



Adoption of Improved Sweet potato Production Technologies by Farmers in South East, Nigeria

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Abstract

The study investigated the adoption of improved sweetpotato production technologies by farmers in South East, Nigeria. The specific objectives were to: assess level of adoption of the improved sweetpotato production practices by farmers and determine factors influencing the level adoption of sweetpotato production practices. A multistage sampling procedure was used to select 240 respondents for the study. Data were collected from primary source through the use structured questionnaires. Data collected were analyzed using frequency, percentage, mean score and multiple regression analysis. Findings showed that age of the farmers (43.3 years), farming experience (16 years), household size (8 persons) and farm size (1.7 hectares) respectively. Findings also indicated that majority (85.3%) of the farmers adopted use of seed selection disseminated to them. However, 25.6% and 20.5%, of the farmers were on interest and awareness, while 18.2% and 15.3% of the farmers were on trial and evaluation stages of the adoption of the technology packages respectively. Factors influencing the adoption of improved sweetpotato production technologies including age (0.009), sex (0.002), farming experience (0.002), farm size (0.003), income (0.001) and levels of education (0.005) significantly influenced level of adoption of the technologies while marital status, family size, access to credit, extension visit, sources of farm input and social participation did not. The study recommended that Government should establish special trust fund for sweetpotato producing states to ensure the availability of soft loans/grants to farmers; this will hasten the adoption of the technologies. There should be efficient and effective information dissemination to sweetpotato farmers at the grass root using various communication channels.

Keywords: Adoption, improved technologies, farmers, factors, influence.

Introduction

Food production has increased significantly as a result of adoption of agricultural innovations (improved crop varieties) and other relevant technologies such as fertilizer, herbicides, pesticides among others (Thomas,*et al*,2017) with sub-saharan African region making a steady rise in agricultural productivity due to the result of agricultural technology adoption. However, despite this, there are still growing concerns about the capacity of the existing traditional agricultural farming to feed the teeming population in the sub-saharan African, with emphasis on Nigeria which has the largest population in the region, largest rate of poverty, food scarcity and malnutrition (Thomas,*et al*,2017).

Researchers in Nigeria have engaged themselves in efforts to develop improved varieties of crops capable of handling food crises and poverty reduction in the country (Esan and Omilani, 2018). The need, therefore, to adopt the crops with high yielding potentials grown with improved production technologies becomes urgent as a sure approach to tackle the poor farm output situation among the farmers. One of such crops that are gaining prominence among farmers is

the sweetpotato (*Ipomoea batatas* (L) lam). The crop is a dicotyledonous plant from the family of convolvulaceae and genus of Ipomoea that grows in both tropical, sub tropical and some temperate zones of the developing countries (Esan and Omilani, 2018; Udemezue, 2019). Udemezue, (2019), expressed that sweetpotato family is made up of 45 genera and 1000 species.

Nigeria is the third largest producer of sweetpotato in the world in terms of quantity after China and Uganda (Udemezue,2019). In 2010, Nigeria produced 2.5% of the world's productions of sweetpotato due to large expanse of land but not in terms of productivities. It is still considered a minor crop in the country (Esan and Omilani, 2018). In 2010 to be specific, sweetpotato had the tenth highest production level of any single food crops in Nigeria after cassava, yam, oil palm fruit, maize, sorghum, millet, paddy rice and plantain. According to Esan and Omilani (2018), the gross agricultural production value for sweetpotato was \$954 million USD and accounted for 1.73% of total agricultural production value for all crops. In developing countries, production of sweetpotato was ranked fifth after the arrays of crops like rice, wheat, maize and cassava, in terms of economies of production, dry matter, digestive energy and protein contents respectively (Esan and Omilani, 2018). Sweetpotato produce more edible energy per hectare per day than wheat, rice or cassava (Esan and Omilani, 2018).

Fatimah *et al* (2014) expressed that for food production to keep pace with rapid population growth and demand for food, a new creative approach to agricultural development must be developed. However, Nigerian should exploit her unexploited food resources, production potentials to address the needs of rural farmers who constitute the backbone of the Nigerian agricultural sector by making financial aids available to them. Meantime, these rural farmers produced about 80% of the total national agricultural outputs using traditional methods under rain-fed conditions. Therefore, since these farmers are capable of making such huge contributions even with crude implements, it can be assumed that more, in terms of output are achievable if they adopt improved production technologies. This calls to the efforts of researchers in Nigeria to develop appropriate technologies for agriculture to tackle the problems of food insecurity and poverty. Agricultural technology adoption studies have many policy implications for agricultural development. They serve as tools for evaluating the distribution impacts of new innovations, documenting the impacts of innovations on extension efforts, identifying and reducing the constraints to adoption and also as research guides for focusing innovation priority (Olusegun *et al*, 2014).

In the light of this, international research institute namely; the International Potato Centre (ICP), International Institute of Tropical Agriculture (IITA), International Rice Research Institute (IRRI), National Root Crops Research Institute (NRCRI), among others, deemed it necessary to introduce new crop varieties that combine higher yield potential with excellent quality, resistance to biotic and abiotic stress to ward off hunger and poverty among farmers (Udemezue,2019). Adoption, according to Rogers (2015), is the decision to make full use of an innovation or technology as the best course of action available. Adoption therefore is defined as the integration of an innovation into farmers' normal farming activities over an extended period of time. Adoption of a new agricultural practice or innovation requires that the farm operator or farmer must be aware of the practice, become interested, evaluate it, try it and then take steps of adoption. It is the acceptance of continued use of an innovation after individual or groups had gone through certain mental process called adoption stage. Adoption is not a permanent behavior. This implies that an individual may decide to discontinue the use of an innovation for a variety of personal, institutional and social reasons. One of the reasons might be the availability of another practice that is better for satisfying farmers' needs. This, therefore, underscores the important role technology stands to play in attaining the much-needed growth in the research sector (Udemezue and Agwu, 2018).

