DETERMINANTS OF OKRA *(ABELMOSCHUS ESCULENTUS)* PRODUCTION IN LIBERIA: CASE STUDY OF MARGIBI COUNTY

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ABSTRACT

Liberia is well known for the consumption of vegetables. However, the nation depends on importation from neighboring countries especially during lean seasons. It has always remained food self-insufficient for decades. There are steps to be taken to become food self-sufficient including in vegetable production. This paper investigates into the factors that determine production of okra in Margibi County of Liberia. Data were collected through the use of well-structured questionnaire and observations. A total of 124 small scale okra farmers were selected using multi stage sampling technique. The data collected were analyzed using descriptive statistics and Cobb Douglas production function. The results show that labour, herbicides, seed quantity and use of improved okra varieties were significant factors for increased production of okra. Farmers that cultivated improved okra varieties were more productive than those that cultivated local seed varieties. It was recommended that all the above inputs should be used optimally; cultivation of improved varieties should be promoted; and credit services should be extended to small scale farmers for improved farm productivity.

Key words: Okra; production; improved varieties; Liberia

INTRODUCTION

Okra is an indigenous plant to tropical Africa. In Liberia, okra is used in making varieties of soups. Households, restaurants and hotels' kitchens are major consumers of the vegetable. In Liberia, okra soup is usually served with rice or food prepared from grated cassava. Okra is a source of food, feed, forage, fiber, foliage, fuel and cooking oil. Okra leaves, seeds, pods, flower buds, shoots, and calices are found edible. This member of the Malvaceae family is a good source of nutrition. Okra produces oil which is useful for cooking. The oil is made of unsaturated fats which are easily processed using a hand mill and sieves. Okra seed can also be roasted and used to make a caffeine-free coffee substitute. The foliage provides good biomass; the stems serve as source of as fuel. The fiber can be used to make rope and paper.

Okra may have originated in Ethiopia but is now grown all over the world. It does well in arid areas but thrives in many types of environments. The cultivation of okra extends throughout the tropics and warmer parts of temperate Asia. It is commercially grown in India, Turkey, Iran, West Africa, Yugoslavia, Bangladesh, Afghanistan, Pakistan, West Bengal, Burma, Japan, Malaysia, Brazil, Ghana, Ethiopia, Cyprus, and the southern USA.

Sharma (1993) reported that okra dry seeds contain 18-20% oil and 20-25% crude protein; it has an average nutritive value of 3.21 which is higher than tomato, eggplant and most cucurbits. Okra is a vegetable crop that belongs to the genus Abelmoschus, family Malvaceae and has two main species: Abelmoschus esculentus (L.) Moench. and Abelmoschus caillei (A. Chev.) according to Stevels (1988). Okra contains carbohydrate, proteins and vitamin C in large

quantities (Rizzo, 2019). World and African production of okra as fruit vegetable is estimated at 9.95 and 3.3 million tonnes in 2019 respectively (FAOSTAT, 2020). In the same period, West Africa had an estimated production of 2.77 million tonnes which is about 80 percent of African output. However, the yield in the region is significantly low compared to African and global yield. In Liberia, there are two distinct seasons for okra, the peak and the lean seasons. During the lean season okra fruit are produced in low quantities, scarce and expensive. The country resorts to importation from neighboring countries like Guinea, Ivory Coast, and Sierra Leone. In the peak season, it is produced in larger quantities. Productivity of okra, its green and seed yield and quality can be increased by improving the agricultural practices. The major factors, which contribute to the green pod yield, include both economic and socio-economic factors.

During Liberia's dry season, local production of vegetables plummets, demand is met by a spike in imports—especially from Guinea, Sierra Leone, and Cote d'Ivoire—and prices soar. Market prices for many vegetables, including chili peppers, tomatoes, "bitter ball," eggplant, okra, and cabbage, are two to five times higher than during the rainy season. This represents a significant opportunity for local farmers who can fulfill dry-season demand. Vegetable production for commercial sales can be a profitable commercial activity for small farmers, especially if simple, affordable, and effective irrigation systems can be developed and delivered. Hence, this study aims at determining the economic factors that influence the production of okra in the study area.

JUSTIFICATION OF THE STUDY

This study will be of significant help to stakeholders in vegetable farming in two ways. Firstly, it would help the farmers in determining steps to take towards improving their farm production; hence, increase their farm revenues. Secondly, this study would help the nation at large in reducing their dependence on neighboring countries for vegetable and increase their self-sufficiency in vegetable sub-sector.

STATEMENT OF HYPOTHESIS

The statement of hypothesis for this study is as follows:

There is no significant difference in the means of the levels of productivity of improved and local varieties of okra by the farmers in the study area.

