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PROFITABILITY AND EFFICIENCY OF CUCUMBER PRODUCTION AMONG SMALLHOLDER FARMERS IN OYO STATE, NIGERIA

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Abstract: Cucumber is one of the most important exotic vegetables in Nigeria. Its profile is rising due to widespread knowledge of its inherent health benefits. To sustain the availability of the crop in order to meet increasing demand, there is the need to enhance its productivity. Crop productivity depends on the efficient use of both material and human resources utilized in the production process. This study therefore examined profitability and efficiency of cucumber production in Iseyin local government area of Oyo state. Primary data on socioeconomic characteristics of farmers, input and output quantity and prices were collected from 73 cucumber farmers and analyzed using descriptive statistics, budgetary technique and stochastic frontier. Majority of the farmers were male (96.7%) with average age of 46.4 years. An average of 17.1 years of farming experience cut across both gender groups. The average hectare was 1.5 with average yield of 5,368 kg/ha. Budgetary analysis revealed that net profit of N=239,440/ha, profit margin percentage of 55.8% and returns on every naira invested of 1.26 were obtained. This is an indication that cucumber production is profitable in the study area. The result of the stochastic frontier indicated that farm size and volume of agrochemical used significantly influenced cucumber production. Age, education status of farmers and access to credit were the significant factors determining technical efficiency of the farmers in the study area. Mean technical efficiency of production was 0.68. The study recommends capacity building for farmers on an appropriate combination of resources.

Key words: cucumber, profitability, input and output, efficiency, smallholder farmers, Oyo state.

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Introduction

Cucumber (*Cucumis sativus* L.) is one of the most important exotic vegetables in the country. It is the fourth most cultivated vegetable in the world and known to be one of the best foods for body's overall health (Natural News, 2014). It is one of the most popular members of the cucurbitaccae family. Cucumbers are a valuable source of conventional antioxidant nutrients including vitamin C, beta-carotene, and manganese. It is acknowledged that increased agricultural productivity would help in attaining the needed food security. Enhanced productivity is a combination of measures designed to increase the level of farm resources as well as to make efficient use of resources (Adeyemo and Kuhlmann, 2009). Productivity and efficiency of resource use in the production must be sustained in order to benefit maximally from production practices.

Efficiency and productivity are indicators of overall competitiveness (Cechura et al., 2014). The efficiency, with which farmers use available resources and improved technologies, is important in agricultural production (Rahji, 2005). The efficient use of farm resources is an important part of agricultural sustainability (Goni et al., 2013) and a prerequisite for optimum farm production since inefficiency in resource use can distort food availability and security (Etim et al., 2005). An efficiency measurement is important because it leads to substantial resource savings (Bravo-Ureta and Rieger, 1991). Technically efficient production is defined as the maximum quantity of output attainable by a given input (Pitt and Lee, 1981). According to Njeru (2004), technical efficiency is the ability of a firm to maximize output for a given set of resource inputs.

Cucumber can contribute to economic empowerment if efficiently produced due to the high unit price of the commodity compared to local fruit vegetables. Inefficiency in the use of available scarce resources has been the bane of increased food production. There is scarce information on economics and efficiency of cucumber production in Oyo State. Empirical studies on the technical efficiency of vegetables in various regions of Nigeria include those of Oguniyi and Oladejo (2011), Adenuga et al. (2013), Ayinde et al. (2011) and Adeoye et al. (2011). The studies focused on tomato, pumpkin and watermelon. None of the studies examined the economics and determinants of the technical efficiency of cucumber production in Oyo state. This study is therefore carried out to examine the profitability and efficiency of cucumber production in Iseyin local government area of Oyo state.

Material and Methods

Area of study

The study was carried out in Iseyin local government area of Oyo State. The local government is one of the 33 local governments in the state. Iseyin **(**7°58′N

3°36′E) is approximately 100 kilometers north of Ibadan. The city is estimated to have a population of 236,000. Crops produced in Iseyin include watermelon, cassava, cucumber, pepper and tomato, among others. There are 11 wards in the local government with landmass of 988.54 km^2 (Wikipedia, 2014). Iseyin was selected because it is particularly known for horticultural crop production and a large percentage of the inhabitants are farmers.