According to Udemezue and Agwu (2018), various factors have been identified to influence the adoption of an innovation. Those factors can be listed as follows: age, family size, farm size, gender, economic status, educational level, social participation, leadership status, proximity to research station or university, contact with extension agents, cosmopolitanisms, mass media exposure, knowledge of recommended practice, and years of farming experience. However, improved production technologies of sweetpotato were jointly developed by the International Institute of Tropical Agriculture (IITA) and the National Root Crops Research Institute (NRCRI), Umudike to eliminate constraints faced by farmers that used local technologies in pursuance of food security effort in Nigeria. Based on this, the research investigated adoption of improved sweetpotato production technologies by farmers in south east, Nigeria. The specific objectives were to: assess level of adoption of the improved sweetpotato production technologies by farmers and determine factors influencing the adoption of sweetpotato production technologies.

Methodology

The study area was South-East, Nigeria. It is made up of Abia, Anambra, Enugu, Imo and Ebonyi States. The area under study stretches from latitude 04°15'N to longitude 09°24'E. It has a land area of 29,526 square kilometers and a population of 10,712,675 people comprising population 75,569,241 females and a male population of 5,142,434 males. There are two main seasons in the zones; the raining season (April- November) and the dry season that takes the rest of

the year. The average annual rainfall is about 1730mm in about 110 rainy days and its maximum monthly atmospheric temperature is about 32.5c (Okeke,2018).

The target population for this study was all the sweetpotato farmers in the selected States. Multistage sampling procedure was used for the study. In the first stage, three States out of the five states that make up South Eastern zones were purposively selected because of their perceived active engagement in sweetpotato production. Anambra, Abia and Ebonyi were selected for the research.

In the second stage, four local governments were purposively selected from each selected state. Ogburu, Anambra East, Ayamelum and Anambra West Local Government in Anambra State, in Abia State the selected local governments were Umuahia South, Ikwuano, Bende and Isialangwa North while Afikpo North, Ezza North, Ikwo, and Ohaukwu local governments in Ebonyi State were also selected. This gave a total of twelve local governments used for the research.

In the third stage, two communities each from the selected local governments were randomly selected in the areas. The communities were as follows; Akili Ogidi and Ossamalain Ogburu LG, Igbariam and Aguleri Otu in Anambra East L.G.; Nmiata Anam and Umuoba Anam in Anambra West L.G.; Omor and Umumbo in Ayamelum L.G.; Umudike and Ibeku in Ikwuano L.G.; Ubalaka and Nserimo in Umuahia South L.G.; Amaputigha and Okpuala-Ngwain Isialangwa North; Nkpa and Bende in Bende L.G. of Abia State; Izzia Ngbo and Effium in Ohaukwu L.G.; Ezza and Umuezoka in Ezza North L.G.; Amagu and Alike-Ndufu Ikwo in Ikwo L.G.; Amaizu and Ohaisu in Afikpo North L.G. of Ebonyi State. This gave a total of twenty-four (24) town-communities that used for the study.

In the fourth stage, ten (10) sweetpotato farmers were selected from the list of information in each community using simple random sampling techniques and this gave a total sample size of 240 farmers.

Data for the study were collected from primary source through the use of structured questionnaires. The interview schedule contained relevant questions which were divided according to the objectives of the study. Data collected on socio-economic characteristics, Objective 1 and 2 were analyzed using frequency; percentage and regression model, respectively.

Measurement of Variables

Determination of the level of adoption of improved sweetpotato production technologies by farmers in the states was achieved using the seven steps adoption model. The farmers were asked to indicate their adoption stage for the different sweetpotato production technologies. The response categories were as follows; Not aware=0, Aware=1, evaluation=3, trial=4, adoption=5, rejection=6. Total adoption score for each farmer would be the summation of the adoption scores for the various technologies. In calculating farmers score, rejection with a weighted value of six was converted to zero to give a meaningful interpretation to the result.

The factors influencing the adoption of sweetpotato production practices were achieved using regression model.

$$T = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + \dots + b_{12}X_{12} + e_i$$

Where

T = levels of adoption of improved sweetpotato production technologies

a = constant term

b_1 - b_{12} = regression coefficients

e_i = error term

X_1 = age (measured in years)

X_2 = marital status ((dummy variable 1=married, 2=not married)

X_3 = sex (dummy variable 1=male, 2=female)

X_4 = Social participation (member = 1, non member = 0)

X_5 = farm size (measured in hectares)

X_6 = family size (measured by number of persons leaving under one roof)

X_7 = farming experience (measured by number of years spent in farming)

X_8 = access to credit (access=1, non=2)

X_9 = extension visit (number of times visited per a year)

X_{10} = source of farm input (access to farm input=1, non=2)

X₁₁ = level of education (measured by number of years spent in school)
 X₁₂ = income

Results and Discussions

The findings of the study were presented and discussed under the following sub-headings:

- 4.1 Socio-economic characteristics of the sweetpotato farmers.
- 4.2 Levels of adoption of the improved sweetpotato production practices by the farmers.
- 4.3 Factors influencing the adoption of sweetpotato production technologies.

