



COMMERCIALIZATION OF ORANGE FLESHED SWEETPOTATO AND FOOD SECURITY STATUS OF PRODUCING HOUSEHOLDS IN BENUE STATE, NIGERIA

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Abstract

The study analyzed commercialization of Orange Fleshed Sweetpotato (OFSP) and food security status of producing households in Benue State, Nigeria. Commercialization of OFSP and food security status of the producers is constrained by inadequate incomes to purchase food, instability of supply and demand, and natural and man-made disasters. The study therefore, specifically described the socio-economic characteristics of the OFSP producing households, assessed the current level of commercialization among OFSP producing households, estimated the food security status of the producing households, analyzed factors that influenced commercialization of OFSP in the area and factors affecting food security of the OFSP producing households and deduced policy implication from the findings. The study adopted purposive and multistage sampling techniques in the selection of one hundred and eighty (180) respondents. The study made use of descriptive statistics, commercialization indices, food security indices, ordinary least square and probit regression analyses to analyze the objectives. The results showed that majority of the OFSP farmers were males (78.89%) whom were still strong and in their productive ages (38.81 yrs), many of whom were literate (88.89%) with household sizes of 1 to 2 persons. Not many of the farmers had long years of marketing experience (62.22%). The average commercialization index was 57.91% with quantity of OFSP produced and sold as 4.13t and 3.19t respectively. Results showed that few of the OFSP farmers were food secure (46.11%) with monthly food expenditure of N27,554.22 compared to the food insecure (51.11%) counterparts with monthly food expenditure of N16,919.59. The multiple regression estimate of the determinants of commercialization with exponential form as the lead equation showed the R^2 value of 0.6429 with the coefficients of household size, quantity of OFSP produced and volume of credit had a direct relationship with level of commercialization and significant at 1% level. The coefficients of membership of cooperatives and years of education also had a direct relationship with level of commercialization of OFSP and significant at 10.0% and 5.0% levels respectively. The probit regression estimates of the determinants of food security among OFSP farmers indicated that the coefficients of volume of capital had a direct relationship with the probability of being food secure and significant at 1.0% level as well as years of education and gender at 10.0% level. The coefficient of household size had an indirect relationship with the probability of being food secure and significant at 1.0% level. The results therefore called for policies aimed at provision of free and affordable education and training opportunities to the farmers.

Keywords: Commercialization, Orange fleshed, Sweetpotato, Food Security and Households

Introduction

Commercialization entails market orientation (agricultural production destined for market based on market signals) and market participation (produce offered for sale and use of purchased inputs) (Otieno *et al.*, 2009). However, the literature (Jaleta *et al.*, 2009) on commercialization of smallholders makes little distinction between orientation and market participation of smallholders. The argument that productivity growth and food security in smallholder agriculture will require a more commercialized orientation implies that policy

must be designed to encourage a transformation out of the semi-subsistence, low-input, low-productivity agriculture that characterized much of rural Nigeria. As convincing as the scenario may seem coupled with the participation of smallholders in commercialization of subsistence agricultural economy, more than 800 million people throughout the world and particularly in developing countries like Nigeria do not still have enough food to meet their basic nutritional needs (FAO, 2019). Constraints on access to food and continuing inadequacy of household and national incomes to

