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Agricultural Intensification and Poverty among Farmers in Kogi State, Nigeria

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ABSTRACT
The study examined the effect of agricultural intensification on poverty status of farmers in Kogi State. Multistage sampling technique was employed in selecting respondents. Primary data was collected from 215 farming households using structured questionnaire. Data collected were analyzed using descriptive statistics, Ruthenberg index, Foster, Greere and Thorbecke (FGT) index and Probit regression model. The results show that majority (69.8%) of the farmers were male, married (84.7%), had formal education (81.4%), and had no access to credit (68.8%). The average household size was 5 and the average farm size was 2.7ha. The mean land use intensity index was 0.75, mean fertilizer use intensity index was 145kg/ha and mean labour use intensity index was 20mandays per hectare. The mean per capita household expenditure was ₦1,827.79. From the estimated poverty line of ₦1,218.53, the FGT measures show that 64.2% of the farmers were poor while 35.8% were non-poor. Also, household size, farm size, organic manure, cover crops and labour use intensity significantly affect poverty. Land use intensity is positively related to the probability that a farmer would be poor.

Keywords: Agricultural Intensification, Poverty Indices, Land Use Intensity, Fertilizer Use Intensity, Labour Use Intensity, Household Expenditure

1.0 INTRODUCTION

In Nigeria, the greatest challenge in agriculture is to grow food for its ever increasing population amidst the myriad of social, economic and cultural problems facing the nation (Fakoya *et al*., 2007). According to Titilola and Jeje (2008), analysis of the future demand for food and agricultural raw materials, as well as trends in their supplies have shown clearly that greater and rapid increases are needed over and above past trends if the goals of improved nutrition, economic development and poverty reduction are to be achieved. They claimed that achieving increased production will require the expansion and intensification of productive land for agriculture which will lead to increased production and improvement in the use of other farm inputs, thereby increasing output and reducing poverty.

According to Udoh *et al*. (2011), the increasing demand for agricultural commodities generates from an ever increasing population. They explained that the existence of various agricultural programmes and policies intended to boost arable crop production are incentives for farmers to increase agricultural production and these have prompted many arable crop farmers to intensify the frequency of cropping, change combination of crops planted in attempts to maximize land use and reduce risks and uncertainties in production.

Agricultural intensification can generally be explained as an increase in the use of inputs of labour or capital on a smallholding, in order to increase output per hectare (Oyekale and Adepoju, 2012). Dixon *et al*. (2001) defined agricultural intensification as increase in the physical or financial productivity of existing patterns of production in all agricultural activities due to the greater use of external inputs, increased use of improved varieties and breeds, utilization of unused resources, improved labour productivity, and better farm management. Ruthenberg (1980) stated that fallow period is an indicator of intensification. Other indicators as noted by Okike *et al.* (2001) are labour use intensity, manure use intensity, fertilizer use intensity and intensity of animal traction.

However, continued increase in land use intensity without corresponding plans to supplement the soil with sustainable nutrients could be detrimental to the national agricultural development goals of self-food sufficiency in the long run (Udoh *et al*., 2011). 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 (Oladeebo and Adekilekun, 2013). Van Noordwijk (2005) suggested that the extent of the intensity of land use could be an indicator of poverty level; at some stages, agricultural intensification provides the financial resources to reduce poverty but, at other times, environmental degradation becomes a determinant of poverty.

Poverty has been identified as a major limitation to economic growth and development (Awotide et al., 2015). In relation to income or consumption, a person is considered as poor if his income or consumption is insufficient for him to enjoy a certain level of well-being or more technically, the person's income or consumption falls below an established threshold which differs across countries (UNESCO, 2015). As indicator of food consumption, poverty is defined as the intake of less than 2,200 calories per day (Von Braun *et al.,* 2009), and in terms of assets, poverty indicates deprivation of basic needs, goods and services such as cattle holdings, the quality of agricultural implements, housing materials, labour resources, access to land and the ability of the household to produce food (Gray and Moseley, 2005).

Iheke (2006) observed that growth in population combined with rapid urbanization has fueled an increased demand for agricultural goods that regional production is increasingly failing to meet. As such, Haggblade (2004) asserted that significant poverty reduction will not be possible without rapid agricultural growth. Therefore, agricultural intensification becomes a veritable option which involves the efficient use of production inputs, increased productivity which comes from the use of improved varieties and breeds, efficient use of labour, and better farm management (Dixon *et al.,* 2001). According to Borlaug (2007), per hectare increase in agricultural productivity will lead to a reduced demand for crop land, potentially sparing these lands for other uses.