4.1 Socio-economic characteristics of the sweetpotato farmers

Age:

Data in Table 4.1 show that a greater proportion (38.1%) of the farmers were between 31-40 years of age, while 27.1% were within the age range of 21-30 years. Those that fell within the age range of 41-50, 51 and above accounted for 23.3% years and 11.3% respectively. The mean age of the farmers was 43.3%. This implies that young people of active age were involved in sweetpotato production. This could also influence farm decision making process as a result the active young people involved in the production. This could be also an indication of the fact that the levels of youth movement in agriculture have been increased due to lack of white-collar job among youths in the study area. This finding confirmed the result of Garba (2016) which reported that most farmers in their study were still in their productive years.

Marital Status:

The entries in Table 4.1 show that greater proportions (40.4%) of the farmers were married, while 18.8% of the farmers were divorced. However, 14.6% of the farmers were single and 13.8% of them were separated. On the other hand, 12.5% of the farmers were widowed, respectively. This finding is in line with farmer's culture as many rural farmers do marry as early as possible in order to avoid unnecessary embarrassment from their age grade, parents, relatives and more importantly to get additional helping hands both at home and on the farm. This result also confirmed the finding of Okeke *et al* (2019) that the largest proportion of the sweetpotato farmers was married in the study. The findings indicate that marriage is a relevant union/institution that brings about the synergy among farm families that can be used to accomplish certain farm activities thereby promoting the spread of innovations on sweetpotato production as the members of the family are possible source of information. This finding is also in consonant with that of Ume, Onunka and Okoro (2016) that the majority of sweetpotato farmers were married. According to Kanu, Nwachukwu and Olojede (2016), marriage is an institution that brings about division of labour among farm families, therefore reducing the cost of labour resulting to increase in income.

Household size:

Result in Table 4.1 reveals that a greater proportion (41.3%) of the farmers had a household size of 1-5 persons while 33.3% of them had a household size of 6-10 persons. On the other hand, 24.4% of the farmers had a household size of 11 and above. The average household size for sweetpotato farmers was 8 persons. This finding is in consistence with the finding of Garba (2016) and Okeke (2018) whose average household size of Irish potato and sweetpotato farmers were 8 persons and 7 persons in their separate studies. This implies that farmers had relatively large-sized household that could sustain their family labour. Household size could influence the level and rate of adoption of improved sweetpotato technologies. The larger the household size, the more likely the farm labour will be available to enhance the practice of various improved sweetpotato production technologies. Household size has a greater role to play in family labour provision because it can serve as an insurance against short falls in application of farm labour such as land preparations, ridging, planting and weeding, among others.

Farm size:

Results in Table 4.1 indicate that 37.1% and 32.5% of the sweetpotato farmers cultivated <0.5 – 1ha and 1.1 – 2ha respectively. On the other hand, 17.9% of sweet potato farmers cultivated 2.1 – 3ha, while 12.5% of the farmers cultivated 3.1ha and above. The average farm size of sweetpotato farmers in the study area was 1.7ha. This implies that farmers cultivated small hectares of land and this could bring about low investment and returns to scale up agriculture for food security. According to Mbanaso (2010) in Udemezue (2019) farm holdings in Nigeria is grouped into three broad categories; small-scale (less than 6 hectares in farm size), medium-scale (6-9 hectares) and large-scale (10 hectares and above). The result from this research implies that sweetpotato farmers were small-scale farmers. This finding collaborates with Okeke (2018) who found small-scale farmers predominantly in the South East zone.

Farming experience:

Entries in Table 4.1 also show that 35.4% of the sweetpotato farmers had 10-19 years of farming experience, while 30.0% and 20.8% of them had 1-9 and 20-29 years of sweetpotato farming experience respectively. Those that had 30-39 years

farming experience accounted for 12.5%. The average mean for the sweetpotato farming experience was 16years. This finding implies that the farmers had fairly long period of sweetpotato farming experience which could serve as an alternative for increased participation in sweetpotato production, since long farming experience promotes specialization, improved knowledge, skill and aspiration. On the other hand, long farming experience could as well influence farmer's willingness to learn and adopt technology packages associated with improved sweetpotato production. Therefore, the more experience the farmer is, the more his ability to make farm decision. This result is in line with the finding of Okeke et al (2019) which said that the average farming experience in their study was 13.34 years.

Types of improved sweetpotato varieties grown by the farmers

Entries in Table4.1 reveal that a greater proportion (37.5%) of the sweetpotato farmer grown butter milk sweetpotato variety while 25% of them grown orange fleshed sweetpotato improved variety. Similarly, 22.9% and 14.6% of the remaining farmers grown ex-igbariam and ex-oyunga improved sweetpotato variety respectively. The fact that a majority of the farmer's cultivated butter milk improved variety may be attributed to its unique quality such as early maturity, higher yield, taste, tolerant to some stress and resistant to pests/diseases when compared to other improved sweetpotato varieties. Yield remains the most important deciding factor and determining choice of sweetpotato genotypes for cultivation. This is mainly for the economic portion of the crop that can be sold for financial benefits of the farm enterprise. According to Effa, Uko and Nwagwu (2019), varieties with good biomass, leaf area index and vine length were most prolific in tuber production and this could be the reason this variety is selected among other disseminated varieties to farmers. The finding, therefore, shows that buttermilk sweetpotato was incorporated into farmers' farming system may be because of the above reasons.