purchase food, instability of supply and demand, as well as natural and man-made disasters have been held culprit. This creates a nutritional gap which leaves the individual, state or nation insecure (Omotesho *et al.*, 2006). As part of the efforts to bridge the widening nutritional gap and its concomitant food insecurity in Nigeria, governments have tried several agricultural interventions, innovations, programmes and projects and while some of the efforts are still on course, many have since gone moribund (Nwachukwu and Ezeh, 2007). Among the innovations include the emergence of orange fleshed sweetpotato varieties. Orange-fleshed sweetpotato (OFSP) is an improved breed of sweet potato (*Ipomea batatas*) that is cultivated in tropical and semi-tropical regions of the world for food and source of income especially among the rural dwellers (Padmaja, 2009). Orange-fleshed sweet potato varieties are rich in beta carotene, which is a precursor of vitamin A and because of the proven high content of this nutrient, it is considered as a key crop to combat vitamin A deficiency (VAD) problem in the Sub-Saharan Africa (Low *et al.*, 2007; Agble, 2004). Nutritionally, OFSP is not only a good source of energy but is also contains high levels of beta-carotene, which is converted into vitamin A in human body. OFSP is a healthy delicious and affordable food that can be enjoyed in numerous forms: the roots can be eaten raw, boiled or roasted or mashed into pure for use in a range of nutritious products including breads, chips, cakes, juices, porridge. OFSP is a low input, low risk crop that is grown widely across Sub-Saharan Africa. In spite of the efforts to accelerate food production and alleviate the menace of food insecurity in Nigeria through formulation of various policies, the agricultural sector and food system have failed to meet food requirements of the populace and dietary diversity among the poor (Headey, 2012). A body of evidence has recently emerged that showed the link between agricultural production and nutrition (Mayanja and McEwan 2015; Low *et al.*, 2007; Hotz *et al.*, 2011). International Potato Centre (2015) observed that forty-three million children under the age of five years across Sub-Saharan Africa including Nigeria are vitamin A deficient, and a large number of older children and adults, particularly pregnant women. Also high rate of eye problems affecting both young and old these days can be associated with a deficiency. This is indication of higher growth opportunity for OFSP as a business and also to meet up with the demand-supply gap. There is need for deliberate efforts to unlock bottlenecks that hinder efficiency and investment in OFSP which is a cheap source of energy and for the control of VAD especially among the risk groups; children less than 5 years, pregnant and lactating mothers. Studies on roots and tuber crops are generally restricted to yam and cassava which are believed to be major income earners (Afuape, 2014). There are less information and research activities on OFSP especially in Northern Nigeria that has huge potentials for the production of specific commercial products for consumption and income generation (Chima *et al.*, 2012). This situation is worrisome and despicable considering the huge potentials of OFSP in food security, income and

employment generation. This is the lacuna this study seeks to fill. This research will also provide new vista and depended insights into the country's agricultural commercialization and its effect on food security of the citizenry. This form a formidable basis for formulating appropriate sub-sectoral policies and dependable platform for taking informed decisions. The study therefore analysed commercialization of orange fleshed sweetpotato and food security status of producing households in Benue State, Nigeria

Methodology

Study Area

This study was carried out in Benue State, Nigeria. Benue state lies between latitudes 6°25' and 8°08'N, and longitudes 7°47' and 10°00'E in the central part of Nigeria called 'Middle belt' (Nyagba, 1995). The State shares boundaries with Nasarawa State to the North, Taraba to the Northeast, in the South by Cross River, while in the southwest is Enugu, Ebonyi and Kogi State to the West. A short international boundary with the Republic of Cameroon is shared around Kwande Local Government Area. The state has a population of 4,253,641 people and a total land mass of 32,518km² (NPC, 2006). The area of study is found within the tropical sub-humid climate belt with a marked seasonal variation in rainfall and temperature distribution. Dry season is from November to March and rainy season is from April to October with mean annual rainfall range of 1100mm to about 2000mm (Rahman, 2007). Temperature is generally high during the day, particularly between the months of March to April. The mean monthly temperature in the region ranges between 20°C to 40°C in most of towns within the state. The vegetation type of the study area is largely characterized by Southern guinea savannah and some element of Northern guinea savannah.

Sampling Technique

For the purpose of collecting data for this study, the study adopted purposive and multistage sampling techniques. Benue state is divided into three (3) agricultural zones. The zones are zone A, zone B and zone C as already mentioned.

Stage 1: This involved purposive selection of two local government areas that are known for active participation in OFSP production from each of the three agricultural zones of the state, from the list of LGAs in the zones mentioned earlier, the local government are zone, A: Makudi and Guma, zone B: Vandeikya and Kwande and zone C: Otukpo and Ohimini.

Stage 2: Two (2) blocks were randomly selected from each of the zones selected

Stage 3: finally, fifteen (15) OFSP producing households were randomly selected from each of the selected block making a total of one hundred and eighty (180) respondents.

