18-32.

Food and Agriculture Organzation, FAO. (2008). Food and Agriculture Organization. *Proceedings of the mini round table meeting on agricultural marketing and food security held at Bangkok*, Thailand. 1-2 November.

Harrel, F. (1986). *The Logistic Procedure.* SAS Institute Inc. SUGI Supplemental Library Users Guide Version 5: 269-293.

International Institute of Tropical Agriculture, IITA. (1998). *International Institute for Tropical Agriculture*, 2005 Annual Report 2005, IITA, Ibadan, Nigeria. Pp. 29-30.

Iwueke, C. C. (1991). Appraisal of yam minisett technique by farmers in south eastern states in Nigeria. In Olukosi, J.O., A.O. Ogungbile and B.A. Kalu (eds) *Appropriate agricultural technologies for resource-poor farmers* (pp. 247-254). Ahmadu Bello University, Zaria, Nigeria.

Iwueke, C. C. (1995). Adoption behaviors of farmers towards yam minisetts technique in Imo State of Nigeria. *The Nigerian Agricultural Journal, 25*(25), 186-189.

Kushwaha, S., & Polycap, I. M. (2001). Economics of small scale yam production. In Qua"an Pau LGA of Plateau. In Abubakar M.M., T.A. Adegbola and L.S.R. Butswat (eds). *The role of agriculture in poverty alleviation.* Proceedings of 34th Annual Conference of Agricultural Society of Nigeria, held at Abubarkar Tafawa Balewa University (ATBU), Bauchi, October 15-19, 2001, pp 69-74.

Madueke, M. C., Ayichi, D., & Okoli, E. C. (2000). Issues in Yam Minisett Technology Transfer to Farmers in South-Eastern Nigeria. African Technology Policy Working Paper No. 21. *African Policy Studies* (ATPS), Network, Nairobi.

NPC. (2006). National Population Census. National Population Commission.

Okoro, J. K., & Kalu, B. A. (1999). *Problems and prospects of the rapid seed yam multiplication technique.* A project submitted for B. agriculture degree at the University of Agriculture, Makurdi.

Onemolease, E. A., & Alakpa, S. O. (2009). Determinants of Adoption Decisions of Rural Youths in the Niger Delta region of Nigeria. *Journal of Social Science, 20*(1), 61-66.

Onwueme, I. C. (1998). *The Tropical Tuber Crops*: Yams, Cassava, Sweet Potato, Cocoyams. John Willey and Sons Ltd. Chichester, 54-55.

Olayemi, J. K. (1998). *Elements of Applied Econometrics.* Department of Agricultural Economics, University of Ibadan, Nigeria, 250.

Pindyck, R. S., & Rubinfeld, D. L. (1988). *Adoption Econometric Models and Economic Forcast*. McGraw-Hill International Edition, UK.

Rogers, E. M. (1992). *Diffusion of Innovations* (fourth Edition, p. 79). The Free Press, New York, USA.

Udoh. (2010). Socioeconomic and Cultural Effects of Biotechnology on Cassava Farmers in Nigeria. Philippine Agricultural Scientist. *An International Journal of Tropical Agriculture.*

Welch, D. G. (2005). *Rapid Multiplication of Yam Minisett Technique*, National Root Crop Research Institute (NRCRI) Umudike, Extension Bulletin, No. 2.

Table 1. Socio-economic Characteristics of the Respondents

Socio-economic characteristics		Frequency	Percentage
Age (years):	<30	3	2.50
	31-40	19	15.83
	41-50	41	34.17
	51-60	40	33.33
	>60	17	14.17
Marital status:	Married	107	89.17
	Not married	13	10.83
Level of Education:	No formal education	53	44.17
	Primary education	52	43.33
	Secondary education	8	6.67
	Tertiary education	7	5.83
Family size:	<4	5	4.17
	4-6	112	93.33
	>6	3	2.50
Farm income (₦):	<50,000	18	15.00
	50,000-100,000	48	40.00
	100,000-150,000	35	29.17
	150,000-200,000	16	13.33
	>200,000	3	2.50
Farm size (ha):	<1	57	47.50
	1-1.99	49	40.83
	2-2.99	12	10.00
	>3	2	1.67
Farming experience (years):	<10	21	15.0
	10-20	76	68.6
	>20	23	16.4