However, agricultural intensification is one of the major threats to sustainable agricultural production (Oladeebo and Adekilekun, 2013). From the foregoing, given agricultural intensification leads to more efficient use of production inputs thereby increasing productivity; it is pertinent to examine its effect on poverty alleviation without further damage to the local and global environment. Therefore, the general objective of the study is to determine the effect of agricultural intensification on poverty status of farmers in Kogi State. The specific objectives are to analyze the extent of agricultural intensification by farmers, determine the poverty status of farmers, and describe the effect of agricultural intensification on poverty status of farmers.

2.0 MATERIALS AND METHODS

The study was carried out in Kogi state, Nigeria. It is located in the North Central region of Nigeria. The state lies between latitude $71'49^0$ North and longitude $61'45^0$ East, with an average maximum and minimum of 33.5^0C and of 23.5^0C. The major ethnic groups found in the state are Igala, Yoruba, Ebira, Nupe and Bassa. Kogi state occupies 27,747 square kilometers and has a population of 3,844,559. The state has two distinct weathers; the dry season which lasts from November to February and rainy season which lasts from March to October. In 2009, the average annual rainfall in the state was 1631.5mm (NBS, 2012).

Multistage sampling technique was used for selection of respondents. In the first stage, one local government area was randomly selected from each of the four agricultural development zones in the state (Aiyetoro-Gbede, Koton-karfe, Anyigba and Alloma). In the second stage, three communities were randomly selected from each of the four local governments. In the final stage, twenty households were randomly selected from each community giving a total of 240 households for the study. Primary data were collected with the use of structured questionnaire administered to the 240 respondents, out of 215 were recovered and used for the final analysis.

2.2 Analytical Techniques

Data collected were analyzed using descriptive and inferential statistics. The socio-economic characteristics of respondents were analyzed using descriptive statistics such as frequency distribution and percentages and the results presented in frequency distribution tables. The objectives were analyzed as follows:

2.2.1 Extent of Agricultural Intensification

Agricultural intensification was analyzed through land use intensity, labour use intensity and fertilizer use intensity which were estimated by adopting the Ruthenberg's index, labour use intensity index and fertilizer use intensity index respectively for each farmer.

Land use intensity index:

$$R = \frac{C}{C+F} \text{ x } 100$$

Where R= land use intensity, C=length of cropping period, F= length of fallow periods

Labour use intensity index:

$$L = \frac{l}{A} \text{ x } 100$$

Where L= labour use intensity, l = total labour used, A = total area of land cultivated

Fertilizer use intensity index:

$$F = \frac{f}{A} \text{ x } 100$$

Where F = fertilizer use intensity, f = quantity of fertilizer used, A = total area of land cultivated

R lies between 0 and 1. The further the value of R is from unity, that is, closer to 0, the more the likelihood that fallow would be adequate to restore natural fertility and improve sustainability (Udoh, 2000). The higher the values of L and F, the higher the intensity of their use.

2.2.2 Poverty Status of Farmers

The poverty level of farmers was determined using the poverty measures by Foster, Greer and Thorbecke (FGT). Poverty line is the value of income or consumption expenditure necessary for a minimum standard of living (Aigbe and Isiorhovoja, 2013). The poverty line is two-thirds of mean per capita household expenditure. The Foster, Greer, and Thorbecke weighted measure of poverty is based on income or expenditure of the household and per capita household expenditure was used in this study. FGT is the most widely used model of poverty measurement because it is consistent and additively decomposable (Foster *et al*., 1984). The FGT index is given by

$$P_\alpha = \frac{1}{N}\sum_{i=1}^{q}\left[\frac{Z - Y_i}{Z}\right]^\alpha$$

Where; Z = poverty line defined as 2/3 of the Mean Per Capita Household Expenditure (MPCHE),

Yi= per capita expenditure in increasing order for all households;

q= number of poor people in the population of size N and

α= poverty aversion parameter that takes values of zero, one or two (zero measures poverty incidence; one, poverty gap and two, poverty severity).

MPCHE = Total per capita household expenditure/Total number of households

To get the poverty line, two sets relative to the standard of living of respondents were estimated thus: Moderate poverty line equivalent to two-thirds of the mean per capita household expenditure; Core poverty line equivalent to one-third of the mean per capita household expenditure.

Households were then categorized into 3 poverty classes namely: Core Poor, moderately Poor and non-Poor households. Any household whose expenditure falls below the upper poverty line (moderately and core poor) is regarded as being poor while those above it are regarded as non-poor.

