INTRODUCTION OF NET TUNNEL IN THE PRODUCTION OF ORANGE FLESHED SWEET POTATO SEED (VINES) IN OYUN LOCAL GOVERNMENT OF KWARA STATE.

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ABSTRACT

This study investigated the potential use of net tunnels for an adequate supply of sweet potato vines, increasing farmer access to quality vines and lowering the cost of maintaining virus-free planting material on the farm. A structured questionnaire was used in collecting information from respondents. Data were analyzed using linear regression and descriptive statistics. Primary data collected from 80 randomly selected farmers from the study area revealed that 72.5% of the respondents were males and most of the farmers attained higher educational levels with 42.50% and 28.75% for secondary and tertiary school levels respectively. The results also show that a larger percentage 23.75% of the respondents obtained their planting materials from informal sources. The farmers' willingness to use net tunnels in terms of their maintenance and simplicity in their construction revealed the mean value of 4.49 and 4.39 respectively. The study also revealed that easiness in maintaining net tunnel, low cost of the technology and market availability for the planting materials all determined the willingness of adoption of net-tunnel technology. The socio-economic factors; membership in agricultural association, farm size of the respondents, and source of capital significantly influenced the farmers' willingness in the adoption of net the technology for OFSP planting material production. However, membership in agricultural association consistently contributed significantly to the factors determining willingness of adoption of net-tunnel technology of the farmers in Oyun Local Area of Kwara State.

Keywords: ***Net tunnel, Orange Flesh sweet potato, Planting Materials, Vines.***

INTRODUCTION

Globally, sweet potato is cultivated in 117 countries in an area of 8.62 million ha producing 105.19 million tons with a yield of 12.20 t ha^{-1} (FAOSTAT, 2019). Africa is the world's largest sweet potato growing region and the majority of the sweet potato production about 95 per cent comes from developing countries, of which China has the maximum share of 67.09 per cent (FAO, 2016). Orange Flesh Sweet potato (OFSP) is high in beta-carotene contents which is the precursor of vitamin A (Afuape, 2014) a vitamin essential for a strong immune system, healthy skin, good vision and eye health (Low *et al*, 2017).

Sweet potato is mostly propagated vegetatively through vine cutting. As with other vegetative production cuttings, sweet potato planting material is bulky and perishable; therefore, there are high transaction and transport costs if distributed over long distances. In the tropics such as Nigeria, vine cuttings from previous crops and volunteer plants are used as sources of planting materials carrying with them accumulated systemic diseases such as viruses and pests (Scovia, *et al*, 2015) resulting in low yields in farmers' fields. In cultivation, Loebenstein (2015) explained that most farmers lost 4-6 weeks of the growing period at the beginning of the rainy season in the process of re-establishing sufficient vine production for

planting, obtaining initially limited planting material from residual plants, re-sprouting roots, or secondary growth of harvested fields, limiting sweet potato production areas. However, sourcing vines as such can be advantageous because they are easily accessible and may not involve monetary transactions but the health of such vines is unknown.

