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A Comparative Analysis of Crop Production Intensification and its Determinants among Kwara and Niger States Maize-Based Farming Households

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ABSTRACT Nigeria has been faced with food supply deficit in the past decades. Continuous increase in population density and the consequent pressures from competing demands for land over time have the tendency of worsening the Nigerian arable land situation in the foreseeable future, if unaddressed. Thus, this study compared crop production intensification and its determinants among Kwara and Niger States maize-based households. A total of two-hundred and fifty-two maize-based households were interviewed using structured questionnaire. Data collected were analysed using crop intensification index and Tobit regression model. Analysis revealed that Niger state households have higher crop intensity scores than those of Kwara state households. The estimated Tobit model revealed that market access, farm income and adoption of land management practices; and extension contact, farm income and adoption of land management practices are the significant variables among Kwara and Niger State maize-based households respectively. For sustainability of maize based production, there is the need for a policy option that addresses the provision of qualitative extension education and farming households' access to market in the study areas.

INTRODUCTION

Agriculture is the main stay of Nigerian economy. It involves small scale farmers scattered over wide expanse of land area, with small holding ranging from 0.5 to 3.0 hectare per farm land. It is characterized by rudimentary farm systems, low capitalization and low yield per hectare (Kolawale and Ojo 2007). The role of agriculture remains significant in the Nigeria economy despite the strategic importance of the oil sector. Agriculture provides primary means of employment for Nigeria and accounts for more than one-third of total gross domestic product (GDP) and labour force. Thus, agricultural development is vital to Nigeria's economic growth, food security and poverty alleviation.

Nigerian agriculture is commonly known to be in crisis. The greatest failure is that food production has not kept pace with population growth. The rate of growth of Nigeria's food production is 2.5 percent per annum in recent years, while food demand has been growing at the rate of more than 3.5 percent per annum due to high rate of population growth of 2.83 percent (Kolawole and Ojo 2007). Food imports including food aid in Nigeria has increased substantially to offset the deficiencies. Hence, there is a gap between what farmers are producing and what consumers are demanding. This has created major macro-economic problems in most developing countries. In the past, such food shortfalls were most commonly met by extending the area put to cultivation rather than by crop production intensification which according to Tiffen et al. (1994) is the use of increased average inputs on smallholding for the purpose of increasing the value of output per hectare. However, in most regions and countries this is no longer possible because agricultural frontiers have closed or declined in many parts of the world (Shriar 2000).

Attainment of food self -sufficiency is a prominent developmental agenda facing most nations of Sub- Sahara Africa. To stem the tide of the current food problem through crop production intensification, the Federal government in 2006 initiated a programme of doubling maize production in Nigeria through promotion of improved production technologies such as fertilizer, hybrid seeds, pesticides, herbicides and better management practices. Since then, several stakeholders have alleged their support for this program. Several improved maize varieties, drought tolerant, low nitrogen-tolerant, Striga-tol-

erant, stem borer resistant and early maturing, have been deployed to address the challenge faced by resource-poor farmers in maize production. Despite these efforts however, marginal increase had been brought about on the yield of most cereal crops (especially maize) and even when such is achieved, it is not sustained for long (FAO 2006). One of the reasons often attributed to decline in productivity is depletion in soil fertility primarily resulting from poor production practices characterized by low use of modern inputs. Given the prime position of maize in the Nigerian economy and given the fact that domestic supply has not been able to meet up with the demand, this study, therefore, measures the levels of crop production intensification and highlights its determinants among Kwara and Niger States maize-based farming households.

METHODOLOGY

Area of the Study: This study was conducted in Kwara and Niger States in the Southern Guinea Savanna ecological zone of Nigeria. The zone is located at longitude 38° 148° E and latitude 78° and 108° N. The savanna ecology can well be called the Corn Belt of Nigeria. The Southern Guinea Savanna of Nigeria has great potential for the expansion of maize production beyond the present level due to its bimodal rainfall pattern, (a short early growing season followed by fairly long late season) high solar radiation and favorable temperature during the growing season. However, the zone is characterized by variable weather, fragile soils with low moisture holding capacity that is prone to drought (Fakorede et al. 2001). The soils are also mainly alfisols that are low in organic matter, especially nitrogen which is one of the most essential units for maize growth and productivity. Thus, the region offers a lot of potential for intensification with a view to bringing about much required growth in the maize sub-sector of the Nigerian economy.