On the other hand, growing OFSP could be attributed to its health benefits, time of maturity, higher dry matter when compared to sweetpotato, much higher beta carotene content, it's tolerant to sweetpotato weevil and resistant to sweetpotato viral disease. These characteristics make OFSP a good candidate for farmers' preference in the study area. This result contradicted Babatunde, Omoniwa and Adeniyi (2019), who said that age of the smallholder farmers, household size, years of schooling, cost of production were the factors that significantly influence the cultivation OFSP in Kwara State, Nigeria.

Sex of the sweetpotato farmers

Table4.1 indicates that 54.2% of the sweetpotato farmers were female while 45.8% were male. This shows that the sex distribution of the sweetpotato farmers skewed towards female farmers and this could be that female farmers are more efficient than male farmers when it comes to minor root crops like sweetpotato production in the study area. The implication of this is that sweetpotato production activities will be more or less masculine activities that will be dominated by younger females than the male counterparts. This can also bring about relegation on sweetpotato production activities in South Eastern zone. This finding disagrees with Okeke *et al* (2019) who observed that sweetpotato is grown mainly by men in their study. majority of the farmers in the study area are females, this may be as a result of the fact that the study area is an agrarian society where the interest of sweetpotato may not be covered by men and this may be as a result of a stigma attached to it as a minor crop that should be cultivated by lazy men. However, in a society where women are mostly not allowed to own other crops like yam and rice, men possess the much access to own these crops, which therefore give them (men) a relative advantage over their counterparts (women).

Occupation

Results in Table4.1 show that a greater proportion (50%) of the farmers was full time farmers, while 22.9% of them were civil servants. On the other hand, 11.7% of the sweetpotato farmers were trader and 9.2% of them were pension earners. The remaining 6.3% of them were artisans as indicated in Table4.1 below. The implication could be that farmers in the study area they see sweetpotato production as an enterprise and also a source of income to support their livelihood. This finding is in line with Ezeano (2015) who saw sweetpotato enterprise as a source of income to augment other incomes in the South East Agro-ecological zone.

Other crops grown

Table4.1 shows that 39.2% of the farmers grow rice as an alternative crop while 22.9% of the sweetpotato farmers grown cassava. However, 18.8% of the sweetpotato farmers grown maize while 13.3% of them grown yam. The remaining 5.8% of the sweetpotato farmers grown okra as a supplement to sweetpotato production. High percentage values attached to rice and cassava may be due to their frequent consumption, high economic values as cash crops and industrial use associated with them when compared to other crops the study area.

Table 4.1: Socio-economic Characteristics of the Farmers

Variables	Frequency	Percentage	Mean
Age			
21-30	65	27.1	43.3
31-40	92	38.3	
41-50	56	23.3	
51 and above	27	11.3	
Sex			
Male	110	45.8	
Female	130	54.2	
Marital status			
Single			
Married	97	40.4	
Divorced	45	18.8	
Separated	33	13.8	
Widowed	30	12.5	
Household size			
1-5	99	41.3	8.0
6-10	70	33.3	
11 and above	61	25.4	
Farm size			
<0.5 – 1ha	89	37.1	1.7ha
1.1 – 2ha	78	32.5	
2.1 – 3ha	43	17.9	
3.1 and above	30	12.5	
Farming experience			
1-9	75	31.3	16.1yrs
10-19	85	35.4	
20-29	50	20.8	
30-39	30	12.5	
Occupation			
Full time farmers	120	50.0	
Trading	28	11.7	
Pension	22	9.2	
Civil Servant	55	22.9	
Artisan	15	6.3	
Types of improved sweet-potato varieties grown			
Ex-Igbariam	60	25	
Buttermilk	90	37.5	
Ex-Oyunga	35	14.6	
OFSP	55	22.9	
Other crops grown			
Yam	32	13.3	
Maize	45	18.8	
Cassava	55	22.9	
Rice	94	39.2	
Okra	14	5.8	

Source: Field Survey 2021

4.1b: Socio-economic characteristics of the sweetpotato farmers

Educational level:

Data in Table 4.1b indicate that 25.0% of the sweetpotato farmers completed secondary school education, while 20.8% of them completed primary school respectively. On the other hand, 16.7% and 15.8% of the farmers attempted secondary and primary school in the study area. On the other hand, only 14.6% of the sweetpotato farmers had no formal education while 3.8%, 2.1% and 1.3% of them had OND/NCE, HND/First Degree and M. Sc/Ph. D certificates respectively. Education had always been known to play a positive role in the adoption of improved technologies among farmers. Based on this, the high number of literate people among the respondents shows that a majority of them are in a better position to adopt new technologies disseminated to them provided they are feasible and compatible to their existing culture. This finding agrees with that of Ezeano (2015) that the intensity of adoption of improved technologies is related to level of education.

Source of farm labour:

Data in Table 4.1b also show that a majority (54.2%) of the sweetpotato farmers used family labour on their sweetpotato farm, while 25%, 10.4% and 10.4% of them used family labour, hired and exchange labour on their farm respectively. The implication of the farmers not using so much hired labour on their farm is that it will result in reduction of cost of production. Relying on hired labour for farming activities sometimes could be dangerous due to shortage of manpower at the time of need. This may result in delaying or abandoning some essential operations such as weeding, ridging, and harvesting, among others in sweetpotato farms and this may have a negative impact on productivity and quality of produce. This result agrees with findings of Ezeano (2015) and Okeke (2018) that a majority of sweetpotato farmers used family labour as their source of labour in South East agro-ecological zones. On the other hand, sweetpotato farmers relied heavily on family labour; this could be also attributed to higher cost of labour due to youth's migration into urban areas in search of white-collar jobs.

