Journal of Forestry Research and Management. Vol. 18(4).18-27; 2021, ISSN 0189-8418

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DETERMINANTS OF LAND USE INTENSITY AMONG FOOD CROP FARMERS IN OLD OYO NATIONAL PARK SUPPORT ZONE COMMUNITIES, OYO STATE, NIGERIA

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ABSTRACT

Increase in food production has been attributed mainly to expansion in areas cultivated to food crop rather than productivity of the arable lands. This study examined the determinants of land use intensity among food crop farmers in Old Oyo National Park Support Zone Communities, Oyo State, Nigeria. A multi - stage sampling procedure was used in selecting the food crop farmers. The settlements were selected using simple random sampling technique while the food crop farmers were selected using purposive random sampling technique. Primary data were collected from 124 food crop farmers. Descriptive Statistics, Ruthenberg value calculation and Multinomial Logit Regression Analysis were used to analyse the collected households' data. The results showed that land use intensification in the study is high/intense (0.74). Household size (ß = -0.3), farm size (ß = 4.7), fallow period (ß = 0.7), total farm income (ß = -1.3), household's head farming experience (ß = -0.1) and household's distance of farm to market (ß = -0.4) are major determinants of land use intensification in the study area. It was concluded that through strengthening efforts of the activities of agricultural extension services, accessibility of food crop farmers to sufficient credit and stakeholders, the investment on yield increasing technology packages would increase the food crop farmers' farm income.

Keywords: Old Oyo National Park, Support Zone, food crop farmers, land use intensity

Introduction

Attainment of food self-sufficiency is a prominent developmental agenda facing most nations of Sub Sahara Africa (SSA). This has severally been attributed to persistent imbalance between population and food growth rate (Rosegrant *et al*., 2001; USDA, 2006). Nigeria by virtue of its prominent position as the most populous nation in the region is in no way facing lesser challenges as regards reducing the countries dependence on food import through improvement in food self-sufficiency ratio which is in turn pivoted on increased domestic food production.

However, previous increased in food production has been attributed mainly to expansion in cultivated land areas (areas cultivate to food crop) rather than productivity of the arable lands. The inherent limitation of this approach is however evident in the decline in Nigerian agricultural land area by 15.4% (FAO, 2000 estimate) attributable to land alienation, degradation and loss of about 351 000 hectares annually to desertification (Brown, 2005). Bamire and Manyong (2003) also attributed the decline to population growth and the consequent pressures from competing demands for land over times; which have resulted in cultivable land being withdrawn from its traditional agricultural uses, reduction in land-man ratio and average size of farmland.

In addition, reports of shortened fallow period (Adelana and Ojo-Atere, 1997; Agbonlahor *et al.* 2003; Bamire and Manyong, 2003; Oyekale, 2007) pervades literature on the dynamics of the Nigerian farming systems thereby underscoring increase in land-use intensity through continuous or intensive cropping. Although, literature on intensification (Boserup, 1981; Buckles and Erenstein, 1996; Erbaugh, 1999) have affirmed the potential of achieving agricultural growth through intensification, commensurate use of modern inputs were identified as fundamental condition for sustainable growth through increased land-use intensity. In the absence of this, increased land-use intensity could lead to continuous depletion of soil fertility, decline in productivity, loss of soil structure, soil erosion and land degradation (Erbaugh, 1999).

This undoubtedly creates a divergence between the need to seek food growth through intensification and the condition for sustainable growth in the country. This divergence is rather indicative of the challenges in the possible quest for increased production through increase land-use intensity.

Nonetheless, the ingenuity of the Nigerian farmers in adjusting to emerging challenges of the production environment cannot be overlooked. Such ingenuity has the long years of experience of the farmers and their interaction with the research system as its bedrock. The application of such experience becomes handy as farmers adapt different cropping systems to fit different compelling agro-ecological and socio-economic circumstances (Hassam, 1996). Consequently, farmers constantly make decisions on what production methods and technologies are best suitable for the prevailing environment, and system of farming. For instance, the desired duration to maturity, and hence a suitable cultivar to be planted, depends on whether double or single cropping is followed and the same applies to the optimal time of planting. These scenarios obviously portray a complex of interacting factors that could either undermine or enhance the country's quest for the much needed growth in the food sub-sector through increased intensity (Saka *et al.*, 2011).

