Journal of Natural Sciences Research www.iiste.org
ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online)
Vol.3, No.9, 2013

Land Use Intensity and Efficiency of Food Crops Production in Osun State of Nigeria

*Oladeebo, J.O and S.K. Adekilekun
Department of Agricultural Economics, Ladoke Akintola University of Technology, P.M.B 4000, Ogbomoso, Nigeria.
*E-mail of corresponding author: jooladeebo@lautech.edu.ng

Abstract
This study examined the relationship between land use intensity and food crops production efficiency in Osun State of Nigeria. Primary data obtained from 90 representative samples of food crop farmers drawn from Ede North Local Government Area in the Southwestern Nigeria were used for the study. Data obtained were analyzed by the use of descriptive statistics, indices of land use intensity and stochastic frontier production function. Results showed that majority of the food crop farmers were in their active age, educated and highly experienced in food crop crops production. Maximum likelihood estimation (MLE) shows that farm size had the highest production coefficient and was statistically significant at 5 percent level of significance. Results of the inefficiency analysis showed that while crop diversification, labour use intensity and age of the food crop farmers contributed positively and significantly to inefficiency, land use intensity contributed negatively to inefficiency of food crops production. Major land management methods used by the farmers were mulching, crop rotation and fertilizer use.
Keywords: Food crops, land use intensity, Ruthenberg index, efficiency, Osun state

1. Introduction

Agricultural development plays a vital role in overall economy of this nation. Nigeria is blessed with substantial natural resources which include fertile soil for growing of different food crops and fresh water resources. It plays an important role in development of industries by supplying raw materials, it is a source of food for the whole nation and also it earns income for many household farmers and for the nation at large (Nweke *et al*, 1994).
Concerted efforts were made by successive governments both long run and short run to boost food production. This is evident in the establishment of institutions like Federal Department of Rural Development (FDRD) in 1976 to coordinate and integrate rural and agricultural development and to initiate and develop appropriate strategies and projects which will help to increase agricultural productivity and employment opportunity in the country.

Agricultural intensification in many sub-Saharan African nations is one of the major threats to sustainable agricultural production. This will be the case for the 21st century and beyond because of increasing population pressure, declining agricultural productivity, environmental degradation, food insecurity and widespread rural poverty (Eswaran, *et al*, 2001). Presently in Nigeria the stakeholders are concerned with the problems of increasing food crops production to feed a rapidly growing population and at the same time proffering solutions to the problems of how to stimulate economic growth and reduce poverty.

Tiffen *et al* (1994) conceptualized intensive agricultural production as increased in the use of inputs of labour or capital on a small-holding in order to increase output per hectare Theoretically, land use intensity, which tells about the allowance farmers give their farmland to fallow is a widely used indicator of intensification (Ruthenberg, 1980). Okike *et al,* (2001) cited in Oyekale (2007), noted that labour use intensity, manure use intensity, fertilizer use intensity and intensity of animal traction are other indicators that could be used. According to Oyekale (2007), Nigerian farmers resolve to continuous cropping as family size increases and agricultural land becomes scarce. In Nigeria the intensification process results from an increase in gross output in fixed proportions due to proportionate expansion in input without any technological change (Okike, *et al* 2001).

Agricultural intensification could be sustainable only if land management practices used by the farmers could compensate for nutrient loss and environmental stress induced by improper use of land. In most states in Nigeria where population growth leads to scarcity of arable land, small scale farmers are using different soil conservation practices. The method of tillage is paramount for sustainable crop production (Couper, 1995).

The major issue of concern to sustainable agricultural production in Nigeria include the problems of vis-à-vis human induced soil degradation, bush burning, soil compaction (FAO, 2000). The need to ensure adequate management of land becomes evident from the fact that despite that Nigeria becomes highly dependent on oil revenue since the 1970s, agricultural land remains the most important long term resource base for the direct and indirect support of plants and animals which man uses (NEST, 1991).

