RESOURCE UTILIZATION AND DETERMINANTS OF EFFICIENCY AMONG URBAN AGRICULTURE IN ABUJA, NIGERIA

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ABSTRACT

The information was coded and analyzed through the use of both descriptive statistics and stochastic production frontier based on Cobb-Douglass production function. The result of the inefficiency model reveals that occupation variable has negative Coefficient (-0.1403), which means farmers that take urban farming as primary occupation are more efficient than the farmers who take urban farming as secondary occupation. The age variable is statistically significant showing increases in the technical efficiency as age increases. It was also shown from the results that urban crop farmers in Abuja are near or operating close to full technical efficiency.

Keywords: Resource utilization, Determinants, Efficiency, Urban Agriculture, Abuja

INTRODUCTION

In many developing countries, urban agriculture is a necessity as it is practiced to supplement household's food supplies, unlike in developed countries where it is practiced as a leisure activity. (UNDP, 1996). Analyses of current trends regarding urban food systems reveal that, in order to achieve food security for the urban poor, a sole reliance on food produced in rural areas and imported food is insufficient. It is necessary for cities to develop plans to enhance urban and peri–urban food production (Dahlberg, 1998)

The scale of urban agricultural production in the world is far above common perceptions. It has been estimated that in 1993, 15–20 percent of the world's food was produced in urban areas, and that this percentage is on the increase. They further estimated that 800 million people are engaged in urban agriculture worldwide, out of which 200 million are considered to be producing for the market employing 150 million people full time (Smith et. al, 1996). It is heartening to note that several cities have created specific agencies for urban agriculture or are implementing related policies and programmes. (René, 2003).

However, urban agriculture has always been part of urban settlements in the past and even today many urban inhabitants turn to it as part of their livelihood strategies. Although the quantity of food produced by city farming does not match up to that outside the city, its

impact is quite considerable (René, 2003). This is because agriculture in the city differs from that undertaken in the rural area in location, economic motive, type of product, the use and distribution of harvests, actors involved and the types of technologies used (René, 2003).

René (2003) observed that urban agriculture is increasingly recognized as a vehicle for the development of productive and sustainable cities. He also reveals that urban farming takes place in locations inside the cities or in the peri – urban areas, on the homestead (on – plot) or on land away from the residence (off – plot) it can include production activities but also processing, distribution and sale. Urban products include different types of crops, trees and animals.

United Nation Development Program-UNDP (1996) defines urban agriculture as a large industry consisting of many small – scale farmers and some large agribusinesses. It takes place on small tracts of land than rural field and open spaces that are vacant, idle or unsuitable for urban development, large tracts of public or quasi – public land such as universities, schools, factories, churches, airports, hospitals, prisons, military bases, park and recreation areas that are kept inbuilt.

Historically, urban dwellers in industrialized country face such severe food insecurity during periods of crises such as wars. According to World Commission on Environment and Development-WCED (1987), the activity of growing food in pots, on window suits, balconies and in small backyard plots were seen as an important source of food. This is true in countries like Hongkong and Singapore where there are significant urban agriculture programs. Also, of the United States during World War II, a popular urban farming programmes called "Victory Gardens" provided about 40 percent of fresh vegetables (World Commission on Environment and Development 1987).

An increasing number of cities and countries are interested in including urban agriculture in their strategies and programmes to reduce urban poverty and enhance urban food security (Michael 2003). Also Maxwell (1999) revealed that one way to help ward off hunger among low – income households may be through urban agriculture: the farming of small plots of land available in urban environments or on the perimeter of the city. He further revealed that urban agriculture might be able to supplement the family's diet.

However, urban agriculture must be manage carefully to address important food safety or food security of the households (this means access to nutritious, affordable, safe, adequate and culturally acceptable food on a daily basis and is to be a right, rather than a priviledge for ourselves and for future generations) and environment concerns.