Sampling Procedure and Sample Size: The target population for this study is the farming households involved in maize-based production systems in the Southern Guinea Savanna zone of Nigeria. The zone represents a geographical area that is majorly made up of Kwara, Niger, Kogi, Taraba, Plateau and Benue States. A three-stage sampling technique was used to select sample for the study. The first stage involved a purposive selection of Kwara and Niger States. The two states have the list number of crop farmers in the zone in the year 2007 (NBS 2008). The ADPs zones are four and three in Kwara and Niger states respectively. The second stage involved the random selection of 4 villages from each of the ADPs zone in each of the states. The upgraded 2001 Agricultural Development Projects (ADPs) village listing served as the sampling frame for the selections in the two states. In each village, 10 farming households were selected among the farming households in the areas to make up a sample size of 280. However, only 252 questionnaires were retrieved and analyzed.

Analytical Techniques: Descriptive and inferential statistics, crop intensity index, and Tobit regression model were the analytical tools employed to achieve the research objectives. Following Shriar (2005), intensification activities such as intercropping, use of legume, use of fertilizer, pesticides use per hectare, use of herbicides, ploughing methods, use of organic fertilizer and improved seeds have been assigned a particular weight based on its contribution to production intensity. These led to weight values ranging from 2 to 3.5 points (Table 1).

Table 1: Scale ranges and weights associated with agricultural intensity index

Intensification activity	*Scale range*	*Weight*	*Max. Points*
Scale of cereal/ legume plots	0-3	3.5	10.5
Scale of improve seeds	0-3	3.0	9.0
Scale of Ploughing	0-3	2.5	7.5
Scale of intercropping	0-3	3.0	9.0
Scale of fertilizer use per ha	0-3	3.0	9.0
Scale of pesticides use per ha (excluding herbicides)	0-3	2.0	6.0
Use of organic fertilization	0-1	3.0	3.0
Scale of herbicides use per ha	0-3	2.0	6.0
Total			60.0

Adapted from Shriar, 2005 but modified

As evident from the Table 1, not all farming activities could be assessed in sufficient detail to justify using a 0-3 scaling and that the maximum points attainable by the household from all the intensification activities is 60. The index is stated as:

$$CI_i = \sum_{J=1}^{8} S_j W_j \qquad i = 1 \ldots N \quad \ldots\ldots\ldots\ldots\ldots (1)$$

Where

CI is the crop intensification index for the i^{th} household; S is the scale range for the agro-tech-

nology and strategy employed by the i^{th} household and W is the weight of the agro-technology and strategy employed by the i^{th} household

A scale range of 0-1 for the use of organic fertilization implies a yes/No dummy variable. If the household is engaged in the activity he gets 1point and 0 if otherwise. In contrast, a scale range of 0-3 indicates whether the household undertakes the activity and if so, does so at low (1point), medium (2 points), or high (3 points) scale. The multi-level scales (low, medium, high) used in the index are based on the proportion of the total area cropped on which the strategy is practiced except for fertilizer and pesticide scales which are based on the quantities of these items used, calculated on a per hectare basis. Cereal/ legume plots received the highest weighting of 3.5, because production values are likely to be more sustainable over time with legumes (Shirar 2005). The scale of cereal/legume plots involves the intercropping of cereal with any leguminous plants .It takes the value of 0, for no, and 1, 2, 3 for low, medium and high levels of activity respectively.

The scale of improved seeds on the other hand, indicates the proportion of the area cropped on which improve seeds are grown. It takes the value of 0, for no, and 1 (if less than 40 percent is cropped), 2 (if 40-69 percent is cropped), 3 (if 70 percent and above is cropped) for low, medium and high levels of activity respectively.

The primary tillage or cultivation implement used in land preparation in the study area represents the Scale of Ploughing. It takes the value of 0, for no, and 1, 2, 3 for use of cutlasses and hoes, animal traction and tractor respectively.

The scale of intercropping entails the intercropping of maize with other crops apart from legumes. It takes the value of 0, for no, and 1 (if less than 40 percent is intercropped), 2 (if 40-69 percent is intercropped), 3 (if 70 percent and above is intercropped) for low, medium and high levels of activity respectively.

