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TECHNICAL EFFICIENCY OF ORGANIC AND INORGANIC LEAFY VEGETABLE PRODUCTION IN OGUN STATE, NIGERIA

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ABSTRACT
The study was carried out to examine the technical efficiency of organic and inorganic leafy vegetable production in Ogun State, Nigeria. This study employed the use of multistage sampling technique in selecting one Local Government from each of the four ADPs zones in Ogun state using simple random sampling. A total of one hundred and seven (107) respondents were selected using multi-stage sampling technique and interviewed with the aid of well-structured questionnaires. The data were analyzed using descriptive statistics and stochastic frontier production function for the technical efficiency of the farmer. The study reveals that majority of the farmers practicing organic leafy vegetable and inorganic leafy vegetable farming are predominantly males and are married. The mean technical efficiency of the farmers was 0.679. This indicates a fair level of technical efficiency of leafy vegetable production in the study area. More importantly, the study showed that there is no difference between the two categories of farms in terms of technical inefficiencies. Other results from the estimated inefficiency model show that the age, educational level, household size, gender and age square are significant determinants of technical inefficiency. Gender, household size, extension agents' visit and age squared have negative coefficients with consequent implication of decrease in technical inefficiency level as these variables increase. Age, level of education, farming experience, marital status and socio economic group have positive coefficients implying an increase in technical inefficiency level as these variables increase. The study recommends that the government should introduce the farmers to formal education through adult literacy education and establishment of demonstration farms should be strengthened among the farmers

Keywords: Inorganic, Leafy vegetable, Organic, Stochastic frontier, Technical efficiency.

INTRODUCTION
Agriculture has been the mainstay of the Nigerian economy since independence, as it constitutes 40% of the GDP, accounts for over 38% of the non-oil foreign exchange earnings and employs about 70% of the active labour force of the population (BPE, 2004). Agriculture constitutes 40% of the GDP, the strong linkages it has with other economic sectors (forward and backward integration) provide significant stimulus for growth and income generation. Therefore, significant progress in promoting economic growth, reducing poverty and enhancing food security cannot be achieved without developing a vibrant agriculture system. Therefore, a strong and effective food and agricultural system forms the primary pillar in the strategy of overall economic growth and development, and more specifically for the developing nations. Agricultural performance, more especially productivity increases have contributed

immensely in many countries round the world to achieving reduction of poverty, this is achieved through agriculture contributing to direct and relatively immediate impact on enhancing rural incomes and this also enables availability of and access to cheaper food for both urban and rural poor. Agriculture's contribution to growth and the generation of economic opportunity in the non-farm sector have also been a contributory factor towards providing additional livelihoods to the communities (Parhad 2012). Nigerian agriculture also faces other sets of challenges such as limited capital, small size landholding, declining soil fertility, deforestation and unsustainable land use (WTO, 2004). Associated with inorganic fanning system are the problems of inaccessibility of poor resources farmers to sufficient farm inputs, degradation in the structure of the soil, environmental pollution and negative effects on human health. For example, most agrochemicals are toxic and can pose danger to human health (WHO, 2008).

Conventional fertilizers are used to provide an abundant amount of nutrients in biochemically available forms, but the scale at which fertilizers are applied coupled with the natural water cycle has led to Nutrient- loaded Run off that feeds into aquatic systems (Goetz *et al.,* 2000). The soil structure on Organic farms is better leading to less pollution from Nitrate and it is healthier for the crop plant, and environmentally organic is better than other forms because it is chemical free (Farhad, 20I2). It is an integrated farming system that strives for a high level of longevity or sustainability to ensure an adequate food supply for future generations (Paul, 2011).

According to the Directorate General for Agriculture and Rural Development for the European Commission (2009), organic farming can broadly be defined as the form of agriculture that relies on techniques such as crop rotation, green manure, compost and biological pest control, and mechanical cultivation to maintain soil productivity and control pests, excluding the use of synthetic fertilizers and synthetic pesticides, plant growth regulators, livestock feed additives and genetically modified organisms. It is an integrated farming system that strives for a high level of longevity or sustainability to ensure an adequate food supply for future generations (Paul, 2011).