Mode of land acquisition:

Entries in Table 4.1b indicate that a greater proportion (39.6%) of the sweetpotato farmers acquired land through inheritance, 35.8% of the farmers got land by renting and 24.6% of the remaining sweetpotato farmers acquired land via outright purchase. Land acquisition and use remain a critical issue of great policy relevance in developing countries such as Nigeria because access to land among farmers brings about positive changes in agricultural domains. Since the majority of the farmers acquired land through inheritance, this could promote the adoption of new technologies disseminated to farmers in the study area. Farmers who have access to land can scale up agricultural technologies that result to food security in totality. According to Oluwatayo, Omowunmi and Ojo (2019), availability of land determines food and livelihood security given the level of agricultural development in Nigeria. This is because farming operations will remain at subsistence level provided that there is inadequate access to land. Therefore, land ownership by inheritance is prevalent and has always been a dominant form of land ownership in Africa. This is in line with Onya, Ugochukwu and Ejiba (2019), who found that land inheritance was the most common ownership structure among male farmers while females purchased land used in agricultural production.

Source of agro-input

Table 4.1b reveals that a greater proportion (39.6%) of the farmers sourced agro-input from fellow farmers, 35.4% of the respondents also sourced agro-inputs from research institutes while 20.8% sourced agro-input from ADP. However, 2.5% and 1.7% of the farmers sourced their agro-input from open market and input dealers. Access to agro-inputs could increase the probability of adopting an improved technology. Therefore, it shows that even if a farmer is aware of a technology, access to it is also paramount in adoption process. The finding disagrees with Sanusi, Lawal, and Sanusi and Adesogan, (2016) who said in their research that farmers sourced agro-input from previous harvest. Based on this, it could be reasonable to say that access to agro-inputs may be a necessary condition for the adoption of an improved technology.

Estimated income generated from sweetpotato production for the three or four months

Table 4.1b shows that 17.1% of the sweetpotato farmers realized between N5,000 – N6,000 for every three months from sweetpotato production, 15.0% of the farmers realized between N41,000 – 50,000 within three months, 14.6% of them realized between N21,000 – N30,000, 10.4% of the farmers also realized between N61,000 – N70,000 in every three months and 4.6% of the farmers realized between N31,000 – N40,000 for each three months respectively. The average income per a sweetpotato farmer in next three or four months is N54, 397.9K. On the other hand, a greater proportion (20.8%) of the sweetpotato farmers realized between N91,000 and above while the remaining 4.2% and 1.3% of the sweetpotato farmers realized between N71,000 - N80,000 and N81,000 – 90,000 accordingly. This result indicated that farming constituted the major share of the respondents' income in the study. This also implies that the adoption of improved agricultural technologies could be easy as far as it could improve their standard of living.

Extension contacts:

Table 4.1b also indicates that a majority (63.8%) of the sweetpotato farmers did not have contact with any extension agent in the last one year, while 36.3% of them had contact with extension in the last one year. This implies that since the majority of the farmers did not have contact with extension agent, they are therefore expected to be less exposed to relevant technologies like improve sweetpotato production being disseminated. Frequent contact with extension agents gives farmers the opportunity to learn about the availability and use of new farming techniques. Moreso, farmers in the area revealed that extension had helped them to increase their knowledge and the volume of their produce as well as qualifying them for higher levels of credit from financial and business institutions/organizations. Therefore, frequent contacts with extension services are expected to have a positive relation with adoption (Udemezue and Agwu, 2018).

In the light of this Saka, Okoruwa, Lawal and Ajijola (2005) in Udemezue and Agwu (2018) indicated frequency of extension contact with farmers to be the significant factors influencing both the decision of farmers to adopt the improved rice varieties and intensity of use. Therefore, the positive impact of contact with extension service is explained by the fact that farmers who have contacts with extension organizations are likely to hear about improved varieties and thus have more incentive to adopt these new agricultural technologies.

Access to credit loan:

Table 4.1b shows that 56.7% of the sweetpotato farmers did not have access to credit loan while 43.3% of the farmers had access to credit loan. The majority who did not have access to credit loan could mean that they were unable to meet up with the required conditions such as interest rates, payment periods and collateral security. However, access to credit is one way of improving farmer's access to new production technology. Farmers who have access to credit can reduce their financial constraints and buy input more readily. Therefore, it is expected that access to institutional credit can increase the probability of adopting improved technologies. Based on this, access to credit could be seen as pre-requisite for adoption of improved agricultural technologies. This study agrees with okeke (2018) who said in her research that the majority of the actors in sweetpotato farming funded their farm operation from their personal savings realized in the previous years.

Membership of social organization/frequency of social participation

Entries in Table4.1b show that a majority (62.5%) of the sweetpotato farmers belongs to social organization while 37.5% of them did not belong to any social organization. In terms of frequency of participation, 70.8% of the sweetpotato farmers participated always in their meetings while 29.2% of the rest participated sometimes in the meeting. Their sometimes participation in the meeting may be due to their engagement in various other farming activities.

Participation in social organizations could be advantageous to farmers because farmer's social organizations offer an effective channel for extension contact and other agricultural related information with large number as well as opportunities for participatory interaction with the organization (Udemezue, 2019). It could also increase farmer's update of new practices such as sweetpotato production technologies.

