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PERSONAL AND SOCIO-ECONOMIC FACTORS AFFECTING THE ADOPTION OF SWEET POTATO PRODUCTION TECHNOLOGY BY FARMERS IN SOUTH-EAST ZONE OF NIGERIA

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ABSTRACT
Sweet potato (Ipomoea batatas (L) Lam) is a very important staple carbohydrate food in sub-saharan Africa, and reputed for its capacity to tolerate marginal environments as well as high energy-fixing efficiency to produce high dry matter at a short period of time. It produces much dry matter per unit of time and contains high levels of vitamins A and C. Apart from the roots, the young leaves serve as green vegetable for man whereas the leaves and vines are cherished as fodder and hay by livestock. Sweet potato production technologies have been developed by the National Root Crops Research Institute, (NRCR) Umudike, and transferred to farmers in Nigeria in conjunction with state Agricultural Development Programmes. This study assessed the levels of awareness and adoption of the sweet potato technology disseminated by NRCRI to farmers and also determined the factors affecting the adoption of the technology. The multistage sampling technique was used in selecting the respondents using structured interview schedule as instrument. Data were collected from 270 respondents. The findings showed that the levels of awareness and adoption of the technologies were high. Age, education, riming experience, household size and farm size were factors that significantly influenced adoption, while the constraining factors to increased adoption of the technology were grouped into production complexity problems, economic problems, poor technical information and pathological problems. The study recommended the intensification of the dissemination of rapid vine multiplication techniques like the 2-node vine cutting technique, and rapid transfer of the integrated pest management technology on sweetpotato.

Key words: Technology adoption, sweet potato, Ipomoea batatas

INTRODUCTION

Sweetpotato (*Ipomoea batatas* (L) Lam), one of the most important staple carbohydrate foods in sub-Saharan Africa, is reputed for its capacity to tolerate marginal environments and high energy-fixing efficiency to produce high dry matter at a short period of time (NRCRI, 1987; Nwokocha, 1993; Ogbonna, Nwauzor, Asumugha and Emehute, 2005). It is highly adaptable to relatively poor soils and erratic rainfall, has high productivity per unit land area and labour, and guarantees some yield even under the most adverse conditions. It also produces much dry matter per unit of time and contains high levels of vitamins A and C (Nwokocha and Onunka, 2002; Ikwelle, Ezulike and Eke-Okoro, 2003). Apart from the roots, the young leaves serve as green vegetable for man, while the leaves and vines are cherished as fodder and hay by livestock (Villereal, Tson, Lo and Chiu, 1985). It arrived Nigeria between 1694 and 1698 through the Portuguese explorers (Chinaka, 1983; Ezeano, 2004). Nigeria ranksed third among the world's largest producers of sweetpotato with 2,150,000 metric tonnes annually (NRCRI, 2009). In Africa, Nigeria is the second largest producer after Uganda with 2,600,000 metric tonnes annually. Sweetpotato production technology has been developed by the National Root Crops Research Institute, Umudike, which has the national mandate for root and tuber crops of economic importance in Nigeria. The components of this technology include seedbed preparation, improved varieties, plant spacing, planting material, time of planting, weed control methods, fertilizer application, earthening up, pest and disease control method and time of harvest. These technologies have been extended to the farmers through the states' Agricultural Development Programmes (ADPs) in the Southeast Geo-politial zone of Nigeria. Adoption studies by Onyenweaku and Mbuba (1991) showed labour

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availability, attendance at farmers' meetings and extension contact to be positively and significantly associated with the adoption of yam minisett technique by farmers in Anambra State. Chikwendu , Chinaka and Omotayo (1995) showed that household size, age, co-operative membership, tenural status and intensity of extension contact as being significant determinants of adoption of yam minisett Ironkwe, Unanma and Asiedu (2003) indicated farming experience, membership of co-operatives and income as being positively and significantly related to adoption; Mbanaso, Chukwu and Chijioke (2005) showed that age, farm size, sex and extension contact were the significant factors affecting the adoption of the two-node cutting technique of sweetpotato production in Ebonyi State. There is the need to assess the awareness and adoption statuses of the sweetpotato production technology in Nigeria. This study was, designed to: examine the personal and socio-economic characteristics of the farmers in Nigeria; assess the levels of awareness and adoption of the technology by the farmers, determine the personal and socio-economic factors affecting adoption of these technologies by the farmers; and identify any constraint to adoption of sweetpotato production technology.