Inorganic farming is the ability to use synthetic fertilizers, pesticides, and its choice of tillage regimen. Inorganic farming can be considered as the most widely spread agricultural system in a given territory or, vice-versa, it could be seen as everything but organic techniques and methods (Offermann and Nieberg, 2000). Inorganic farming is often a mix of agronomic techniques, some quite similar to the organic ones.

The study was designed to provide answers to the following research questions: what are the socio-economic characteristics of the respondents? Does the level of technical efficiency differ between the two categories of farmers? The specific objectives of the study include; describe the socio-economic characteristic of the respondents and examine the effect of adopting the organic farming methods on technical efficiency in vegetable farming in the study area.

MATERIALS AND METHODS

The Study Area

This study was based on vegetable level data collected from vegetable farmers in Ogun State, Nigeria. Ogun state is also known as the Gateway state. Ogun state was created out of the western state of Nigeria on February 3rd, 1976. Ogun state is situated within the tropics, with a total land of 16,762 km square which lies within latitude 6˚20' South and 7˚58' North in

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the tropics and longitude 2°40' West and 4°35' East of the Greenwich Meridian and has an estimated population of 4,054,272. Ogun State is a state in South-western Nigeria, the state borders Lagos state to the South, Oyo and Osun state to the North, Ondo state to the East and the republic of Benin to the West. Abeokuta is the capital and the largest city in Ogun state.

Sampling Technique

Multi-stage sampling technique was employed to select a cross section of 107 farm households from the study area. The study was carried out in the following locations namely Alabata, Mokolokin, Ososa, and Ayetoro communities.

Method of Data Collection

The primary data used for this study was collected through the administration of structured questionnaire administered to vegetable farmers in the study area. The data collected include socio-economic characteristics of the vegetable farmers such as age, their gender, marital status, household size, level of education, years of experience as a farmer, and so on.

Method of Data Analysis

The analytical techniques used for this study include descriptive statistics and stochastic frontier. The descriptive statistics includes table of frequencies, mean and percentages for the presentation of the socio-economic characteristics of the respondents such as age, marital status, educational qualification, farming experience, sex, and household size, etc. The stochastic production frontier was used to determine the technical efficiency of leafy vegetable production in the study area and identify any differences in technical efficiency that could be associated with whether farmers are practicing organic or inorganic farming. The explicit functional form of this model adopted in estimating the level of technical efficiency is the Cobb-Douglas type (Bravo-Ureta and Evenson (1994).

$$\ln Yi = \beta o + \beta 1 \ln (X_1) + \beta 2 \ln (X_2) + \beta 3 \ln (X_3) + \beta 4 \ln (X_4) + \beta 5 \ln (X_5) + Vi - Ui \quad \ldots(1)$$

where;
ln = natural logarithm
βi = parameter to be estimated
$\beta 0$ = constant term
i = 1,2,3,4,............,n
Y = vegetable output (kg)
X_1 = seeds (kg)
X_2 = fertilizer (kg)
X_3 = pesticides (litre)
X_4 = labour use (man-days)
X_5 = land area (ha)
X6= manure (kg)
X7 = other cash inputs (naira)
Vi = symmetric error associated with uncontrollable factors related to production process (such as weather and other factors beyond the control of farmers).
Ui = inefficiency component of error term.

The technical inefficiency effects, Ui is defined as:

$$Ui = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 + Wi \quad \ldots(2)$$

where;
δ_0 = constant term

δ_1 = co- efficient to be estimated
Z_1 = age of the farmers
Z_2 = education (years of schooling)
Z_3 = experience (years)
Z_4 =household size (number of people)
Z_5 = sex
Z_6 = age squared (years)
Z_7 = variety
Z_8 = Organic farming dummy (1 if organic; 0 otherwise)

RESULTS AND DISCUSSION

Socio-economic Characteristics of Organic and Inorganic Leafy Vegetable Farmers

This comprises the attributes of the respondents which include variables such as their age, sex distribution, marital status, household size, educational status, and years of experience. Result in Table 1 reveals the distribution of the organic and inorganic leafy vegetable farmers based on their ages.