LITERATURE REVIEW

There are several studies that show the factors determining productivity of vegetables in African countries and other countries of the world. Alimi et al. (2006) indicate thatapplication of organic fertilizer in vegetable production resulted in significantly increased yield. Application of 610kg per hectare of organic fertilizer resulted in additional yield of 3,375kg per hectare. This also resulted in 401% rate of returns over and above the non-users of the fertilizers. The study concluded that adopters of organic fertilizer technology had significantly more output and returns than to non-adopters.

Darpeix (2009) carried out a study on the impact of the labour force composition in fruit and vegetable farms on farm productivity. The share of labour force considered for the study includes family labour, permanent hired labour and seasonal hired labour. The study used simple transformation of Cobb-Douglas production function in estimating the relative efficiency of each labour force. It was shown that labour force composition affects farm productivity; family workers were observed to be less productive than hired workers. It was also observed that

seasonal workers were not less productive than permanent ones. It was noted that seasonal work in agriculture was synonymous with low earnings, job insecurity and absence of career development.

Abd El-Kader et al. (2010) signified that growth and yield of okra were huge when drip irrigation is coupled with application of chicken manure. It was also confirmed that access to fertilizer, agro-chemicals and improved seeds/planting materials had been important drivers of agricultural production and productivity among Sub-Saharan African farmers. Using stochastic frontier model, Ogundele and Okoruwa (2006) examine that fertilizer application increases agricultural productivity of crop in both dry savannah and humid forest agro-ecological zones of Nigeria. In same vein, Nkonya et al. (2005) also give assertion to the positive impact of fertilizer farm crops. Moreover, Ogundele and Okoruwa (2006) state that use of herbicides had positive correlation with technical efficiency and productivity of farmers. Conversely, Tella (2006) employed Timmer and Kopp indices which revealed that utilisation of chemicals results in inverse productivity if not appropriately utilized.

Ogundele and Okoruwa (2006); Tella (2006); Idjesa (2007) and Ogundele (2003) affirm that use of improved seeds and planting materials have positive influence on agricultural productivity in most agro-ecological zones.

Agbede and Ologunagba (2009) and Obwona (2000) show that credit and extension services are significant factors that influence productivity of vegetable farms. Obwona (2000) employed the translog production function to show that access to credit and extension services contribute positively towards the improvement of efficiency among tobacco farmers in Uganda. Agbede and Ologunagba (2009) concluded that zero tillage and manual clearing were suitable for okra production.

Katung (2007) conducted a study on the productivity of okra varieties as influenced by seasonal changes in northern Nigeria. It was established that wet season conditions were most favourable for increased growth, leaf formation and fruit yield, as compared with the dry season environment which resulted in less vegetative and reproductive growth.

MATERIALS AND METHODS

This study was carried out in Margibi County, Liberia. Margibi is a county on the north to central coast of Liberia. The county has four districts: Kakata, Firestone, Gibi and Mambah-Kaba districts. Kakata is the capita of Margibi County. It has an area of 2,616 square kilometres (1,010 sq mi). The county is bordered by Montserrado County to the west, Grand Bassa to the east, and Bong County to the north. The southern part of Margibi is boardered with the Atlantic Ocean. The county has coastal plains that rise to a height of 30 m (98 ft) above the sea-level. These plains receive a very high rainfall ranging from 4,450 mm (175 in) to 4,500 mm (180 in) per year and receive longer sunshine with a humidity of 85 to 95 per cent. It is swampy along rivers and creeks, while there are patches of Savannah woodland. Rice and cassava interplanted with Sugarcane are the major crops grown in the region. The northern or the upper part of the highland has tropical forest which is usually 30 m (98 ft) above the mean sea level. The regions receive a bimodal rainfall with a gap of two weeks in between. Cocoa, coffee, rubber, citrus, oil palm and vegetables are the commonest crops in the region (FAO, 2016).

The target population for this study was vegetable farmers that cultivated okra. The study employed three-stage sampling technique. Firstly, there was a selection of Kakata and Mambah-

Kaba among the four districts in the County. Secondly, there was a selection of ten rural communities (6 from Kakata and 4 from Mambah-Kaba) from the county. Lastly, one hundred and twenty four small scale vegetable farmers were selected from the population of vegetable farmers within the 10 communities.