Method of Data Collection

The study employed primary data for data collection. The primary data were elicited from pre-tested and structured questionnaire set that were administered on

the OFSP producing households in the study area. Data of interest included socio-economic characteristics such as; input and output prices, quantities and other variables related to the farmers' commercialization propensities.

Method of Data Analysis

$$HCI = \frac{\text{Value of crop sold}}{\text{Total value of crop produced}} \times 100\% \dots \dots (1)$$

The household commercialization index (HCI) that determined household specific level of commercialization (Govere, *et al.*, 1999; Strasberg *et al* 1999). The index measured the ratio of the gross value of crop sales by household *i* in year *j* expressed as a percentage. The index measures the extent to which household crop production is oriented toward the market. A value of zero signified a totally subsistence oriented household and the closer the index is to 100, the higher the degree of commercialization. The advantage of this approach is that commercialization is treated as a continuum thereby avoiding crude distinction between “commercialized” and “non-commercialized” households. This effectively brought subsistence food production to the center of discussion about commercialization.

Food Security Index

The households will be classified into food secure and food insecure households using food security index, which will be used to establish the food security status of various households (Omonona and Agoi, 2007). It is given by;

F_i = Ratio of Per capita food expenditure for the *i*th household by 2/3 mean per capita food expenditure of all households. (2)

Where F_i = food security index

When $F_i \geq 1$ = food secure *i*th household

$F_i \leq 1$ = food insecure *i*th household.

A food secure household is therefore that whose per capita monthly food expenditure fall above or is equal to two-third of the mean per capita food expenditure. On the other hand, a food insecure household is that whose per capita food expenditure falls below two-third of the mean monthly per capita food expenditure (Omonona and Agoi, 2007; Arene and Anyaeji, 2010).

Multiple Regression Model

The implicit form of the regression is stated as follows:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}) + e_i \dots \dots (3)$$

Where:

Y = Commercialization index

X_1 = Sex (dummy variable; 0=female and 1=male)

X_2 = Farm size (hectares)

X_3 = Household size (number)

X_4 = Age (years)

X_5 = Income (naira)

X_6 = Quantity of sweetpotato produced (kg)

X_7 = Membership of Cooperatives (dummy variable; 1=yes, 0=No)

X_8 = Volume of credit accessed (naira)

X_9 = Education (years)

X_{10} = Distance to market (km)

e_i = Error term

Probit Model

The Probit model for the estimation of determinants of food security is specified thus:

$$P(Y=1/X) = F(XB) = 1/\sqrt{2\pi} \int_{-\infty}^{XB} e^{-\frac{(XB)^2}{2}} dx \dots \dots (4)$$

Where: $X = (1, x_{1i}, x_{2i}, \dots \dots x_{ki})$

$\beta' = (\beta_0, \beta_1, \dots \dots \beta_k)$

Y = vector of dependent variable (1 for food secure households; 0 for food insecure households);

X = vector of explanatory variables (predictors);

α = Probit coefficients;

e_i = random error term.

The explanatory variables included in the model are as in equation 3:

Results and Discussion

Socio Economic Characteristics of the Sweetpotato Producing Household Heads

The result in Table 1 shows the distribution of respondents according to age. The results show that 52.22% of the respondents were between the ages of 26 and 35 years. The result also shows that 19.45% and 16.11% of the producing households were between the ages of 36 and 45 years and 46 and 55 years respectively. The mean age of the respondents is 34.96 years. This suggests that the respondents were relatively young and were full of vigor and strength to carry out high labour demanding nature of farming activities. The result is in line with the finding of Olagunju *et al.* (2013) that noted that sweetpotato production is dominated by younger farmers. This is expected to assist in the degree of agricultural commercialization in the study area. The younger farmers tend to commercialize in sweetpotato production in the study area than the older ones. The results in Table 1 show the distribution of respondents according to sex. The results revealed that 78.89% of the producing households were males. However, 21.11% others indicated as female households. The result is in contrast with the findings of Nungo *et al.*, (2007) who noted that sweetpotato production and marketing are being mainly done by women. This may be as a result of profitability of sweetpotato production as a business that attracted the male farmers in the study area. The results in Table 1 show the distribution of respondents according to level of education. The finding shows that 49.33% of the respondents attained secondary school education while 31.11% others attained tertiary education. This implies that the respondents had formal education. Education is important since it helps in reducing cost of accessing for information and the time taken to process and act on the information declines with education (Pingali, 2001). The result (Table 1) shows the distribution of respondents according to household size. The results indicated that 82.22% of the respondents had a household size in the range of 1 to 2 persons. The findings also revealed that 17.22% and 0.56% had household size in the range of 3-4 and greater than 4 persons respectively. The mean household size is 1.83 persons. This implies that the sweetpotato producers in