Sampling procedure and data collection

A two-stage sampling technique was used in selecting respondents for the study. Iseyin local government area is made up of 11 wards. In the first stage of the sampling, 4 wards were purposively selected due to the intensity of cucumber farming in the wards. In the second stage of the sampling, farmers were randomly selected from each of the selected wards based on probability proportionate to size of each ward to constitute a total number of 73 farmers. Primary data were collected through the use of a pretested questionnaire. Data collected include socio-economic characteristics of the respondents, input requirement, yield, prices of input and output.

Methods of analysis

This study employed descriptive statistics, costs and returns analysis and stochastic frontier model. Descriptive statistics was carried out using the mean, percentage and frequency. Costs and returns analysis was carried out using the budgetary technique. Indicators such as net income, profit margin percentage and return per naira invested were analyzed:

$$\text{Net farm income} = TR - TC \quad (1)$$

$$\text{Profit margin \%} = \frac{Netincome}{Totalreven\ ue} x100 \quad (2)$$

$$\text{Returns per naira invested} = \frac{Netincome}{Total\ \cos t} \quad (3)$$

TC = *TFC* + *TVC*,
TR = Total revenue,
TC = Total cost,
TFC = Total fixed cost,
TVC = Total variable cost.

Stochastic frontier production function

The stochastic frontier production model for the estimation of the technical efficiency is specified as follows:

$Y = f(X_{ij}\ \beta) + e_i$ (4)

Y = Yield in kg,

X_i = Vector of input quantities,

β is a vector of parameters to be estimated and

ei = Error term.

The error term consists of two components V_i and U_i: $e_i = V_i - U_i$.

The components (V_i and U_i) are assumed to be independently distributed. V_i is the symmetric component and permits random variation of the production function across farms. It also captures factors outside the control of the farmer. A one-sided component (U_i>0) reflects the technical efficiency relative to the stochastic frontier. U_i = 0 indicates that production lies on the stochastic frontier, while if U_i=0, production lies below the frontier and is inefficient.

The technical efficiency of the individual farmers is calculated as:

$TE_i = \exp(-U_i)$ so that $0 \leq TE \leq 1$.

The stochastic production frontier is specified as:

$Yi = \beta_0 + \beta_1 InX_1 + \beta_2 InX_2 + \beta_3 InX_3 + \beta_4 InX_4 + \beta_5\ InX_5 + \beta_6 InX_6 + Vi - Ui$ (5)

Y = Yield of cucumber (kg),

X_1 = Farm size (ha),

X_2 = Quantity of seed used (kg per hectare),

X_3 = Quantity of fertilizer (kg per hectare),

X_4 = Volume of chemical (litre),

X_5 = Number of labour employed (man-day),

In's = Parameters estimated,

Ln's = Natural logarithms,

Vi = Random error associated with random factor under the control of cucumber farmers,

Ui = The asymmetric error component which represents the deviation from the frontier production.

The efficiency model is as follows:

$Ui = \alpha_0 + \alpha_1 Z_1 i + \alpha_2 Z_2 i + \alpha_3 Z_3 i + \alpha_4 Z_4 i + \alpha_5 + Z_5 i$ (6)

where:

U_i = Technical efficiency of the cucumber farmers,

Z_1 = Marital status (married = 1, 0 = otherwise),

Z_2 = Sex (male = 1, female = 0),

Z_3 = Age of farmers (years),

Z_4 = Years spent in school (years),

Z_5 = Marketing information (yes =1, no = 0),

Z_6 = Years of experience in farming,

Z_5 = Access to credit (yes=1, no = 0),

α_i's = Parameters to be estimated.