Analytical techniques: Data collection was carried out through questionnaire method, interview and direct observation. The data collected include biodata of the farmers, okra outputs, and level of inputs. The data collected was analyzed using descriptive statistics (mean, standard deviation and frequency distribution) and inferential statistics (Cobb-Douglas production function); Chow test was used for the test of the hypothesis. The Cobb Douglas production function for the study is stated thus:

$$\ln Y = b_0 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + Ɛ$$

Where Y = output of okra (kg); X_1 = labour (manday); X_2 = quantity of fertilizer (kg); X_3 = quantity of herbicides (litres); X_4 = quantity of seeds (kg); and b's = parameters to be estimated; Ɛ = random error

RESULTS AND DISCUSSIONS

Table 1: Socio-economic characteristics of the selected farmers in the study area

Socio-economic characteristics	Frequency	Percent (%)	Average
Sex			
Male	75	60.5	
Female	49	39.5	
Age (years)			42.8 $\pm$ *5.8*
20 – 29	23	18.5	
30 – 39	32	25.8	
40 – 49	35	28.2	
50 – 59	25	20.2	
60 & above	9	7.3	
Household size			5.8 $\pm$ *1.5*
1 – 3	24	19.4	
4 – 6	50	40.3	
7 – 9	32	25.8	
10 & above	18	14.5	
Level of formal education			
None	36	29.1	
Primary	52	41.9	
Secondary	30	24.2	
Tertiary	6	4.8	
Farming experience (years)			8.6 $\pm$ *5.5*
1 – 5	48	38.7	
6 – 10	37	29.8	
11 – 15	21	16.9	
16 – 20	12	9.7	
21 & above	6	4.8	
Access to improved varieties			
Accessible	15	12.1	
Non-accessible	109	87.9	

From Table 1 above, about 60 percent of the farmers were male while the rest were female. This implies that there was appreciable number of women involved in vegetable farming in the study area. The average age of the farmers was approximately 43 years. Majority of them were within age ranges of 30's and 50's. The farmers within the age range of 40 – 49 years form the modal age class. The average household size was approximately 6 persons per household. Most of the households comprised of 4 – 6 persons. This variable is important because members of households may serve as sources of family labour on household farmlands. The level of formal education is relatively low among the selected farmers. About 70 percent of the selected farmers had only primary education or no formal education at all. This low level of education could imply difficulty in admittance of improved technologies necessary for increased farm yield and productivity. The average farming experience was approximately 9 years. About two thirds of the farmers had farming experience between 1 and 10 years. This implies that the farmers were relatively well knowledgeable in their farming practices. The study also shows that very few (12%) of the selected farmers had access to improved varieties of the crop under consideration. This implies that low yield of okra would not be unexpected among the farmers in the study area. Lastly, less than one fifth of the selected farmers had access to credit facilities in the study area. It was observed that credit services from both formal and informal credit institutions were uncommon in the study area. The existing credit institutions did not encourage patronage of small scale business enterprises.

The Results of the Analysis Showing the Factors Determining the Productivity of the Selected Okra Farmers in the Study Area

Table 2: The results of the Cobb-Douglas production function for all the selected farmers cultivating okra in the study area

Variables	coefficient	Standard error	t value
Constant	1.1707	0.2864	4.0876
labour	0.7079	0.2625	2.6968***
fertilizer	-0.3065	0.2295	1.3355
herbicides	0.2013	0.0578	3.4851***
seeds	-0.5856	0.1827	3.2053***
R^2	0.8964		

*NB: *** - 1% significant level*

The variables that influence output of okra among the selected farmers were labour, herbicides, seed quantity and crop variety (Table 2). An increase in the level of labour input resulted into increase in production of okra. This implies that the farmers needed to increase labour input for there to be an increase in output. The result shows that a 0.7 unit increase in labour input would result in 1 unit increase in output. Also, an increase in the level of herbicides utilisation resulted into increase in production of okra. It implies that the farmers would need to increase level of herbicides for there to be an increase in output. The result shows that a 1.2 unit increase in herbicides would result in 1 unit increase in output. An increase in the quantity of seeds planted resulted into a decrease in production of okra. This implies that there was an over utilisation of seed input. Hence, there was need to decrease quantity of seed sown for there to be an increase in output. This is in contrast to Ume, Ezeano, Okeke and Gbughemobi (2016) who worked on the resource use efficiency, and reported that seed inputs were underutilized. The result shows that a

0.59 unit increase in quantity of seeds would result in 1 unit decrease in output of okra. The result shows that a 0.87 unit increase in adoption level of improved varieties would result in 1 unit increase in output. The R^2 of 0.8964 implies that the variables under consideration were responsible for about 90 percent of factors determining okra production in the study area.

Table 3: The results of the Cobb-Douglas function for all the selected farmers cultivating improved okra varieties in the study area

Variables	coefficient	Standard error	t value
Constant	0.5021	0.1130	4.4434
labour	0.1994	0.2840	0.7021
fertilizer	-0.0411	0.3109	0.1322
herbicides	0.0062	0.0029	2.1713**
seeds	0.0889	0.2226	0.3994
R^2	0.8426		

*NB: ** - 5% significant level*

Table 3 shows that the variable that influenced output of okra among the selected farmers that cultivated improved crop varieties was herbicides. An increase in the level of herbicides utilisation resulted into increase in production of okra. It implies that the farmers would need to increase level of herbicides for there to be an increase in output. The result shows that a 1.01 unit increase in herbicides would result in 1 unit increase in output. The R^2 of 0.8426 implies that the variables under consideration were responsible for about 84 percent of factors determining okra production among farmers that adopted improved crop varieties in the study area.