the study area have small household sizes and this have implication for the provision of farm labour to drive the commercialization process. Norman (1972) noted that household size depicts the number of people eating from one pot. It also implies consumption unit equals the production units. The household provides most if not all the labour requirement for farming under small scale farming (Nwaru, 2004). The result (Table 1) shows the distribution of respondents according to marketing experience. The result shows that 67.22% of the respondents had years of marketing experience of less than 5 years and 21.11% of them had marketing experience of between 6 and 10 years with mean marketing experience of 4.95 years. This implies that the respondents are better equipped to compete in the commercialization process as years of marketing experience were long following the finding of Vakis and Saudoulet (2003). The number of years spent in sweetpotato commercialization may give an indication of the practical knowledge acquired on how to overcome certain inherent problems in such enterprise and thus enhance output performance (Okolo, 2007; Nwaogu, 2006).

Level of Commercialization of Orange Fleshed Sweetpotato in Benue State, Nigeria

The result (Table 2) shows the level of commercialization of Orange Fleshed Sweetpotato Producing Households in Benue State, Nigeria. The results show a mean score quantity of sweetpotato produced and sold as 41,268.89kg and 31,970.00kg respectively. The mean score for commercialization index was 75.91 indicating that 75.91% of the quantity produced was commercialized. This implies that there is a high level of orientation of orange fleshed sweetpotato (OFSP) towards commercialization in the study area. The result is not in line with Agwu *et al.* (2012) who obtained 19.06% of sweetpotato commercialized in Abia state but agrees with Govereh *et al.* (1999) and Strasberg *et al.* (1999) who opined that the closer the commercialization index is to 100%, the higher the degree of commercialization.

Food Security Status of Orange Fleshed Sweetpotato (OFSP) Producing Households in Benue State, Nigeria

The results in Table 3 show the food security status of OFSP producing households in the study area. The results show a mean monthly food expenditure profile of N27, 554.22 and N16, 919.59 for the food secure and non-food secure households respectively, indicating that the food secure households expenditure on food was higher by 38.60%. The per capita food expenditure for the food secure households and non-food secure households was N16,481.92 and N6,761.62, indicating that the food insecure households had more household size than their food secure household counterparts in Benue State. The results also shows that about 53.11% of the respondents were food secure (with per capita food expenditure greater than N11,234.77) while 46.11% were non-food secure (with total mean per capita food expenditure \leq N11,234.77). According to

Mutai *et al.* (2013), this crop (orange fleshed potato) has the potential to diversify the farming systems, spread risks, contribute to food security, and provide income opportunities for the most vulnerable and women in particular. If sweet potato commercialization efforts are to be put in place then a majority of the farmers would be better off.

Determinants of Commercialization of Orange Fleshed Sweetpotato among Producing Households in Benue State, Nigeria

