ANALYSIS OF TECHNICAL EFFICIENCY IN TOMATOES PRODUCTION IN ZARIA LOCAL GOVERNMENT AREA OF KADUNA STATE

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ABSTRACT

The study analyzed technical efficiency and its determinants in tomatoes production in Zaria, Kaduna state. The study was based on primary data collected from 120 tomato farmers by the use of multistage sampling techniques. The data was analyzed by descriptive statistics and the use of stochastic production frontier. The results indicate that most (70%) of the farmers were men between the ages of 31 and 50. It also showed that increase in farm size, fertilizer and seeds will lead to a considerable increase in tomato production. Furthermore, the mean technical efficiency was 0.6 and this was influenced by age, farm experience, contact with extension agents and access to credit. The study concludes that farmers can further increase their output and therefore recommends that credits should be made available to farmers and also extension agents should be encouraged to visit the farmers more often as this translates into increased efficiency.

Keywords: efficiency, technical, stochastic, tomato, production

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INTRODUCTION

Nigeria is endowed with large expanse of arable land, a good coastal region, substantial area of mangrove for agricultural production and this has made Agriculture the main stay of the of the Nigerian economy. However, rural farmers according to Fayinka (2004) constitute the backbone of the agricultural sector as they produce 80% of the total farm output. Stable foods such as cereals, legumes and vegetables (tomato, spinach, pepper) are some of the major crops produced in Nigeria.

Tomato (*Lycopersicon esculentum*) is one of the most important crops in the world and it is grown both in home gardens and as a commercial crop (Longer and Hill 1991). It is highly nutritious and a vital food component consumed in Nigeria. This is evident in the fact that most Nigerian dishes have tomatoes as an ingredient component. Tomatoes which is very rich in vitamins and has almost as many calories per hectare as rice Barbara (1994) could be used to solve the problem of undernourishment in sub Saharan Africa where quite a large number(43%)of its population has been found to be chronically undernourished (World Food Programme (WFP) 1995).

In spite of its popularity and importance, tomato total production in Nigeria has been found to be inadequate (Abu, 2011). According to Murthy *et al.* (2009), the inability of farmers to fully utilize the available technologies which in turn results to lower efficiencies of production is responsible for the low productivity experienced in Agriculture all over the world. Rahji (2005) opined that efficient use of resources and technologies is necessary in the Nigeria agricultural production system since the major problem in the country still revolves around low productivity. Tomato production in itself requires high level of management, large labor and

capital inputs; hence the efficient use of these resources is important if production is to be increased.

In view of the aforementioned, there is a need to examine the possibility of raising productivity by improving the efficiency of the tomato farmers using the current technology and resource base. This study will therefore evaluate technical efficiency in tomato production and examine the factors that determine technical efficiency in the study area.

MATERIALS AND METHOD

Study Area

The study was carried out in Zaria local government area of Kaduna state, Nigeria. It lies on coordinates $11^0$04N $7^0$42`E and has a total land mass area of 300km^2 and density 1400/km^2 with a population of 408,198 persons as at 2006 census population . Zaria's economy is primarily based on agriculture and it is also the home of numerous artisans, from traditional crafts like leather work, dyeing and cap making, to tinkers, print shops and furniture makers. Zaria is also the center of a textile industry that for over 200 years has made elaborately hand-embroidered robes that are worn by men throughout Nigeria and West Africa.

Sampling Technique and Method of Data Collection

Multistage sampling technique was used for the study. In the first stage Zaria local government area was purposively selected in Kaduna state because tomato based cropping system dominates in the area. The second stage was the random selection of four (4) villages namely, Detu, Dakace,Biraza and Wusasa from the local government area. In the final stage, 120

tomato farmers (30 farmers each) were randomly selected from the selected villages in the study area. Primary data based on personal administration of questionnaire was use for the study. The respondents were asked questions that had to do with their socio- economic characteristics such as age, sex, educational level, farming experience and other input and output related questions.

Method of Data Analysis

The study data were analyzed using descriptive and stochastic production frontier. Descriptive statistics such as mean, frequencies and percentages were used to describe the socio-economic characteristics of the tomato farmers.

Stochastic Production Frontier

Technical efficiency in a production unit refers to the achievement of the maximum potential output from given amounts of factor inputs, taking into account physical production relationships. There two major approaches used to measure efficiency; the Data Envelopment Analysis (DEA) which is a non parametric method and the Stochastic Production Frontier (SPF) a parametric method . The main differences between the two are that the first does not assume a functional form for the frontier (non-parametric), it is deterministic and involves mathematical programming, and the second assumes a form for the frontier, it is stochastic and it uses econometric methods (Iraizoz *et al*. 2003). The SPF according to Coelli *et al*. (1998); Battese and Coelli (1995) attributes part of the variation in production to random errors and others to farm specific inefficiencies.

