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Determinants of land-use intensity among cassava farmers in Ondo State, Nigeria

Arifalo SF

ABSTRACT

This study explores the determinants of land use intensity among cassava farmers in Ondo State, Nigeria, through an analysis based on a sample of 100 farming households. Utilizing descriptive statistics and a Tobit regression model, the research delineates the socio-economic characteristics influencing land use practices. Key findings reveal that the majority of cassava farmers are middle-aged men with substantial farming experience, primarily engaging in sole cropping on smallholder farms. Notably, the study identifies marital status, years of education, farming experience, and household size as significant predictors of land use intensity. Specifically, larger household sizes correlate with higher land use intensity, reflecting the pressure to meet increased subsistence needs. Additionally, mixed cropping is shown to result in greater land use intensity than sole cropping, suggesting that diversification may be employed as a strategy to maximize land output. These insights emphasize the need for sustainable land management practices and targeted educational programs to foster effective resource use and enhance agricultural productivity in Ondo State. This study's findings offer crucial considerations for policy formulations aimed at sustainable farming enhancements in similar regions.

Keywords: Cassava; Land-Use; sustainable farming

1. INTRODUCTION

Land use intensification refers to the extent to which land resources are used to achieve specific goals. This process often involves the conversion of marginal land, such as grassland or pasture, into areas for crop production (Li et al., 2013). In Nigeria, farming is relatively easy due to the fertility of the agricultural land and favorable weather. Despite this, only about 40% of the country's arable land is currently under cultivation (Soludo, 2006). Nigeria boasts about 92.4 million hectares of land suitable for agriculture Oladiran et al., (2020), but a significant portion is not accessible for agriculture. As a result, farmers are forced to use the limited available land. Rapid industrialization and urbanization are further exacerbating this problem by diverting land from agricultural use, threatening Nigeria's ability to maintain food supplies.

Historically, increases in food production in Nigeria have been primarily due to the expansion of cultivated land rather than improvements in the productivity of existing arable land. This approach has inherent limitations as evidenced by the 15.4% decline in agricultural land area, attributed to land alienation, degradation, and the annual loss of about 351,000 hectares due to desertification. Bamire and Manyong, (2003) also noted that population growth and competing demands for land have led to the conversion of arable land, reducing the land-to-population ratio and the average size of farmland. Despite considerable investment in the development of improved crop varieties and complementary technologies, only modest success has been achieved in increasing crop yields. A key limiting factor is the deteriorating state of the resource base coupled with increasing pressure on land and the inability of smallholder farmers to obtain and afford inorganic fertilizers (Okoruwa et al., 2006; Ibitola et al., 2019).

Nigeria's agricultural system is dominated by smallholder farmers who rely on traditional farming practices and face limited access to land. Traditional practices have struggled to meet the increasing demand for food caused by population growth and increased demand for agricultural products, leading to the intensification of agricultural land. This new agricultural practice involves changes in land use and land use patterns. Studies on intensification Boserup, (1981), Isubikalu et al., (1999), Klasen and Nestmann, (2006), Saka et al., (2011), Harbi et al., (2018) confirm the potential for agricultural growth through intensification. However, sustainable growth in increased land use intensity depends on the adequate use of modern inputs. This study aims to identify factors affecting land use intensity among cassava farmers in Ondo State. The specific objectives are to;

Examine the socio-economic characteristics of the cassava farmers in Ondo State, Nigeria;

Determine the land use intensity; and

Determine factors influencing land use intensity in the study area.

2. RESEARCH METHODOLOGY

Area of Study's Description

The study was conducted in Ondo State, which is located in the South West Zone of Nigeria, between latitudes 5° 45' and 8° 15' N and 4° 45' and 6° E, being entirely located in the tropics. Ondo State borders Ekiti State to the northwest, Osun State to the west and center, Ogun State to the southeast, Delta State to the southeast and the Atlantic Ocean to the south. The climate in Ondo State is tropical and characterized by two distinct seasons: The rainy season from April to October and the dry season from November to March with slight annual variations. Annual rainfall ranges from 1,150 mm in the northern parts to 2,000 mm in the southern region. Agriculture is the predominant occupation in Ondo State, providing income and employment opportunities to over seventy percent of its population.