1.1 Problem Statement

Available evidence confirms that food crop production in the country is low (FAO, 2000). Perennial food shortage with hungry season is common. The effect of this is high, underfeeding and malnutrition throughout the nation. Nigeria as a nation only depends on rural inhabitants who constitute over 15 percent of the total population for the production of foods (FAO, 2000). These farmers are poor subsistence farmers and they spend little on food production, which lead to low productivity (Fresco, 1993).

Moreover, Nigeria is witnessing an upward trend in price of foodstuff, which should not be attributed to inflationary tendencies alone. The price increase is mainly due to decrease in production coupled with rise in demand as a result of increase in population and purchasing power. For example, cassava production was reported to be declining by less than 10% for reasons connected with losses from livestock and declining soil fertility which is as a result of the effect of land use intensity (Fresco, 1993). Hence, there is every need to increase food crop production due to increase in human population so as not to cause hunger and starvation among the teeming population

This study was therefore conceived to determine the relationship between land use intensity and efficiency of food crops production in Osun State of Nigeria using Ede North Local Government Area as a case study. Hence the study provided answers to the following research questions:

i. What are the socio-economic characteristics of the food crops farmers in the study area?
ii. How does intensity of land use affect the efficiency of food crop production?
iii. What are the major indicators of agricultural intensification in the study area?
iv. What are the types of land management practices in the study area?

1.2 Objectives of the study

The general objective was to examine the effect of land use intensity on efficiency of food crops production in Ede North Local Government Area of Osun State, Nigeria. The specific objectives were to:

i. Identify and discuss the socio-economic characteristics of the respondent in the study area;
ii. Determine how intensity of land use affect the efficiency of food crop production;
iii. Describe the indicators of agricultural intensification in the study area;
iv. Determine the type of land management practices prevalent in the study area.

2. Methodology

2.1 The Study Area

The study was carried out in Ede North Local Government Area (LGA) of Osun State, Nigeria. The area is lies between rainforest and savannah zone and consist of extensive fertile soil suitable for cultivation of wide range of food crops. Ede North is multi – occupational area with majority engage in white collar jobs and others in farming and trading. The farm produce in the study area are yam, cassava, maize, okra, sorghum, tomato, pepper, and sweat potato *et cetera*. Ede North is located in Osun State. Its neigbours are Egbedore, Irepodun, Iwo, Ejigbo, Osogbo, Ife North and Ayedaade LGAs with which it shares common boundary.

Ede North lies approximately on latitude 4.5 North of the equator in what was formerly a deciduous forest belt, part of which has now been transformed recently into savannah through indiscriminate farming methods and annual burning for games. It is situated on relatively flat land with the longitude between 800 and 1,000 meters above the mean sea level. The town (Ede North) was bisected in to two by river Osun. The river was dammed at kilometer 5 on old Ede Osogbo road to provide the town with regular supply of drinkable water. Ede Township covers total land area of about 4.059 km2 out of which 1.589km2 had been developed.

2.2 Population of the area

Population of the farmers in Ede North LGA was used as the population of the study area. Although there is no complete list of farmers in the area, the wards with the highest concentration of farmers were identified and used for the study.

2.3 Sample size and sampling procedure

A total of 90 farmers were used in this study. Purposive sampling method was used in selecting those farmers engaged in food crops production in the study area.

2.4 Instrument for data collection

The data were collected with the aid of structured questionnaire which contained questions on the socio-economic characteristics, land use issues and crop production activities of the farmers.

2.5 Methods of data analysis

i. Descriptive statistics was used to analyze the socio-economic characteristic of the respondents in the study area.
ii. Stochastic frontier analysis was used to examine the relationship between land use intensity and efficiency of food crops production.
iii. The indicators of agricultural intensification were calculated with the use of Rutherberg's and

Herfindahl indices. Descriptive statistics was then used to describe the indicators calculated.

iv. Descriptive statistics was also used to explain the type of land management practices prevalent in the study area.

