ADOPTION OF YAM MINISETT TECHNOLOGY BY FARMERS IN NIGER STATE, SOUTHERN GUINEA SAVANNAH, NIGERIA

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ABSTRACT

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Yam minisett technology was developed by National Root Crop Research Institute, Umudike in 1982 to address the problem of access to quality seed yam and improved productivity of yam farmers. This study examined the level of awareness, adoption and factors that influence adoption of yam minisett technology package in Niger State. Data for the study were obtained from a field survey of 150 yam farmers using multistage simple random sampling technique. Descriptive statistics and probit regression model was used to analyse the data. The results of the study shows that a typical yam farmer is about 42 years, married, literate with about 17 years’ experience in yam production and cultivating about 2.19 hectares of land in two plots. Mixed cropping is the predominant cropping system; yam was planted either as sole crop or as intercropped with either cereals or legume. The result also reveals that about 69.35% of yam farmers were aware of the yam minisetts technology while only and 35% adopted the technology on their farms during the survey. Compliance with recommended production technology also varied among the adopters with 100% for pre-planting of yam minisetts and 22.05% for use of fertilizer in yam farms. The low level of adoption of was shown to be primarily due to poor and non uniform germination of setts and size of seed yam produced which was said to be small; high labour requirement and poor assess to production inputs and technical information on minisettes technology. The results of probit regression shows that educational status of respondent (X₂), access to credit (X₅), number of extension contact (X₆) and membership of cooperative society (X₇) are positive and statistically significant(P < 0.05). This implies that these variables significantly influence farmer’s likelihood to adopt yam minisets technology. Farming experience (X₃) and household size (X₄) are negative but significant (P < 0.05). This implies that more experience farmers with large household size tend not to adopt yam minisets production technology. To realise the full potentials of yam minisett technology, the study recommends that the researchers should address the issues of non uniform germination and size of seed yam from minisets. Farmers’ practices should also be integrated into the technology package while government should scale up information dissemination on the technology and provide access to production inputs for ease of adoption

INTRODUCTION

Agriculture remains the main stay of Nigeria economy; it plays a dominant role in Nigeria economy in terms of contribution to the Gross Domestic Product (GDP) (about 40 percent of the Nation’s GDP, employment generation (about 80 percent of the population), sources of raw material and market for other sector of the economy as well as export earnings (Okumadewa, 2009). It also provides markets for industrial goods and different classes of food for man. More importantly, an improvement in agriculture has been known in other countries to help in the facilitation of growth in other sector of the economy. The foods includes grains and legumes; vegetables, fruits and spices and roots and tubers (Akande, 2002). Root and tubers crops comprise crop covering several genera. They are staple food crops, being the source of daily carbohydrate intake for the large populace of the world. The term refers to any growing plant which store edible materials in subterranean root, corm or tuber (Oke, 1990). Yam is an important food crop especially in the yam zones of West Africa, comprising Cameroon, Nigeria, Benin, Togo, Ghana and Cote d’ Ivories. This zone produces more than 90% of the total world production which is estimated at about 20 – 25million tons per year (Sanusi and Salimonu, 2006). Nigeria is the main producer of yam in the world with about 71- 75% of the world output followed by Ghana, Cote d’ Ivoire, Benin and Togo Annual production of yam in the country is estimated at 26.587 million metric tons (FAO, 2006). Yam has some inherent characteristics, which make it attractive, first, it is rich in carbohydrate especially starch consequently has a multiplicity of end use. Secondly, it is available all year round making it preferable to other seasonal crops. Yam also plays vital roles in traditional culture, rituals and religion as well as local commerce of the African people (Hahns et al., 1993).