Source of Data and Sampling Procedure

The study primarily used primary data collected through interview schedules and well-structured questionnaires administered to rural women living near forest reserves in the study area. A multistage sampling procedure was used. In the first phase, two of the 18 Local Government Areas (LGAs) in Ondo State namely Owo Local Government and Okitipupa Local Government were purposively selected because of the predominance of cassava farmers in these areas. In the second stage, five villages were randomly selected from each of the selected local governments. The selected villages in Owo were Uso, Isuada, Amirin, Emure-ile, and Eporo while in Okitipupa they were Aye, Idepe, Ayeka, Igbofigbo, and Igodan. In the third stage, 10 farm households were randomly selected from each of these villages, resulting in a total sample size of 100 respondents.

Data Analysis

The study used several analytical techniques, including descriptive statistics, a land use intensity model, and a Tobit regression model. Descriptive statistics such as percentages, frequencies, means, and standard deviations were used to address objectives 1 and 2. The land use intensity model as adopted by was used to determine the intensity of land use by farmers in the study area and cited in Olatunji et al., (2022). The model is listed as follows:

$$LUI = \frac{CYL}{LCLC} * 100$$

Here, LUI is the "Land use intensity", CYL is the "Cropping years on land", and LCLC is the "length of cycle of land cultivation".

The Tobit regression model was used to determine the factors influencing the intensity of land use. The model is specified as:

$$LUI_i = X_i\beta_i + e_i$$

Where,
 LUI_i = "Land use intensity"
 X_i = "Vector of explanatory variables"
 β_i = "Vector of unknown coefficients"
 e_i = Error term
 i = Number of households = 1, 2, 3...100
The Tobit model was estimated assuming that R, land use intensity, was related to the following independent variables explicitly stated:

$$LUI_i = f(Z_1, Z_2, Z_3, Z_4, Z_5, Z_6, Z_7, Z_8, Z_9, Z_{10})$$

- Here, are the details:
- Z_1 = Farmer’s Gender (1 for male, 0 otherwise)
 - Z_2 = Farmer’s Marital status (1 for married, 0 otherwise)
 - Z_3 = Education in years
 - Z_4 = Farm size (acres)
 - Z_5 = Farming Experience (years)
 - Z_6 = Household size in numbers
 - Z_7 = Type of labour used (1 for hired, 0 otherwise)
 - Z_8 = Type of cropping pattern (1= mixed cropping and 0, otherwise)
 - Z_9 = Total man-days of labour used
 - Z_{10} = Herbicides usage (1 for usage, 0 otherwise)

3. RESULTS AND DISCUSSION

Socioeconomic Characteristics of Respondents

Table 1 provides detailed insights into the socioeconomic characteristics of the respondents, who are cassava farmers in Ondo State, Nigeria. The majority of respondents (29%) fall within the age range of 50-59 years, with an average age of approximately 49 years, indicating a predominantly middle-aged farmer population. This age group suggests a balance between experience and physical capability in farming activities as also observed by several studies in the literature (Adegoroye et al., 2023; Olubunmi-Ajayi et al., 2023; Oparinde et al., 2023). A significant majority of the respondents (82%) are male, highlighting a gender disparity in cassava farming in this region. The data also shows that 87% of the respondents are married, which could imply stable family structures potentially beneficial for labour support and resource allocation in farming activities.

Education levels among the respondents vary, with 49% having completed secondary education and 24% holding tertiary education degrees. This relatively high educational attainment could enhance the adoption of improved farming practices and decision-making processes (Olutumise et al., 2024). Farming experience among respondents is notably high, with 36% having 11-20 years of experience. This extensive experience could correlate with better farming practices and higher productivity (Oparinde et al., 2023). Most respondents (56%) operate on small farms of less than 1 hectare, which is typical for smallholder farming systems in Nigeria. Additionally, 47% of the respondents rent the land they farm, suggesting a significant reliance on leased land for cassava cultivation.