The study therefore examined food crop farmers' land use intensity determinants in Old Oyo National Park Support Zone Communities, Oyo State, Nigeria with a view to ascertain the socioeconomic characteristics of food crop farmers, determine the factors influencing land use intensity and evaluate the land use intensification in the study area.

Methodology

Study Area

Old Oyo National Park, one of the seven National Parks in Nigeria is located in Oyo State, South Western part of Nigeria. It lies between latitude 8º 15' – 9º 00' N and longitude 3º 35' – 4º 42' E. and has a total land area of 2,512km^2. The park is surrounded by twelve (12) Local Government Areas out of which eleven (11) falls within Oyo State. These include Atiba, Atisbo, Irepo, Iseyin, Itesiwaju, Iyamopo/Olorunsogo, Oorelope, Orire, Oyo West, Saki East and the only one in Kwara State is Kaiama. The Park lies in plain lowland between 330m and 508m above the sea level with a gentle slope along the Ogun river valleys. The Park is well drained by rivers Ogun, Owu, Owe and their tributaries in the central and southern parts, while river Tessi drains the north east part of the Park. There are four vegetation types in the Park: deciduous forest and dense savannah mosaic woodland; dense and open savannah, woodland mosaic; dense savannah woodland, and open savannah woodland north east of the park. Annual rainfall in the Park ranges between 900mm and1500mm and main annual temperature is between 12ºC and 37ºC. The rainy season begin in April through

Journal of Forestry Research and Management. Vol. 18(4).18-27; 2021, ISSN 0189-8418

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September with the highest rainfall record between July and August. The dry season begins in October through early April and the driest and hottest period is between March and April. The Park experiences the harmattan period from November through February (OONP, 2012).

Sampling procedure and Data collection

Structured questionnaire with open and closed ended questions were administered in selected settlements in the peripheral support zone of Old Oyo National Park, Oyo State. A multi - stage sampling procedure was used for the purpose of selecting households. The first stage involved was identifying the food crop farming settlements that was within 0-10 Kilometre borders of the surrounding areas of the Old Oyo National Park (Shackleford, 2020). Following this, nine settlements were selected using simple random sampling method while a minimum of ten food crop farmers were selected using purposive random sampling method. In all, 124 farmers were interviewed and were later used for data analysis.

Ruthenberg value: The land use intensity of all arable fields is estimated following Ruthenberg (1980) calculation. This is represented by the degree of residence or R-factor. This factor can be calculated in the spatial dimension by dividing the cultivated area (S), by the total Usable area (U), that is.

$R = S/U$ … Eq. 1

However, whereas cultivated area is physically marked and hence, relatively easy to measure, total usable area, that is., cultivated and fallow land is difficult to define and measure in the field. On the other hand, farmers easily remember the length of the cropping and fallow period of their fields. Therefore, the land use intensity is estimated in the temporal dimension by dividing the Cropping period (C), of the field by the total length of a rotation cycle, that is. $R = \frac{C}{C+F}$

...Eq. 2

Taking into account the Fallow period (F). The Eq. 3 allows us to obtain an estimate of the total usable area, that is., U =

$S/U = \frac{S(C+F)}{C}$ …Eq. 3

Multinomial Logit Regression Model was used to analyse the collected data on the determinants of land use intensity of food crop farmers in the study area. Four categories were considered in this model. These are low land use intensity (= 0.4), moderate land use intensity (0.4 – 0.6), high land use intensity (0.6 – 0.8) and very high land use intensity (= 0.81). However, the reference category for the multinomial logit analysis was very high land use intensity (= 0.81).