Results and Discussion

Socioeconomic characteristics of cucumber farmers

The socioeconomic characteristics of the cucumber farmers in the study area are presented in Table 1. The results indicate that most of the farmers (96.7%) were male while 3.3 percent were female. This indicates that male dominated cucumber production in the study area. This is in line with the findings of Oyediran et al. (2014) and Tambo and Gbemu (2010), whose findings indicated that men were majorly involved in melon and tomato production in their respective study areas.

Table 1. Socioeconomic characteristics of cucumber farmers.

Variable	Percentage
Sex	
Male	96.7
Female	3.3
Total	100.0
Age (years)	
Less than 30	11.7
30–40	25.0
41–50	25.0
Greater than 50	38.3
Total	100.0
Mean=46.4, SD=11.0	
Marital status	
Married	80.0
Single	20.0
Total	100.0
Years spent in school (years)	
Less than 6	23.3
6–12	15.0
Greater than 12	51.7
Total	100.0
Mean=9.8, SD= 6.3	
Farming experience	
1–5	25.0
6–12	21.7
Greater than 12	53.3
Total	100.0
Mean=17.1, SD=12.4	
Market information	
Yes	56.7
No	43.3
Total	100.0
Access to credit	
Yes	64.4
No	35.6

The results disagree with the findings of Adebisi et al. (2012) and Owombo (2012) that discovered that female farmers dominated food/fruit crop production in south-western Nigeria. The distribution of the farmers by age shows that 50% of cucumber farmers were in the age range of 31–50 years, 38.3% of the farmers were in the age range greater than 50 years while the mean age of farmers was 46.4 years. This is an indication that majority of the farmers in the study area are still in the working age range. Most of cucumber farmers were married and literate. The educational level may improve the level of adoption of new technologies necessary to improve productivity. About 53.3% of the farmers had farming experience of more than 10 years. This implies that cucumber farming is a source of livelihood for the producers in the study area. The results agree with the inference of Nandi et al. (2011) that most farmers in Nigeria have been farming for years. The distribution of farmers by access to credit revealed that 64.4% of the cucumber farmers had benefited from a credit institution while 35.6% had not benefitted from credit institutions and hence relied on their savings. The results show that over half of the cucumber farmers did not have access to market information.

Yield and other explanatory variables

Findings (Table 2) reveal that an average yield of 5,368 kg of cucumber was produced by the farmers with 641g of seeds. An average of 175 kg of fertilizer was utilized by the farmers while the average farm size of 1.5 ha was utilized in the study area.

Table 2. Summary of yield and other explanatory variables.

Variable	Mean	Standard deviation	Minimum value	Maximum value
Yield (kg)	5,368	4,059.7	500	11,500
Seed (g)	641	348.9	254	2,032
Fertilizer (kg)	175	141	64	635
Labour (man-day)	53	17.02	23	119.4
Farm size (ha)	1.5	0.78	0.4	4
Age (years)	49.4	11.0	28	68
Education (years)	9.8	6.3	0	18
Experience (years)	17.1	12.46	3	45

Costs and returns in cucumber production

The results of the analysis (Table 3) indicate that the total cost estimated for cucumber production in the study area was N=190,000/ha while the total revenue

estimated was N=429,440/ha. Labour cost (41.8%) constituted the highest percentage of cost followed by cost on tools and transportation cost (13.16%). The least cost of production was incurred with rent on land (2.63%). The profit margin percent of 55.8% was obtained while the return on naira invested was N=1.26. This is an indication for every naira invested in cucumber production; N=1.26 will be obtained in return. Cucumber production was profitable in the study area since the total cost of production was less than the total revenue obtained.

Table 3. Costs and returns in cucumber production.