2.6 Model Specification

The Stochastic frontier analytical statistical software developed by Coelli (1994) was used to estimate the maximum likelihood estimate of the specified Cobb Douglas production function in equation 1. This method incorporates the hypothesized determinants of efficiency into the inefficient error components. The model is stated as:

$$LnYi = \beta_0 + \beta_1 \ln X_1 + \beta \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + (V_i - U_i) \quad (1)$$

$$V_i = N(0, \sigma_v^2)$$

Where

ln = Natural logarithm

Y_i = farmers output (Kg)

X_1 = family labour used (Man day)

X_2= hired labour used (Man day)

X_3 = fertilizer / chemical input (Kg)

X_4 = Land cultivated by the farmer (Ha)

V_i = Symmetry error]

U_i = Inefficiency

The inefficiency model can be stated as follows:

$$U_i = \beta_0 + \beta_1 \ln Z_1 + \beta_2 \ln Z_2 + \beta_3 \ln Z_3 + \beta_4 \ln Z_4 + \beta_5 \ln Z_5 + \beta_6 \ln Z_6 + \sum_{i=1}^{6} \beta_i D_i + e_i \quad (2)$$

Where

Ui= inefficiency of ith farmer

Z_1 = Crop diversification index measured by the Herfindahl Index

Which is $$\sum_{i=1}^{13} \left[\frac{C_i}{\sum_{i=1} C_i} \right]^2 * 100$$

With Ci being the area of land planted to ith crop

Z_2 = Land use intensity of ith farmer measured by the

Rutherberg's Index (Ruthenberg, 1980)

$$L_i = \frac{A_i}{L_i} \times \frac{100}{1}$$

Z_3 = Labour use intensity of ith farmer measured as total labour used divided by number of hectares cultivated (%)

Z_4 = Family size of ith farmer

Z_5 = Age of ith farmer

Z_6 = Experience in farming of ith farmer (years)

D_1 = Dummy variable for use of mulching (Yes = 1, otherwise = 0)

D_2 = Dummy variable for use of crop rotation (Yes = 1, otherwise = 0)

D_3 = Dummy variable for use of organic manure (Yes = 1, otherwise = 0)

D_4 = Dummy variable for using cover crops (Yes = 1, otherwise = 0)

D_5 = Dummy variable for use of inorganic fertilizer (Yes = 1, otherwise = 0)

D_6 = Dummy variable for no serious environmental degradation (Yes = 1, otherwise = 0)

e_i = Error term.

βs = estimated parameters

3.0 Results and Discussion

3.1 Socio-economic characteristics of the food crops farmers

3.1.1 Age of food crops farmers

Table 1 shows that 40 percent of the food crops farmers were between the age ranges of 45-54 year, 26.4 percent were between 35 – 44 years and 15.6 percent were between the age of 65years and above. This implies that majority of the farmers were in their active age. The minimum, maximum, mean, mode and standard deviation of age of the respondents were 19, 70, 47.4, 42 and 10.6 years respectively. The average age of about 47 years for the food crop farmers showed that the farmers were in their active years which may increase the efficiency of food crops production.

3.1.2 Household size of the food crops farmers

Table 2 shows that 48.9 percents had household size of between 6 and 10 persons. 36.7 percent had between 1 and 5 persons while 14.4 percent had 11 persons and above. The mean household size was about 8 persons, the mode was 4, the minimum was 2, and maximum was 14 persons while standard deviation was 3.38 implying that majority of the food crops farmers household size was large which might be an indication of high availability of family labour which might improve their efficiency in food crops production.

3.1.3 Years of farming experience of food crops farmers

Table 3 reveals that 31.1 percent of the respondents had 11-20 years of experience, 22.2 percents had 31 years and above. The minimum, maximum, mean, mode and standard deviation of the years of experience in farming by the respondents were 7, 34, 7.3, 10 and 6.79 years respectively. The result implies that majority of the food crops farmer have been producing food crops for a long time and this might be an indication of efficiency in food crops production.

