

# Production function analysis of Pumpkin (*Cucurbita spp*) in Central Agricultural Zone of Nasarawa State, Nigeria

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**ABSTRACT:** The study analyzed the production of Pumpkin (*Cucurbita spp*) in Central Agricultural Zone, Nasarawa State, Nigeria. Specifically, the study described the socioeconomic characteristics of farmers and analyzed the factors that affect the production of pumpkin (*Cucurbita spp*) in the study area. A multi-stage sampling technique was used to select 60 respondents. The data were analyzed using descriptive statistics and production function analysis. The results of the socio-economic characteristics showed that 68.3% of the respondents were male and between the ages of 31 and 40 years (53.3%). Also, majorities (81.7%) of the respondents were married. and larger proportion (71.7.0%) had one form of education or the other. The findings also revealed that 55.0% had household sizes of between 6 and 10 persons, with 41.7% having household sizes of less than 5 persons. Major proportion (58.3%) had farm sizes of less than 2 ha. Larger portion (70%) of the respondents did not belong to any cooperative association and substantial percentage (73.3%) had no access to credit facilities and 71.7% had no access to extension services. Coefficients for household size, labour, seed, fertilizer and farm size have the expected positive *apriori* signs. Agrochemicals had negative coefficient sign and significant at 5 % probability level. The R<sup>2</sup> was also computed at 0.894 indicating that about 89.4% variations were explained by the variables included in the model. Government should encourage pumpkin farmers through provision of affordable and accessible credit facilities to boost scale of production and Research institutions should be encouraged to develop technologies that will minimize the menace of pests and disease infestation in pumpkin production. Adequate and well trained extension agents should be made available to provide supports to the farmers.

**Key words:** Agricultural zone, analysis, production function, pumpkin.

## INTRODUCTION

Pumpkin (*Cucurbita pepo*) is from the family Cucurbitaceae (common names are; Pumpkin, Elegede (Yoruba), Kabewa (Hausa)). It is a small to medium sized vegetable plant generally grown for its fruits and edible seeds. It is commonly known to be used for both food and in herbal medicine formulation for the treatment of various ailments in Nigeria and world in general (Megersa et al., 2013). Several efforts are being made to expand the relevance of some local food sources which are

becoming increasingly pursued because of the importance of some of the local foods that are readily available with many of them containing valuable seeds that are of immense benefit to man and animals (Elemo et al., 2002). Pumpkin seeds are good sources of protein, fats, carbohydrates and minerals (Bello et al., 2008). Many researches have indicated that the seeds not only contain nutritionally important bio-compounds but are also major sources of other phyto-compounds which

have significant anti-nutritionally effects (Omorayi and Dilworth, 2007; Elinge et al., 2012; Jacob et al., 2015 ). These compounds may include oxalate, phytate and cyanide, among others. Pumpkin is quietly receiving recognition as food and to some extent health protective values of its seeds (Elinge et al., 2012). The seeds are directly consumed as snacks in many traditional cultures in the study area, Nigeria and the world in general (Dietmar, 2005). Pumpkin plant is an annual plant with leafy green vegetable with climbing stem of up to 12m long and fruits with a round fibrous flesh (Dietmar, 2005). The fruits vary in shape, sizes, weight and colour. Besides, they have a moderately hard flesh with a thick edible flesh and a central cavity containing the seeds.

Vegetables are important source of food for both human and animal consumption. Although, the actual quantity of carbohydrates, protein, minerals and fats may be limited and varies from one vegetable to the other, the real value of vegetables generally lies in its minerals, vitamins and fiber content.

The per capital consumption of vegetables in the developing world is only 100 g compared with 220 g in the more advanced countries. Nigeria alone produces over 3.8 million tonnes of different types of vegetable annually, which is short in the requirement compared to other developed countries (FAO, 2007). Pumpkin despite its enormous benefits still faces neglect; this is as a result of inadequate knowledge on its importance and how livelihoods of many families will be affected by its production. Pumpkin (*Cucurbita pepo* L.) young leaves and vines are consumed as vegetables among the rural dwellers in Southwest Nigeria. It is a cheap source of protein, vitamins, fibres and antioxidants in their diet. Due to the intensive cultivation of available lands which affects the nutrient status of most soils and their productivity, the need to apply fertilizer on pumpkin became pertinent so as to improve the low average yield being experienced, possibly due to the application and utilization of local seeds, non-recognition of the immense benefit and economic importance of the vegetable in income generation, employment creation, fast growth, long shelf life during storage among others (Oloyede et al., 2013). *Cucurbita pepo* grows as large annual vines, historically in areas that are 2000 m above sea in altitude. The vegetable has large, showy, yellow-orange, insect pollinated flowers and round, lobed leaves often with fine hairy prickles. *Cucurbita pepo*, like all species in the family, it is frost sensitive.