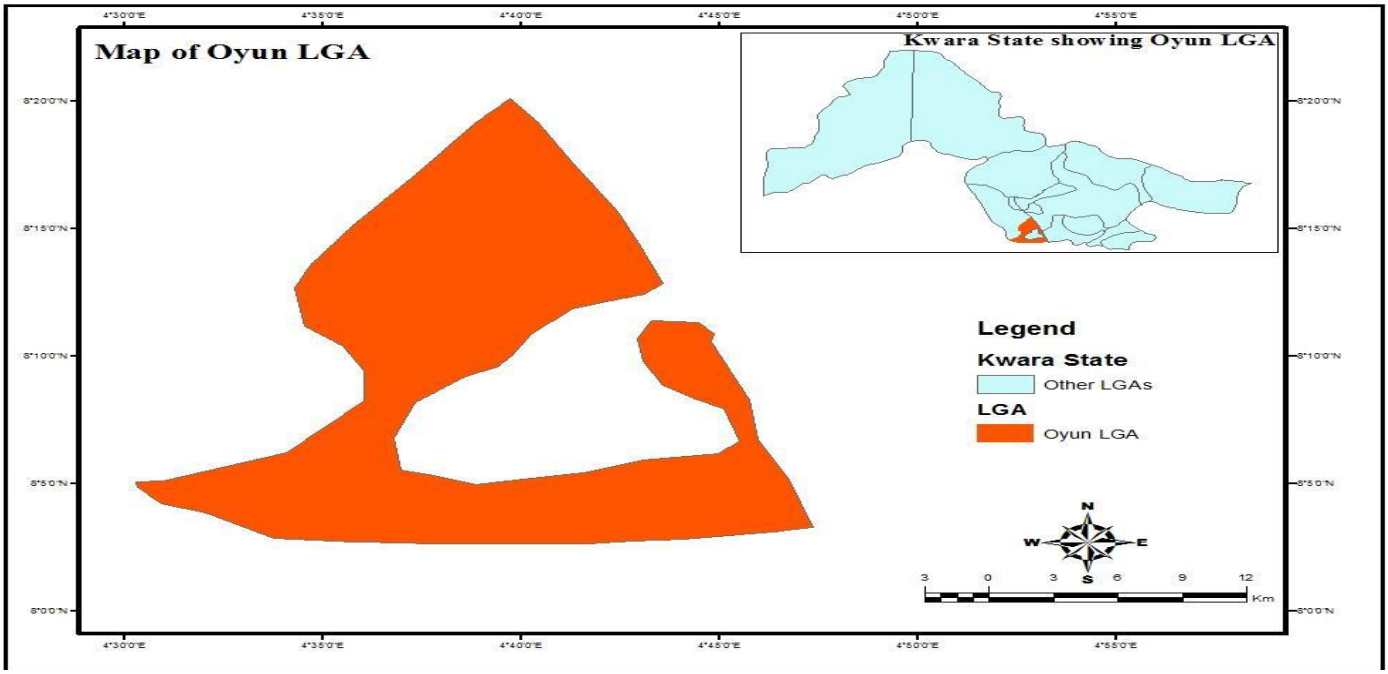
The strengthening and leveraging of informal vines networks for the dissemination of new varieties and healthy vines, and understanding how to scale up interventions appropriately to benefit more farmers with quality vines are important questions. In this regard, Coomes *et al*. (2015) and McGuire and Sterling (2016) advocate simple technology when they identified poor quality planting material as the contributor to low yield in sweet potato production in their study areas. Therefore, Kwara state is known to be a sweet potato-producing state in Nigeria that is also facing similar challenges of low yield emanating from poor planting materials. Hence, planting sweet potato vines in the net tunnel would provide support for farmers with timely access to adequate quality vines. Increasing production of sweet potatoes in Kwara State required accessible, sustainable and low-cost technology; a net tunnel, to generate clean vines for farmers to access quality sweet potato planting materials on their own fields for continuous production of sweet potato roots.

Therefore, the study is to determine what socio-economic characteristics of the sweet potato farmers influence the use of net tunnels in vines multiplication. How do the sweet potato farmers source for planting materials (ofsp vines)? what factors would motivate the willingness to use the net tunnel for vines multiplication?

METHODOLOGY

The study was carried out in Oyun Local Government of Kwara State, Nigeria. Oyun is located on latitude 8° 7' 0" North and longitude 4° 42' 0" East which covers a landmass of about 476km^2 (Ashaolu and Abubakar, 2014). Kwara State is known as one of the largest producers of sweet potatoes in the country with an average production of 3.93 tonnes/hectare cultivated averagely on 1.69 hectares of land (Adeyonu *et al.*, 2019). Offa and Oyun Local governments combined produced more than 60% of production accounted for in Kwara state (Adeyonu *et al.*, 2019).

However, the study adopted a three-stage sampling technique. The first stage was a purposive selection of Oyun LGA based on the larger proportion of sweet potato production in the state. In addition, two communities (Ilemona and Igosun), one from each district (Odo-Ogun and Oke-Ogun) were selected randomly. The second stage involved the training of farmers separately in these communities on the use of net tunnels. This was followed by a random/proportional selection of farming households among the trained farmers. Lastly, a proportional sample to size method was used to randomly select 50 respondents from the Igosun and 30 respondents from Ilemona making a total of 80 respondents.



Map of the Study Area, Incest Map of Kwara State, North-central, Nigeria

Data collected on the socio-economic characteristics of the farmers in the study area include gender, educational level, source of capital, primary occupation, specialization, source of land, source of labour and membership in the agricultural association while the Likert scale was used to obtain data on willingness factors to use the net tunnel.