2.2.3 Effect of Agricultural Intensification on Poverty Status of Farmers

To describe the effect of agricultural intensification on the poverty status of farmers, the Probit model was adopted. The dependent variable is dichotomous, that is, poor and non-poor; poor takes the value of 1 and 0, if non-poor. It is expressed thus:

$$P_i = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + B_6X_6 + B_7X_7 + B_8X_8 + B_9X_9 + B_{10}X_{10} + B_{11}X_{11} + B_{12}X_{12} + B_{13}X_{13} + e_i$$

Where P_i = Poverty status dummy (poor = 1, 0 otherwise)

B_i = Coefficients of the explanatory variables

X_1 = Level of education, X_2 = Household size (no of people living in households), X_3 = Farm size (hectares), X_4 = Access to credit (1 for access, 0 otherwise), X_5 = Bush burning (yes =1, 0 otherwise), X_6 = Crop rotation (yes =1, 0 otherwise), X_7 = Organic manure (yes =1, 0 otherwise), X_8 = Zero tillage (yes =1, 0 otherwise), X_9 = Cover crops (yes =1, 0 otherwise), X_{10} = Mulching (yes =1, 0 otherwise), X_{11} = Land use intensity index, X_{12} = Fertilizer use Intensity index, X_{13} = Labour use intensity index, e= Error term

It is expected that level of education, farm size, access to credit, organic manure, zero tillage, cover crops and mulching would be inversely related to poverty. Household size is expected to be directly related to poverty; land use intensity, labour use intensity and fertilizer use intensity are expected to either increase or decrease poverty.

3.0 RESULTS AND DISCUSSION

3.1 Distribution of farmers according to their socioeconomic characteristics

The socioeconomic characteristics of farmers are presented in Table 1. From the results, 69.8% of the farmers interviewed were male meaning that farming is an occupation dominated by men which may be due to the intensive labour requirement for agricultural activities. Also, 84.7% of the farmers were married. According to Egbetokun *et al*. (2014), the marital status of farmers influence the productivity of a farmer, because a married man would be more committed to his work than the single considering the dependent(s) on him. This implies that married farmers may use land more intensively.

The high percentage of respondents (81.7%) who had received formal education implies that farmers were literate and they may adopt land conservation practices which would prevent land degradation and reduce poverty. Households with 5-9 persons were found to be the highest (67.4%). This implies that majority of farmers in the study area had large households and this might increase the quantity of family labour in the study area. Households with larger sizes may use land unsustainably compared to households with smaller sizes which may lead to degradation of the land. The mean household size of farmers in the study area was 5± (2.02).

The mean years of farming experience of respondents was 24 years ± (8.72). Farming experience may also be positively related with adoption of better land management practices by farmers which would prevent land degradation and reduce poverty. Majority (91.6%) of the farmers had farm sizes below 4ha, implying that land may be used intensively as farmers may not have adequate land to practice bush fallowing. Also, 68.8% of the farmers did not have access to credit, implying that majority of the farmers in the study area could not access credit necessary for purchasing inputs such as fertilizer, seeds, and etcetera.

Table 1: Socioeconomic Characteristics of Farmers

Variables	Frequency n = 215	Percentage	Mean	Standard Deviation
Gender				
Male	150	69.8		
Female	65	30.2		
Marital Status				
Single	11	5.1		
Married	182	84.7		
Divorced	4	1.9		
Widowed	10	4.7		
Separated	8	3.7		
Level of Education				
Primary School	80	37.2		
Secondary School	75	34.9		
Tertiary	20	9.3		
No formal Education	40	18.6		
Household Size				
1 – 4	66	30.7		
5 – 9	145	67.4	5	2.02
≥10	4	1.9		
Farming Experience (years)				
< 10				
11 – 20	20	9.3		
21 – 30	66	30.7	24	8.72
> 30	86	40		
	43	20		
Farm size (ha)				
< 2	89	41.4		
2 – 4	108	50.2	2.7	1.14
> 4	18	8.4		
Access to Credit				
No	148	68.8		
Yes	67	31.2		

Source: Field Survey, 2015

3.2 Distribution of farmers by Agricultural Intensification Indices

Results of agricultural intensification indices are presented in Table 2. The mean land use intensity index of farmers in the study area was 0.75. According to the Ruthenberg model, since the mean land use intensity was closer to unity (1), intensity of land use is said to be high. This shows that time allowed for fallow is short. This may be due to the inadequacy of land (below 4ha) for farming activities. Also, the mean labour use intensity index was estimated at 20.3 mandays/ha. The result may be due to the large number of members of households which increases the available family labour. Furthermore, the mean fertilizer use intensity index was 0.0145kg/square meter. This means that an average of 145kg of fertilizer was used per hectare on farm. The high usage of fertilizer may be attributed to the continuous use of land shown by the high value of land use intensity index and limited time allocated for fallow by farmers.

