DETERMINANTS OF NET RETURNS FROM GARDEN EGG *(Solanum melongena)* PRODUCTION IN IMO STATE, SOUTHEAST NIGERIA

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Abstract
This study determined the net returns from garden egg production in Imo State, Southeast Nigeria. Data were collected with structured questionnaire from 96 smallholder garden egg farmers. Data were analysed using descriptive statistics (mean, frequency distribution and percentages), cost- returns analysis and multiple regression techniques. Results showed that the mean age, level of education, household size, farming experience and farm size were 51years, 12years, 6 persons, 23years, and 0.511 hectares respectively. The results also showed that labour cost took the highest proportion with 61.17% of the total expenses incurred in garden egg production, while marketing charges took the lowest proportion with 1.25%. The mean net return per hectare from garden egg production was ₦105, 140.07.The results also showed that cost of agro-chemicals and size of farm land were the major determinants of net returns from garden egg production by showing a statistically significant effect at 5% level. Provision of these inputs in adequate quantities and at affordable prices will ensure enhanced net returns from garden egg production.

Key words*: Net returns, Regression, hectares,, Garden egg, Smallholder farmers.*

Introduction

Garden egg (*Solanum melongena*) originated in tropical Africa (Norman, 1992; Grubben and Denton, 2004). Garden egg is scientifically known as *Solanun melongena* and belongs to the subgenous *leptostemanum melongena* (Obeng-Ofori et al; 2007). The fruits may be pear shaped, round, long or cylindrical depending on the variety. The genus solanum comprises over 1000 species and almost cosmopolitan, with at least 100 indigenous African species (PROTA, 2004). Four cultivar groups are recognized within solanum species, three of which are important for Africa (PROTA, 2004; Horna and Gruere, 2006). They are the Gilo, Kumba, Shum and Aculeatum. The first three are the most important in Africa, Gilo and Kumba groups are produced for their fruits especially in the humid zone of west Africa while Shum is cultivated for its leaves in the savannah area. (Horna and Gruere, 2006).The crop is widely cultivated across most of the African continent, and more intensively in west and East Africa. Garden egg is also produced in brazil (Known as "Jilo") and occasionally in southern Italy and France (Grubben and Denton, 2004).

The eggplant is a warm season crop which prefers relatively high temperatures for optimum growth and development. It requires optimum day temperature of 25-35^{0}C and optimum night temperature of 20-27^{0}C (Norman, 1992; Obeng-Ofori et al; 2007). Diurnal variation in temperature is not essential and the most satisfactory environmental conditions are normally found in low land coastal areas with stable high temperature varying from 25-35^{0}C. High soil temperatures are injurious to the root system and can be reduced by mulching. The garden egg requires well-drained soil with good moisture retaining properties. The root system is sensitive to excess water, and deep cultivation prior to planting is required Soil rich in organic matter and pH ranging from 5.5- 6.5 is suitable for its production (Rice et al; 1993). The early cultivars do well in sandy loam soils (Obeng-Ofori et al; 2007). Norman (1992) reported that the crop should be grown on soils that have high organic matter content and soils deficient in organic mater should have compost or green manure incorporated in it at two weeks before planting. Water logging is likely to cause leaf drop in garden eggs. Manual preparation of the soil is sufficient, but large scale production necessitates mechanized soil preparation. According to Akambi et al; (2001) in their work "Response of *Solanum melongena* to NPK fertilizer and age of transplant" the field used were cleared, ploughed and harrowed once each to obtain good seed bed. PROTA, (2004) prescribed 15-15-15 or 10-10-20 NPK fertilizer to be applied at 150kg per hectare days after transplanting and at 50kg per hectare at first flowering and then at monthly intervals. Soluble fertilizer may be fed by drip irrigation. Farm yard or poultry manure can be applied

at the rate of 10-20t/ha. The productivity of garden egg is highly responsive to N fertilizers. Pal et al (2002) reported that garden egg plant fruit yield increases with increase in N up to 187.7/kg N/ ha.

According to PROTA, (2004), yield of Garden eggs varies depending on the climate, the variety and the growing techniques. Obeng–Ofori et al; (2007) reported of yield of up to 15-20t per hectare in Cape Verde and Mauritania. According to Norman (1992), the local egg plant can give an average yield of about 35-40 fruits per plant weighing between 0.9-1kg per plant. Also according to PROTA (2004), one plant may produce from 500g to about 8kg of fruits, depending on the cultivar and growing conditions. Improved cultivars grown under favourable conditions may yield 50-80 tonnes per hectare.