MATERIALS AND METHODS

Abuja, Nigeria's new capital city is located in the middle of the country. The Federal Capital Territory has a land area of 8,000 square kilometers, which is two and halftimes the size of Lagos, the former capital of Nigeria. The FCT is bounded on the north by Kaduna State, on the west by Niger State, on the east and south-east by Nasarawa State, and on the south-west by Kogi State. It falls within latitude 7° 25' N and 9° 20° North of the Equator and longitude 5° 45' and 7° 39'.

The FCT has two distinct seasons, namely the rainy season that begins around March and runs through October and the dry season which begins from October and ends in March. However, within these seasons is a brief harmattan season that is occasioned by the north east trade wind and the attendant dust haze, increased cold and dryness.

Weather conditions in Abuja are influenced by its location within the Niger-Benue trough on the windward side of the Jos Plateau and at the climate transition zone between the essentially 'humid' south and the 'sub-humid' north of the country. The climatic dictates of the FCT are essentially from the south West to the North West due to the rising elevation from the Gurara valley in the south west, to the Bwari-Aso hills and the Agwa -Karu hills to the north east.The high temperatures and the relative humidity in the Niger-Benue trough give the Federal Capital Territory a heating effect but the increasing elevation towards the north east reduces the heat in areas like on the Gwagwa plains where the Federal Capital City (FCC) is sited than on the Iku-Gurara plains to the west.

Rainfall in the FCT reflects the territory's location on the windward side of the Jos Plateau while the monthly rainfall distribution intensifies during the months of July, August and September. It is endowed with fertile land for agriculture and at the same time a yearly climate that is neither too hot nor too cold. The FCT is divided into six area councils namely, Abuja Municipal, Gwagwalada, Abaji, Kuje, Bwari and Kwali.

Sampling Techniques

The study makes use of Multistage Simple Random Sampling Techniques. A list of farmers practicing urban agriculture was be prepared with the help of officials of the agricultural department. The listed farmers were further categorized based on farm holdings. Twenty five respondents were selected randomly from the six area councils in Abuja, namely, Abuja Municipal, Gwagwalada, Abaji, Kuje, Bwari and Kwali. Totaled to One Hundred and Twenty in number.

Method of Data Collection

The research work will be based on primary data. Structured questionnaire, interviews, and observation will be employed to gather the data related to economic analysis of resource-use efficiency among urban farmers in Abuja. The target populations are people are engaging in urban farming activities in Abuja.

Model Specification

Multiple regression model based on stochastic production frontier was used to measure resource-use efficiency in urban crop farming in the study area.

The Empirical Model (Econometric)

The stochastic production frontier for urban crop farmers in Ibadan metropolis is assumed to be defined by

$\text{Ln } Q = b_o + b_i \text{ Ln (land)} + b_2 \text{ Ln (Hired labour)} + b_3 \text{ Ln (Family labour)} + b_4 \text{ Ln (fertilizer)} + b_5 \text{In (Plantlings)} + V_i - U_i$ ------- (1)

Where the technical inefficiency is assumed to be explained by

m_i = do + di (Age) + d_2 (Education) + d_3 (Experience) + d_4 (Gender) + d_5 (Purpose) + d_6 (Landownership) + d_7 (Cropping Pattern)----------(2)

Where, Ln denotes the natural logarithm (i.e. logarithm to the base e).

Q = the total quantity of crop mix in each urban farm standardized as grain equivalent.

Land: is the hectare of cultivated land

Labour: is the family and hired labour, expressed as adult male equivalent in mandays.

Fertilizer: is expressed in kilogramme

Plantlings: is the values of items (e.g. seeds and other planting materials) used per farm.

Age: This is the age of the urban crop farmer

Education: This is the education level of the farmer (year)

Experience: This is the experience of urban crop farmer in farming (year).