The Multinomial logit model is thus specified as:

$$P_{ij} = \text{Prop}(Y=1) = \frac{\exp(X'\beta)}{1+\sum_{j=1}^{j}\exp(X'\beta)}$$

for j = 1,…, n …Eq. 4

where,

ß* is a vector of unknown parameters that can be interpreted as the net influence of the vector of explanatory variables influencing land use intensity,

X_is are the explanatory variables, and they included the following

X_1 = Family Size (Household Members)

X_2 = Total Farm Size/Holding (Ha)

X_3 = Farming Experience (Years)

X_4 = Average Distance of Home to Farm(s) (Km)

X_5 = Average Distance of Farm(s) to Nearest Market (Km)

X_6 = Average Distance of Household to Nearest Market (Km)

X_7 = Years of Settlement (Years)

X_8 = Average Fallow Period (Months)

X_9 = Total Farm Income (Naira)

Results and Discussion

Socioeconomic characteristics of the respondents

Table 1 shows that majority (41.9 %) of households had household size between 6 and 10 members with an average household size of 9 members. The relatively large size of the households is attributable to the dominance in some parts of the State which permits marriage with more than one wife (Babatunde and Qaim, 2010). More so, the results might point to the fact that most farming households in the study area used the proceeds from farming to complement the non-farming income of their families and employ relatively large and affordable family labour in arable crop production (Shittu, 2014).

The result shows that majority of crop farming household heads in the study area (49.2%) have farming experience above 21 years with an average farming experience of 22.4 years. The result implies that majority of the food crops households have been producing food crops for a long time and this might be an indication of efficiency in food crops production. It also means that farming business is a well-established venture in the study area with vast potentials for increase in private investment. Majority of the food crop farmers (57.3%) made more than an average of 200,000 Naira as their farm income overtime having a mean of 214,965.29 Naira in the study area. This means that crop farming activities is profitable in study area. About 42.7% of crop farming households have their total farm size between 5.01 ha to 10.0 ha. The mean total farm size for all the households stood at 8.1ha. This implied that most of the farmers had large farm size for production of food crops. The result could also be linked to the continuous subsistence nature of cultivation of arable crop enterprises in the study area imposed by increasing land fragmentation, rural development and urbanization (Gebissa, 2021).

Majority of the food crop farmers (75.0%) travelled an average of about 5 kilometres from their house to the farm(s). Mean average distance of home to farm(s) is 3.9 km. The distance travelled by the farmers who do not have means of transportation is likely to have a negative influence on labour hours spent by the farmers on their farms. Majority of the food crop farmers (65.3 %) travelled an average of over 5 kilometres or more from their farm(s) to the nearest market. Mean distance of their farm(s) to the nearest market is 7.3 km. The distance travelled by the farmers who do not have means of transportation is likely to have a negative influence on marketing efficiency of farm products by the farmers on their farm(s) to the nearest market. Likewise, about 63.7% of the food crop farmers travelled an average of over 5 kilometres or more from their (s) to the nearest market. Mean average distance of their home to the nearest market is 9.1 km. This finding is similar to Adebayo *et al.*, (2016) who studied the market orientation participation of food crop farming households' land use in Kainji Lake National Park Support Zone, Niger State, Nigeria.

Table 1: Socio-Economic Characteristics of the respondents

Variable		Frequency	Percentage
	= 5	42	33.9
Household size (Household members):	6 - 10	52	41.9
Mean= approx. 9	11 - 15	19	15.3
	> 15	11	8.9
Farming experience (Years):	= 15	25	20.2
Mean=22.4	16 - 20	38	30.6

	> 21	61	49.2
	= 200,000	53	42.7
Farm income (Naira) / Cropping Season: *Mean=214,965.29*	200,001 - 250,000	44	35.5
	> 250,000	27	21.8
	= 5	38	30.6
Total Farm Size/holding (Ha): *Mean=8.1*	5.01 - 10	53	42.7
	> 10	33	26.6
Years of Settlement (Years):	= 25	43	34.7
Mean=29	> 25	81	65.3
Agricultural Land Fallow Period (Years):	= 5	85	68.5
Mean=3.3	> 5	39	31.5
Average Distance of home to farm(s) (Km):	= 5	93	75.0
Mean=3.9	> 5	31	25.0
Average Distance of farm(s) to nearest market (Km):	= 5	43	34.7
Mean=7.3	> 5	81	65.3
Average Distance of home to nearest market (Km):	= 5	45	36.3
Mean=9.1	> 5	79	63.7

Determinants of Food crop farmers' Land Use Intensity

The presence of a relationship between the dependent variable and combination of independent variables is based on the statistical significance of the final model chi-square. In this analysis, the probability of the model chi-square (127.572) which is also statistically significant ($p<0.05$) suggested a strong explanatory power of the model and meaning that the variables considered jointly exert a very significant influence on the intensity of land use of the food crop farmers. This is an indication that all or some of the slope coefficients are significantly different from zero. It therefore means that the model is capable of showing and explaining the determinants of intensity of land use of the food crop farmers. This indication is also confirmed by the pseudo R square measures or likelihood ratio index (Cox and Snell = 0.611, Nagelkerke = 0.729 and McFadden = 0.436).