To demonstrate the multi-faceted importance of the vegetable, various parts are edible including the fruits, flowers, young leaves, and seeds and these makes it to be an agricultural species of great value, both as food and in its medicinal influence. It is cultivated worldwide, Nigeria and Nasarawa State in particular. The quantity produced varies from region to region and location to location with yields also varies from one area to another depending on the mode of cultivation and the production

practices. Seeds, sap, leaves, and pulp have long been used for medicinal purposes, including treatment of intestinal worms, urinary issues, and poultices for burns. The vines and fruits are used as fodder for livestock, and gourds used for vast array of ornamentals, traditional and other related functional purposes (Saade and Hernandez, 1994; Wikipedia, 2017) Despite its health and dietary benefits, the production of pumpkin (*Cucurbita*) in Nasarawa Eggon, Akwanga, Wamba (Study Area) and Nigeria at large is still on a small scale with very low average yield occasioned by low knowledge on its economic importance (Author's views based on field experience). However, the cultivation of this multi-purpose and nutrient rich food crop is most desirable for the purpose of overcoming the problems of under-nourishments and food insecurity. With the current emphasis on consumption of fruits and vegetables to promote good health and life longevity, it is expected that the demand for pumpkin (*Cucurbita*) as a fruit vegetable may be increased in Nigeria and this increase must be matched with an increase in production and productivity. Several varieties of pumpkins are cultivated and there are no documented studies on their production, productivity, factors influencing production, profitability and its improvement for higher returns, acceptability, employment creation, value addition as well as proffering solutions to possible constraints and factors militating its production which may help in increasing income and improvement of the socio-economic well-being of the rural dwellers .Yet such studies are very important for policy decisions and the improvement of the agricultural sector.

The study intends to analyse the production of pumpkin (*Cucurbita*) in Central zone of Nasarawa State, Nigeria. This will aid the development of improved technologies that will address the inefficiencies in the identified variables that affects the achievement of high productivity of pumpkin.

Though studies have been conducted on *Cucurbita* spp both locally and internationally, the studies were mostly on genetic variability, resource use efficiency, nutritional evaluation, nutrient composition, growth, yield and antioxidant (Aruah et al., 2012; Ogisi et al., 2014; Oloyede, 2012). More so, these studies did not analyse the productivity of pumpkin (*Cucurbita*) and none of the studies was conducted in Nasarawa State. Hence, the research questions are:

- i. What are the socio-economic characteristics of the pumpkin producers in the study area and
- ii. What factors affect the production of pumpkin (*Cucurbita*) in the study area,

Hence, the objectives of this study are to describe the socio-economic characteristics of pumpkin (*Cucurbita*) farmers; and determine the factors that affect pumpkin (*Cucurbita*) production in the study area.

## METHODOLOGY

### Study area

The study area is the Central Agricultural Zone of Nasarawa State. The zone comprises of three Local Government Areas (LGAs) namely; Akwanga, Nasarawa-Eggon and Wamba. This study Area is located in the North Central zone of the state. The three (3) LGAs have a combined population of 335,453 (NPC, 2006). The State, lies between latitude 7° and 9° North and longitude 7° and 10° East (Nasarawa State Ministry of Information, 2005). The state shares common boundary with Plateau State and Taraba State in the East, Benue State in North, and Kaduna State in the North, Kogi State and FCT in the West.

The State covers a land area of about 27,137.8 Square kilometre with a population of 1,863,275 million people and also the projected population of 1,915, 544.67 million people using a growth rate of 2.8% for year 2015 (NPC, 2006). The State has a distinct dry and wet season climate with maximum mean temperature reaching as high as 34°C. December and January are the coolest months. The mean annual rainfall pattern shows that the amount ranges from 1100 to 2000 mm in the Southern part. Generally, mean annual rainfall is less than 1000mm. The major vegetation formations in the State are Southern guinea savanna, Northern guinea savanna and the Sudan savanna. Nasarawa state is endowed with significant hectares of arable land suitable for the production of various agricultural crops. The climate favors the production of both permanent and arable crops. Mixed farming is the major type of farming system practiced in the State. The prominent food crops produced are rice, sorghum, cowpea, maize, beniseed, cassava, yam, pumpkins among others. While the cash crops are mainly groundnut and sugarcane. The state capital is about 165 Kilometers away from Abuja, the capital of Nigeria.