The descriptive statistics such as mean, mode, percentages and frequency distribution tools were used to describe the data collected. The multiple regression analysis was used in determining the personal and socio-economic factors and other independent variables affecting the willingness of using net tunnel technology for OFSP vines production by the farmers. The model specification function is given by;

$$\hat{Y} = b_0 + b_1X_1 + b_2X_2 + \ldots + b_pX_p$$

where $\hat{Y}$ is the predicted or expected value of the dependent variable (i.e., willingness factors), X_1 through X_p are p distinct independent or predictor variables such as the source of capital, gender, vines availability from the source, education level, farm size (acres), age (yrs), farm experience (years), b_0 is the value of Y when all of the independent variables (X_1 through X_p) are equal to zero, and b_1 through b_p are the estimated regression coefficients. Each regression coefficient represents the change in Y relative to a one-unit change in the respective independent variable.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Respondents

The result in Table 1 shows the socio-economic characteristics of the respondents with respect to the adoption of net tunnel technology in the production of Orange-Fleshed Sweet potato (OFSP) Seeds (vines). The gender distribution from the analysis shows that 72.5% of the respondents were males while 27.5% were females. This shows the vulnerability of females compare to their male counterparts in technology adoption. In addition, male are mostly the head of the household and decision maker which make them have more access to

and control over vital production resources than women due to socio-cultural values and norms. The result is in accordance with Hamidah et al., (2021) that more than 70% of sweet potato farmers were male. On the other hand, Egwuonwu and Ozor, (2020) stated that women were more involved in sweet potato production than men.

The age distribution shows that the respondents below 30 years and above 60 years were less involved in sweet potato production (5% and 3.75% respectively) while 41 – 50 years (38.75%) constituted most age group involved in the cultivation of sweet potato in Oyun. On the contrary, Odebode et al., (2021) and Hamidah et al., (2021) asserted that farmers aged greater than 50 years were more into sweet potato production than the younger generation. The average age of sweet potato farmers of 45 years in Oyun LGA is similar to the report of Ben-Chukwu et al., (2021) that sweet potato farmers average age in Ebonyi and Abia States were 47.11 and 49.86 years respectively.

The educational level of the respondents as shown in Table 1 above indicates that most of the farmers attained a basic level of education with 42.50% for the secondary school level and 28.75% for the tertiary school level. Only 7.5% had no formal education. The considerably high percentage of sweet potato farmers with higher educational levels could be attributed to the presence of a number of tertiary institutions in the study areas (Abolake *et al.*, 2014).

Moreover, 37.5% of the sweet potato farmers affirmed that they engaged in non-farming occupations like trading, teaching, and artisan. 5% engaged in other farming activities like fishery, livestock, and apiculture. The result shows that farming is the primary occupation of the respondents. The respondents farm size as shown in Table 1 indicates that majority of the sweet potato farmers (42.50%) have farm size between 3 – 5 acres, followed by 37.5% which have farm size above 5 acres. The farm size below or equal 2 (≤ 2) acres constitutes the least percentage of the farmers (20%). This is similar to Garba et al., (2013) which reported that more farmers cultivate less than 5 acres of farm size.

Also, in line with the report by Mwangi and Kariuki (2015), farmers with small land may adopt land-saving technologies such as greenhouse technology, net tunnel technology, and zero grazing among others as an alternative to increased agricultural production.

Sources, Quality and Availability of Planting Materials

The results from Table 2 indicate that 23.75% of the respondents obtained their planting materials from their previous sweet potato fields. This shows that sweet potatoes have the tendency to regenerate for a longer period of time i.e., perennial in nature as long there is a constant supply of water. Also, 22.5% got theirs from friends, 15% affirmed that the vines are sourced from the Decentralized Vines Multiplier (DVM) while 12.5% obtained theirs from Research Institute. The lower patronage of farmers for obtaining sweet potato vines from formal seed sectors i.e., DVM and Research can be attributed to the high monetary value of the quality vines and distance to locate the formal seed sectors as also described by Adam (2014) that formal seed sector plays a limited role in the seed provisioning choices for smallholder farmers. In addition, 35% of the respondents claimed that the quality of the vines obtained from their chosen sources was acceptable but fairly readily available as 47.5% claimed that the vines were sometimes available and 17.5% affirmed that the vines were always available.