In this analysis, the last category was used as the "reference state." The reference category for the multinomial logit analysis was Very High Land Use Intensity, that is, LUI = 0.81 and the result is presented in the Table 2.

The results of the estimates of the explanatory variables shows the set of significant explanatory variables and their sign vary across the groups.

The result showed that household size was significant ($p<0.05$) but negative, implying that an increase in household size will decrease the probability of households' of low land use intensity. For each unit increase in household size, the odds of being in the group of survey households whose land use intensity is low will decrease by 30% (Adeyemo *et al.*, 2019).

The coefficient of farmland size was found to be significant and positive, for low land use intensity ($p<0.05$), moderate land use intensity ($p<0.05$), and high land use intensity ($p<0.05$). This implies that an increase in this variable will increase the likelihood of sampled households land use intensity respectively. The associated odd values of households land use intensity as opposed to very high land use intensity are 59.3, 30.4 and 28.8 respectively. With these in mind, households with larger farmland size are more likely to reduce their farmland use intensity (Weldearegay *et al.*, 2021).

However, the coefficient of average fallow period of farmland was found to be significant and positive, for low land use intensity ($p<0.05$), moderate land use intensity ($p<0.05$), and high land use intensity ($p<0.05$). This implies that an increase in this

variable will increase the likelihood of sampled households land use intensity respectively. The associated odd values of households land use intensity as opposed to very high land use intensity are 0.9, 0.8 and 0.8 respectively. The implication of this is that households with longer farmland fallow periods are more likely to reduce their farmland use intensity. This may be as a result of the replenishment of the soil, however reducing the intensity in the use of their farmland (Mechiche-Alami and Abdi, 2020).

In terms of households' farm income, the study found out that households' farm income is significant and negative, for low land use intensity($p<0.05$), moderate land use intensity ($p<0.05$), and high land use intensity ($p<0.05$). The implication is that an increase in households' farm income will decrease the probability of households' of land use intensity (= 0.8). For each unit increase in households' farm income, the odds of being in the group of survey households whose land use intensity is = 0.8 will decrease by 75%, 69% and 70% (Satterthwaite *et al.*, 2010).

Also, households' head farming experience is significant ($p<0.05$) and negative for moderate land use intensity ($p<0.05$). This implies that an increase in households' head farming experience will decrease the probability of households' of land use intensity (0.41-0.6). For each unit increase in households' head farming experience, the odds of being in the group of survey households whose land use intensity is between 0.41- 0.6 will decrease by 3% (Kouassi *et al.*, 2-2021).

Furthermore, households' average distance of farm(s) to nearest market ($p<0.05$) and negative. The implication is that an increase in households' average distance of farm(s) to nearest market will decrease the probability of households' of land use intensity (0.61 - 0.8). For each unit increase in households' average distance of farm(s) to nearest market, the odds of being in the group of survey households whose land use intensity is between 0.61 - 0.8 will decrease by 40%. This findings are similar to Adebayo *et al.*, (2016) and Umunna, (2016) who studied the determining factors influencing the intensification of land use around protected areas in Niger State, Nigeria.