MATERIALS AND METHODS

The study was carried out in the South-east zone of Nigeria. Using the multistage sampling technique, three states were randomly selected out of nine states in the zone. These were Abia, Ebonyi and Imo States. Three agricultural zones, according to the State ADP's delineation, were selected from each state, and three extension blocks from each agricultural zone. Two circles were selected from each extension block while five farmers were selected from each circle using a list provided by the extension agent overseeing the circle. This gave 90 farmers from each State and a total of 270 farmers. Structured interview schedule was used as instrument for data collection. In analyzing data generated for the study, descriptive statistics were used in examining the personal and socio-economic characteristics of the farmers, as well as assessing the levels of awareness and adoption. In determining the personal and socio-economic factors affecting adoption of the sweetpotato production technology by the farmers, the probit regression analysis was used as a statistical tool. The estimated probit function is given by

$Pi = bo+b_1Xi$

Where

Pi = estimated probit value for adoption (Z_A)

Xi = the independent or explanatory variables for adoption (Z_A)

bo = Intercept

b_1 = regression parameter to be tested for significance

Subsequently, the determinants of adoption of the sweetpotato production technologies are given, respectively, as:

$$\mathbf{Z_A}=bo+b_1X_1+b_2X_2+b_3X_3+b_4X_4+b_5X_5+b_6X_6+b_7X7+b8X_8+b_9X_9+b_{10}X_{10}+b_{11}X_{11}$$

Where:

$X_{1=}$ Age, measured in years

$X_{2=}$ Sex, male= 1, female=0

X_3= Education , dummy variable for education of head of household. 1 if an education, 0 otherwise

$X_{4=}$ Marital status, dummy variable for having life partner; 1 if there is life partner, 0 otherwise

$X_{5=}$ Household size, total number of household members

$X_{6=}$ Occupation, major occupation of the respondent

$X_{7=}$ Credit, dummy variable for participating in a formal or informal credit system. 1 if participates, 0 otherwise

$X_{8=}$ Farm size, hectares of land a household farmed (with sweetpotato) in the previous year

$X_{10=}$ Membership of social/farmers' organization. 1 if involved in any organization, 0 otherwise

$X_{11=}$ Extension, dummy variable for having had contact with extension agency. 1 if had such contact, 0 otherwise

Identification of the constraints to the adoption of the sweetpotato production technology in the country was achieved using a five-point Likert-type rating scale. The response options and assigned values were: To a very great extent=5; To a great extent=4;To some extent=3;To a little extent=2; None at all=1. A list of possible constraints was supplied, from which the respondents were asked to indicate the extent of their perceived seriousness of each constraint according to the response options provided. Data were subjected to exploratory factor analysis procedure, using the principal factor model with varimax rotation in classifying the constraint variables into major constraint factors. In factor analysis, the factor loading under each constraint variable (beta weight) represents a correlation of the variables (constraint areas) to the identified constraint factor, and has the same interpretation as any correlation coefficient. The variables with loadings of 0.40 and above (10% overlapping variance; Chukwuone, Agwu and Ozor, in Akinnagbe 2009) were used in naming the factors.