3.1.4 Education status of the food crops farmers

Table 4 reveals that 55.6 percent of respondents attended primary school, 6.7 percent attended secondary school while 11.1 percent attended tertiary institution. This implies that literacy level of respondents was high. The implication of these results is that well educated farmers might be efficient in food crops production all other things being equal.

3.1.5 Farm size of the food crops farmers

Table 5 reveals that 84.4 percent of the respondents had farm size within 1-10 hectares of land, 6.7 percent of the respondent had farm size within the range of 11-20 hectare of land while 10% of the respondent had 21 and above hectares of land. The average farm size was about 7 hectares while the minimum and maximum farm sizes were 1 and 34 hectares respectively. This implies that most of the farmers had large farm size for production of food crops.

3.1.6 Source of land

Table 6 shows that 64.1 percent of the respondents acquired land through inherited source, 29.0 percent acquired land through renting of farmland while 6.9 percent of the respondent acquired land through purchase. This implies that majority of the farmers in the study area acquired land through family inherited source and this might be one of the reasons for the large farm size operated by the farmers since they had free access to abundance farm land. All other things being equal, access to abundance farm land might lead to efficient food crops production.

3.2 Results of the Stochastic Production Frontier (Maximum likelihood Estimates) and Inefficiency Analysis

Table 7 shows the maximum likelihood estimate of the farmer production function specified as equation 1, given the specification of the inefficiency relationship expressed as equation 2. The diagnostic statistics revealed that the efficiency effect jointly estimated with the production frontier function are not simply random errors. The gamma is the ratio of the errors in equation 1. If $\gamma = 0$, inefficiency is not present and if $\gamma = 1$, there is no random noise (Oyekale, 2007). The estimated value of γ is 1.0×10^{-8} and is significantly different from zero thereby confirming that food crop farmers in the study area (Ede North Local Government) are grossly inefficient. The relative contribution of the inefficiency effect to the total variance term is measured by γ (Coelli *et al*, 1998).

Also, the generalized likelihood ratio test reported in table below is highly significant. This suggests the presence of one sided error component and implies that the effect of technical inefficiency is significant.

The elasticity coefficients are presented in the upper segment of the table. This shows that family labour, hired labour and total farm size are statistically significant at least at 5 percent level. The coefficient of total farm size had the highest elasticity of 1895.63 followed by hired labour with 587.39 and then by family labour with 72.92. In economic sense, increase in farm size will enhance more output.

The results further show that crop diversification index, labour use intensity, years of experience and use of cover crops were statistically significant at 10 percent level of probability and contributed to food crop farmers' level of inefficiency. However, land use intensity which had a negative coefficient could have contributed to the reduction in food crop farmers' inefficiency but for the fact that the coefficient was not

statistically significant.

3.2.1 Efficiency Scores

The result of the efficiency scores of the respondent are shown in table 8. The minimum efficiency score was 0.69 while the maximum efficiency score was 1.0 and the mean score was 0.94. The ranges with minimum score is 0.9 – 1.0 amounting to 76.87 percent of the total sample which indicated that most of the farmers in the study area are highly efficient than remainder. The ranges with the least efficiency score was 0.60 - 0.71 amounting to 1.11percent.

The mean efficiency of 94 percent shows that there was a scope of 6 percent by the farmers to be fully efficient in food crops production under the present technology.

3.2.2 Agricultural intensification Indices

Table 9 shows the indices of agricultural intensification in the study area. The table indicated that labour; land and fertilizer use intensities (72.2%, 82.06% and 67.8% respectively) were the major contributors to agricultural intensification in the study area.

3.2.3 Land Management Practices

Use of land could be sustainable only if land management practices used by the farmers could compensate for nutrient loss and environmental stress induced by improper use of land. Farmers are using different soil conservation practices. Table 10 shows that about 27 percent of the farmers were using mulching on their farms. Mulching is the use of crop and plant residues to cover the top soil before or after planting for the protection of the soil from direct sun and raindrops. The use of these practices might make much impact on efficiency of food crop production in the study area where problem of erosion is well pronounced. Crop rotation could be a good land management practices if the choice of crop rotation is properly done for enhancing soil nutrient. However, about 26 percent of the farmers were using it.