In this study however, (SPF) was used to estimate the technical efficiency. The SPF following Tanko and Jigril (2008), is written as;

$\ln Y_i = f(\boldsymbol{X}, \boldsymbol{\beta}) + v_i - u_i$.....equation 1

Where;

Y_i is output of tomato (kg)

X is a vector of the logarithm of explanatory variables which include;

X_1 = farm size (hectares)

X_2 = labour (man hours)

X_3 = seed input (kg)

X_4 = fertilizer (kg)

X_5 = Agrochemical (litres)

v_i = a symmetric random error that is assumed to be independent and identically and normally distributed with a mean of 0 and variance of σ_v^2 and it is independent of u_i .

u_i = is a non-negative random variable associated with technical inefficiency across observation points. It is assumed to be identically and independently distributed normal, with mean η and variance σ_u^2. Where u_i is expressed as a function of some factors as shown below;

$u_i = \delta_0 + \sum \delta_k Z_k$ ……equation 2

Where u_i represents technical inefficiency of the farmer and Z_k is a vector of farm specific variables assumed to influence technical efficiency and they include;

Z_1= age in years

Z_1= number of years of formal education

Z_1= years of farming experience

Z_1= household size

Z_1= number of meetings with extension agent

Z_1= sex (male = 1 and female = 0)

Z_1=credit status (accessed credit= 1 otherwise=0)

Z_1= co-operative society (member of cooperative =1 otherwise=0)

The double logarithmic (Cobb-Douglas) specification was chosen for the function in equation 1 and the parameters as well as the estimates of the inefficiency term, u_i, were estimated simultaneously by the maximum likelihood method using FRONTIER 4.1 (Coelli 1996).

RESULTS AND DISCUSSIONS

Socio-economic characteristics of the tomato farmers

The socio-economic characteristics of the respondents are summarized on table 1. As shown on table 1, a larger percentage (62.5%) of the respondents falls within the economic active age of 31-50years and are mostly (70%) men. This is however expected as tomato production involves some tedious operations, hence the young, aged and females are to take care of the household and also assist during fertilizer application, planting as well as primary processing. of the respondents is that majority(64.2%) of the respondents were married while a small percentage (21.7%) were single.

Another striking feature of the respondents is the fact that more than half (54.2%) of the respondents had no formal education while 21.6% and 14.2% of the farmers had primary and secondary education respectively. Only one-tenth (10%) of the respondents had tertiary education and the implication of this is that respondent may not be exposed to new technologies and they may be unable to use the resources they have appropriately. This is because education enables the farmers to read and understand extension guide and manufacturers manual with respect to technology use and input utilization which enhances production and marketing of farm produce.

Also shown on table 1 is the farming experience of the farmers. Although most of the farmers had little or no education, a large percentage (44.2%) had farming experience that was above 10 years. This implies that most of the farmers are experienced and should be able to carry

out measures that will aid them to increase their production also; they should be able to deal with certain problems encountered during each production cycle since they may have experienced them in the past. The household size of the respondents ranged between 1-10 persons with an average of 8 persons per household. This will enhance tomato production activities and promote low dependence on hired labour since tomato production requires intensive use of labour .

Distribution of respondents by method of land acquisition and source of capital

Agriculture can be seen as the cultivation of land and the right to hold and cultivate land at any point in time depends on the land tenure system in operation. Table 2 describes the respondents by method of land acquisition and source of capital.

As shown on table 2, the main mode of acquisition of land is by inheritance as 55% of the respondents indicated that they inherited their lands. Only a small proportion (9.2%) in the study area actually purchased their land. The implication of this is that most of the lands may be under utilized as the land tenure system in operation hinders the acquisition of large hectares of land for large scale agricultural production. Also, land fragmentation will be the order of the day since ownership through inheritance according to Blarel *et al.*, (1992) has been a major cause of farm fragmentation in Africa. Majority (63.5%) of the farmers rely on their personal savings for their production activities while a negligent number (4%, 8.7%) obtain their capital from co-operatives and commercial banks respectively. This however, is not good enough for agricultural development as it implies the farmers are small scale producers since, commercial production involves large capital outlay which cannot be based on the farmer's personal savings alone.