Table 2: Determinants of Food crop farmers' Land Use Intensity

Land Use Intensity Group	Variables	ß	Sig.	Odd Ratio
Low Land Use Intensity (= 0.4)	Intercept	-0.32	0.35	
	Family size (household members):	-0.30	0.03	-0.30
	Total farm size/holding (ha):	4.60	0.01	59.29
	Farming experience (years):	-0.03	0.43	0.04
	Av. distance of home to farm(s) (km):	0.69	0.86	0.24
	Av. distance of farm(s) to nearest market (km):	-0.16	0.18	-0.34
	Av. distance of household to nearest market (km):	-0.10	0.77	0.09
	Years of settlement (years):	-0.01	0.29	0.06
	Av. fallow period (months):	0.70	0.00	0.87
	Total farm income	-1.32	0.01	-0.75
Moderate Land Use Intensity (0.41-0.6)	Intercept	-1.68	0.13	
	Family size (household members):	-0.05	0.18	-0.04
	Total farm size/holding (ha):	4.77	0.01	30.42
	Farming experience (years):	-0.10	0.03	-0.03
	Av. distance of home to farm(s) (km):	0.56	0.61	0.34
	Av. distance of farm(s) to nearest market (km):	-0.07	0.23	-0.21
	Av. distance of household to nearest market (km):	0.12	0.80	0.16
	Years of settlement (years):	-0.01	0.40	0.09
	Av. fallow period (months):	0.68	0.00	0.84

	Total farm income	-1.03	0.01	-0.69
High Land Use Intensity (0.61-0.8)	Intercept	-0.30	0.27	
	Family size (household members):	-0.07	0.12	-0.05
	Total farm size/holding (ha):	4.68	0.01	28.77
	Farming experience (years):	-0.05	0.74	0.11
	Av. distance of home to farm(s) (km):	0.68	0.33	0.53
	Av. distance of farm(s) to nearest market (km):	-0.43	0.02	-0.40
	Av. distance of household to nearest market (km):	0.18	0.34	0.22
	Years of settlement (years):	-0.02	0.19	0.07
	Av. fallow period (months):	0.65	0.00	0.78
	Total farm income (naira)	-1.06	0.01	-0.70

The reference category is: **Very High Land Use Intensity (= 0.81)**

Land use intensification

Ruthenberg-value was estimated for each farming households. The Ruthenberg-value shows the land use intensity (intensification index) for each farming households.

The result reported in Table 3 showed a distribution of food crop farmers' land use intensification. Majority of the food crop farmers' land use intensification in the study are is high and intense. The findings revealed an average value of 0.74 and the minimum as well as the maximum values of 0.24 and 0.93 respectively. This implies that, an average farming household in the study area cultivate crops almost on continuous basis (Tandzi and Mutengwa, 2020). This finding could be explained by the constraints imposed by excessive land fragmentation, relative scarcity of fertile land, land use protection and reservation of the area (Dias *et al*, 2016). Farmers faced with this limitation have no option than to adopt continuous cropping which is usually accompanied by soil degradation and poor yields and has negative effect on their income generation (Erbaugh, 1999). Depending on the agronomic practices adopted by the food crop farmers in the study area, the land use may be unsustainable or may not (Idowu and Adeogun 1997).

Table 3: Land Use Intensification Indices

Land Use Intensity (LUI)	Frequency	Percentage
Low LUI (= 0.4)	8	6.67
Medium LUI (0.41-0.6)	35	28.15
High LUI (0.61-0.8)	49	39.26
Very high LUI (= 0.81)	32	25.93
Mean = 0.74 ; Minimum = 0.24 ; Maximum = 0.93		

Conclusion

This study has shown and provided additional insights into the households' current and intensified land use and its relationship with households' socioeconomic characteristics. It is however concluded that household size, farm size, fallow period of land, household's total farm income, household's head farming experience and household's distance of farm to market are the major determinants of land use intensification in the study area.

Activities of agricultural extension services in the study area should be intensified and re-directed to focus more on demonstration of appropriate crop combinations technique. To achieve this, focus group discussion, seminars, workshops and farm demonstrations should be organized for farming household heads. Through these channels, food crop farmers would be aware of the danger of increase land use intensification and made attempts to adopt appropriate strategies to amend the soil and conserve the land. Special attention should be given to fertilizer procurement and distribution to food crop farmers in the study area. Increase fertilizer use might reduce the menace of increase land use intensification through increase in output.

Policies from government, private initiatives and other stakeholders should ensure that food crop farmers have access to sufficient credit to increase their ability and flexibility to change production strategies in response to the decision made on land use and its conditions. There should also be investment on yield increasing technology packages to increase farm income.

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