S/N	Variable	Mean amount (N=)	Percentage of cost
1	Revenue 5,368 kg of cucumber @ 80/kg	429,440	
	Costs		
2	Mean cost of seed	6,000	3.16
3	Fertilizer (kg) 175 kg @ 120/kg	21,000	11.05
4	Land preparation cost	22,500	11.84
5	Chemicals	6,000	3.16
6	Total cost of labour 53 mandays @ 1500/day	79,500	41.84
7	Depreciation on tools	25,000	13.16
8	Land rent/ha	5,000	2.63
9	Transportation cost	25,000	13.16
10	Total cost	190,000	
11	Net margin/income	239,440	
12	Profit margin % (11/1)	55.8	
13	Return per naira invested	1.26	

Factors affecting cucumber production

Table 4 shows the results of the stochastic frontier model of cucumber farmers. The maximum likelihood estimate of the Cobb-Douglas production function shows that the lambda and gamma values were 0.737 and 0.99 respectively and significant at the 1% level. The values were significantly different from zero suggesting that the model was a good fit. The results of the analysis indicate that production factors influencing cucumber production in the study area were farm size and volume of chemical utilized. The coefficient of farm size was positive and statistically significant at the 5% level. This is in line with the findings of Nwachuckwu and Onyenweaku (2007) and Tambo and Gbemu (2010), who indicated a positive relationship between farm size and profit level of farmers in telfairia and tomato production. Thus the capacity of farmers to employ improved

techniques should be looked into to ensure the ability to manage bigger farm size. The coefficient of volume of chemical (0.53) was negative and significant at the 1% level indicating that increasing the quantity of chemical by one litre would lead to about 53% percent reduction in the output of the cucumber farmers in the study area. Farmers should therefore be encouraged to use an appropriate dosage of agrochemicals and to adhere strictly to manufacturers' instructions. However, the coefficient of seed and fertilizer was positive and not statistically significant. It therefore suggests that increasing seed rate and improvement in the fertility status of the land may lead to improvement in the yield of the farmers.

Table 4. Stochastic frontier model of cucumber farmers.

Variable	Coefficient	Standard error	t value
Constant	4.5016130	0.84491321	05.3278999***
Farm size	0.26772703	0.11997077	2.2316022**
Qty of seed	0.061456687	0.25995049	0.23641689
Qty of fertilizer	0.094434637	0.17991842	0.52487475
Volume of chemical	-0.53118391	0.18259572	2.9090709***
Qty of labour	0.73688547	0.40795945	1.8062713
Inefficiency			
Constant	1.0843560	0.45698947	2.3728250**
Marital status	0.17431528	0.18584901	0.93794036
Sex	-0.015034474	0.37394734	-0.040204790
Age	-0.015128796	0.047338394	-0.3.1958827***
Years spent in school	-0.018941432	0.68671780	-2.7582556***
Market information	0.23165206	0.12169087	1.9036109
Farming experience	-0.057909420	0.059878807	-0.96711045
Access to credit	-0.35796537	0.10526869	3.4004922***
Variance parameter			
Sigma squared	0.073695061	0.10497487	4.0202577***
Gamma	0.9999812	0.07801335	12.81829***
Log likelihood function	10.699046		
LR Test	13.76994		

Source: Field survey (2014), *** = significant at 1% ** = significant at 5%.

For inefficiency variables (Table 4), the coefficients of variables relating to age, educational status and access to credit were significant at the 1% level. This is an indication that these factors are important determinants of efficiency in cucumber production. The coefficients of age and education were negative indicating that they may contribute to the technical efficiency in cucumber production in the area. These results are consistent with the findings of Abdulai and Eberlin (2001). An increase in efficiency with age of farmers may also be attributable to the experience they have gained over time especially with regard to

combination of resources. The number of years spent in school is a proxy for the literacy level of the farmers. The results show that it was negatively related to the technical efficiency of cucumber farmers. This implies that farmers with better education were technically more efficient. These findings are similar to Dey et al. (2000), who reported the increased farm efficiency with the level of education. The increased level of education may lead to a better evaluation of importance of farming decision making, including the efficient use of inputs. The negative and significant relationship between access to credit and efficiency suggests that farmers who had access to credit for the purchase of inputs experienced higher technical efficiency. The coefficient of sex, marital status, market information and years of experience were not statistically significant. The coefficients of sex of farmers and farming experience were negative while the coefficients of marital status and market information were positive. The positive coefficient of marital status indicates that being married means additional responsibility for the cucumber farmer. Market information was negatively related to efficiency of cucumber farmers in the study area. The negative value of the coefficient of market information is an indication that the farmer with some market information will be more technically efficient in production compared to those with no appreciable information of prices.