RESULTS AND DISCUSSION

Personal and socio-economic characteristics of respondents

As shown in Table 1, the highest(24.82%) proportion of the respondents were within the age range of 40-49 years, followed by those of 50-59 years (23.70%), 60 years and above (23.33%), 30-39 years (17.78%) and lastly 20-29 years (10.37%). The average age of the respondents was about 48 years, showing that there was a relatively high proportion of people in their prime of life among the respondents. This falls within the economically productive proportion of the population as defined by Food and Agriculture Organization (1997) cited in Emodi (2009). Moreover, the farmers were still in their active years, as majority (66.30%) of them were between 30 and 59 years, a situation that is likely to favour the adoption of the sweetpotato production. About 51% of the respondents were males while 49% were female. This implies that gender distribution among farmers in sweetpotato production is skewed slightly towards male. This is at variance with the findings of Okwusi, Amamgbo and Asumugha (2005) which showed that female predominated in the production, processing and utilization of sweetpotato in South-eastern Nigeria. The table further showed that 72.59% of the respondents were married, followed by 14.82% who were widowed, 9.26% who were single and 3.33% were divorced or separated. Entries in Table 1 also revealed that 14.07% of the farmers had no formal education, 26.30% had primary education, 38.89% had secondary education, while 20.74% had post secondary education. This means that majority of the farmers were literate, as about 86% of them had one form of formal education or other. The high proportion of literate people among the farming population implies that majority of them are in a better position to be aware of, understand and adopt the sweetpotato production technology. Education has always been known to play a positive role in the adoption of improved technologies among farmers (Sheikh, Ather, Arshed and Kashi, 2006). Table 1 also showed that 27.78% of the respondents had 1-10 years of farming experience, 31.48% had between 11 and 20 years of experience, while 40.74% had 21 or more years of farming experience. The mean years of farming experience was 22.22 years, implying that the farmers have long period of farming experience that will enhance their understanding and subsequent adoption of the sweetpotato production technology. The table further showed that households that had between one and five people made up 37.78% of the respondents, those with six to ten members constituted 49.26%, while those households with 11 persons or more made up 12.96% of the respondents. The average household size was 7 persons. This means that the farmers had relatively large-sized households. This is advantageous to farming since it will enable the farmer to use family labour and thereby reduce the cost of hiring labour for sweetpotato production. Entries in Table 1 showed that majority (90.74%) of the respondents belonged to social/farmers'organization, while only 9.26% did not. This is advantageous to farming since, according to Peterson (1997) in Agwu (2000), farmers'/social organizations offer an effective channel for extension contact with large numbers of farmers, as well as opportunities for participatory interaction with extension organizations. This enhances farmers' uptake of new practices such as the sweetpotato production technology. The table further revealed that majority (95.56) of the respondents did not participate in any credit system for the production of sweetpotato while less than 5% did. This implies that their scales of operation were such that can easily be funded from their personal earnings without resorting to loans. This should be expected since sweetpotato is a low input crop, and does not require large capital outlay to produce (Nwokocha, 1993; Ogbonna, Nwauzor, Asumugha and Emehute, 2005).Table 1 further showed that 60% of the respondents have had contact with the extension agency in the zone while 40 percent had none. This means that majority of the respondents have had contact with extension and are, therefore, expected to be more exposed to relevant technologies like the sweetpotato production technologies being disseminated through the agency. Majority (62.96%) of the respondents cultivated less than one hectare of land for sweetpotato, 25.93% of them cultivated 1 to 1.99 hectares, 7.41% cultivated 2 to 2.99 hectares, 1.85% cultivated 3 to 3.99 hectares while another 1.85% cultivated 4 to 4.99 hectares. The average farm size was 1.34 hectares. Shaib, Aliyu and Bakshi (1997) classified farm holdings in Nigeria into three broad categories of small-scale, medium-scale and large-scale. Small-scale farm holdings were less than 6 hectares in size, medium-scale farm holdings were 6 to 9.99 hectares in size while large-scale farm holdings were 10 hectares and more in size. In this study, none of the farmers cultivated more than 4.99 hectares of land. This means that all the sweetpotato farmers in the zone were small-scale farmers. This finding is in agreement with the findings of studies by Aniedu (2006) and Emodi (2009) which found

small-scale farmers predominating in the zone. The implication is that farmers in the Southeast agro-ecological zone of Nigeria are small-scaled farmers.