Garden egg is not planted insitu, rather on a nursery after which it is transplanted into a field. It is a labour intensive crop, and labour costs are more than 60% of the total cost of production (Grubben and Denton, 2004). Labour is especially needed during the harvesting period. On the average, both family labour and hired labour are used in similar proportions. Ploughing is the main service provided to garden egg farmers who cultivate larger areas of land and are able to afford it. Together, equipment and service cost represents 9% of the total production costs incurred by garden egg producers (Grubben and Denton, 2004). Garden egg production can be a profitable activity but it also involves risks. On the average, according to Horna and Gruere, (2006), in their work "marketing underutilized crops" the farmers they interviewed faced 30% chances of having negative returns. Producer activities with a positive return have a large net income to cover all cash costs plus an opportunity charge for unpaid producer labour and management. A production glut occurs in the rainy season when market prices are lowest during the year. Farmers with access to irrigation facilities can produce during the dry season and obtain higher total returns. However, it is also an income generating activity for small holder farmers.

According to Horna and Gruere, (2006), a number of pests and diseases attack this vegetable crop in the field. Mites, stem borers, fruit borers and flower borers are the main pests that attack garden egg. The damage caused can reduce yields and affects the quality and quantity of the produce and also affect the price significantly. Some medicinal properties are attributed to the roots and fruits. They are described as carminative and sedative, and are used to treat colic and blood pressure. The fresh garden egg is mostly eaten raw as it enriches the body with minerals and vitamins. Its leaves also play major role in the diet and are of medicinal use, (Grubben and Denton, 2004).

Garden egg's perceivable quality attributes such as colour, shape, size and taste vary widely. Preferred product characteristics for the export market are taste and aesthetic value. The aesthetic value is measured by the damage free condition, uniformity in size, daily defined shapes, glossy appearance, white colour and good preservation qualities. . However, local consumers adjust to what the market offers during the different seasons. Based solely on taste, consumers prefer the non-round type, but freshness, colour and size are also taken into account by consumers. In general, the consumer looks for a larger, fresher and whiter garden egg, but there is also a market for garden egg that have aged, changed colour and lost water. There are about four grades of garden egg to be found in the market: unripe (white), ripe (yellow/ orange), aged (dehydrated) and small sizes. There is no evidence of price differentials. Normally ripe garden eggs are sold at half the price of the unripe (white/eggs). The aged and small –sized garden eggs could also be sold at half the price of the ripened one's. A few traders sell both the ripe and the unripe at the same price, arguing that a difference in price could create a perception of inferiority (Horna and Gruere, 2006). Garden egg prices fluctuates significantly during the year (GIDA et al; 2004), increasing from November and reaching a peak during April –May. This is the harvesting period for farmers who were able to produce during the dry season (at least in the southern parts of the country). Farmers who have irrigation facilities and produce during the dry season obtain higher market prices. Often, however, they prefer to use irrigated lands for other cash crops, such as tomato in the north or other exotic vegetables in the rest of the country that might represent a higher income. (Danquah-Jones, 2000). At this recent age, the demand for garden egg is on the increase. Garden egg is going beyond being a staple fruit to a more commercial commodity that is now a major source of income for producing households and marketers in the forest zone, (Danquah-Jones, 2000).

According to F.A.O (1970), one major problem of garden egg production could be related to inadequate marketing arrangement and facilities. Marketing has been seen as an incentive to promote further production and consumption of agricultural products (Njoku, 1986). Horna and Gruere, (2006) indicated that the average shelf life of garden egg is three to seven days depending on the harvesting frequency and conditions. They postulated that the limited shelf life affects the internal price of the product and results to losses due to spoilage. Nigerian vegetables are made up of diverse plant species with considerable genetic variability for agronomic, economic and

morphological characters (Denton and Olufolaji, 2000). Prior to 1975, improvement of vegetable crops was not accorded sufficient priority in the national agricultural research system as well as in the national development plan. However the establishment of National Horticultural Research Institute (NIHORT) marked a major change in government policy and the beginning of a systematic improvement and detailed study of the vast vegetable resources in the country (Denton and Olufolaji, 2000). In this study, the researcher seeks to evaluate the determinants and hence profitability of garden egg production amidst the production and marketing challenges highlighted above.