Based on the recommended fertilizer input rate by ADP (2000), fertilizer application rate per hectare of between 50-100kg, 150- 200kg and 250-300kg is hereby regarded as low, medium and high application rate respectively for scale of fertilizer use per hectare.

The quantities of herbicides such as Altrazin, Gramozone, Primextra etc. that are used up in the production processes on per hectare basis represents the scale of herbicide use per hectare. Based on ADP (2000) recommended rate of 4 litres/ hectare, the following classifications are made: 0.1-1.5 litres, 1.6-3.0 litres and 3.1-4.5liters and are thus regarded as low, medium and high application rate respectively.

The scale of pesticides use per hectare involves the quantities of insecticides, fungicides, nematicides etc. that are used up in the production processes on per hectare basis. Based on the ADP, (2000) recommended rate of 4 litres/ hectare, the following classifications are made: 0.1-1.5 litres, 1.6-3.0 litres and 3.1-4.5 litres and are thus regarded as low, medium and high application rate respectively. The scale of organic fertilization is a dummy variable, if the household is engaged in the use of animal dung's and/ or poultry droppings on the farm to raise soil productivity he gets 1point and 0 if otherwise.

Tobit Regression Model: The Tobit model developed by Tobin (1958) described as an extension of the Probit model (Gujarati 2003), used by Adejobi (2004) and Muhammad-Lawal (2008) was adapted for this study. The linear Tobit regression model was used to analyze the effect of certain socio-economic factors on the crop production intensification of farming households. The model was used because the dependent variable crop production intensification scores are censored having values ranging between 0 and 1. The model specification is given as:

$V_j = \beta z_{ij} + e$ 1

$V_j = V_j$ if $V_j > 0$

$V_j = 0$ if $V_j \leq 0$

j = 1 411

V_j^* = Limited or censured dependent variable. It is the measure of severity of household crop production intensification. It is defined as

$(K-Y_j) / K$ 2

Where K = threshold level; V_j = $_j$th household's crop intensity; β = Parameter estimates; z_{ij} = Vector of the explanatory variables.

The farm households' decision to intensify crop production intensification may be related to the characteristics and composition of the household, the size of the farm, capital lay out of the household and the level of transaction costs incurred in the process of using the crop intensification strategy. The household composition and characteristics were captured by number of household members, age, farm and market distances and the number of visits by the extension agents. A negative coefficient implies that the variable is reducing the severity of crop produc-

tion intensification of farming households and vice versa. The following variables affecting crop production intensification of farming households were fitted into the Tobit model:

Z_1 = Age of the household head (years)
Z_2= Education of the household head (dummy)
Z_3= Adjusted household size (number)
Z_4 = Extension contact (number)
Z_5= Household income (Naira)
Z_6= Land management practices (dummy)
Z_7= Market distance (km)
Z_8= Farm distance (km)
μ = error term which explains other effects outside the household's control e.g weather, natural disaster, etc.

RESULTS AND DISCUSSION

The age of the households' heads ranged between 30 and 75 years with an average of 47.1 and 48.3 years in Kwara and Niger State respectively. About 6.4 percent of Kwara State maize based households' heads are above 60 years. While in Niger State 37.6 percent of the maize based households' heads are below 60years of age. About 88 percent of the households' heads in the two states are below 60 years of age. This has implication on the available family labour and productivity of labour.

Sex distribution varies appreciably, 14.3 percent of the households' heads were females, these were made up of 10.3 percent and 4.0 percent Kwara and Niger States maize based households' heads respectively. This may be due to cultural and religious belief of the people in the area, which prohibits woman to go out freely and engage in activities such as farming. Women are usually not allowed to own land and where the woman owns land, they usually delegate its administration to their senior male child or one of their male relations (Table 2).

The average household size is 9 and 11 persons for Kwara and Niger States maize based farming households respectively. Polygamous nature of the people probably explains the large family size recorded in the area. Household size is used as a proxy for labour because individual in the household is a potential source of labour. Their availability reduces labour constraints faced during the peak of the farming season (TeckleWold et al. 2006). Majority of the households' heads (82 percent) are literate with most of them having primary education (32.1 percent) and this is closely followed by Quranic education (30.6 percent). Those who had tertiary education probably constitute the civil servants who engaged in part-time farming in the area. Given this level of literacy, it is expected that information can be disseminated with ease among these farmers.