Table 1 Socioeconomic Characteristics of Respondents (N = 100)

Variables	Frequency	Percentage	Mean	Min	Max	SD
Age						
≤ 39	19	19.0	-	-	-	-
40 – 49	27	27.0	49.2	25	75	10.7
50 – 59	29	29.0	-	-	-	-
≥ 60	25	25.0	-	-	-	-
Sex						

Male	82	82.0	-	-	-	-
Female	18	18.0	-	-	-	-
Marital Status						
Married	87	87.0	-	-	-	-
Single	13	13.0	-	-	-	-
Highest level of education						
Primary education	27	27.0	-	-	-	-
Secondary education	49	49.0	-	-	-	-
Tertiary education	24	24.0	-	-	-	-
Farming experience (years)						
1-10	21	21.0	-	-	-	-
11-20	36	36.0	20.5	1	50	12.9
21-30	29	29.0	-	-	-	-
31-40	8	8.0	-	-	-	-
41-50	6	6.0	-	-	-	-
Farm size (ha)						
< 1.00	56	56.0	-	-	-	-
1.00 -1.99	29	29.0	-	-	-	-
2.00 – 2.99	14	14.0	-	-	-	-
≥ 3.00	1	1.0	-	-	-	-
Method of Land Acquisition						
Purchased	13	13.0	-	-	-	-
Inherited	16	16.0	-	-	-	-
Communal	24	24.0	-	-	-	-
Leasehold	47	47.0	-	-	-	-
Cropping Pattern						
Sole cropping	78	78.0	-	-	-	-
Mixed cropping	22	22.0	-	-	-	-

Type of Land Management Practiced

Table 2 indicates that the majority of respondents do not engage in several key land management practices. For instance, none of the respondents apply inorganic fertilizers, which might be due to cost constraints or lack of access. However, a significant proportion (71%) use herbicides, which suggests a reliance on chemical weed control to manage farm productivity.

Table 2 Type of Land Management Practiced (n = 100)

Land management	Practiced	Not practiced	Total
Fallow	32.0	68.0	100.0
Crop rotation	22.0	78.0	100.0
Shifting cultivation	34.0	66.0	100.0
Herbicide application	71.0	29.0	100.0

Estimation of Land Use Intensity

Table 3 reveals that the land use intensity (LUI) among respondents is generally high, with 48% having an LUI between 0.91 and 1.00 and an average LUI of 0.89. This high LUI indicates that most respondents engage in continuous and intensive cropping practices, which could potentially lead to soil degradation if not managed sustainably.

Table 3 Distribution of Respondents by Land Use Intensity

Land use intensity	Frequency	Percentage (%)
≤ 0.50	5	5.0
0.61 - 0.70	1	1.0
0.71 – 0.80	4	4.0
0.81 – 0.90	42	42.0
0.91 – 1.00	48	48.0
Total	100	100.0
Mean	0.89	
SD	0.12	

Land Use Intensity of Respondents by Cropping Pattern

According to Table 4, respondents practicing mixed cropping have a higher mean intensity index (0.9198) compared to those practicing sole cropping (0.8851). This finding suggests that mixed cropping systems might be more intensive and possibly more efficient in land use, supporting diversification as a strategy to maximize land productivity.

Table 4 Land Use Intensity of Respondents by Cropping Pattern

Cropping pattern	Percentage	Mean Intensity index
Sole cropping	78.0	0.8851
Mixed cropping	22.0	0.9198
Total	100.0	-

Socio-Economic Factors Influencing Land Use Intensity of the Respondents

Table 5 presents the results of the Tobit regression analysis, which examines the socio-economic factors influencing land use intensity (LUI) among cassava farmers in Ondo State, Nigeria. The model's sigma is 0.1085239, significant at the 1% level, indicating a good fit and robustness of the model. Household size significantly and positively influences LUI. A larger household size increases the land use intensity, with a unit increase in household size leading to a substantial increase (1.289802) in LUI. This relationship suggests that larger households, with more members to support, engage in more intensive land use to meet their subsistence needs. Marital status negatively impacts LUI. Being married reduces the land use intensity by 0.059389 units. This could be because married farmers may have more stable incomes and less pressure to intensively use land compared to their single counterparts.