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. This is because increased production of yam is believed to be constrained mostly by high cost of seed yam (NRCRI, 2004). Although yam production in Nigeria has more than tripled over the past 40 years from 6.7 million tonnes per annum in 1961 to 27 million tonnes per annum in 2001. This increase is however attributed to larger hectares of land planted to yam than to increased productivity. There is decline in average yield per hectare from 14.9% in 1986 -1990 to -2.5% in 1999
In establishing a yam farm, seed yam and yam setts are used. Seed yam are whole tubers that weigh between 100g and 150g while yam setts are whole tubers cut into setts of about 100g used as planting materials. Therefore, to establish 1 hectare of yams farm 3 tons of seed yams is required. The cost of planting materials (seed yams/yam setts) constitute about 33 - 45% of capital outlay in yam productions as reported by various workers - Nweke et al, (1991); Agbaje and Oyegbami (2005); and Lawal and Adigun (2012). This is a major constraint to yam production; sometimes planting materials are difficult to obtain, expensive and often of low quality. The National Root Crop Research Institute (NRCRI) in association with the International Institute for Tropical Agriculture (IITA) developed the yam minisett technology in 1982 as a means of rapid multiplication of seed yams to reduce inadequate supply of high quality and disease free seeds yam. The technology involves the use of about 25g cut sett to produce whole tubers of about 100g that serve as yam seed. This technology solves the problem of scarcity of planting material and allows farmers opportunity to produce yam of uniform sizes. In addition, it helps lower the cost of production and also reduces the cost of controlling pest and disease since it makes use of healthy mother yam from sanitized source. In addition to the development of minissets technology, complementary management practices have been developed to form the minisets technology package. The minisets technology package has been disseminated to farmers in Nigeria for adoption since 1982. This study was carried out to investigate adoption of yam minisets technology and how the farmer’s factors affect the adoption of recommended practices for yam production in Niger state which has not been sufficiently investigated. The questions that the study answered centre on understanding the adoption behaviour of yam farmers with regards to yam minisets production technology. These questions include:-

- What is the level of awareness and adoption of yam minisets technology?
- What factors significantly influence the adoption?
- What is the nature of acceptance of the complementary technology associated with yam minisett technology?

The study bridged the gap in the literature and increases our understanding of adoption behaviour of yam farmers which allow us to make policy decision that will improve adoption of yam minisets technology and productivity of yam production system in Nigeria.

**MATERIALS AND METHODS**

The study was carried out in Niger State, Nigeria. Niger State is in the southern guinea savanna of Nigeria, it is located between 8° 11’ to 11° 20’ N of the equator and between 4° 39’ and 7° 15’ E. It covers an estimated land area of 4240km sq. The mean annual rainfall ranges between 800mm – 1100mm in the north and 1600mm in the south of the state. The average number of raining days ranges between 187 – 220 days. The rain starts in late April and ends in October with the peak in July. The average temperature ranges between 26°C – 38°C. The mean humidity ranges between 60% (January - February) and 80% (June - September) (NSADP, 2007). Data used for this study were from primary sources. The relevant primary data were obtained through a farm management survey of yam farmers in the state conducted between March and May, 2010. The target population for the study is the yam farmers in Niger State, Southern Guinea Savannah, Nigeria. Niger State is divided into three agricultural zones. There are Bida (Zone I), Kuta (Zone II) and Kontagora (Zone III). Multistage sampling technique was used to select the samples for the study.

In the first stage, Kuta zone was purposively selected. The selection was based on its long history of yam production as reported in NSADP report (2007). In the second stage, three (3) out of the seven local governments in Kuta zone were randomly selected. These are Shiroro, paikoro and gunara local government areas (LGA’s). In each LGA five (5) villages were randomly selected to have a total of 15 sampled villages. In each village 10 yam farmers were selected. A total of 150 rice farming households were used for the study. The list of farmers prepared during survey visit to the selected villages served as sampling frame for the study.

**Theoretical framework and model specification**

The probit regression model is one of the two binary response model in which a dichotomous regression variable is considered as the dependent variables. The ‘term’ probit stands for probability unit. The two binary response model logit and probit are very similar to one another, however, the probit models offer an alternative to logistic regression for modelling categorical dependent variables. Although, the outcome tends to be similar, the underlying distribution is different (Wikipedia, 2008). Logistic analysis is based on log oddrs while probit uses the cumulative normal probability distribution. The probit model is a regression model in which the dependent variable (Y) measures the different that a unit change in the independent variable makes in terms of cumulative probability of the dependent variable. The traditional consumer theory explains how consumer chooses what to consume subject to certain constraints (Sadoulet and Dayeney, 1995).