Table 4: The results of the Cobb-Douglas function for all the selected farmers cultivating local okra varieties in the study area

Variables	coefficient	Standard error	t value
Constant	0.1013	0.0338	2.9970
labour	0.5954	0.3148	1.8914**
fertilizer	-0.7341	0.2320	3.1642***
herbicides	0.0062	0.0020	3.1483***
seeds	0.9807	0.1713	5.7250***
R^2	0.9214		

*NB: ** - 5% significant level; *** - 1% significant level*

The variables that influence output of okra among the selected farmers that cultivated local okra varieties were labour, herbicides, seed quantity and credits (Table 4). An increase in the level of labour input resulted into increase in production of okra. This implies that these farmers needed to increase labour input for there to be an increase in output. The result shows that a 0.6 unit increase in labour input would result in 1 unit increase in output. There is a negative coefficient for fertilizer. The result is in contrast with Gani and Omonona (2009) who examined resource use efficiency and productivity. Their study showed that labour input was over-utilized.

The result in Table 4 shows a significant over-utilization of fertilizer input. It was observed that most of the cultivable farmlands in Liberia were very fertile with little or no need for additional fertilizers. This might result in the over-utilization status shown in this regression result. This result also implies that addition of fertilizers to the soils resulted in reduction in okra outputs from the selected farms. The result is similar to Gani and Omonona (2009) who examined resource use efficiency and productivity. Their study showed that fertilizer and some other inputs were over-utilized. It could be implied that farmers in the study area need to reduce the rate of use of fertilizers in order to enhance their production. In addition, an increase in the level of herbicides utilisation resulted into increase in production of okra. It implies that these farmers would need to increase level of herbicides for there to be an increase in output. The result shows that a 0.006 unit increase in level of herbicides would result in 1 unit increase in output. An increase in the quantity of seeds planted resulted into an increase in production of okra. This implies that these farmers would need to increase the quantity of seeds planted in order to have increased okra production. The result shows that a 0.98 unit increase in quantity of seeds would result in 1 unit decrease in output of okra. This is similar to the study carried out by Ume, Ezeano, Okeke and Gbughemobi (2016) who reported that seed inputs were underutilized.

The R^2 of 0.9214 implies that the variables under consideration were responsible for about 92 percent of factors determining okra production among farmers that cultivated local crop varieties in the study area.

TEST OF HYPOTHESIS

The Chow test was used to test the hypothesis that there is no significant difference in the means of the level of production between the two okra varieties cultivated in the study area. The Chow test is computed thus:

$$w_t = \frac{(RSS_i - RSS_l) / r}{(RSS_l) / n - k} \sim F_{r, n-k}$$

Where RSS_l = Sum of Square error for the regression result comprising all the selected farmers

RSS_i = Sum of Square error for the regression result comprising all the selected farmers cultivating local okra varieties

r = number of restricted varieties (i.e. 1)

n = population size

k = total number of variables

The above formula is used to compute the F value. The rule of thumb states that if the critical F value is less than calculated F value, then the null hypothesis is accepted. Otherwise, the null hypothesis is rejected. For this study, the F value is 46.39 while the critical F value is 3.92. Hence, in this instance, the null hypothesis earlier stated that "there is no significant difference in the means of the levels of production of improved and local varieties of okra by the farmers in the study area" is thereby rejected. It could therefore be concluded that there is significant difference between the levels of production of improved and local varieties of okra in the study area. The result is similar to the work of Amaza and Olayemi (2001) who observed that superior technology in the form of improved seeds is needed to enhance food crop output.

CONCLUSION AND RECOMMENDATIONS

Improving on the level of production of okra in Liberia has a lot of potentials for households and national economy. Improving upon the level of production of the crop and other vegetables would reduce dependence upon neighboring countries. This would reduce the leakages of the foreign exchange earnings. There could be enhancement of foreign exchange earnings through improvement in production for export. In order that all these would be a reality, the followings are suggested from the findings of the study:

Farmers should increase the labour inputs; this could be in form of cheap family labour and hired labour.

The stakeholders should promote the use of herbicides for control of weeds which are a serious challenge in crop production.

Cultivation of improved okra varieties is very crucial for improved okra productivity

Utilisation of optimal quantity of seeds planted and fertilizers should be ascertained to reduce wastage and enhance optimal yield.

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