The table shows that about 31 percent of the food crop farmers made use of fertilizer as a means of land management. This might not be unconnected with the fact that there was then a free distribution of fertilizer to the farmers in the study area by the Ede North Local Government Area Council. One other reason for having fertilizer use with the highest percentage was that fertilizer substituted for nutrient loss in the land and fertilizer also enhances soil fertility to achieve efficiency in food crop production (Akanbi, 2006). Table 10 also revealed that cover crop had the lowest value of about 16 percentages. This was as a result of the high use of fertilizer instead of cover crop as a means of land management.

4.0 Conclusion

This study examined the relationship between land use intensity and food crops production efficiency in Osun State of Nigeria. Results showed that majority of the food crop farmers were in their active age, educated and highly experienced in food crop crops production. Maximum likelihood estimation (MLE) shows that farm size had the highest production coefficient and was statistically significant at 5 percent level of significance. Results of the inefficiency analysis showed that while crop diversification, labour use intensity and age of the food crop farmers contributed positively and significantly to inefficiency, land use intensity contributed negatively to inefficiency of food crops production. Hence, there was 6 percent scope for increasing efficiency of production by food crop farmers. Food crop farmers would therefore need an upward shift in technology in order to substantially increase output given their input level. Labour use intensity, crop diversification and years of experience when properly adjusted will help in efficiency of food crop production. Major land management methods used by the farmers were mulching, crop rotation and fertilizer use.

REFERENCES

Akanbi W.A. (2006): *Introduction to Tropical Food Crops*. Agronomy Department, LAUTECH, Ogbomoso

Coelli, T.J., D.S Prasada Rao, and G.E.Batesse (1998): *An Introduction to Efficiency and Productivity Analysis.* Springer: New York 331Pp.

Coelli T.J. (1994). Recent Development in Frontier estimation efficiency Measurement.*Australian Journal of Agricultural Economics* **39**:219-245.

Couper, D. C. (1995): No till farming in the humid and sub humid tropics of Africa. IITA *Research Guide **3***. Training Programme, Institute of Tropical Agriculture Ibadan, Nigeria Third Edition. P 26

Eswaran, H.R. Lal and P.F. Reich (2001): Land degradation: An overview: In: Bridges, E.M., I.D. Hannam, L.R. Oodeman, F.W. T. Paning de Vries, S.J. Scherr and S. Sompatpanit (Eds.)

Response to land Degradation. Proceedings of 2nd International Conference on Land Degradation and Desertification, Khon Kacn, Thailand. Oxford Press, New Delhi, India.

FAO (2000): Land and Water Constraints to Sustainable Agriculture.

www.fao.org/waicent/faoinfo/agricult/agl/swl/wpr/nigeria/e-bright.htm.

Fresco, L. 0.n (1993): The dynamics of cassava in Africa: an outline of research issues. COSCA *Working paper*

No. **9** Collaborative Study of Cassava in Africa. IITA. Ibadan, Nigeria.
NEST (Nigeria Environmental Study Action / Team) (1991). Nigeria's Threatened Environment: A National Profile. Nigeria: NEST.
Nweke, F., Haggblade, S. and Zulu B. (2004). *Building on Success in African Agriculture, Recent Growth in African Cassava.* Focus **12**, Brief **3** of 10, IFPRI: Washington D.C.
Okike I, Jabbar M.A., Mayong U, Smith J.W., Akinwumi J.A, Ehui S.K. (2001). Agricultural Intensification and Efficiency in the West African Savannahs: Evidence from Northern Nigeria, Socio-Economics and Policy Research Working Paper 33. International Livestock Research Institute.
Ruthenberg. H (1980): *Farming system in the Tropics.* Oxford University Press: London. 424 pp.
Tiffen, M., M. Mortimore and F. Gichuki (1994): *More People less Erosion*. African Centre for Technology Studies: Nairobi, Kenya. 311Pp

Table 1: Age Distribution of food crops farmers

Age (years)	Frequency	Percentage
25-34	7	7.8
35-44	24	26.7
45-54	36	40
55-64	9	10
65 above	14	15.6
Total	90	100

Source: Field Survey Data Analysis.