The primary occupation of the households' heads is predominantly farming (Table 2). Ma-

Table 2: **Socio-economic characteristics of the households' heads in the study area**

Variables	*Kwara*	*Niger*	*Pooled*
i) Age of the Household Head			
21-40 years	38 (15.0)	29 (9.5)	062 (24.6)
41-60 years	90 (35.8)	71 (28.l)	161 (63.9)
61-80 years	06 (6.4)	13 (5.2)	029 (11.5)
Total	144 (57.1)	108 (42.9)	252 (100)
ii) Sex of the Household Head			
Male	118 (46.9)	98 (38.8)	216 (85.7)
Female	26 (10.3)	10 (4.0)	036 (14.3)
Total	144 (57.1)	108 (42.9)	252 (100)
iii)Marital Status of the Household Head			
Married	104 (41.2)	94 (37.3)	198 (78.6)
Single	34 (13.5)	10 (3.9)	044 (17.5)
Widower/Separated	06 (2.04)	04 (1.6)	010 (3.9)
Total	144 (57.1)	108 (42.9)	252 (100)
iv)Household Size			
1- 5	20 (7.9)	06 (5.6)	026 (10.3)
6- 10	71 (28.2)	46 (42.6)	117 (46.4)
11-15	51 (20.3)	48 (44.4)	099 (39.3)
16-20	02 (0.8)	08 (7.4)	010 (3.9)
Total	144 (57.1)	108 (42.9)	252 (100)
v)Education Status of the Household Head			
No formal education	29 (11.5)	17 (6.7)	046 (18.3)
Quranic education	35 (13.9)	42 (16.6)	077 (30.6)
Primary education	46 (18.3)	35 (13.9)	081 (32.1)
Secondary education	21 (8.3)	09 (3.6)	030 (11.9)
Tertiary education	05 (2.0)	02 (0.8)	07 (2.8)
Adult education	08 (3.2)	03 (1.2)	011 (4.4)
Total	144 (57.1)	108 (42.9)	252 (100)
vi)Primary Occupation of the Household Head			
Farming	111 (44.0)	81 (32.2)	192 (76.2)
Agricultural trading	10 (4.0)	09 (3.6)	019 (7.5)
Non-agricultural trading	11 (4.4)	07 (6.5)	029 (9.5)
Business	10 (4.0)	08 (7.4)	015 (5.9)
Civil service	02 (0.8)	03 (2.8)	06 (2.4)
Total	144 (57.1)	108 (42.9)	252 (100)
vii) Experience of the Household Head			
1- 10	06 (2.4)	07 (2.8)13	13 (5.2)
11-20	34 (13.5)	21 (8.3)	55 (21.8)
21-30	42 (16.7)	34 (13.5)	76 (30.2)
31-40	26 (10.3)	30 (11.9)	56 (22.2)
41-50	36 (14.3)	16 (6.3)	52 (20.6)
Total	144 (57.1)	108 (42.9)	252 (100)
viii) Household Head Introduction to Farming			
Inherited	100 (39.6)	83 (32.9)	183 (72.6)
Farm friends	12 (4.8)	10 (3.9)	22 (8.7)
Relations	32 (12.7)	15 (5.9)	47 (18.6)
Total	144 (57.1)	108 (42.9)	252 (100)

jority (76.2 percent) depend on farming for their livelihood, while others were traders involved in both agricultural and non-agricultural products. Other sources of livelihood are business and civil service. This result has effect on the cropping patterns and intensity in which the agriculture land is used. The households' heads years of experience ranged between 5 and 45 years, the average farming experience of the farmers is 29.1 and 28.0 years in Kwara and Niger States respectively. This indicates that most of the farming households have been practicing farming for long. The accumulated years of experience may help households in crop selection and enable them to evolve the farming practices that are most suitable to their fragile environment. Households experience is expected to have a considerable effect on their productive efficiency. Majority of the households' heads (72.6 percent) have inherited farming business as an occupation, while the remaining was introduced to it by either friends or relations.