Table4.1b: Socio-economic characteristics of the farmers

Variables	Frequency	Percentage
Educational Level		
No formal education	35	14.6
Primary School attempted	38	15.8
Primary school completed	50	20.8
Secondary school attempted	40	16.7
Secondary school completed	60	25.0
OND/NCE holders	9	3.8
HND/First Degree	5	2.1
M.Sc/Ph.D	3	1.3
Source of Labour		
Family labour	130	54.2
Hired labour	25	10.4
Exchange labour	25	10.4
Family, hired and exchange	60	25.0
Land Acquisition		
Inherited	95	39.6
Rented	86	35.8

Purchased	59	24.6	
Income (N)			
<10,000 – 20,000	29	12.1	
21,000 – 30,000	35	14.6	
31,000 – 40,000	11	4.6	
41,000 – 50,000	36	15.0	
51,000 – 60,000	41	17.1	N54,397.9K
61,000 – 70,000	25	10.4	
71,000 – 80,000	10	4.2	
81,000 – 90,000	3	1.3	
91,000 and above	50	20.8	
Source of Agro-Inputs			
Input dealers	4	1.7	
Fellow farmers	95	39.6	
Market	6	2.5	
Research institute	85	35.4	
ADP	50	20.8	
Membership of Social Organization & Social participation			
Yes	150	62.5	
Frequency of social participation			
Always	170	70.8	
Sometimes	70	29.2	
Extension Visit			
Yes	87	36.3	
Access to Credit			
Yes	104	43.3	

Source: Field Survey, 2021

4.2: Levels of adoption on sweetpotato production technologies

This section discusses the extent of adoption of farming operations on sweetpotato production technologies by the farmers in South Eastern Nigeria.

Seed Selection (planting material)

Entries in Table4.2 show the distribution of the farmers according to their levels of adoption of farming operation practice such as seed selection. The majority (85.3%) of the farmers adopted use of seed selection disseminated to them. Similarly, 25.6% and 20.5% of the farmers were on interest and awareness stages of the adoption of the technology packages associated with sweet potato production practices in the study area, 18.2% and 15.3% of the farmers were on trial and evaluation stages of the adoption of the technology while 1.8% of the farmers were not aware of the technology. This implies that those who were not aware of the technology assumed to be uneducated among the farmers and this could be the reason they did not hear about the technologies since the inception. Therefore, the high number of literate people among the respondents indicated that the majority of them are in a better position to adopt new technologies disseminated to them provided they are feasible to their culture. This finding agrees with Ezeano (2015) who noted that the intensity of adoption of improved technologies is related to the level of education.

Planting method

Table4.2 shows that a greater proportion (33.5%) of the farmers adopted planting method indicated them while 25.6% of them were aware of the technology. However, 11.5%, 2.3% and 1.8% of the farmers were still on trial, interest and evaluation state of the technology disseminated to them while 1.3% of the farmers were not aware of the technology. The implication of those who adopted planting method disseminated may be attributed to the training attended or they might have gained knowledge of it from other users and observed the relative advantages of the technology. Farmers who were not aware of the technology may be as a result of their level of education or their inability to attend workshop on the existing technology due to being unexposed to social trends.

Plant spacing

Entries in table4.2 also show that 75.3% of the farmers adopted plant spacing disseminated to them while 40.3% of the farmers were on the awareness stage. However, 9.3%, 8.8% and 3.6% of the sweetpotato farmers were on the trial, evaluation and interest stage of adoption. On the other hand, 25.3% of the farmers were not aware of the plant spacing. Adoption of agricultural innovation goes with compatibility and relative advantage of the technology and this has seen as the reason a majority of the farmers adopted it. Farmers who were not aware may be as a result of their complaint that they rarely see an extension agent who is an engine for information dissemination about new innovation in their area. However, it could be that they relied so much on their existing knowledge and experience which made them not seeking extra knowledge from an extension practitioner and because of these, they may see the innovation with less relative advantage and incompatible to their social norms and values.

Fertilizer application

Application of NPK

Results in table4.2 show that 60.5% of the sweetpotato farmers rejected application of NPK fertilizer in their farm while 1.7% of them adopted it. Similarly, 35.5%, 8.9%, 5.2% and 1.2% of the farmers were on awareness, evaluation, trial and interest stage of adoption. On the other hand, 1.3% of the farmers were not aware and this may be as a result of their level of exposure to education or other farmers. However, the majority of the farmers who rejected the technology may be due to their financial capacity to adopt the innovation not really that they don't like it. This may also be simply because they may not have easy access to it when they want to use it. This result is in line with the study of Tooraj and Sahel (2015) which indicated that lack of access to available and timeliness of fertilizer delivery discourage adoption.

Use of poultry manure

Table4.2 shows that a majority (88.2%) of the farmers adopted the use of poultry manure in their farm while 50.3% and 40.5% of them were on the awareness and interest stage of adoption respectively. Moreover, 30.5% and 10.5% of the farmers were on trial and evaluation stage of adoption while 1.8% of them were not aware of the technology.