Source: Farm Survey, 2010

Table 2. Distribution of Respondents' Practices of Yam Minisett Technology

Practice	Frequency	Percentage
Level of awareness:		
Aware	118	98.33
Watched the demonstration	81	68.64
Tried it	31	25.83
Currently using it	11	9.33
Not aware	2	1.67
Source of information:		
Agricultural extension agents	116	97.67
Family/friends	37	30.83
Size of yam minisett farm (ha):		
<1	4	36.36
1-2	6	54.55
>2	1	9.09
Source of seed yam:		
Previous harvest	74	61.67
Friends/family	33	27.50
Open market	92	76.67
Extension agent	3	2.50

Source: Farm Survey, 2010

Table 3. Gross Margin Analysis of One Hectare of Yam Minisett Production

Items	Total quantity	Unit value (N)	Total value (N)	Relative value (%)
Labour (mandays)	19	800.00	15,200.00	40.32
Other farm inputs:				
Seedlings (tubers)	150	80.00	12,000.00	
Fertilizers (bags)	4	1,500.00	6,000.00	31.83
Pesticides (litres)	2	1,000.00	2,000.00	
Transportation			1,500.00	
Total capital cost			22,500.00	59.38
Total variable cost		29.00	37,700.00	
Yam minisett output (tubers)	1300	40.00	52,000.00	
Gross margin			14,300.00	
Benefit-Cost ratio				1.38

Source: Farm Survey, 2010

Table 4. Maximum Likelihood Probit Estimates of Factors Affecting Adoption of Yam Minisett Technology

Parameters	Estimates	Standard error	t-values
Age (X_1)	0.062	0.017	3.876***
Marital status (X_2)	-0.024	0.050	-0.687
Household size (X_3)	-0.016	0.030	-0.552
Education (X_4)	-0.014	0.086	-0.859
Farm size (X_5)	0.138	0.021	6.452***
Labour (X_6)	-0.013	0.021	-0.623
Farming experience (X_7)	0.065	0.014	5.052***
Tenancy status (X_8)	0.127	0.620	0.218
Membership of association (X_9)	0.388	0.190	-2.020**
Amount of credit (X_{10})	0.009	0.004	2.231**
No. of extension contacts (X_{11})	0.036	0.020	1.819*
Intercept	-4.935	0.473	-10.244**

Note: ***, ** and * imply statistical significance at 1%, 5% and 10% levels respectively.

Source: Computed from survey data 2010

Table 5. Problems Constraining the Adoption of Yam Minisett Technology

Constraints	**Frequency**	**Percentage**
Scarcity of mother yam	79	65.83
Scarcity of treatment chemicals	81	67.50
Inability to understand the practice because it is highly technical	58	48.33
Not convinced with the harvest	21	17.50
Tediousness of the practice	32	26.67
Produces small size of yam	8	6.67
Not compatible with the farming system	4	3.33

Source: Farm Survey, 2010

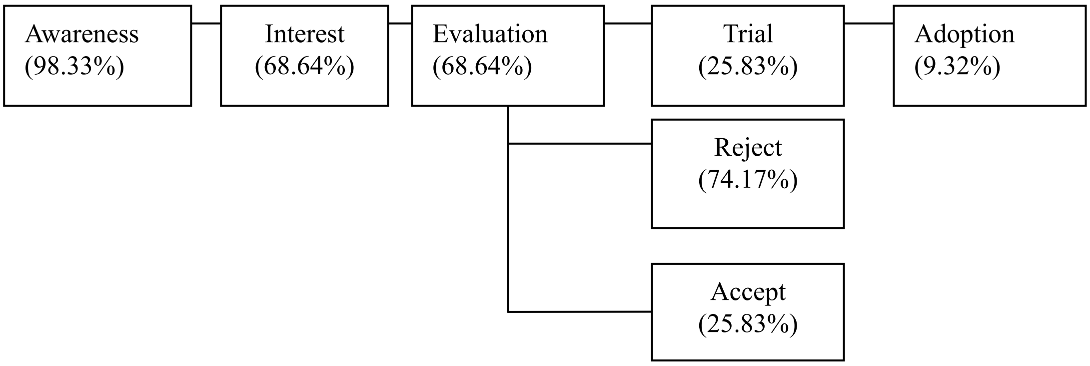

Figure 1. Farmers' Level in the Yam Minisett Adoption Process

Source: Farm Survey, 2010. Adapted to Rogers, 1992, Pg 79