Table 2: Agricultural Intensification Indices

Index	Mean value
Land Use Intensity	0.75
Labour Use Intensity	20.3 man day/ hectare
Fertilizer Use Intensity	145kg/hectare

Source: Data Analysis, 2015

3.3 Land Management Practices

Results show that 56.3% of farmers practiced bush burning and 59.5% of respondents practiced clean clearing. This implies that most of the farmers did not allow crop residues and other types of foliage cleared from the farm to decompose but burn it or dispose of it. On the other hand, 71% of respondents practiced crop rotation and 68.4% practiced mulching. This may be due to awareness of the importance of crop rotation which has the potential to enhance soil nutrients, and mulching in conserving soil moisture and nutrients. Also, 48.4% of farmers in the study area used organic manure while high percentage (95.8%) of farmers used inorganic fertilizer. Cover cropping was practiced by 47.4% of the farmers and only 7.4% engaged in zero tillage. For land preparation, 23.7% of the farmers used tractor.

Table 3: Land Management Practices of Respondents

Variables	Frequency	Percentage
Bush burning	121	56.3
Clean clearing	128	59.5
Crop rotation	159	71.0
Mulching	147	68.4
Organic manure	104	48.4
Use of fertilizer	206	95.8
Cover crop	102	47.4
Zero tillage	16	7.4
Use of tractor	51	23.7

Source: Data Analysis, 2015

3.4 Analysis of Poverty Status of Respondents

The total per capita household expenditure was found to be ₦392, 975.20. The mean per capita household expenditure was estimated by dividing the total per capita household expenditure by the number of households (215). The calculated mean per capita household expenditure was ₦1,827.79. The poverty line which represents 2/3 of the mean per capita household expenditure was estimated as ₦1,218.53. This means that any household whose per capita expenditure was below ₦1,218.53 was regarded as poor and any household whose per capita household expenditure was above ₦1,218.53 was regarded as non-poor. Based on this, 64.2% of the respondents were poor while 35.8% were non-poor. Also, 1/3 of the poverty mean per capita household expenditure was estimated as ₦609.26. Any household whose per capita household expenditure was below ₦609.264 was regarded as extremely poor.

From the results, 6.1% of the respondents were core (extremely) poor implying that 6.1% of the respondents could not afford to spend ₦609.264 in a month for the basic necessities of life. The results also show that 58.1% of the respondents were moderately poor which implies that their monthly consumption was above ₦609.264 but below the poverty line which is ₦1,218.528. On the other hand, 35.8% of the respondents were non-poor which implies that their per capita household expenditure was above the poverty line and could afford the basic necessities of life. These results are explainable considering the fact that majority of the farmers earned below ₦100 000 yearly and only 0.9% of farmers earned above ₦300 000 per annum.

The poverty incidence or head count ratio (P_0) of farmers was 0.64. This implies that 64% of respondents in the study area fell below the poverty line and were relatively poor. The poverty depth or gap (P_1) was estimated at 0.21 which means that 21% of the poverty line that is ₦255.89 was required to move an average poor person to the poverty line. The poverty severity or intensity

was 0.085. Poverty severity measures the distance between each poor person (Mailumo *et al*., 2013). This implied that 8.5% of the respondents were severely poor, that is, even poor households vary in the degree of poverty.

Table 4: Per Capita Household Expenditure and Poverty Status of Farmers

Variable	(₦)/Frequency	Percentage
TPCHHEXP	392,975.20	
MPCHHEXP	1,827.79	
Poverty line	1,218.53	
1/3 MPCHHEXP	609.264	
Poverty Status		
Non poor	77	35.8
Poor	13	6.1
Core poor	125	58.1
Moderately poor	138	64.2

Source: Data Analysis, 2015
TPCHHEXP – Total per Capita Household Expenditure
MPCHHEXP – Mean per Capita Household Expenditure

Table 5: Poverty Indices

Index	Percentage
P_0	64
P_1	21
P_2	8.5

Source: Data Analysis, 2015
P_0 – Poverty Incidence, P_1 – Poverty Gap, P_2 – Poverty Severity

3.5 Effect of Agricultural Intensification on Poverty Status of Farmers

Results of the probit regression showing the relationship between poverty status of farmers and indices of agricultural intensification in the study area are presented in Table 6. Household size, farm size, organic manure, cover crops, mulching and labour use intensity had significant effect on poverty status of farmers in the study area.