The results (Table 4) showed the regression estimates of the factors that influenced commercialization of orange fleshed sweetpotato among producing households in Benue State, Nigeria. Among the four functional forms estimated, the exponential form was chosen as the lead equation based on a high R^2 value, number of significant factors and agreement with *a priori* expectations. The F-value was highly significant at 1.0% level indicating a regression of best fit. The R^2 value of 0.6429 showed that 64.29% of the variability in commercialization was explained by the independent variables. The result showed that the coefficient for household size (0.4919) was positively signed and significant at 1.0% level of probability. This implies that any increase in household size will lead to increase in sweetpotato commercialization in the State. This is expected and in accordance with *a priori* expectations. Large household size supply labor at the production level which will have a positive effect on commercialization, since the household will probably increase the area of land cultivated. The finding is consistent with the findings of Barrett (2007) on the positive association between household size and commercialization. The coefficient for quantity of sweetpotato produced (8.9×10^{-6}) was positive and highly significant at 1.0% level of probability. This implies that any increase in quantity of sweetpotato produced will lead to increase in sweetpotato commercialization in the state. The possible explanation for this is due to the ability of these households to produce a marketable surplus after surpassing their consumption/subsistence needs. These findings concur with those of Komarek (2010) who in a study on the commercialization of bananas, found that its yield positively influenced the quantities of bananas traded; the author further goes ahead to argue that yields realized help to explain market commercialization decision. Rios *et al.*, (2008) in a study on linkages between market participation and productivity reported that households with higher productivity tended to sale more in agricultural markets regardless of market access factors. The coefficient for membership of cooperative society (0.3521) was positively signed and significant at 5.0% level of probability. This indicated that the more the membership of the farmers to cooperative societies, the more the increase in sweetpotato commercialization in the state. This also is in accordance with *a priori* expectations. Most cooperative societies create markets for their members through group markets formation. Following the argument that non-member producer households experience difficulties (like compliance with the group membership demands) in their quest for

selling their product. These findings are consistent with Jagwe *et al.* (2010) and Mathenge *et al.* (2010) who argue that producer groups can be good platforms for social market formation and through which smallholders can obtain market information at a lower cost hence lowering the fixed transaction costs and increase commercialization. The results also show that coefficient for volume of credit (5.6×10^{-7}) was positive and highly significant at 1.0% level of probability. This implies that increase in volume of credit will lead to an increase in the orange flesh sweetpotato commercialization in the state. This also is in accordance with *a priori* expectations. Increased volume of credit gives the farmer more cash resources hence it has an effect on orange flesh sweetpotato commercialization activities. Household with increased volume of credit are more likely to increase their production thereby increasing commercialization. Following the argument that poor households experience difficulties trying to sustain immediate family, increased volume of credit helps to better financial capacity of such households. The result supports findings by Martey *et al.*, (2012) and Lubungu *et al.*, (2012). Furthermore, as the credit status of the sweetpotato farmer increases, farmers tend to produce for the market. The coefficient for education (0.0317) was positive and significant at 1.0% level of probability. This implies that any increase in number of years of education will lead to a corresponding increase in orange fleshed sweetpotato commercialization in the State. High educational level have the effect of enabling households access and conceptualize information on good farming methods, access better paying rural labour market and capable of profitably combining various experiences. Education provides important indicators of household welfare and that raising poor household's access to education is likely to have beneficial effects on commercialization process (Apata, *et al.*, 2010). The coefficient for gender (0.1705) was positively signed and significant at 5.0% level of probability. This implies that increase in number of male household producers will lead to corresponding increase in orange fleshed sweetpotato commercialization in the study area. This is in line with *a priori* expectation because key decisions in a household are made by men. Gender is an important indicator of household decision making whereby in traditional setup, gender also depicts preferences of male heads and female household heads. The findings agree with observation of Musyoki *et al.*, (2013) that gender is crucial determinant of household decision in agricultural production and this has effect on commercialization of agricultural produce.

Determinants of Food Security of the OFSP Producing Households in Benue State (Probit Model)

The empirical results of the Probit regression estimates for determinants of food security of the OFSP producing households in Benue State are shown in Table 5. The χ^2 was highly significant at 1.0% level of probability indicating regression of best fit. The likelihood ratio tests indicate that the slope coefficient was significantly different from zero for seller decision. The coefficient

for gender (0.6973) was positively signed and significant at 5.0% level of probability. This indicates that increase in number of male household producers will increase the probability of being food secure in the study area. This is expected because key decisions in a household are made by men. Gender is an important indicator of household decision making whereby in traditional setup, gender also depicts preferences of male heads and female household heads. The findings agree with observation of Musyoki *et al.*, (2013) that gender is crucial determinant of household decision in agricultural production and this has effect on food security.