### Sampling procedure and data collection method

Both primary and secondary sources of data and information were used for the study. Multi-stage sampling techniques were adopted for the selection of the farmers for the 2015 crop season. The first stage involved the selection of 3 Local Government Areas from the existing 5 Local Government Areas located within the Central Agricultural zone which are; Akwanga, Wamba and Nasarawa-Eggon. The second stage involved the selection of two villages each from the selected Local Government Areas where pumpkin is extensively grown, making a total of six (6) Villages. Next, 10 pumpkin farmers were randomly selected in each of the villages using a compiled list of pumpkin growers in the area obtained with the aid of key informants, making a total of 60 respondents through which structured questionnaire

was administered. While the secondary information was generated from related academic journals, statistical publications, seminars/workshop papers, thesis and textbooks.

### Method of data analysis

Data were analyzed using both descriptive and inferential statistics. Apart from mean and simple percentages, other analytical technique employed was the regression analysis. The descriptive statistics were applied in the analysis of the socio-economic characteristics of the farmers while inferential statistics was employed in achieving objective two.

#### Descriptive statistics

Mean, percentages, frequency distribution were applied to achieve objective two and it is presented as follows:

Arithmetic mean was computed according the following formulae:

$$\bar{X} = \frac{\sum x_i}{N} = \frac{X_1 + X_2 + X_3 \dots \dots \dots X_n}{N} \dots \dots (1)$$

Where:  $\bar{X}$  – Mean,  $\sum X_i$  = summation of the sample, N = Total number of observations,  $\Sigma$  = Summation,  $X_i$  = Individual observation, N = Total number of observation.

Percentage is mathematically expressed as:

$$\text{Percentage (\%)} = \frac{X}{N} \times 100 \dots \dots \dots (2)$$

Where: % = Percentage, X = Individual observation, N = Total observation.

#### Regression analysis

A production function was fitted to determine the factors that affect the production of pumpkin (*Cucurbita*) in the study area. Three functional forms were estimated; the linear, semi log and double log functions. The production function for pumpkin (*Cucurbita*) production in the study area is implicitly stated as follows:

$$Y = f(X_1, X_2, X_3, X_4 \dots X_6 + U)$$

Where: Y = Output of pumpkin (kg),  $X_1$  = Household size (number),  $X_2$  = farm size (Ha),  $X_3$  = labour (man-days),  $X_4$  = Fertilizer (kg),  $X_5$  = Quantity of seeds (kg),  $X_6$  = herbicide/insecticides (liters), U = error term,  $X_1 \dots X_6$  = are the explanatory variables.

Here, the data obtained from the above was fitted into three functional forms via:

Linear function

$$Y = f(b_0, b_1X_1, b_2X_2, b_3X_3, b_4X_4, b_5X_5 + e)$$

Double – log form

$$\ln Y = f(b_0, b_1\ln X_1, b_2\ln X_2, b_3\ln X_3, b_4\ln X_4, b_5\ln X_5 \dots + X_n + e)$$

Semi – log function

$$Y = f(b_0, b_1\ln X_1, b_2\ln X_2, b_3\ln X_3, b_4\ln X_4, b_5\ln X_5 \dots + X_n + e)$$

Where:  $b_0$  = constant or intercept,  $b_1 - b_6$  = coefficient of the parameter used in the model ( $X_1 - X_6$ ),  $e$  = error term.

## RESULTS AND DISCUSSION

### Socio-economic characteristics of pumpkin farmers

The socio-economic variables used for this study includes; the respondents' gender, age, marital status, educational level, household size, farm size, membership of cooperatives, access to credit, and access to extension services.

#### Gender

The gender of the respondents as presented in Table 1 shows that majority (68.3%) of the respondents were male while only 31.7% were female. This implies that men were involved in pumpkin production than female in the study area. The reason behind this maybe because men are stronger than women and in most cases, more energetic to carry out strenuous work. Also, it may be attributed to the fact that household heads are responsible for major production decisions, hence agreeing with Johnson et al. (1998).

#### Age

Also, the results shows that majority (53.3%) of the respondents were between the age range of 31 to 40 years, 26.7% were between the age range of 41 to 60 years, while only 20.0% are between the age range of 20 to 30 years. The mean age was 37.4. This indicated young people of economic active age dominated in the study area, and it may also be that most of the activities in the farm are done manually. The physical ability of a man obeys the law of diminishing returns. In this wise, the productivity of man increases with age to a peak level after which it declines as the farmer advances in age. According to Otunaiya et al. (2014), middle-age is the