Table 1: Socio-economic Characteristics of Organic and Inorganic Farmers

	Organic			Inorganic		
Index	Frequency	Percentage	Mean (std.)	Frequency	Percentage	Mean (std.)
Age						
<30	1	2.17		6	9.84	
30-39	12	26.09		11	18.04	
40-49	15	32.61		20	32.76	
50-59	10	21.73		16	26.24	
>60	8	17.39		8	13.12	
Total	46	46.65(10.43)		61	46.20(11.62)	
Sex						
Male	32	69.57		44	72.13	
Female	14	30.43		17	27.87	
Total	46	100.00		61	100.00	
Marital status						
Single	2	4.35		3	4.92	
Married	42	91.30		54	88.52	
Divorce	1	2.17		1	1.64	
Widowed	1	2.17		3	4.92	
Total	46	100.00	2.02(0.39)	61	100.00	2.07(0.51)
Household size						
1-3	2	4.35		6	9.84	
4-6	17	36.96		22	36.06	
7-9	18	39.14		20	32.79	
10-12	3	6.51		10	16.40	
13-15	4	8.70		1	1.64	
>16	2	4.34		2	3.28	
Total	46	100.00	7.85(3.77)	61	100.00	7.23(3.23)

Source: Field survey, 2019

The finding indicates that the mean age of organic famers is 47 years while the mean age of inorganic farmers is 46 years. Majority of organic farmers (58.7%) age between 30 and 49 years, while majority of inorganic farmers (59%) had ages between 40 and 50 years. With regards to the sex distribution of organic and inorganic leafy vegetable farmers, the result reveals that majority of the organic and inorganic leafy vegetable farmers were males with 69.57% and 72.13%, respectively. It can therefore be said that the enterprise is currently dominated by male farmers. 91.30% and 88.52% of organic and inorganic leafy vegetable farmers respectively were married. Thus, most of the farmers involved in the practice of leafy vegetable whether organic or inorganic are married. The mean household size is 7.89 and 7.23 for organic and inorganic farmers, respectively.

Table 1: Socio-economic Characteristics of Organic and Inorganic Farmers **Contn'd**

	Organic			Inorganic		
Index	Frequency	Percentage	Mean (std.)	Frequency	Percentage	Mean (std.)
Education						
Non formal	19	41.30		13	21.31	
Primary	13	28.26		21	34.43	
Secondary	10	21.74		21	34.43	
NCE/OND	2	4.35		5	8.20	
HND/B.Sc.	1	2.17		1	1.64	
Postgraduate	1	2.17		0	0.00	
Total	46	100.00	2.5(1.86)	61	100.00	3(1.60)
Farming experience						
<10	8	17.38		15	24.60	
10-19	16	34.78		16	26.23	
20-29	10	21.73		14	22.96	
30-39	7	15.21		11	18.04	
>40	5	10.86		5	8.20	
Total	46	100.00	19.37(11.83)	61	100.00	19.49(12.31

Source: Field survey, 2019

Most of the farmers belong to households between 4 and 9 members. Thus, the relatively large household size may enhance family labour supply to the vegetable farms. Majority of organic farmers had less than primary school education complete, while most of the inorganic farmers have completed primary education. The mean years of experience are 19 years for both organic and inorganic farmers. Also majority of the farmers have less than 19 years of farming experience. Experience they say is the best teacher. The more experienced a farmer is the more familiar he is to techniques and inputs which will bring about improved and quality yield.

Technical Efficiency of Organic and Inorganic Leafy Vegetable Production

Stochastic production frontiers were initially developed for estimating technical efficiency rather than capacity and capacity utilization. However, the technique also can be applied to capacity estimation through modification of the inputs incorporated in the production (or distance) function. These allow simultaneous estimation of individual technical efficiency of the respondent farmers as well as determinants of technical efficiency. The stochastic frontier production model also accounts for the technical inefficiencies of production of different farms and as a result, this model was adopted to determine efficiency of organic and inorganic leafy vegetable production among leafy vegetable producers in Ogun State. The mean technical efficiency of the farmers was 0.679 (Table 2). This value is higher than the 65%, reported by Udoh and Akpan (2007) but slightly lower than the 72% reported by Umoh (2006) and 82% (0.82) by Bozoglu and Ceyhan (2007) in their studies. This indicates high efficiency of leafy vegetable production in the study area.