Given two discrete choices ‘i’ and ‘j’; the probability of choosing ‘i’ over ‘j’ occur when the utility of ‘i’ is greater than that of ‘j’ that is \( U_{i>U_{j}} \).
Therefore, the probability of an individual ‘n’ choosing ‘i’ is
\[
Pr(i) = Pr(U_{in} > U_{jn}) \quad \text{----------------- (1)}
\]
While that of choosing ‘j’ is
\[
Pr(j) = 1 - Pr(i) \quad \text{----------------- (2)}
\]
However, the utility function although observed is a function of observed characteristics (Ben-Akwa and Lerman, 1985)
\[
U_{in} = V_{in} + e_{in} \quad \text{----------------- (3)}
\]
\[
U_{jn} = V_{jn} + e_{jn} \quad \text{----------------- (4)}
\]
Where e’s are the random components, the V’s are the deterministic components and can be written as
\[
\beta_1X_1 + \beta_2X_2 \quad \ldots \quad + \beta_nX_n \quad \text{----------------- (5)}
\]
Where the estimated parameters (\(\beta\)’s) are the X’s observed characteristics. Replacing U with V and e in equation 1 and rearranging the components gives
\[
Pr(i) = Pr(e_{jn} - e_{in}) = V_{in} - V_{jn} \quad \text{----------------- (6)}
\]
Thus the differences in the error terms (\(e_{jn} - e_{in}\)) are the same differences in the observed characteristics. The concept of random utility which states the observed inconsistencies in choice behaviour are a result of the analyst’s deficiencies (Ben-Akwa and Lerman, 1985), which necessitates the utilities to be treated as random variables. The model specification is done by considering differences in the error term and the assumption that these differences are a large number of unobserved, but independent variables.

Therefore in deciding to adopt minisett technology, it is assumed that yam farmers weigh the expected utility of wealth from adoption represented as \(U_{A}(\pi)\), and the expected utility of wealth from non-adoption represented as \(U_{N}(\pi)\) where \(\pi\) represented wealth (net farm returns). Adoption occurs if \(U_{A}(\pi) > U_{N}(\pi)\), assuming that a farmer is risk neutral. The parameters of this decision are not observable, but can be represented by a latent variable
\[
1 = U(\pi) \quad \text{if} \quad U_{A}(\pi) > U_{N}(\pi) \quad \text{and} \quad U(\pi) = 0 \quad \text{if} \quad U_{A}(\pi) < U_{N}(\pi) \quad .
\]
We can drop the superscripts for exposition and express the utility of adoption \(U(\pi)\) as related to a set of explanatory variables \(X\) as:
\[
U = \beta_0 + \sum_{i=1}^{n} \beta_iX_i + e \quad \text{----------------- (7)}
\]
where variables in \(X\) include characteristics of the farmer and resource characteristics of the farm, \(\beta\) is a vector of parameters and \(e\) is a random error term. The dependent variable \(U\) is binary: The variables are
\[
\begin{align*}
U &= \text{Adoption of yam minisets technologies; 1 for adopters and 0 for non adopters.} \\
X_1 &= \text{Farm size in hectarre} \\
X_2 &= \text{Highest educational levels of sampled yam farmer in years.} \\
X_3 &= \text{Farming experience of sampled yam farmer in years} \\
X_4 &= \text{Household size of sampled yam farmer} \\
X_5 &= \text{Access to credit expressed as dummy; 1 for access and 0 for no access} \\
X_6 &= \text{Number of extension contact per year.} \\
X_7 &= \text{Cooperative membership of sampled yam farmer dummied as member = 1 and non-member = 0} \\
\beta_0 &= \text{Coefficient to be estimated.}
\end{align*}
\]

Adoption index used in categorising yam farming household

In this study, the package approach to technology adoption as used by Daramola, 1987; Rahji, 2006 and Lawal and Alabi 2011 was adopted. As a result an index that quantifies the adoption level of the recommended practices or component of the innovation is required. This is used to measure the relative contribution of each component to output (Net farm return). The components are ranked and the ranking are used to develop the adoption index of the farmer. The minisett technology consists of using healthy whole yams to produce “clean” seeds within a production technologies in the probit model.

Adoption occurs if \(yam\) farmers score 60% and above hence an adoption index is equal to 1 if the yam farmers scores 60% and above hence an adoption otherwise it is 0 implying non-adopter. This is the threshold concept that is used to categorise the yam farmers as adopters and non-adopters of yam minisett production technologies in the probit model.
RESULTS AND DISCUSSION

Socioeconomic characteristics of yam farmer in Kuje area council

Table 1 shows the variables analysed in this study which include: age, household size, sources of capital, farming experience in years, educational background. Age is an important factor in labour productivity and literacy level affects adoption of technology (Adewumi and Omotesho, 2002). About 65% of the sampled yam farmers were 50 years or less than. A typical yam farmer is about 42 years, married, literate with about 17 years’ experience in yam production and cultivating about 2.19 hectares of land in two plots which shows that they can give reliable information about the yam farming in the study area. Mixed cropping is the predominant cropping system; yam was planted either as sole crop or as intercropped with either cereals or legume. The results show that farming is still popular among the young and active in the villages around the major yam producing area of Niger State. Access to formal credit facility was poor; about 73.33% of the respondents do not have access to formal credit facility during the survey. This result is in line with that reported by Rahji (2006) and Lawal (2008) in their work on rice farmers and fadama farming households in Niger State.