Resource Productivity Estimate (Formula)

This is got from MLE result:

Average physical product (APP) is calculated by dividing average total output (Q) by unit of each resource.

i.e. APP = $\frac{\text{Total output (Q)}}{\text{Unit of input } (X_i)} = \frac{Q}{X_i}$

(ii). Marginal physical product (MPP) is calculated thus: Multiplying Average Physical product (APP) by Coefficient (Elasticity).

i.e. Mathematically,

MPP = $\frac{\text{Average total output (Q)}}{\text{Average Unit } (X_i)}$ X Elasticity

RESULTS AND DISCUSSIONS

Table 1: Resource Productivity

The estimation of the marginal physical productivities (MPP) and average physical productivities (APP) of the input by the urban crop farmers are shown in the table 1.

Productivity of Land: The MPP and APP of land are 6.6620 and 11.1798 respectively. The result shows that, if the land is increased by a hectare, output of crop would increased by 6.662 grain equivalents. But on the average a hectare of land contributes 11.1798 grain equivalent of crop output. Also, since APP is higher than MPP, the production process is in stage 2 with respect to land, therefore land input is experiencing a decreasing return to scale. (That is, as farmland decreases the output of crop also decreases). This is the best stage to produce.

Productivity of Fertilizer: The use of fertilizer has no marginal effect on output of crop. Since the value of MPP (-0.0033) is negative and that of APP is very small in magnitude.

This shows that production process is in stage 3 with respect to fertilizer. This means that each additional unit of fertilizer used makes a negative contribution to total physical product.

Productivity of Hired Labour: The MPP and APP of hired labour are 0.1686 and 11.3908 respectively. The result shows that if the hired labour is increased by 10 mandays, output of crop would increase by 1.686 grain equivalents showing that production process is in stage 2 and there is decreasing return to scale (that is, as hired labour decreases the output of crop also decreases)

Productivity of Plantling: The MPP and APP are 0.0022 and 0.0109 respectively. The low MPP is due to the fact that plantlings cannot on their own increase crop productivity, if land, labour and fertilizer are low. As MPP approaches zero there is decreasing return to scale and since APP is greater than MPP the production process is in stage 2.

Table 2

The log-likelihood function is estimated to be 55.86 which maximizes the joint densities in the estimated model.Sigma-squared (σ^2) has the value of 0.0186 that is variation that occurs in the technical efficiency of the farms is caused by1.86% of the error term (Measurement error). Gamma (γ) is not statistically/significantly different from zero which implies that technical inefficiency plays a minimal role in the variation of observed urban farms output. The estimated value of Gamma in the model, which is 0.1282 implies that 12.8% of the total variation in urban farm output is due to technical inefficiency. The negative sign of the parameters in the inefficiency function means that the associated variables have a positive effect on the technical efficiency and a positive sign indicate the reverse. Coefficient Values indicate elasticises.

Production Elasticity

Farmland: The coefficient (0.5959) is statistically significant at 1% meaning that land is an important factor explaining changes in output. If the land size is increased by 10 percent, output level would rise by 5.959 percent, all things being equal (ceteris paribus). This implies that the magnitude of the coefficient shows inelastic nature of output with respect to land.

Fertilizer: The coefficient (-0.0054) is not statistically significant showing that fertilizer is not important factor that explain changes in output of crop production in Ibadan metropolis.

Hired Labour: The coefficient (0.0148) is not statistically significant, showing that hired labour is not an important factor that explains changes in output of crop.

Family Labour: The coefficient (0.0899) is statistically significant at 10 percent showing that family labour appears to be an important factor that explains changes in output of crop. But the magnitude of the coefficient shows inelastic nature of output with respect to the family labour. If family labour is increased by 10 percent, output level would improve less than proportionate by a margin of 0.899 percent in a ceteris paribus case. Therefore, there is still some scope for increasing output by increasing number of family labour.

Plantlings: The production elasticity of output with respect to cost of plantlings is 0.1979 showing an inelastic situation. If amount spent on plantlings is increased by 10 percent, output level would improve by a margin of 1.979 percent in a ceteris paribus case. The

coefficient is statistically significant at 5 percent. This shows that there is still some scope for increasing output of crop production per plot by increasing cost of plantlings especially when the land area can be increased.