Results show that the coefficient of household size was 0.331948 and was significant ($p< 0.01$). This implies that a percentage increase in size of household would result to increased probability of poverty of farmers by 33.2%. Farm size was shown to have a negative relationship with poverty and was significant ($P< 0.01$) with a coefficient of 0.651942. This implies that a percentage increase in land hectarage will decrease the probability that a household will be poor by 65.2%. This is in line with the *a priori* expectation that an increase in farm size would have an inverse relationship with poverty thereby reducing the poverty depth of farmers.

Organic manure had an inverse relationship with poverty and significant ($P< 0.10$) with a coefficient of 0.463504. This shows that a percentage increase in the use of organic manure for agricultural activities would reduce the probability that a farmer would be poor by 46.4%. Mulching is a land management practice that is important for conserving soil moisture and nutrients. The results show that it was significant at 10%. The use of mulch would increase the probability that a farmer would be poor by 82.8%. This result disagrees with *a priori* expectation because theoretically, mulching helps to improve the fertility of the soil which leads to better yield and consequently lessen poverty. However, mulching on land that is being intensively used may not be effective. This is obvious from the land use intensity index of 0.75 that was obtained from the study.

Cover crop was significant and negatively related to poverty ($P<0.10$) with a coefficient of 0.541516 which means that farmers who plant cover crops had a lesser probability of becoming poor. A percentage increase in planting of cover crops would lead to a decrease in the probability of being poor by 54%. This is expected because cover crops help to prevent erosion, loss of moisture and nutrients which would improve the yield of farmers and therefore reduces poverty. Labour use

intensity was significant (P< 0.10) and negatively related to poverty and had a coefficient of 0.016772. This implies that a percentage increase in labour use intensity would reduce the probability that a farmer would remain poor by 1.8%. As a measure of agricultural intensification, the study revealed that the mean labour use intensity index of farmers in the study area was 20mandays per hectare. This implies that the higher the quantity of mandays per hectare used by a farmer, the lesser the chances that the farmer would be poor.

Other variables used in the analysis which could have effect on the poverty status of farmers in the study area were level of education, access to credit, bush burning, crop rotation, zero tillage, land use intensity and fertilizer use intensity.

Table 6: Probit Regression Showing the Relationship between Poverty and Agricultural Intensification

Variables	Coefficient	Standard error	Z value(b/se)	P value
Constant	-0.170593	0.968413	-0.18	0.860
Level of education	-0.105232	0.100337	-1.05	0.294
Household size	0.331948***	0.059886	5.54	0.000
Farm size	-0.651942***	0.113566	-5.74	0.000
Access to credit	-0.072393	0.236602	-0.31	0.760
Bush burning	0.214388	0.258137	0.83	0.406
Crop rotation	0.119799	0.277105	0.43	0.666
Organic manure	-0.463504*	0.276622	-1.68	0.094
Zero tillage	0.604186	0.455990	1.32	0.185
Cover crops	-0.541516*	0.252736	-2.14	0.032
Mulching	0.827755*	0.350679	2.36	0.018
Land use intensity	0.959404	0.960092	1.00	0.318
Fertilizer use intensity	-0.566984	3.114212	-0.18	0.856
Labour use intensity	-0.016772*	0.009721	-1.73	0.084
Log -likelihood = -96.914561 McFadden Pseudo R-squared = 0.3090 P-value (chi square) = 0.0000 Chi square value = 86.68				

***, * = significance @ 1% and 10% respectively

Source: Data Analysis, 2015

4.0 CONCLUSIONS

Based on the poverty line of ₦1,218.528 established by the study, it was established that 64% of the farmers in the study area were poor and required about 21% of the poverty line (₦255.89) to move an average poor person to the poverty line. Based on the findings, 64% of farming households lived below the poverty line. Hence, there is need for a restructuring and redirection of poverty alleviation programmes and projects to become community based in other to target those that are actually poor. Also, farmers use their land almost on a continuous basis (land use intensity index of 0.75) which also influenced the high usage of fertilizer (145kg/ha). It is recommended that farmers should be sensitized on best sustainable land management practices to adopt in order to improve their standard of living.

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