**Table 1.** Socio-economic variables of the respondents.

Variable	Frequency	Percentage
Gender		
Male	41	68.3
Female	19	31.7
Total	60	100
Age		
20-30	12	20.0
31-40	32	53.3
41-60	16	26.7
Total	60	100
Marital status		
Single	8	13.3
Married	49	81.7
Widow	3	5.0
Total	60	100
Educational Status		
Primary	13	21.7
Secondary	27	45.0
Tertiary	3	5.0
Non formal education	17	28.3
Total	60	100
Household Size		
1-5	25	41.7
6-10	33	55.0
11-15	2	3.3
Total	60	100
Farm size		
Below 1	16	26.7
1-2	35	58.3
Above 2	9	15.0
Access to loan		
Yes	16	26.7
No	44	73.3
Total	60	100
Member of cooperative		
Yes	18	30.0
No	42	70.0
Total	60	100.0
Access to Extension		
Yes	17	28.3
No	43	71.7
Total	60	100

Source: Field survey, 2016

productive period where farmers are innovative and could undertake the strenuous activities like pumpkin production.

### **Marital status**

The results in Table 1 also revealed that majority (81.7%) were married, 13.3% are single, and 5% are widows. The high number of married respondents could increase the release of labour, thus making more hands available for productive activities on respondents' pumpkin farm. This result is in line with Akinbile (2007), who reported that married people accounted for majority of pumpkin farmers' population.

### **Educational status**

Also, results from Table 1 indicated that larger proportion (45.0%) of the farmers had secondary education, 28.3% of the farmers had no formal education, 21.7% of the farmers had primary education and 5.0% of the farmers had tertiary education. It is noteworthy that education is one of the major socio-economic factors that have great impact on the output and productivity of the farmers. Farmers with formal education are privileged to have early contact with new innovations and improved technologies which are designed to improve output and productivity. Moreover, such farmers are early adopters and risk aversion tendency reduces with formal education. This is collaborated with the findings of Adams (2009), who reported that in farming, formal education affords farmers especially, those that have training in agriculture, the opportunity to understand proper management of resources in production. Babatunde et al. (2007) stated that low level of education makes introduction of improved technologies by extension agents difficult.

### **Household size**

It was also observed from Table 1 that majority (55.0%) of the farmers had a household size between 6 to 10, 41.7% had between 1 to 5 and 3.3% had a household size between 11 to 15. The mean household size was 6.23. This showed that there are large family sizes which could help by providing family labour in the farming which eventually will help in the additional costs to be incurred in carrying out farming activities. Although a large family size implies that there are many mouths to be fed. This is in line with Baruwu and Oke (2012) who stated that the size of household is a good indicator of labour available for work in the production activities.

### **Farm size**

Also, results from Table 1 showed that majority (58.3%)

of the respondents had between 1 to 2 hectares and 26.7% had below 1 hectare while 15% had above 2 hectares. Sahib et al. (1997) grouped farm holdings in Nigeria into three broad categories; small-scale (less than 6 hectares in farm size), medium-scale (6 to 9.99 hectares) and large-scale (10 hectares and above). The mean farm size was 1.36. This implies that most of the farmers in the study area are small scale farmers.

### **Membership of cooperative**

The results also revealed that majority (70.0%) of the respondents were not members of any cooperative group, while 30% are members of one form of cooperative society or the other. This may greatly affect their ability to pull their resources together and get loan from financial institutions. This findings is related to the report of Ibrahim et al. (2007) who stated that belonging to a cooperative society enhance farmers productivity through farm inputs acquisition and distribution.

### **Access to credit**

Also, majority (73.3%) of the respondents had no access to loan while only 26.7% had access. Farmers with access to loans in the form of credit tends to produce more than farmers without access to financial facilities, this is so because credit is an important farm input to raise scale of production and equip the farm with modern technologies to raise frontier of production. This is in line with Adebayo and Adeola (2008) that credit access is an essential input to raise farm productivity.

### **Access to extension**

The results from Table 1 also showed that majority (71.7%) of the respondents had no access to extension services in the study area while only 28.3% had access to extension support. Lack of or inadequate visits by extension agents and extension personnel are usually weak in the study area and Nigeria at large. The inadequacy of the extension services may be due to many factors, possibly due to low level of education, poor remuneration, insecurity, inadequate logistic supports, inadequate motivations, lack of periodic capacity building on new techniques and innovations, among others. All these constraints tends to make the little number of the extension agents available not to put in their best towards the delivery of effective services to the needy farmers and hence tends to create negative multiplier effect in terms of achieving accelerated food sufficiency efforts of the government.