Since it has been observed that inadequate researches and insufficient information have been problems in Nigerian agricultural production and marketing especially as it relates to garden egg plant (Adegeye and Ditoh, 1985) and that garden egg production has a great impact on the socio-cultural, socio- economic, nutritional, and the environmental lives of millions of people in the world, this study becomes very pertinent.

Materials and Methods

This study was carried out in Imo State, Southeast Nigeria. The state lies between longitudes $6^0 35'$ and $7^0 28'$E and latitudes $5^0 10'$ and $5^0 37'$N, covering an area of 5156.60km^2. It is bounded on the east by Abia State, on the west by Delta State, on the North by Anambra State and Ebonyi States, on the South by Rivers State. The State falls within the tropical rainforest zone with an average annual rainfall of 2550ml (Kenkwo and Egeonu, 2000). Imo State has an estimated population of 3,934,897 persons with population densities ranging between 200 and 1500 persons per square kilometre (INEC, 2008). Administratively, the State has 27 Local Government Areas found in three distinct agricultural zones. These zones are, Okigwe, Orlu and Owerri. Farming is the inherent occupation of the people with most families engaging in garden egg and other food crop production although at varying subsistence levels.

Multi-stage sampling technique was used to select a sample of 96 garden egg producer households from a pre-survey sample frame of 320 farmers. This was made possible with the availability of list of garden egg producers from the village extension agents (VEAs). Data were collected with the aid of well structured questionnaire administered to the respondents by the researcher and other trained enumerators. Most of the data collected bothered on the farmers' socio-economic variables, input and output relationships in physical and in value terms, marketing problems, transport problems, pests and diseases among others.

Analytical Procedure

Data were analysed using descriptive statistical and the ordinary least square multiple regression techniques. The regression model is stated explicitly in four functional forms as thus;

Linear form:

$NRt = b_o + b_1P_{X1} + b_2P_{X2} + b_3P_{X3} + b_4P_{X4} + b_5T_c + b_6M_c + b_7F_z + e$ ……eqn (1)

Semi-log fuction:

$NRt = \ln b_0 + b_1 \ln P_{X1} + b_2 \ln P_{X2} + b_3 \ln P_{X3} + b_4 \ln P_{X4} + b_5 \ln T_c + b_6 \ln M_c + b_7 \ln F_z + e$ ..eqn (2)

Double –log function

$\ln NRt = \ln b_0 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln T_c + b_6 \ln M_c + b_7 \ln F_z$ …eqn (3)

Exponential function:

$\ln NRt = b_o + b_1P_{X1} + b_2P_{X2} + b_3P_{X3} + b_4P_{X1} + b_5T_c + b_6Mc + b_7F_z + e$ …. ..eqn (4)

where

NRt = π = Profit = Net Returns is given as

$$\Sigma P_yQ_y - \Sigma_{i=I}^{n} P_i X_i - \Sigma_{k=I}^{n} P_k C_k \quad \text{…. eqn(5)}$$

Adopted from (Odii 1998 ; Amaechi *et al* 2006)

π	=	Profit / Net returns
Q_y	=	Quantity of Garden egg output (kg)
P_y	=	Unit price of garden egg output (naira)
P_i	=	Unit price of i^{th} variable input
X_i	=	Quantity of i^{th} variable input
n	=	Number of input used in production
f	=	Function expressing production
Σ	=	Summation.
P_k	=	Unit price of fixed input
C_k	=	Quantity of k^{th} fixed input

X_1 = Land area (Hectares)
X_2 = Quantity of agro-chemical (litres)
X_3 = Quantity of planting material (kg)
X_4 = Quantity of labour (mandays)
P_{X1} = Land rent (naira)
P_{X2} = Agro-chemical cost (naira)
P_{X3} = Cost of planting materials (naira)
P_{X4} = Labour cost (naira)
T_C = Cost of transports in naira
M_C= Marketing charges in naira.
F_Z = Farm size (Ha)
e= stochastic error term

It is expected a priori that the coefficients of $P_{X1,}$ $P_{X2,}$ $P_{X3,}$ $P_{X4,}$Tc, Mc < 0 while the coefficients of Fz > 0.