Awareness of the sweetpotato production technology

Entries in Table 2 show that 79.63 percent of the respondents were aware of the sweetpotato production technology, while 20.37 percent were not aware of it. This means that majority of the farmers in the South-east geo-political zone of Nigeria were aware of it. This is of advantage to the adoption of the sweetpotato production technology, as awareness is an indispensable and preceding step towards the adoption of any improved practice.

Level of adoption of sweetpotato production technology

Table 3 showed the levels of adoption of the components of the sweetpotato production technology. All (100.00%) the farmers who were aware of this technology adopted the technology of seedbed preparation, which is the use of ridges or mounds. Use of improved sweetpotato varieties had 77.20% as level of adoption, while plant spacing had the lowest (59.50%) level of adoption. Use of planting materials (5/6-node vine cuttings) had 80.00% as adoption level, time of planting, 98.00%, weed control methods, 100.00%, and fertilizer application, 92.00%. Earthening-up technique, pest and disease control methods and time of harvesting had adoption level of 100.00% each. This means that
the sweetpotato production technology has a high level of adoption among the farmers in Nigeria. The implication is that the farmers in the South-east agro-ecological zone of Nigeria are willing to adopt this technology once they are aware of it.

Personal and socio-economic factors affecting adoption of sweetpotato production technology in Nigeria

Table 4 shows the result of the probit regression analysis of the personal and socio-economic factors affecting the adoption of sweetpotato production technology. Age, education, farming experience, household size and farm size were found to be significant factors affecting the adoption of the technology. Farm size was found to be positively related to the adoption of sweetpotato production technology at 10% level. This means that increases in farm size would result to corresponding increases in adoption of the technology. This is in agreement with Mbanaso, Chukwu and Chijioke (2005) who found similar positive relationship between farm size and adoption of the 2-node vine cutting technique of sweetpotato production in Ebonyi State. Household size was found to be positively and significantly related to the adoption of the technology at 5% level. This means that an increase in household size will lead to a corresponding increase in the adoption of the sweetpotato production technology. Large household size is expected to provide cheap family labour needed for increased sweetpotato production. Farming experience was similarly positively and significantly related to adoption at 10% level, implying that increases in farming experience will lead to increases in the adoption of the technology. In Mbanaso, Chukwu and Chijioke (2005), this variable was not found to be significant. Education was statistically significant at 1% level, meaning that increased levels of formal education will result to increased adoption of the sweetpotato production technology. This is consistent with literature on the role of education in the adoption of new technologies, and posits that education level influences a person's allocative and technical efficiency, thus positively influencing the adoption decision (Wendland and Sills, 2008). Age was negatively and significantly related to adoption at 5% level. This means that increases in age would lead to decreases in adoption. This is contrary to expectation since sweetpotato is a low-input crop and its production less tasking or resource-demanding than such crops as cassava, yam and cocoyam.

Table 1: Percentage distribution of respondents according to their personal and soco-economic characteristics (N=270)

Category	%	Mean (M)
Personal characteristics		
Age (Years)		
20-29	10.37	
30-39	17.78	
40-49	24.82	
50-59	23.70	
≥ 60	23.33	**48.31**
Sex		
Male	51.11	
Female	48.89	
Married status		
Married	72.59	
Single	9.26	
Divorced/separated	3.33	
Widowed	20.74	
Formal education		
None	14.07	
Primary	26.30	
Secondary	38.89	
Post secondary	20.74	
Farming experience (Years)		
1 – 10	27.78	
11 – 20	31.48	
≥ 21	40.74	**22.22 years**
Household size		
1-5	37.78	
6-10	49.26	
≥ 11	12.96	**7 persons**
Socio-economic characteristics		
Membership of social/farmers' organization		
Yes	90.74	
No	9.26	
Access to credit facility		
Yes	4.44	
No	95.56	
Extension contact		
Yes	60.00	
No	40.00	
Farm size (Ha)		
≤ 0.99	62.96	
1.00-1.99	25.93	
2.00 – 2.99	7.41	
3.00 – 3.99	1.85	
4.00 – 4.99	1.85	