### **Determinants of pumpkin production in the study area**

Three functional forms of regression analysis were used

**Table 2.** Determinants of Pumpkin Production in the Study Area.

Variable	B	Std. error	Beta	T
Constant	-848	0.251		-3.374*
Household size	0.026	0.012	0.109	2.132**
Labour	2.61E-05	0	0.254	2.336**
Seed	2.35E-05	0	0.359	2.652*
Agrochemical	-6.85E-05	0	-242	-2.176**
Fertilizer	6.31E-05	0	0.465	.3.805*

to arrive at the best function and they include; double-log regression, semi-log regression and linear regression. Among these three, Semi log function was selected and used for result interpretation because it had the highest  $R^2$  values and considerable F-value, which test the goodness of fit of the overall model. Besides, it had the highest number of significant explanatory variables and consistency of the signs with *a priori* expectations. The coefficients for household size, labour, seed, fertilizer and farm size have the expected positive *a priori* signs, indicating that the more these variables increases the higher the level of pumpkin produced and vice versa, while agrochemicals had negative sign (Table 2). Hence, the semi-log functional form was selected as the lead equation. The result shows that the estimated coefficient of multiple determinations ( $R^2$ ) was estimated at 0.894 indicating that the postulated regressors (i.e. included variables in the model) explained 89.4% in the variation of the dependent variable (i.e. net return from pumpkin production). The F-value was estimated at 41.2, which indicated the joint effect of the variables included in the model as well and it was found to be significant. This further indicated the significance of the  $R^2$  value and hence concluded that semi-log functional form has the goodness of fits in explaining the influence of these factors on net farm margin in pumpkin production. This is not surprising since agricultural production output per person decrease with age because the younger the farmer, the more energy and vigor to work in the farm. Household sizes, costs of labour, agrochemicals were all significant at 5%, seed and fertilizer were as well significant but at 1% level of probability. This means that as the quantities of seed and fertilizer increases, it tends to increase the net return from pumpkin production. This implies that they were the factors influencing productivity of pumpkin in the study area. The  $R^2$  value was estimated at 0.894 implying that the variables included in the model accounted for 89 percent variation in the productivity level of pumpkin produced in the study area.

Household size was positive and significant at 5% and it contributed positively to pumpkin output. This could be because larger households provided cheap labour for the farmers and labour also increases output. It was noted that the farmers were over-utilizing labour as a factor of production. Umoh (2006) noted that this situation has variously been attributed to small and scattered land

holdings and lack of affordable equipment and makes up about 90% of the costs of production in many African farming systems.

The coefficient of total cost of labour was positive and significant at 5% level of probability. Labour as a factor of production is generally overwhelming. This agrees with the observation by Cleave (1974) and Dvorak (1996) that labour generally constitutes the highest production costs in many African farming systems. Other studies have shown the importance of labour in farming, particularly in developing countries where mechanization is only common in large (commercial) farms (Fasasi et al., 2006). Seeds had positive relationship with output and were significant at 1%. Therefore, it shows that the seed produces well and this gives rise to more pumpkins. Agrochemicals used had negative relationship with the output and was significant at 5%. This may be as a result of wrong application of this input by the respondents.

The coefficient of fertilizer was positive and significant at 1%. This is to be expected as leafy vegetables usually require heavy application of fertilizer for vigorous growth and leave formation.

Farm size was positive and was not significant and this suggests that increases in land area will bring about increases in pumpkin output. This is to be expected as the competition between infrastructural development and agricultural activity could hinder the production of pumpkin in the study area.

## Conclusion

The results of socio-economic characteristics showed that majority of the farmers (68.3%) are male while 31.7% were female. The age distribution revealed that 73.3% of the respondents were below 40 years signifying that they are still active and strong. The results of the marital status of the respondents indicated that 81.7% were married. 71.7% of the farmers had had one form of education or the other, while 28.3% had no formal education. It is observed that 55.0% of the farmers had household size between 6 and 10 with 41.7% had less than 5 and the remaining 3.3% had between 11 and 15 persons. Results of the land holdings of the farmers demonstrated that 85% had less than 2 hectares while 15% had above 2 hectares. 70% of the respondents were

not members of any social group, while 30% are members of different cooperative society. Significant number of the respondents (73.3%) had no access to credit facilities, while 26.7% had access. Most (71.7%) of the respondents had no access to extension services with 28.3% opportune.

The semi-log functional form was selected as the lead equation for the determinants of pumpkin production. The  $R^2$  and F.value were also computed at 0.894 (89.4%) and 41.24 respectively. The most important determinants of pumpkin production were identified.

## Recommendations

Based on the study, the following were recommended that:

- i. Labour saving methods should be introduced to farmers., and
- ii. Farm inputs such as fertilizer, herbicides and others should be made available and subsidized.

## CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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