Results and Discussion

Table 1 shows the Socio-economic Characteristics of Garden Egg Producers in the Study Area

Table 1: Distribution of farmers according to socio-economic characteristics

VARIABLE		
	Mean Value ($\overline{X}$)	**Std. deviation(∂)**
Age (years)	51	10.07
Educational Level (years)	12	4.22
Household size (number of persons)	6	2.12
Plot size cultivated (Ha)	0.511	0.21
Farming Experience (Years)	23	15.3
Land rent (naira)/ha/annum	32222.36	1412.45
Labour cost (naira)/ha/annum	86669.72	33684.93
Cost of planting material (naira)/ha/annum	6827.29	2828.10
Cost of agro-chem. Inputs/ha,annum	9420.86	3671.72
Cost of transport (naira)/ha/annum	4771.28	1122.18
Marketing charges/ha/annum	1767.36	99.95
Cash expense on Garden egg enterprise (₦)/Ha	141,678..87	-
Annual income from Garden egg enterprise (₦)/Ha	246,818.94	-
Profit/ Net Returns (₦)/Ha	105,140.07	-

Source: Field Survey Data, 2011

Table 1 shows that the mean age, educational level, household size, and farm size were 51 years, 12 years, 6 persons, and 0.5 hectare respectively. This implies that farmers in the study area were at their middle ages and within the working class limit. They are expected to be in the position to effectively and efficiently utilize available resources to them. Their 12 years level of education implies that most of the farmers attended at least primary education. This feature puts them in the position to be able to understand and adopt available innovations that encourage increases in garden egg production. Also the mean household size of 6 persons shows that the farmers have reasonable family sizes. The mean farm size of 0.5 hectares agrees with the previous findings that majority of farmers in Sub-Saharan Africa are smallholders of farm sizes of less than 6 hectares (Olayide, 1980; Ogungbile and Olukosi, (1991) Nwaiwu, 2007;). This farm size available to the garden egg producers obviously showed that they only produced at subsistence level and may also have used rudimentary capital for production. The mean level of experience in garden egg production was 23 years which implies that most of the farmers interviewed had been in the business for a reasonable number of years. This period would have exposed them to various challenges associated with garden egg production and therefore would have found adaptive strategies to those challenges hence better productivity. The mean annual income from garden egg per hectare was ₦246,818.94 and the mean annual expenses was ₦141,678.87 given rise to a mean annual net return of ₦105,140.07/ha. Although the result indicated a positive return on investment, it also implies that most of the farmers in the study area were leaving below the poverty line of less than one dollar ($1) per day. This low income level was expected to have affected their level of growth in garden egg production because low income leads to low savings, low investment and consequently low output. This scenario therefore perpetuates vicious cycle of poverty in the area.

According to the table also, the cost of land (rent), labour, planting materials, transport, marketing and agro-chemicals in naira per hectare were 32,222.36, 86,669.72, 6827.29, 4771.12, 1767.36 and 9420.86 respectively. These figures clearly show that labour cost took the highest proportion with 61.17% of the total expenses incurred in garden egg production in the study area while marketing charges took the lowest proportion with 1.25%. According to Olayide and Heady, (1982) labour is the second most important resource in farm production and constitutes a serious limiting input in the production process. Olayide and Heady (1982) and Upton (1997) also posited that labour and entrepreneurship are the most important resources next to land in traditional agriculture because it is in them that the decision making power in any production process resides. Labour with respect to agriculture means the available human effort for use in production. In view of this prevailing high cost of labour in the study area, increases in the output and profitability of garden egg would have been seriously constrained by this factor. Another serious limiting resource in garden egg production and profit was land rent. The high level of expenses on land rent also implies that land for agriculture was not available and affordable to the resource poor farmers, therefore likely to reduce the marketing margin significantly.

Table 2 shows the multiple regression results of the regression models explicitly stated in equations 1-4

which indicates the determinants of net returns from garden egg production.

Table 2 Determinants of net returns from garden egg production in the study area.