Table 2: Maximum Likelihood Estimates of the Stochastic Frontier Production Function

Variables	Parameter	Coefficient	Std-error	T-ratio	p>/t/
Efficiency Variables					
Constant	B	1.790	1.134	1.580	0.114
Seed	X_1	1.199	0.184	6.510***	0.000
Fertilizer	X_2	0.057	0.104	0.550	0.581
Pesticides	X_3	0.199	0.226	0.750	0.456
Labour	X_4	-0.115	0.091	-1.270	0.205
Land	X_5	-0.462	0.209	-2.210**	0.027
Manure	X_6	-0.054	0.034	-1.590	0.112
Inefficiency Variables					
Age	Z_1	0.459	0.246	1.860*	0.062
Education	Z_2	0.144	0.073	1.980**	0.048
Experience	Z_3	0.013	0.036	0.360	0.716
Household size	Z_4	-0.372	0.166	-2.240**	0.025
Sex	Z_5	-1.696	0.531	-3.190***	0.001
Age squared	Z_6	-0.005	0.003	-1.710*	0.088
Marital status	Z_7	0.027	0.880	0.030	0.976
Extension agent's visit	Z_8	-0.529	0.066	-0.800	0.421
Socio economic group	Z_9	0.037	1.218	0.030	0.976
Organic dummy	Z_{10}	0.859	0.638	1.350	0.178
Diagnostic statistic					
Sigma square		0.434	0.055		
Gamma		0.342	0.221	3.700	0.000
Log-likelihood		-93.102			
Mean		0.679			

Source: Field survey, 2019

The result of the estimated coefficient is the inefficient model with variables such as age, education, experience, household size, gender, age squared, marital status, extension agents visit etc., were also presented in Table 2. Given the results of the inefficiency model in the Cobb-Douglas frontier model, age ($\alpha_{0.10}$), educational level ($\alpha_{0.05}$), household size ($\alpha_{0.05}$), sex ($\alpha_{0.01}$) and age squared ($\alpha_{0.10}$) of the respondents are significant determinants of technical inefficiency. The sign of the variables in the inefficiency model is very important in explaining the observed level of technical efficiency of the farmers. A negative sign implied that the variable had the effect of reducing technical inefficiency, while a positive coefficient indicate that the variable has the effect of increasing inefficiency. Age is positively significant at 10% which implies that age is a contributing factor to inefficiency of the farmer. The higher the age, the higher the increase in farming experience. Education status is positively significant at 5% which implies that the less the educational level, the more they have time for efficient supervision of their farm because they will not be involved in other societal activities. Year of experience is positively insignificant, household size is negatively significant at 5%, gender is negatively significant at 1%, age squared is negatively significant at 10%, marital status is positively insignificant, extension agents visit is negatively insignificant and socio economic group is positively insignificant. The major purpose for estimating the Stochastic Frontier Model in this study is to investigate whether any difference in technical inefficiency for organic and inorganic vegetable farmers. To achieve this we insert a binary dummy (organic dummy) into the estimated inefficiency equation. The lower panel of Table 2 shows that the organic farming dummy variable which is 1 if organic or 0 otherwise is positive but insignificant which implies that there is no difference in technical inefficiency between the two categories of farms studied. That is the average organic leafy vegetable farm and the average inorganic leafy vegetable farms are more or less identical in terms of technical efficiency.

CONCLUSION AND RECOMMENDATIONS

The primary aim of this study is to make a technical efficiency of organic and inorganic leafy vegetable production in Ogun state, Nigeria. To achieve this aim, 107 leafy vegetable farmers were interviewed. The study reveals that majority of the farmers practicing organic leafy vegetable and inorganic leafy vegetable farming are predominantly males and are married. The stochastic frontier production function was used to determine the level of technical efficiency of farmers. The mean technical efficiency of the farmers was 0.679. The study therefore, recommends as follows:

1. For an effective improvement in the level of efficiency among the leafy vegetable farmers, provision should be made by governments and other stakeholders in the agricultural sector to provide farmers with access to affordable inputs such as seed, herbicides, pesticides, fertilizer as well as making provision for alternative source of family labour.
2. The government should introduce the farmers to formal education through adult literacy education and establishment of demonstration farms should be strengthened among the farmers.

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