The coefficient for household size (0.4893) was negative and highly significant at 1.0% level of probability. This implies that increase in household size will decrease the probability of being food secure in the study area. A larger household size may be synonymous with increased consumption needs and higher dependents that hardly contribute to food production or income generating activities that would promote food security (Kirimi *et al.*, 2013). The coefficient for volume of credit (3.98×10^{-6}) was positive and significant at 1.0% level of probability. This indicates that increase in credit will lead to a corresponding increase in probability of being food secure in the study area. Thus, availability and volume of credit has a positive impact towards food security. Funds obtained are expected to improve farmer's knowledge and skills, buy farm inputs, pay wages and thus productivity will increase therefore enhance farmer's commercialization activities leading to improved food security. This finding is in line with Ahmed *et al.*, (2015) who opined that credit is an important means of investment and households who have access to credit can invest in preferred business and earn more income resulting in increased financial capacity and purchasing power of households, thus reducing the risk of food insecurity. The coefficient for years of education (0.1514) was also positive and significant at 10.0% level of probability. This implies that increase in years of education will lead to a corresponding increase in the probability of being food secure in the study area. It also indicates that households that are relatively higher educated are more likely to be food secure than those of households with relatively lesser education. This is in consonance with the findings of Habtom *et al.*, (2004), who revealed that educational levels of households have a relatively high potential to more than double the number of food secure households in the study area. Formal education of the household is a measure of human capital development. Formal education will reduce the relative risk of households being either food secure or insecure. Education is important in enhancing skills and ability to make decisions which can enable access to better economic opportunities or better utilization of information including use of technology and farming practices to improve agricultural production and hence food security. These results are consistent with findings by Suri *et al.*, (2009) and Kimiri *et al.*, (2013) that having formal education is a key driver in reducing the

likelihood of a household ever being poor and food insecure.

Marginal Effects for Continuous Determinants

To facilitate interpretation of the estimation results presented in Table 6, the marginal effects of each variable on the predicted probability of farmers' determinants of food security of the OFSP producing households in Benue State evaluated at the means of the explanatory variables are reported in Table 4.15. The table provides the probability estimation for the likelihood of farmer's food security status were given the statistically significant variables: 'sex', 'household size', 'volume of credit, and 'years of education. The marginal effect report of the Probit regression in table 4.15 indicates that there is a probability of 27.03% increase in being food secure in the study if the number of male headed households were increased by one. The marginal effect result also shows that there is probability of 11.52% decrease in being food secure if they have one additional active member per household. If the volume of credit increases by one Naira, at mean value, then the likelihood of ensuring food security in the study area increases by 3.1×10^{-6} . Similarly, there is a probability of 6.03% increase in food security if the level of education of the household producers were increased by one year.

Conclusion

The study analyzed the influence of commercialization on the food security status of OFSP producing households in Benue State, Nigeria. In the study, food security status and level of commercialization were profiled and the determinants of commercialization and probability of being food secure were estimated in the study area. The study however, showed that the level of commercialization was high with more households being more food insecure. Important factors influencing commercialization and food security include; credit, education, household size, membership of cooperatives, gender and quantity produced. There is need therefore for policies aimed at addressing these factors for increased OFSP commercialization and food security in the study area. It is generally believed that investment in education is a prerequisite for increased economic growth. Since the level of food security increases with advancement in educational level and increases with commercialization in the study area, it is imperative to improve human capital development. There is also need to encourage the formation of cooperative societies among farmers. This will enhance information on marketing, dissemination on new and improved technologies and bulking of their produce for increased commercialization at lower transaction costs.