Table 1: Distribution of Respondents According to their Socio-economic Characteristics Socio-Economic Characteristics of the Respondents

Variables	Frequency	Percentages	Mean	SD
Gender				
Female	22	27.50		
Male	58	72.50		
Age (yrs)				
≤ 30	4	5.00		
31-40	23	28.75		
41-50	31	38.75	**44.9375**	**8.7386**
51-60	19	23.75		
Above 60	3	3.75		
Educational level				
Vocational	5	6.25		
No formal Education	6	7.50		
Primary Education	12	15.00		
Secondary Education	34	42.50		
Tertiary Education	23	28.75		
Household size				
≤ 5	14	17.50		
6-10	55	68.75	**7.45**	**2.73236**
Above 10	11	13.75		
Source of Capital				
Friends and relatives	13	16.25		
Personal savings	41	51.25		
Co-operatives	4	5.00		
Bank loan	22	27.50		
Primary Occupation				

Farming	50	62.50		
Others	30	37.50	**.625**	**.4871774**
Farm Specialization				
Crop production	46	57.50		
Others	4	5.00		
Non-farm	30	37.50		
Farm Size (Acres)				
≤ 2	16	20.00		
3-5	34	42.50	**5.5125**	**3.405111**
Above 5	30	37.50		
Farming Experience (yrs)				
≤ 5	6	7.50		
6-10	26	32.50		
11-15	13	16.25	**16.25**	**9.377457**
16-20	11	13.75		
Above 20	24	30.00		
Source of land				
Inherited	25	31.25		
Hired	26	32.50		
Purchased	29	36.25		
Source of labour				
Hired	51	63.75		
Family	29	36.25		
Membership of Association				
No	27	33.75		
Yes	53	66.25		

Table 2: Identification of the sources, quality and availability of OFSP planting materials.

Variables	Frequency	Percentages	Mean	SD
Sources of Planting Material				
Previous Sweet potato field	19	23.75		
Friends	18	22.50		
Farmers Group	9	11.25	**2.25**	**1.626521**
Decentralized Vines Multiplier (DVM)	12	15.00		
Research Institute	10	12.50		
Not Aware of OFSP	12	15.00		
Quality of Planting Material				
Very Poor	1	1.25		
Poor	4	5.00		
Acceptable	28	35.00	**3.0625**	**1.537248**
Good	23	28.75		
Very Good	12	15.00		
Planting Material Readily Available				
Never	2	2.50		
Rarely	14	17.50	**2.5**	**1.252845**
Sometimes	38	47.50		
Always	14	17.50		

Willingness to Use Net Tunnel for Vines Multiplication

The factors determining the willingness to use net-tunnel for vine multiplication were ranked using the means score computed from the 5-point Likert scale type. Table 2 presents factors affecting the willingness to use net-tunnel for vine multiplication. The study revealed that the most highly rated factor that encourages the use of net-tunnel for vines multiplication is that it is easy to maintain which has a mean value of 4.49, followed by simplicity in its construction with a mean value of 4.39. Resources availability is rated third (4.21 average value). The result revealed that market availability for vine sales is least agreed with (3.03 average value). The result buttressed the principle of adoption of an innovation whereby the farmers weigh the relative advantage, compatibility, complexity, divisibility and accessibility of an innovation compared to the existing methods (Sahin, 2006). However, the availability of the market for vines which is the least ranked value from the result was an indication that there is little or no demand for OFSP root in the study area. This result is according to Ben-Chukwu et al., (2021) that OFSP acceptance is below the adoption stage in Abia and Ebonyi States in Nigeria. Kaguongo (2012) highlighted that to spur the adoption of OFSP, it was important to identify market opportunities for processed products and link farmers to potential processors and market outlets.

Table 3: Factors affecting the willingness to use the net tunnel for vines multiplication

Willingness Factors	SA F(%)	A F(%)	UD F(%)	D F (%)	SD F (%)	Mean	Rank
Easy to construct	32(40)	47(58.75)	1(1.25)	-	-	4.39	2nd
Readily available resources	30(37.5)	42(52.5)	3(3.75)	5(6.25)	-	4.21	3rd
Easy to maintain	48(60)	24(30)	7(8.75)	1(1.25)	-	4.49	1st
Low cost of technology	18(22.5)	29(36.25)	23(28.75)	9(11.25)	1(1.25)	3.68	5th
Availability of market for vines	16(20)	14(17.5)	14(17.5)	28(35)	8(10)	3.03	6th
Size of the net tunnel	25(31.25)	29(36.25)	16(20)	5(6.25)	5(6.25)	3.80	4th