Farming experience is inversely related to LUI. Each additional year of farming experience decreases LUI by 0.0019412 units. Experienced farmers might adopt more sustainable farming practices and avoid intensive land use that could degrade soil quality. Education has a negative effect on LUI. An increase in the number of years of education reduces LUI by 0.0056704 units. Educated farmers are likely more knowledgeable about sustainable agricultural practices and the long-term benefits of soil conservation, leading to less intensive land use. The type of cropping system significantly affects LUI. Mixed cropping is associated with a decrease in LUI by 0.1096336 units compared to sole cropping. This indicates that farmers practicing mixed cropping use their land less intensively, possibly due to the benefits of crop diversity in maintaining soil health and reducing the need for intensive practices.

The results underscore the importance of household dynamics, educational attainment, and farming practices in influencing land use intensity. Larger households increase the pressure on land resources, necessitating more intensive use to meet food and income needs. Conversely, factors like marital status, experience, and education contribute to more sustainable land management practices, reducing the reliance on intensive land use. The negative impact of mixed cropping on LUI suggests that diversification in cropping

systems can be an effective strategy for sustainable land use. Mixed cropping systems are likely more resilient and can optimize resource use without overburdening the land, promoting long-term agricultural sustainability.

Table 5 Tobit Regression Analysis

Variables	Coefficients	Standardized Error	P> t
Constant	1.154834	0.0658906	0.000
Gender	0.010997	0.0261701	0.675
Household size	1.289802***	0.7697	0.0029
Farming Experience	-0.0019412*	0.0010948	0.079
Farm size (acre)	-0.0022763	0.0049081	0.644
Marital Status	-0.059389**	0.0259602	0.024
Years of Education	-0.0056704*	0.002923	0.055
Types of Labour	-0.0296309	0.0377012	0.434
Herbicides	-0.013425	0.025522	0.600
Type of Cropping	-0.1096336***	0.0417972	0.010
Entire Man-days	-0.000012	0.0000206	0.560
Sigma	0.1085239*	0.0080363	0.000

*, **, *** mean significant at 10%, 5%, and 1% levels, respectively

4. CONCLUSION AND RECOMMENDATIONS

This study on the determinants of land use intensity among cassava farmers in Ondo State, Nigeria, offers critical insights into the agricultural practices and factors influencing land utilization in the region. The results indicate that a combination of socio-economic factors, including marital status, farming experience, educational levels, and household size, significantly impacts the intensity of land use among cassava farmers. The predominance of male farmers in their productive years underscores a gendered dimension in agricultural engagement and land use decisions. The use of the Tobit regression model revealed that while increased farming experience and educational attainment generally lead to more sustainable land management practices, larger household sizes are associated with higher land use intensity, likely driven by greater subsistence needs.

Notably, the adoption of mixed cropping systems was linked with higher land-use intensity compared to sole cropping, suggesting that diversification in cropping might be a strategy employed by farmers to maximize the output from available land. Therefore, it is recommended that there is a need for targeted agricultural extension services to promote sustainable land management practices. Education programs should focus on soil conservation, the benefits of crop rotation, and the use of organic fertilizers to enhance land productivity sustainably. Also, increase support for farmer education to improve agricultural productivity through informed practices. This can include workshops and training sessions on advanced farming techniques and the economic benefits of sustainable practices.

Develop policies that specifically address the gender disparities in agriculture. Encouraging female participation in farming through targeted policies could help in diversifying the agricultural landscape and enhancing productivity. Given that mixed cropping correlates with higher land use intensity, policies should support this cropping pattern through subsidies for seeds and farming inputs that can facilitate diverse crop cultivation. Address issues of land access and security to provide a stable environment for long-term investment in land improvements and sustainable practices. Reforming land tenure systems to provide more farmers with land ownership or secure leases may encourage investment in sustainable practices.

Informed consent

Oral informed consent was obtained from individual participants included in the study.

Conflicts of interests

The authors declare that there are no conflicts of interests.

Ethical approval

Not applicable.

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Data and materials availability

All data associated with this study are present in the paper.

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