Weed management

In terms of weed management, 90.2% of the sweetpotato farmers adopted the use of manual method to control weeds in their farm, 40.2% and 30.5%, of them were still on awareness and interest stages of adoption while 25.3% and 15.2% of the farmers were on evaluation and trial. On the other hand, the majority (85.3%) of the farmers adopted the use of chemical method to control weeds while 40.5%, 30.3%, 18.3% and 16.1% of the farmers stopped at interest, awareness, trial and evaluation stages of adoption. Farmers who stopped at interest, awareness, trial and evaluation stages may be attributed to their financial inability to purchase the chemicals needed to control weeds in their various farms. Moreover, it could be the belief that the use of such chemical can be hazardous to the body system or may change the taste of sweetpotato root during consumption.

Disease/pest control

Table4.2 shows that 55.7% of the sweetpotato farmers adopted the use of natural method to control pests/diseases in their farm while 46.3%, 15.7%, 10.5% and 8.7% of the remaining farmers were on the awareness, trial, evaluation and interest stages of adoption of an improved technology.

On the other hand, majority (65.3%) of the farmers adopted the use of chemical method to control pests/diseases in their farms while 50.3%, 20.8%, 18.3% and 1.5% of the farmers stopped at awareness, interest, trial and evaluation stages of adoption. However, 10.5% of the farmers rejected the application of chemicals to control pests/diseases from their various farms.

Harvesting method

Table 4.2 also indicates that 75.3% of the sweetpotato farmers adopted the use of manual method to harvest sweetpotato while 60.5% of them were aware of the use of mechanical method. Similarly, 30.1%, 15.6% and 10.1% of the remaining farmers stopped at trial, evaluation and interest stages of adoption of mechanical method respectively. On the other hand, a majority (50.6%) of the farmers rejected the innovation while 40.5% of the farmers were aware of the use of manual method such as the use of digger.

Table 4.2: Levels of adoption on sweetpotato production technologies by the farmers

Farming operations	Not aware 0	Aware 1	Interest 2	Evaluation 3	Trail 4	Adoption 5	Rejection 6
Land preparation							
Seed selection (planting material)	1.8	20.5	25.6	15.3	18.2	85.3	-
Planting method	1.3	25.6	2.3	1.8	11.5	33.5	
Plant spacing (30x100cm using ridges or 25x100cm on mound)	25.3	4.3	3.6	8.8	9.3	75.3	1.5
Fertilizer application							
(a) Apply NPK: 15:15:4-8 bags depending on the fertilizer of the soil	1.3	35.5	1.2	8.9	5.2	1.7	60.5
(b) Use of poultry manure and others	1.8	50.3	40.5	10.5	30.5	88.2	-
Weed management							
(a) Use of manual method	-	40.2	30.5	25.3	15.2	90.2	-
(b) Use of chemical method	1.7	30.3	40.5	16.1	18.3	6.5	85.3
Disease/pest control							
(a) Use of natural method	-	46.3	8.7	10.5	15.7	55.7	-
(b) Use of chemical method	1.2	50.3	20.8	1.5	18.3	65.3	10.5
Harvesting method							
(a) Use of manual method such as hoe, fork, digger etc.	-	60.5	10.1	15.6	30.1	75.3	-
(b) Use of mechanical method such as potato harvester	1.3	40.5	3.6	16.3	15.3	-	50.6

Multiple responses:

Source: Field survey, 2021

4.3 Relationship between the socio-economic characteristics of the farmers and level of adoption of the improved sweetpotato production technologies

Table 4.3 shows that the factors influencing adoption of sweet potatoes were age ($p < 0.009$), sex ($p < 0.002$), farming experience ($p < 0.004$), farm size ($p < 0.003$), income ($p < 0.001$) and levels of education ($p < 0.003$). They were significantly related with the adoption of improved sweetpotato production practices. The proportion of variance in adoption of improved sweetpotatoes (0.87) explained by this variable was very high. The decision of the research was based on the value R^2 (0.867) and adjusted R^2 (0.846) that supported the behaviour of the dependent variable at 95% level of confidence.

Age

Age is of the socio-economic variables that influencing adoption of sweetpotato production technologies in the study area. Age of the farmers was positively and significantly influenced the adoption of sweetpotato production technologies. This implies that as people grow older; their interest in adoption and willingness to take an active role would increase. Therefore, as people grow old, their interest in farming becomes aroused and their rates would be significantly increased. This result agrees with that of Okeke (2018) which said that age is positively and significantly influenced the adoption improved sweetpotato technologies in Anambra and Abia State.

Sex

Sex has a positive influence on the adoption of improved sweetpotato production technologies in Anambra, Abia and Ebonyi State, Nigeria. This positive influence implies that as the number of farmers increases with sex, the more adoption of the improved sweetpotato production technologies and this could be the reason the population of the farmers skewed to female in the study area. This result also suggested that the gender gap is attributed to different participatory beliefs and different meanings attached to personal engagement in sweetpotato farming. This finding disagrees with the finding of Okeke (2018) which said that sweetpotato farming is labour intensive that requires a substantial energy.

Farming experience

Years of farming experience was positively significant and related to the factors influencing adoption of improved sweetpotato production technologies in the study area. The implication is that the high level of farming experience among the farmers is expected to bring about a positive influence on adoption. That is, the more their farming experience, the higher the probability of adoption of the recommended improved sweetpotato production practices. Farming experience is an important determinant of the farmers' level of farm income. Farming involves a lot of risks and

uncertainties, so to be competent enough to handle all the vagaries of agriculture, farmers must have a long farming experience (Garba, 2016).