Table 2: Percentage distribution of respondents by level of awareness of the sweetpotato production technology (N=270)

Category	%
Aware	79.63
Unaware	20.37

Table 3: Percentage distribution of respondents according to levels of adoption of components of sweetpotato production technology (n=215)

Production technology	Adoption level (%)
Seedbed preparation	100.00
Improved varieties	77.20
Plant spacing	59.50
Planting material	80.00
Time of planting	98.00
Weed control methods	100.00
Fertilizer application	92.00
Earthening up	100.00
Pest and disease control methods	100.00
Time of harvesting	100.00

Table 4: Probit regression of adoption of sweetpotato

Variable	Coefficient	Std. err.	Z
Age	-.0330114	.0162069	-2.04**
Sex	.1588849	.2426512	0.65
Marital status	.0627935	.2971412	0.21
Educ	.1304912	.0293332	4.45***
Farmexp	.0300743	.0176014	1.71*
HHS	.1294995	.0438295	2.95**
Member	-.1509982	.4191726	-0.36
Credit	.8213977	.5535358	1.48
Extension	.0730928	.2563753	0.29
Farmsize	.4130043	.2474007	1.67*
Const	1.105428	.6759891	1.64

*=significant at 10%; **= significant at 5%; ***=significant at 1%

Factors constraining the adoption of technologies

Table 5 showed the varimax rotated constraint factors influencing the adoption of the sweetpotato production technologies as perceived by the farmers. The identified constraint factors were: production complexity problems, economic problems, poor technical information and pathological problems. Production complexity problem was dominated by recommended sweetpotato production practices are costly to carry out (0.805), high cost of sweetpotato vine needed for planting (0.709), low consumer preference associated with sweetpotato product (0.707), and difficulty in integrating sweetpotato production technology into existing production system (0.684). Other constraining variables included unavailability of sweetpotato vines needed for planting (0.643), recommended sweetpotato production practices are complex to carry out (0.628), and lack of market to sell increased quantities of sweetpotato (0.595). Most farmers in the rural areas will not adopt any innovation which they find to be complex. In this regard, the farmers will be unable to manipulate the innovation (van den Ban and Hawkins, 1996; Adekoya and Tologbonse, 2005). Subsequently, they will not be able to integrate such innovations, like the sweetpotato innovation, into their existing production system.

Items that loaded high in factor 2, (economic problem), included high cost of available inorganic fertilizer (0.774), available agro-chemicals (herbicides) are costly (0.758), unavailability of inorganic fertilizer (0.748) and unavailability of agro-chemicals (0.673). In many situations, the development of sustainable production requires increased use of purchased inputs such as inorganic fertilizers and agro-chemicals like herbicides (Agwu, 2000). These inputs require funds, and the poor economic conditions of the farmers often constrain them from using these sweetpotato technologies. This situation is compounded by the unavailability of the inputs. Issues which loaded high under factor 3, (poor technical information), included: lack of contact with important sources of information on sweetpotato production (0.768), and lack of adequate technical knowledge about recommended farm practices associated with sweetpotato production (0.725). The transfer of agricultural technologies is a process that involves multiple functions of information, teaching, technology supply and technology service (Asiabaka, 1991). The implication is that the recipients of the technology require the technical knowledge that underlie the formulation and design of the technology (Okono,1994, in Agwu, 2000). Thus the poor technical knowledge of the farmers may contribute in making the adoption of the sweetpotato production technologies difficult.