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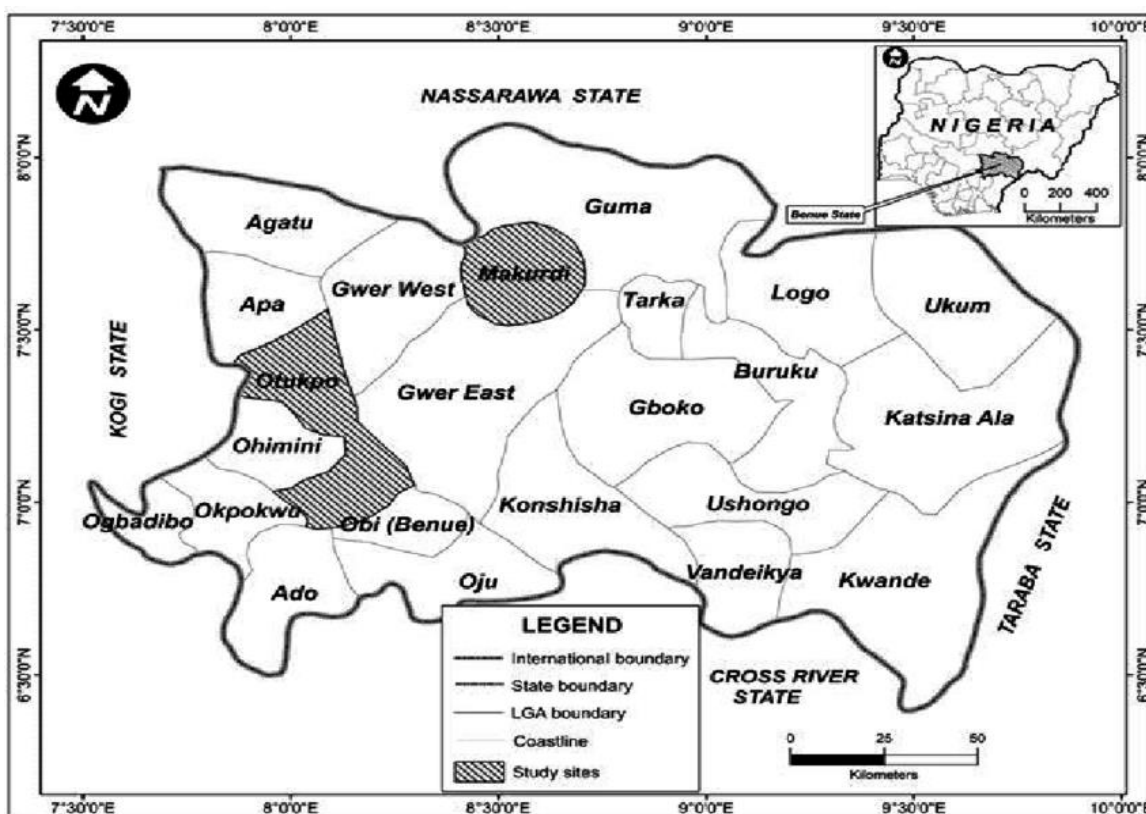


Table 1: Socio-Economic Characteristics of the Respondents

	Frequency	Percentage
Age Range (years)		
<25	4	2.22
26-35	94	52.22
36-45	35	19.45
46-55	29	16.11
>55	18	10.00
Mean	34.96	
Sex		
Male	142	78.89
Female	38	21.11
Level of Education		
No formal education	20	11.11
Primary	15	8.33
Secondary	89	49.44
Tertiary	56	31.11
Household Size Range		
1-2	148	82.22
3-4	31	17.22
>4	1	0.56
Mean	1.83	
Marketing Experience		
<5	121	67.22
6-10	38	21.11
11-15	9	5.00
16-20	7	3.89
>20	5	2.78
Mean	4.95	
Total	180	100.00

Source; Survey Data, 2021

Table 2 Level of Commercialization of Orange Fleshed Sweetpotato Producing Households in Benue State, Nigeria

Variables	Mean	Std. dev	Minimum	Maximum
Quantity of Sweetpotato produced (kg)	41268.89	27910.99	750.00	100000.00
Quantity of sweetpotato sold (kg)	31970.00	22604.63	500.00	85000.00
Commercialization index	75.91	13.24	36.36	180.00

Source: Field Survey, 2021

Table 3: Food Security Status of Sweetpotato Producing Households in the Study Area