Table 1: Distribution of Respondents by Socio- economic Characteristics

Characteristics	Frequency	Percentage(%)
Age (years)		
10-20	11	9.2
21-30	19	15.8
31-40	44	36.7
41-50	31	25.8
51-60	15	12.5
Sex		
Male	84	70.0
Female	36	30.0
Marital status		
Single	26	21.7
Married	77	64.2
Widow(er)	12	10.0
Divorced	5	4.1
Educational level		
None	65	54.2
Secondary	17	14.2
Tertiary	12	10.0
Farming experience		
1-5	28	23.3
6-10	39	32.5
Above 10	53	44.2
Household size		
1-5	48	40.0
6-10	36	30.0
11-15	22	18.4
16-20	13	10.8
Greater than 20	1	0.8

Source: Data from field survey 2011

Table 2: Description of Respondents by Mode of Land Acquisition and Source of Capital

Description	Frequency	Percentage(%)
Mode of land acquisition		
Community owned	19	15.8
Inherited	66	55.0
Leased	11	20.0
Purchased	24	9.2
Source of Capital		
Commercial Bank	13	8.7
Co-operative Society	6	4.0
NACRDB	18	11.9
Personal Savings	96	63.5
Relatives and Friends	18	11.9

Source: Data from Field Survey 2011

Stochastic Production Frontier

The main tenet of this study was to estimate technical efficiency and examine its determinants. The maximum likelihood estimates result as shown on table 3 indicates that 84.2% of the variation in the output of the tomato farmers is as a result of inefficiency in the allocation of production resources. The coefficients of farm size, seeds and fertilizer were positive and significant at 1% and corresponds with the results of Abu (2011) and Adewunmi(2008).

In the case of farm size, a 1% increase in farm size will lead to an increase in tomato output by about 3.5% while increase in the use of fertilizer and seeds by 1% each will be associated with increase in tomato output by 8.4% respectively.

Based on the parameter estimates of the influence of socio-economic factors on technical inefficiency, results on table 3 indicated that age, farming experience, number of extension contacts and access to credit were the factors that increased efficiency of the farmers as the coefficients of these variables were significant and negative. Increase in farming experience

reduces inefficiency as the farmers become more specialized and this in turn increases their efficiency. Furthermore access to credit enables the farmers to buy and use new technologies which enhance their production.

Table 3: Estimates of the Stochastic Revenue Frontier and Inefficiency Model

Production Factors	Estimate Coefficient	t-ratio
Intercept	33.040	35.102
Farm Size	3.507***	3.113
Labour	3.191	0.735
Seeds	8.432***	3.150
Fertilizer	8.433***	3.142
Agrochemical	3.092	0.543
Inefficiency Factors		
Constant	0.204	0.211
Age	-1.188***	-5.372
Educational Level	72.311	0.164
Farming Experience	-2.376***	-8.735
Household Size	7.023	0.202
Extension Contact	-0.144***	-4.631
Gender	-0.331	-0.855
Credit Status	-0.114***	-3.710
Co-operative	0.018	0.532
Diagnostic Statistics		
Likelihood ratio	-91.410	
L.R test	83.732	
Sigma Squared	0.583***	2.850
Gamma	0.841***	8.911

Source: Data from Field Survey 2011

*** *implies the associated coefficients was significant at 1%*

Table 4: Percentage distribution of tomato farmers by level of technical efficiency

Efficiency Level	Frequency	Percentage
0.21-0.30	12	10
0.31-0.40	9	7.5
0.41-0.50	19	15.8
0.51-0.60	10	8.3
0.61-0.70	27	22.5
0.71-0.80	29	24.2
0.81-0.90	14	11.7

Mean =0.604; Maximum 0.893; Minimum 0.204
Source: computed from Frontier 4.1 output.

Technical efficiency ranged between 0.2 to 0.9. The mean technical efficiency of tomato farmers in Zaria was 0.604 as shown on table 4 however; many (46.7%) had technical efficiencies ranging between 0.6 and 0.8. This implies that an average farmer still had room for improvement and can increase output by 40% if he is able to allocate his resources efficiently.

CONCLUSIONS AND RECOMMENDATIONS

The main findings of this study indicate that majority of the farmers were males aged between 31and 50 who have had no formal education. Also, the mode of land acquisition was by inheritance while the main source of capital was personal savings of the farmers. The study further revealed that increase in output can be achieved by increasing the use of land, seeds and fertilizers. Furthermore, farmers were found to be efficient in the use of their resources however, they could be more efficient if they had more access to credit and extension agents the farmers were reasonable efficient and still had room for expansion.

The study therefore recommends that tomato farmers in Zaria should be encouraged to use more seeds, fertilizers and increase their farm size. In addition, credit should be made available to farmers and extension agents should be encouraged to visit the farmers since this will translate to increased efficiency and therefore lead to increased output.

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