Table 5: Varimax rotated factors constraining the adoption of sweetpotato production technology by farmers

Constraint variables	Factor 1	Factor 2	Factor 3	Factor 4
Scarcity of land	-0.127	0.066	-0.344	0.504
Low soil fertility	0.275	0.265	0.028	0.205
Unavailability of labour	-0.037	0.328	-0.577	0.438
High cost of hired labour	-0.167	0.430	-0.527	0.340
Difficulty in integrating sweetpotato production technologies into existing production system	0.684	0.134	0.141	-0.155
Low consumer preference associated with sweetpotato product	0.707	-0.051	0.178	-0.053
Lack of market to sell increased quantity of sweetpotato	0.595	-0.088	-0.097	-0.091
Lack of capital to carry out necessary farm activities	0.022	0.459	-0.457	0.314
Unavailability of sweetpotato vines needed for planting	0.643	-0.048	0.012	0.383
High cost of sweetpotato vines needed for planting	0.709	-0.147	-0.099	0.332
Unavailability of inorganic fertilizer	0.017	0.748	0.020	0.044
High cost of inorganic fertilizer	0.051	0. 774	-0.107	0.309
Unavailability of agro-chemicals (herbicides)	-0.013	0.673	0.210	-0.140
Available agro-chemicals are costly	0.037	0.758	0.101	-0.167
Recommended sweetpotato production practices are complex to carry out	0.628	0.165	0.377	-0.050
Recommended sweetpotato production practices are costly to carry out	0.805	0.068	0.125	-0.143
Lack of adequate technical knowledge about recommended farm practices associated with sweetpotato production	0.224	0.200	0.725	-0.073
Lack of contact with important sources of information on sweetpotato production	0.069	0.066	0.768	0.329
Problem of pest attack on sweetpotato	-0.105	0.021	0.052	0.809
Problem of disease attack on sweetpotato	-0.115	-0.034	-0.032	0.783

Personal and socio-economic factors affecting adoption of sweetpotato production technology in Nigeria

Specific issues with high loading under factor 4 (pathological problem) included problem of pest attack on sweetpotato (0.809), problem of disease attack on sweetpotato (0.783) and scarcity of land (0.504). The major pathological problem of sweetpotato in the South-east agro-ecological zone of Nigeria (Abia, Akwa Ibom, Anambra, Bayelsa, Cross River, Ebonyi, Enugu, Imo and Rivers States) is attack by the sweetpotato weevil, *Cylas spp*. The incidence of this pest increases with increase in the dryness of the soil. Therefore, farmers who harvest their crops piece-meal or leave their crops in the soil into the dry season stand the risk of losing more of their produce through the attack of this pest than those who harvest their crops earlier (Nnodu, 1981; Anioke, Ene and Abazie 1987) However, some variables were loaded high in more than one factor and were, as a result, not considered in the process of naming the extracted factors. These included: unavailability of labour (loaded in factors 3 and 4), high cost of labour (loaded in factors 2 and 3) and lack of capital to carry out necessary farm activities (loaded in factors 2 and 3). One variable, low soil fertility, had loadings that were below 0.40 which was used in naming the factors. It was, therefore, not included in the naming of the naming of the extracted factors.

CONCLUSION AND RECOMMENDATIONS

There is a high level of awareness of the sweetpotato production technology among the farmers in Southeast agro-ecological zone of Nigeria. Similarly, the study reviewed high level of adoption of the technology. The variables age, education, farming experience, household size and farm size were significant factors influencing adoption of the technology by farmers in Nigeria. Four factors were identified as constraints to increased adoption of the sweetpotato production technology. These were: production complexity problems, economic problems, poor technical information and pathological problems, with production complexity problems predominating. It

was, therefore, recommended that, firstly, there be intensification of dissemination of technologies on rapid multiplication of sweetpotato vines, such as the 2-node vine cutting technique, by the extension agency. Finally, integrated pest management (IPM) technologies on sweetpotato should be rapidly disseminated among the farmers to reduce over-dependence on agro-chemicals.

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