SA=Strongly Agree, A=Agree, UD=Undecided, D=Disagre SD=Strongly Disagree

Table Table 3 presents the mean square values from the regression analysis of farmers' willingness in the adoption of net-tunnel technology for OFSP production in Oyun Local Government Area. The analysis shows that among the measured variables, the variables; Net-tunnel easiness to maintain (Easy to Maintain), Net-tunnel low cost of technology (Low Cost of Technology) and market availability of vines (Market Availability) were highly significant. This implies these three variables determined the farmers' willingness in the adoption of net-tunnel technology for OFSP vines production. The result mirrored the findings from Kaguonro et al., 2012 who stated that availability of vines affects both adoption and intensity of adoption of OFSP; hence extension programs should ensure adequate access to vines either through the conservation in wetlands or irrigated areas or through the establishment of a sustainable network of vine multipliers.

Table 3: Mean square values from the regression analysis of farmers' willingness in the adoption of net-tunnel technology for OFSP production in Oyun Local Government Area

Source of Variation	df	Easy to Construct	Resources Availability	Easy to Maintain	Low Cost of Technology	Market Availability	Size of Tunnel
Regression	9	0.0462ns	0.0162ns	0.0209**	0.0568***	0.1143**	0.0568ns
Residual	70	0.0462	0.0139	0.0069	0.0186	0.0447	0.0351
R2		11	15	25	27	24	17
Mean		4.39	4.21	4.49	3.68	3.03	3.80

*** significant at P≤0.01; ** significant at P≤0.05; * significant at P≤0.1; ns not significant (P>0.1).

Table 4: Significant socio-economic factors responsible for the willingness of adoption of net-tunnel technology for OFSP production in Oyun Local Government Area

Factors	Easy to Maintain			Low Cost of Technology			Market Availability			VIF
	Coeff	S. E	t-stat	Coeff	S. E	t-stat	Coeff	S. E	t-stat	
Constant	0.92	0.07	13.99***	0.71	0.11	6.98***	0.53	0.16	3.37***	
Association Membership	0.04	0.02	2.70***	0.06	0.03	2.35**	-0.09	0.04	-2.40***	1.457
Farm Size (Acres)				0.03	0.01	3.51**	0.023	0.01	3.62***	2.463
Source of Capital	-0.02	0.01	-2.36**							1.143

*** significant at P≤0.01; ** significant at P≤0.05; * significant at P≤0.1; ns not significant (P>0.1). VIF Variance Inflation Factor; S.E Standard Error

The result of the significant socio-economic factors responsible for the willingness of adoption of net-tunnel technology for OFSP production in Oyun Local Government Area (Table 4) indicates that membership of agricultural associations, farm size and source of capital were crucial socio-economic factors determining farmers' willingness in the adoption of net-tunnel technology for vines production. While membership in the agricultural association and farm size were the factors that influenced the low cost of technology of net-tunnel and market availability for vines, membership in the agricultural association and source of capital factors influenced the easiness of maintenance.

However, age, gender, educational level, farming experience and household size did not affect willingness to adopt. The high significance of association membership (P < 0.01) in determining the willingness to adopt might be attributed to the important roles farmers' associations play in innovation adoption. Vu *et al.*, 2020 stated that farmers' association aid their access to information, capital and technology which enhance general productivity. The result validated farmers' membership in agricultural associations as an important socio-economic factor in the adoption of net-tunnel technology among farmers in Oyun LGA, Kwara State.

CONCLUSION

The study assessed the socio-economic factors of sweet potato farmers in the Oyun Local Government area of Kwara State and their willingness to adopt net-tunnel technology for orange-fleshed sweet potato (OFSP) planting material production. The study revealed that 72% of the respondents were males, the majority (39%) were within 41-50 years age-group and 80% had a minimum of secondary school education. 62% of the respondents were primarily farmers by occupation and 66% were

members of agricultural society. About half of the respondents (51%) sourced farming capital from their personal savings.

Furthermore, the study revealed that easiness in maintaining net-tunnel was a significant factor determining willingness in the adoption of net-tunnel technology among respondents in the Oyun Local Government Area of Kwara State. In addition, the low cost of the technology and market availability for the vines also determined the willingness to adopt. However, while only three socio-economic factors, that is, membership in the agricultural association, farm size of the respondents and source of capital significantly influenced the farmers' willingness the adoption of net technology for OFSP planting material production, membership in the agricultural association consistently contributed significantly to the factors determining the willingness of the adoption.

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