Inefficiency Function

Age: The coefficient (0.0095) is statistically significant at 1 percent showing that as age increases, inefficiency in resource use in urban farms increases and technical efficiency decreases. A 10% increases in age will lead to 0.09% increases in inefficiency in a ceteris paribus case.

Education: The Coefficient (-0.19926) is statistically significant at 1 percent showing that as educational level of the urban farmers increases, inefficiency in resource use decreases and technical efficiency increases that is the more education, the less is technical inefficiency. The years of former education of the farmer is increased by 105 inefficiency is decreased by 1.9926% in case of ceteris paribus

Experience: The coefficient (-0.1926) is not statistically significant.

Gender: The coefficient (0.0234) is not statistically significant

Cropping System: The coefficient (0.1362) is statistically significant at 10 percent. This shows that the mixed cropping system practiced affects the technical efficiency of the farmers negatively. (i.e. farmers practicing sole –cropping are more efficient than mixed cropping). And the majority of the urban farmers practiced mixed cropping which reduces the technical efficiency.

Occupation: The coefficient (-0.1403) is statistically significant at 10 percent showing that the secondary nature of occupation in urban farming affects the technical efficiency negatively. That is, farmers that take urban farming as primary occupation are more efficient than farmers that take urban farming as secondary occupation

Table 3

The problem encountered by the urban crop farmers is shown in the table 3 and they are:

1. Low economic returns with hard labour due to small plots.
2. Usage of crude implements.
3. Lack of permanent site for farming that is, majority of the land are owned by the government (state).(Tenurial Security)
4. Fear of insecurity on the planted Crops. (Pilfering)

Table 1. Resource Productivity Estimate

Resource	Elasticity	Unit of input	APP	MPP
Land (ha)	0.5959	1.1977	11.1798	6.6620
Fertilizer (kg)	-0.0054	22.0820	0.6064	-0.0033
Hired Labour (Mandays)	0.0148	1.1755	11.3908	0.1686
Family Labour (Mandays)	0.0899	0.8291	16.1500	1.4519
Plantlings (₦)	0.1979	1228.2	0.0109	0.0022
Average Total Output (Q)		13.39		

Source: Computed from MLE Result

Table 2. The Final Maximim Likelihood Etimates (Mle) And Inefficiency Function

	Coefficient	**t – ratio**
Constant term (β_o)	2.5938	8.6916***
Land (ha) (β_i)	**0.5959**	**7.9476*** **
Fertilizer (KG) (β_2)	-0.0054	-0.3904
Hired labour (mandays) (β_3)	0.0148	1.3776
Family labour (mandays)	0.0899	1.6763*
Plantlings (₦) (β_5)	0.1979	2.4027**
Inefficiency Model		
Intercept (δ_0)	-0.6715	-7.6526***
Age (year) (δ1)	0.0095	3.5853***
Education (δ2)	-0.1926	-2.9191***
Experience (Year) (δ_3)	-0.0037	-0.9259
Gender (δ_4)	0.0234	0.3339
Primary purpose (δ_5)	0.0497	0.8152
Land ownership (δ_6)	0.0543	0.8769
Household size (δ_7)	0.0054	0.7804
Cropping System (δ_8)	0.1362	1.8821*
Occupation (δ_9)	-0.1403	-1.9680*

Diagnostic	**Statistics**	
Sigma-squared (σ^2)	0.0186	5.2659***
Gamma (γ)	0.1282	0.4515
Log likelihood Function	55.8605	
LR test	29.3172	
Number of observation	120	

Source: computed from MLE results.