Distribution of technical efficiency of cucumber farmers

The technical efficiency of the cucumber growers (Table 4) ranged between 39% to 99% and a mean was 68%. The mean technical efficiency estimated indicates that the realized output could be increased by about 32% by adopting the best practices.

Table 5. Distribution of technical efficiency indices.

Technical efficiency range	Frequency	Percent
0.31–0.40	1	1
0.41–0.50	12	16
0.51–0.60	16	22
0.61–0.70	13	18
0.71–0.80	15	21
0.81–0.90	9	12
0.91–1.00	7	10
Total	73	100
Min	0.39	
Max	0.99	
Mean efficiency = 0.68		

Source: Field survey (2014).

Conclusion

The maximum likelihood estimates of the parameters in the Cobb-Douglas production function for the efficiency of the sampled farmers show that farm size and quantity of agrochemical significantly determined productivity of the farmer. The results of this study show that the mean technical efficiency of the farmers in the study area was 68%. The results reveal that age of the farmers, years spent in school and access to credit significantly determined farmer's technical efficiency. Based on the findings from the study, there is the need to strengthen multi stakeholder process to achieve better understanding of the appropriate dosage of agrochemicals in cucumber production. Critical x-ray and re-engineering of issues of credit access and education are also crucial.

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PROFITABILNOST I EFIKASNOST PROIZVODNJE KRASTAVACA MEĐU MALIM POLJOPRIVREDNIM PROIZVOĐAČIMA U DRŽAVI OJO U NIGERIJI

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R e z i m e

Krastavac je jedno od najvažnijih egzotičnih vrsta povrća u Nigeriji. Njegov značaj je u porastu zbog rasprostranjenog poznavanja njegovih svojstava i koristi za zdravlje. Kako bi se održala dostupnost ovog useva radi zadovoljenja sve veće tražnje, javlja se potreba da se poveća njegova produktivnost. Produktivnost useva zavisi od efikasne upotrebe, kako materijalnih, tako i ljudskih resursa koji se koriste u procesu proizvodnje. Stoga se ovim istraživanjem ispituje profitabilnost i efikasnost proizvodnje krastavca u području lokalne samouprave Isejin u državi Ojo. Primarni podaci o socio-ekonomskim odlikama poljoprivrednih proizvođača, ulaganjima, dobiti od proizvodnje i cenama su prikupljeni od 73 poljoprivredna proizvođača i analizirani su uz pomoć deskriptivne statistike, budžetske tehnike i stohastičke granice. Većina poljoprivrednih proizvođača su bili muškog pola (96,7%) prosečne starosti of 46,4 godine. Prosek od 17,1 godine iskustva bavljenja poljoprivredom važi kod oba pola. Prosečna veličina poseda je bila 1,5 ha sa prosečnim prinosom od 5.368 kg/ha. Budžetska analiza je pokazala da je neto dobit bila N=239.440/ha, procenat marže profita 55,8% i da su dobijeni povraćaji od 1,26 na svaku uloženu nairu. Ovo je pokazatelj da je proizvodnja krastavaca profitabilna u ispitivanom području. Rezultat stohastičke granice je ukazao da veličina gazdinstva i količina agrohemikalija, koje se koriste, značajno utiču na proizvodnju krastavca. Starosna dob, obrazovni status i pristup kreditima bili su značajni faktori koji određuju tehničku efikasnost poljoprivrednih proizvođača u ispitivanom području. Srednja tehnička efikasnost proizvodnje bila je 0,68. Ovim istraživanjem se preporučuje izgrađivanje kapaciteta za poljoprivredne proizvođače u odgovarajućoj kombinaciji raspoloživih resursa.

Ključne reči: krastavac, profitabilnost, ulaganje i dobit, efikasnost, mali poljoprivredni proizvođači, država Ojo.

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