Table 1: Socioeconomic Characteristics of Yam Farmers in Niger State (N = 150)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years</td>
<td></td>
</tr>
<tr>
<td>21 – 30</td>
<td>6.67</td>
</tr>
<tr>
<td>31 – 40</td>
<td>26.00</td>
</tr>
<tr>
<td>41 – 50</td>
<td>32.67</td>
</tr>
<tr>
<td>51 – 60</td>
<td>18.00</td>
</tr>
<tr>
<td>&gt;60</td>
<td>16.67</td>
</tr>
<tr>
<td>Highest Educational Level</td>
<td></td>
</tr>
<tr>
<td>No Formal Education</td>
<td>27.33</td>
</tr>
<tr>
<td>Quranic</td>
<td>38.67</td>
</tr>
<tr>
<td>Primary</td>
<td>12.67</td>
</tr>
<tr>
<td>Secondary</td>
<td>17.33</td>
</tr>
<tr>
<td>Tertiary</td>
<td>4.00</td>
</tr>
<tr>
<td>Farm size (Hectares)</td>
<td></td>
</tr>
<tr>
<td>0.1 – 2.0</td>
<td>28.67</td>
</tr>
<tr>
<td>4.0</td>
<td>57.33</td>
</tr>
<tr>
<td>4.1 – 6.0</td>
<td>14.00</td>
</tr>
<tr>
<td>Yam Farming Experience (Yr)</td>
<td></td>
</tr>
<tr>
<td>1 – 5</td>
<td>6.67</td>
</tr>
<tr>
<td>6 – 10</td>
<td>19.33</td>
</tr>
<tr>
<td>11 – 15</td>
<td>13.33</td>
</tr>
<tr>
<td>&gt;20</td>
<td>37.33</td>
</tr>
<tr>
<td>Source of Credit</td>
<td></td>
</tr>
<tr>
<td>No credit</td>
<td>33.33</td>
</tr>
<tr>
<td>Family and friend</td>
<td>30.00</td>
</tr>
<tr>
<td>Money lenders</td>
<td>10.00</td>
</tr>
<tr>
<td>Cooperative society</td>
<td>21.33</td>
</tr>
<tr>
<td>Community Bank</td>
<td>4.00</td>
</tr>
<tr>
<td>Agric and Coop bank</td>
<td>1.33</td>
</tr>
</tbody>
</table>

Yam minisetts technologies adoption characteristics

The survey result shows that awareness level of the technology is low; only about 32.67% (49) of sampled yam farmers in the study were aware of yam minisetts production technology. The farmers that adopted the technology in their farm during the survey were 15.33% (23) of the sampled farmers and only 46.93% of those farmers that were aware of the minisetts technology. The finding in this study differ from that reported by Bolarinwa and Oladeji (2009) that reported about 70% adoption for Yam minisetts technique in Oyo, Osun and Kwara States of Nigeria. However, the result is similar to those reported by Iwueke and Okoro (1999) and Okoro (2008) who reported less than 30% adoption rate for yam minisetts technology. As stated under section 2.2 which described the adoption index used in this study, there are seven main components of yam minisetts technology package. The rate of adoption of this component of the package differs among the respondents. Table 2 shows the adoption characteristics of the sampled yam farmer during the survey. All the adopters’ utilised pre-germination of yam setts and hand weeding in the nursery while the use of fertilizer and herbicide were the least adopted among the production package in yam minisetts technology. Non-adoption of pre-sprouting may be due to extra care needed
in raising the nurseries and transplanting which deviate from the farmer’s previous planting experience. Farmers seldom need to apply fertilizer on yam because land judged very fertile is used for yam production. This study corroborated F. A. O (1997) that asserted that farmers adopted only those practices they have been familiar with and which are in line with existing farm practices.