Variable	Linear function	Semi-log function	Double function	Exponential function
Land rent (P_{X1})	-0.28344	-3567.61	-0.09926	-6.17181E06
	(-1.11692)	(-0.81959)	(-0.80197)	(0.789955)
Agro-chemical cost (P_{X2})	-0.1061	-9664.88	-0.28676	-4.95501 E 06
	(-0.79262)	(-1.84525)***	(-2.05289)**	(-1.16346)
Cost of planting materials (P_{X3})	3.647805	13340.86	0.359045	8.65726E05
	(2.004468)**	(1.829392)***	(1.731536)***	(1.545165)
Labour cost (P_{X4})	0.018676	-697.626	0.139278	3.56752E05
	(0.014296)	(-0.1059)	(0.743535)	(0.887016)
Cost of transports (T_C)	-0.61476	4063.548	0.123532	-1.36158 E06
	(-0.37231)	(1.55707)	(1.128698)	(0.026783)
Marketing charges (M_C)	13.3885	14960.35	0.765854	0.000805034
	(0.88653)	(1.003325)	(1.806366)***	(1.731422)***
Farm size (F_Z)	66551.02	32105.66	0.845669	1.640482167
	(9.050516)*	(8.418199)*	(7.798268)*	(7.246312)*
R^2	0.551971	0.558765	0.569342	0.525109621
Adj. R	0.552971	0.523666	0.535085	0.48733425
Error term	13853.04	14283.93	0.406151	0.426499022
F ratio	17.71999**	15.92001**	16.61976**	13.90085**
N	96	96	96	96

Source: Field Survey Data, 2011

(*) =1% level significance, (**) = 5% level of significance, (***) = 10% level of significance

Table 2 shows that out of the four functional forms tried, the double-log form gave the best fit because it has the highest number of t-values that are statistically significant at 5% level (agro-chemical cost P_{X2}, and farm size Fz). Also it has a relatively lowest standard error of 0.406151, and a high R^2 and F-values of 56% and 16.62 respectively. The R^2 value indicates that 56% of the variations in the endogenous variable Net returns (NRt) were explained by the variations in the exogenous variables. The F-value shows that the proportion of the variation in the dependent variable as explained by the independent variables is significant at 5% level.

The results also show that factors such as cost of agro-chemicals and size of farm land are the major factors that affect the net returns of garden egg farmers because they have shown a statistically significant effect at 5% level. It is worthy to note also that land rent and cost of agro-chemicals are negatively related to net returns from garden egg. This is in line with the a priori theoretical expectation that the higher the cost of agro-chemical and land, the lower the net returns from garden egg. This supposition is based on the fact that land is an indispensable resource in garden egg production just like other crops and also a fixed factor which its price increases with population that is always on the increase in Nigeria. Similarly, agro-chemicals especially pesticides are crucial to the production, storability and market value of garden egg fruits, hence any increase in its cost will definitely reduce the net returns from garden egg. Furthermore, the coefficients of $P_{X3,}$ P_{X4}, Tc, and Mc are positive showing that the higher the cost of these factors, the higher the net returns from garden egg. This is against the a priori theoretical expectation that the higher their costs the lower the net returns. This result could be attributed to the fact that farmers may be increasing the price of garden egg more than proportionately to increases in the cost of these factors. Besides, this act may have been made possible because of the socio-cultural, socio-economic and nutritional relevance of the crop that makes the demand fairly inelastic. Finally, the coefficient of Fz, is also positive and in line with the a priori expectation that the higher the farm size the higher the net returns from garden egg production. This assertion is supported by the fact that increases in farm size will enable the farmers to enjoy the benefits of economy of large scale production and bulk purchases. This will make it possible to produce and market at least cost per unit of output.

Conclusion

This result portend that the net returns from garden egg can be improved if agro-chemicals like pesticides are made available to farmers in adequate quantities and at affordable prices. Furthermore, availability of adequate farm land and at reasonable price/rent will ensure higher net returns from garden egg production. It was therefore recommended that government and indeed private investors should gear their effort

towards producing agro-chemicals especially pesticides that will facilitate effective and efficient garden egg production. This could be made possible and cheaper by encouraging local producers and discouraging importation where possible to reduce the higher prices due to erratic currency exchange rates. Finally, land use act in Nigeria should be amended to favour genuine farmers so that they can be accessing adequate land for agriculture at reasonable prices without undue competition with land users for other purposes like building of residential houses and factories.

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