Variable	Frequency	Percentage	Mean monthly Food expenditure	per capita food Expenditure	Total per capita food Expenditure
Food Secure	83	46.11	N27,554.22	16,481.92	N11,243.77
Non-Food Secure	97	53.11	N16,919.59	6,761.62	
Total	180	100.00	N21,823.33		

Source: Field Survey, 2021

Table 4: Regression Estimates of the Determinants of Commercialization of Orange Fleshed Sweetpotato among Producing Households in Benue State, Nigeria

Variables	Parameter	Linear	+Exponential	Cobb Douglas	Semi-log
Constant	B ₀	86.9125 (2.37**)	3.5060 (8.88***)	6.7877 (4.23***)	354.4547 (3.49***)
Sex	X ₁	19.5281 (1.86*)	0.1705 (1.51**)	-0.0139 (-0.15)	3.1657 (0.54)
Farm Size	X ₂	14.8881 (1.17)	0.0830 (0.60)	-0.2877 (-2.04**)	-14.6359 (-1.65*)
Household size	X ₃	33.7034 (5.27***)	0.4919 (7.14***)	0.5059 (6.51***)	36.9961 (7.54***)
Age	X ₄	-0.3644 (-0.72)	-0.0044 (-0.81)	-0.3448 (-1.43)	-21.9067 (-1.44)
Income	X ₅	0.0003 (1.31)	2.7 x 10 ⁻⁶ (0.99)	0.0576 (0.55)	4.6285 (0.70)
Quantity of Sweetpotato produced	X ₆	0.0007 (3.23***)	8.98 x 10 ⁻⁶ (3.60***)	0.3810 (5.00***)	25.8939 (5.38***)
Membership of cooperative	X ₇	43.4648 (2.97**)	0.3521 (2.24**)	0.1312 (0.32)	24.0024 (0.93)
Volume of credit	X ₈	0.00007 (1.79**)	5.6 x 10 ⁻⁷ (3.91**)	0.0624 (0.85)	9.5400 (2.07**)
Years of education	X ₉	0.0403 (0.02)	0.0317 (3.02***)	0.9881 (2.74***)	57.7449 (2.54**)
Distance from farm to market	X ₁₀	-0.2916 (-0.92)	-0.0029 (-0.84)	-0.0649 (-0.32)	-13.8756 (-1.08)
R ²		0.5733	0.6429	0.6033	0.6330
R ⁻		0.5536	0.6206	0.5644	0.5970
F		22.08***	28.80***	15.51***	17.59***

Source: Results from STATA 4A

*, ** and *** is significant at 10%, 5% and 1% level of probability respectively

Figures in parentheses are t-values

+ = Lead equation

Table 5: Determinants of food security of the OFSP producing households in Benue State (Probit model)

Variables	Parameters	Coefficients	Std. Error	T- Value
Sex	X ₁	0.6973	0.33117	2.24**
Farm size	X ₂	0.0768	0.4269	0.18
Household size	X ₃	-0.4893	0.1048	-4.67***
Age	X ₄	-0.0038	0.01533	-0.25
Income	X ₅	-1.14 x 10 ⁻⁶	8.55 x 10 ⁻⁶	-0.13
Quantity of Sweetpotato produced	X ₆	-9.48 x 10 ⁻⁶	6.9 x 10 ⁻⁶	-1.37
Membership of cooperative	X ₇	-0.3032	.4304	-0.70
Volume of Credit	X ₈	3.98 x 10 ⁻⁶	1.20x10 ⁻⁶	3.32***
Years of education	X ₉	0.1514	0.0832	1.82*
Distance from farm to market	X ₁₀	-0.0028	0.0022	-1.30
Constant	B ₀	1.7342	0.8359	2.07**
Log likelihood		-87.8055		
χ ²		61.30		
Pseudo R ²		0.2587		
Number of Observations		171		

Source: Results from STATA 4A

*, ** and *** is significant at 10%, 5% and 1% level of probability respectively

Table 6: Marginal Effects for Continuous Determinants

Explanatory Variables	DY/DX (Partial Effect)
Sex	0.2703
Household size	-0.1152
Volume of credit	3.1 x 10 ⁻⁶
Years of education	0.0603

Source: Results from STATA 4A