Farm size

The coefficient of farm size was found to be negative and statistically influenced the adoption of improved sweetpotato production practices. This implies that as the farm size increases, adoption of the recommended improved sweetpotato production practices also increases. According to Garba (2016), farm size has bearing on the capacity of farmers to adopt improved technologies and new farm practices. Farmers who have large farm size can afford to allocate part of their farm for yam production without significantly affecting the total land left for the production of the staple food crops compared to small land holder. This corroborates the findings of Tijjani, Tijjani and Audu (2018) which suggests a positive relationship between awareness and farm size among farmers in Jere LGA of Borno State.

Income

Income is one of the socio-economic variables that related to adoption of improved technologies in the modern world. As this study has shown, people have to be predisposed to take part in adoption as far as there is income from it and this has been the reason some elements (farmers) termed themselves “early adopters” in the stages of adoption categories. Therefore, income of the farmer is positively related and influenced the adoption of improved technologies.

Education level

Level of education is one the positive variables in the adoption of improved sweetpotato production technology. Formal education helps the farmers to obtain useful information from radio, internet, agricultural newsletter and other sources. Former education usually aids famers and lead them to accept new farm technologies more readily to increase their income than those farmers without a formal education. In developing countries, a general characteristic of famers is that they are tradition bound. They are afraid of taking risk and will not take until they are convinced that the new methods are safe, will pay and will not violate their values. However, most famers are tradition bound because of their low levels of education. Farmers are responsive to change provided it paid them and did not conflict with their value system. Hence literate farmers tend to adopt innovation more readily than illiterate farmers. In the light of the above, this finding is in line with the result of Okeke, *et al.*, (2019) which saw education as one of the factors that triggers farmers’ participation in improved sweetpotato farming. According to Okeke, *et al.*, (2019) the level of education attained by a farmer is not only increased his farm productivity but also enhanced his ability to know and evaluate more about the new technologies exposed to him.

Table4.3: Factors influencing adoption of sweetpotato production technology in South East.

Unstandardized coefficients		Standardized Coefficients			
Variables	B	Standard Error	Beta	T	Significant
Constant	3.841	1.068		5.490	0.002
Age	0.0531	0.245	0.162	1852	0.009
Sex	0.005	0.014	0.013	4.061	0.002
Marital status	0.027	0.042	0.042	0.485	0.821
Family size	0.023	0.023	0.067	0.872	0.387
Source of farm input	1.077	0.164	0.667	0.872	0.387
Farm size	-0.847	0.238	-0.354	-3.668	0.003
Income	0.2120	0.035	0.355	5.387	0.001
Access to credit	0.230	0.257	0.080	0.877	0.378
Extension visit	0.858	0.295	0.402	-4.695	0.537
Farming experience	1.087	0.163	0.679	6.251	0.002
Levels of education	0.1220	0.031	0.345	3.806	0.005
Social participation	0.018	0.048	0.038	0.498	0.721

Source filed survey, 2021. $R = 0.876$, $R^2 = 0.867$, Adjusted $R^2 = 0.846$

4.4: Conclusion

Based on the results of this study, the following conclusions were drawn: majority of the respondents were in the middle age and also literate, showing that many of them were in a better position to be aware and understand the adoption of improved sweet potato production technologies. Findings also indicated that the majority of the farmers were female with long period of farming experience. However, most of the farmers were married with average household size of 8 persons and this could be used as a factor to increase the adoption of the improved technologies since supply of labour is possible.

With regards to the factors influencing the adoption of improved sweetpotato production technologies, out of 12 variables investigated as the factors influencing the adoption of sweet potato 6 variables (age, sex, farming experience, farm size, income, and level of education) were found to be statistically significant.

On the extent of adoption of farming practices on sweet potato production technologies, the majority of the farmers adopted seed selection while the majority of them rejected the use of inorganic fertilizer in their farm. Farmers adopted the use of manual method for weed management while some farmers rejected the use of chemical method for weed control. As regards pest/disease management, a majority of the farmers adopted natural method while some of the farmers rejected the use of chemical methods to control pest/disease. Greater proportion of the farmers adopted harvesting method using manual and some of the farmers rejected the use of mechanical method disseminated to them respectively.

4.5: Recommendations

- i) Government should broaden extension services by engaging more extension agents and providing them with working facilities. This will enable the availability of the improved technologies and higher rate of adoption.
- ii) Government should establish special trust fund for sweetpotato producing states to ensure the availability of soft loans/grants to farmers; this will hasten the adoption of the technologies.
- iii) There should be efficient and effective information dissemination to sweetpotato farmers at the grass root using various communication channels.
- iv) Existing farmers' organization should be strengthened through proper coordination and monitoring by special committee. In this case, farmers' organizations could also be linked to financial institutions for easy access to credit facility to boost sweetpotato production.
- v) Distributions of planting materials free of charge to farmers and establishments of village information centre for effective channels of information are needed to adopt sweetpotato production activities in the region.
- vi) Decentralization of training on improved sweetpotato production technologies and provision of basic infrastructures are needed to adopt sweetpotato production in South East, Nigeria.

4.6: Contributions to knowledge

The followings were some of the contributions of this study to knowledge;

- i) The study showed that sweetpotato farming in South East, Nigeria skewed to female farmers.
- ii) Farmers' socio-economic factors such as age, sex, farming experience, farm size, income and levels of education significantly influenced level of adoption of improved sweetpotato technologies.
- iii) Improved sweetpotato farming in South East, Nigeria is a profitable business venture.
- iv) Decentralization of training on improved sweetpotato production technologies and provision of basic infrastructures were one of the strategies to adopt sweetpotato production in South East, Nigeria.

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