Note: From the tables above,

Asterisks: *** indicates 1% significant level

** indicates 5% significant level

* indicates 10% significant level

Table 3

Problems encountered	**Frequency**	**Percentage**
Low economic returns	85	100.0
Usage of crude implement	85	100.0
Tenurial security	72	84.7
Pilfering	81	95.3

Table 4. Socio – Economic Characteristics of Farmers

Age Distribution of Farmers

Age Range	Frequency	Percentage	Mean Efficiency
20 –29	16	12.9	0.89
30 – 39	20	17.7	0.88
40 – 49	36	30.6	0.86
50 – 59	30	23.5	0.85
60 – 69	18	15.3	0.83
TOTAL	120	100.0	

Distribution of Farmers by Farm Size

Farm size (hectare)	Frequency	Percentage	Mean efficiency
0.1 – 1.0	74	69.4	0.96
1.1 – 2.0	33	27.1	0.89
2.1 – 3.0	1 3	3.5	0.83
TOTAL	120	100.0	

Distribution of Farmers by Primary Purpose of Farming

Primary purpose of farming	Frequency	Percentage	Mean efficiency
Subsistence Commercial	80	58.8	0.93
	40	41.2	0.93
TOTAL	120	100.0	

Distribution of Farmers by Marital Status

Marital Status	Frequency	Percentage	Mean efficiency
Single	20	11.8	0.95
Married	90	82.3	0.95
Widowed	10	5.9	0.95
TOTAL	120	100.0	

SUMMARY OF FINDINGS

This study was based on data collected from 120 urban crop farmers in Abuja metropolis, in order to determine the economic appraisal of urban farming in the study area. The stochastic frontier production approach using the maximum likelihood procedure was used to estimate the model and predict the individual farmer's technical efficiency. The stochastic production frontier model results showed that the mean technical efficiency is 0.93. The results also indicate that farmland, family labour, and plantlings have decreasing returns to scale since their coefficients (0.5959, 0.0899 and 0.1979 respectively) are positive and statistically significant in urban crop production. The results of the inefficiency model reveals that occupation variable has negative Coefficient (-0.1403), which means farmers that take urban farming as primary occupation are more efficient than farmers who take urban farming as secondary occupation.

Also, age variable is statistically significant, with coefficient of 0.0095, showing that as age of the farmer increases the technical inefficiency increases. Level of education Coefficient is negative which means that the more education, the less is the level of technical inefficiency. Also cropping system has positive coefficient (0.1362) which means the mixed cropping system decreases the technical efficiency. The results of the resource productivity reveal that the MPP and APP of farm land are 6.6620 and 11.1798 respectively meaning that as farm land decreases the output of crop also decreases since production process is in stage 2.

Also MPP and APP of hired labour are 0.1686 and 11.3908 respectively meaning that there is decreasing returns to scale with production process in stage 2. It is also shown from the result that the use of fertilizer has no marginal effect on output of crop, since the value of MPP (-0.0033) is negative and that of APP is very small in magnitude. Finally, from the result it was shown that most of the urban crop farms in Ibadan metropolis are near or operating close to full technical efficiency and it was also revealed that no farm is one hundred percent efficient in the stochastic production frontier model.

Policy Implication

The resource productivity of the physical input (i.e. farmland, family labour and plantlings) show that there is still some scope for increasing output by increasing the physical inputs (that is, there are still opportunities to raise the present level of technical efficiency of urban crop production in the study area.)

CONCLUSION

In view of the above findings, it was clearly established that urban crop farmers, though cultivate on small plot of land can still improve their productivity with the resources available, and reduce technical inefficiency by considering the factors stated above which will enhance food security by households and food sufficiency in the country.

RECOMMENDATIONS

Based on the result of the findings, the following are hereby recommended to ensure continuous availability of food to urban households and efficient use of resources in urban crop farms.

1. Land is a limiting factor in the urban areas; therefore government policy should concentrate on addressing this issue by allocating some portion of urban lands for permanent framing purposes.
2. It was shown from the study that as age of the farmers increase the technical efficiencies also decrease, therefore people should enter into urban farming early because they will benefit more and it will enhance food security.
3. Since formal education has positive effect on productivity of farmers therefore farmers should be encouraged to have formal education.
4. From the study it was shown that farmers that practice sole cropping are more efficient than farmers that practice mixed cropping, therefore farmers should be encouraged to practice sole cropping.

There is need to carry out further research on urban farming as related to food security and food sufficiency.

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