Table 2: Adoption characteristics of yam minisetts package by farmers in Niger State and FCT

<table>
<thead>
<tr>
<th>Production Technologies</th>
<th>Niger State (N =40) Adoption %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-planting of yam setts (25g)</td>
<td>100.00</td>
</tr>
<tr>
<td>Treatment of yam setts with Aldrin or Ash</td>
<td>65.00</td>
</tr>
<tr>
<td>Hand weeding in nursery</td>
<td>100.00</td>
</tr>
<tr>
<td>Field planting at 25 cm spacing in may</td>
<td>100.00</td>
</tr>
<tr>
<td>Staking with trills or using pyramid method</td>
<td>67.50</td>
</tr>
<tr>
<td>Use of fertilizers</td>
<td>32.5022%</td>
</tr>
<tr>
<td>Use of herbicide</td>
<td>55.00</td>
</tr>
</tbody>
</table>


Reasons for non use of yam minisetts technology

The reasons for non use of the yam minisetts technology by farmers is presented in Table 3 which shows that low percentage germination of setts due to rotting and dying in the nursery (81.82 %) and small size of seed yam produced through the technique (72.73% ) as the two most important during the survey in Niger State . Onwueme (1982) attributed the rotting and drying up of setts to the problem of apical dominance in tubers. He define apical dominance as a phenomenon whereby tubers sprout first from the head region whether in whole tuber or cut setts, followed by the middle portion and lastly from the tail region, due to greater concentration of the hormones which promote sprouting on the head region. This results in non uniform sprouting of setts from various portions of the tuber as reported by farmers during the survey. This result is similar to those reported by Okoro (2009) and Bolarinwa and Oladeji (2009) on the reasons for non use of that reported about 70 % adoption for Yam minisetts technique in Oyo, Osun and Kwara States of Nigeria.

Table 3: Major reason for non use of yam minisetts technology by farmers that are aware of the technology in Niger State

<table>
<thead>
<tr>
<th>Reason for Non Use</th>
<th>Niger(%) N= 49</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low germination of setts</td>
<td>81.82</td>
</tr>
<tr>
<td>Too small seed yam produced</td>
<td>72.73</td>
</tr>
<tr>
<td>Labour intensive</td>
<td>64.55</td>
</tr>
<tr>
<td>Poor access to production inputs – agrochemicals, fund</td>
<td>55.46</td>
</tr>
<tr>
<td>Ignorance of technical details</td>
<td>47.27</td>
</tr>
</tbody>
</table>


Factors affecting adoption of yam minisetts production technology in the study area

Table 4 shows the probit regression model estimates of the likelihood influence of farm size, education status of respondent, farming experience, household size, access to credit, number of extension contact and membership of cooperative society on adoption of yam minisetts production technology among sampled yam farmers during the study. The result indicates a chi-square value of 144.57 for the estimated model. This implies a good fit for the regression model used for the analysis. The coefficient of the probit regression model shows that educational status of respondent (X_2), access to credit (X_5), number of extension contact (X_6) and membership of cooperative society (X_7), were positive and statistically significant at different levels. This implies that these variables significantly influence farmers likelihood to adopt yam minisetts technology that is farmers that are educated who are members of an association with access to credit and extension services are more likely to adopt the minisett technology. Farming experience (X_3) and household size (X_4) are negative but significant ($P < 0.05$). This implies that more experience farmers with large household size tend not to adopt yam minisetts production technology because it is different from the farming practice they are familiar with. FAO (1997) asserted that farmers adopted only those practices they have been familiar with and which are in line with existing practices. This results support the findings of Bolarinwa and Oladeji (2009) and Tiamiyu et al., 2010 who reported similar trend in their work on adoption of yam minisetts and NERICA rice production technologies respectively.
CONCLUSION AND RECOMMENDATION

The study assessed the level of awareness and adoption of yam minisetts and its complementary technology among yam farmers in Niger state after about 26 years since the introduction of the technology. The result reveals that about 49% 69.35% of yam farmers were aware of the yam minisetts technology while only 23 adopted the technology on their farms during the survey. Compliance with recommended production technology also varied among the adopters, they only adopted those parts of the technology they are familiar with. The low level of adoption of minisetts and its complementary technology was shown to be primarily due to poor and non uniform germination of setts and size of seed yam produced which was said to be small; high labour requirement and poor assess to production inputs and technical information on minisetts technology. The result of this study shows that there is need for a reappraisal of the yam minisetts technology package for it to be attractive to yam farmers. Therefore, to realise the full potentials of yam minisetts technology package, the researchers needs to address the issues identified in this study with regards so size of seed yam produced and non uniform germination of minisetts. Farmers’ practices should be integrated into the technology package while government should scale up information dissemination on the technology and provide access to necessary production inputs for ease of adoption.

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