Table 2: Distribution of the food crops farmers by household size

Household size	Frequency	Percentage
1-5	33	36.7
6-10	44	48.9
11 above	13	14.4
Total	90	100

Source: Field Survey Data Analysis.

Table 3: Distribution of food crops farmers according to their years of experience

Farming experience	Frequency	Percentage
1-10	23	25.6
11-20	28	31.1
21-30	20	22.2
31 above	19	21.1
Total	90	100

Source: Field Survey Data Analysis.

Table 4 : Distribution of food crops farmer by their educational level

Level	Frequency	Percentage
No formal education	24	26.7
Primary	60	55.6
Secondary	6	6.7
Tertiary	10	11.1
Total	90	100

Source: Field Survey Data Analysis.

Table 5: Distribution of food crops farmers by their farm size

Size (ha)	Frequency	Percentage
1-10	76	84.4
11-20	6	6.7
21 above	9	10
Total	90	100

Source: Field Survey Data Analysis.

Table 6: Distribution of food crops farmers by source of land

Source of land	Frequency	Percentage
Family inherited	84	64.1
Rented land	38	29.0
Purchased land	9	6.9
Total	131*	100

Source: Field Survey Data Analysis
***Multiple responses**

Table 7: Maximum likelihood estimate of the stochastic production frontier

Variables	Coefficient	Standard Error	t-ratio
Constant	52560*	1.54	34.052
Family labour	72.92*	7.25	10.06
Hired labour	587.39*	15.53	37.83
Fertilizer / chemical input	0.224	0.42	0.495
Total farm size	1895.63*	5.43	348.9
Inefficiency model			
Constant	-2.154	1.74	-1.23
Crop diversification index	327.23***	150.59	2.17
Land use intensity	-192.18	129.97	-1.48
Labour use intensity	33.22***	15.64	2.21
Family size	-6.84	6.23	-1.20
Age	76.25**	30.29	2.32
Years of experience	180.47***	87.12	2.57
Use of mulching	1.66	1.22	1.35
Crop rotation	-1.05	1.32	-0.79
Organic manure	-0.99	1.35	-0.73
Cover crop	6.98***	3.63	1.92
Fertilizer use	-2.15	1.74	1.23
Environmental degradation	0.75	1.09	0.68
Sigma square	$8.75x10^{8}$	1.00	$8.7x10^{8}$
Gamma (γ)	$1.0x10^{-8}$	$1.6x10^{-6}$	0.0062

*** Indicate significance at 1% level**
**** Indicate significance at 5% level**
***** Indicate significance at 10% level**
Source: Computer printout of Data Analysis.

Table 8: Distribution of the efficiency scores

Efficiency score	Frequency	Percentage
0.60-0.70	01	1.11
0.71-0.80	06	6.67
0.81-0.90	14	15.56
0.91-1.0	69	76.67
Total	90	100

Source: Field Survey Data Analysis.
Mean efficiency: 0.94

Table 9: Agricultural Intensification Indices

Indices	Percentage
Labour use intensity	72.2
Land use intensity	20.0
Crop diversification	4.4
Fertilizer use intensity	3.3
Total	100.0

Source: Field Survey Data Analysis.

Table 10: Land management practices

Cultural practices	Frequency	Percentage
Mulching	79	26.9
Crop rotation	77	26.2
Cover crops	48	16.3
Fertilizer use	90	30.6
Total	294*	100

Source: Field Survey Data Analysis.
*** Multiple responses**