Crop Production Intensification Strategies among Kwara and Niger States Maize-based Farming Households

The crop production intensification strategies in the study area are capital-intensive, labor-intensive and land-intensive, or a combination of these. The capital-intensive strategies commonly used in the study area are the application of inorganic fertilizer, use of improved hybrid maize seed and agro-chemicals. The application rate ha^{-1} of these inputs in the two states was low compared to the recommended rates. An average of 76.9kg and 93.8 kg of NPK fertilizer was applied per hectare by all Kwara and Niger state farming households respectively. This is obviously lower than the recommended rate of 600kg ha^{-1} for maize-based cropping systems (ADP 2001). Given the low inorganic fertilizer application rate, the farming households were unable to maintain or improve the maize production levels and yield. About 36 percent and 53 percent of the farming households used fertilizer mainly for the purpose of direct and immediate supply of needed plant nutrient to growing crops in Kwara and Niger state respectively. This result revealed that fertilizer use was the most prevalent practice among the sampled farming households.

The major agro-chemicals used were attracine, karate and Paraquate which are all insecticides. The mean level of application of the insecticides per hectare was 1.03 litres which is lower than the ADP recommended rate of between 3.0-5.0liters ha^{-1}. About 15 percent and 28 percent of the farming households applied insecticides in Kwara and Niger state respectively.The use of improved hybrid maize seed which is capital-intensive strategy was also higher in Niger state (17 percent) than those of Kwara state farming households (9 percent). Overall, 26 percent of the households used improved hybrid maize seed on an average farm size of 0.87 hectares. This percentage (26 percent) is low given that maize productivity in Nigeria can only be increased through increased productivity and not by land expansion. The improved hybrid seed is a crop production intensification strategy used to improve the yields only when all agronomic aspects of planting, weeding and fertilizer application are strictly followed. The improved hybrid maize seed was not accompanied with the appropriate agronomic management practices that raise the yields by households in the study area (Table 3).

Table 3: Land management practice, percentage use and farm size in maize production

Input use or management practice	*Percentage of household use in maize-based production*			*Average farm size (ha)*
	Kwara	*Niger*	*Total*	
Hybrid maize	09	17	26.0	0.87
Tractor usage	06	03	09.0	2.31
Minimum tillage	47	40	87.0	1.05
Cover cropping	14	36	50.0	1.20
Crop rotation	10	13	23.0	0.65
Organic fertilization	04	18	22.0	1.29
Mulching	03	02	05.0	0.57
Intercropping	34	39	73.0	0.89

Source: Field survey 2009/2010

Tractor usage was another capital intensive strategy used by farming households in the study area. However, it is clear that tractor usage was more prevalent among those with the requisite resources, judging from their better located land and higher overall wealth. This strategy was applied by 3 percent and 6 percent of Kwara and Niger state households respectively. Overall, about 9 percent of all households used tractors on an average farm size of 2.11 hectares. About 23 percent of the households rejected the use of tractor services because of costs implication and the effect on their soils.

The labor-intensive strategies are most common since households in the study area were cash constrained. The households merely added labour in crop production, allowing them to crop more densely, weed and harvest more intensively. Also, due to land constraints, labour/land ratios are rising, and therefore households choose production methods that are as labor-intensive as possible to raise productivity. The households used two or more of the integrated soil management practices on their respective fields. Labour-intensive strategies were mainly soil management practices. These included uses of minimum tillage, crop rotation, cover cropping, animal manure application and mulching.

Minimum tillage was the second most prevalent land management practice after fertilizer use. This strategy is more prevalent in Kwara state. About 47 percent and 40 percent of the farming households used minimum tillage in Kwara and Niger state respectively. Eighty seven percent of the all sampled households practised minimum tillage on an average farm size of 1.05 hectares. Other households that did not practice minimum tillage used animal traction and tractors to till the soil. This practice was more prevalent among low intensity households. Cover cropping; the third most prevalent land management practices in the area was practiced by about 50 percent of the households on an average farm size of 1.20 hectares. Cover cropping was practised by 14 percent and 36 percent of Kwara and Niger states farming households respectively. The major problem with cover cropping practice is the opportunity cost which the households consider to be very high.

Crop rotation was the fourth most common land management practices among the sampled farming households. About 23.4 percent of the sampled respondents practised crop rotation on an average farm size of 0.65 hectares. It involved the alternation of legumes and non-legumes or the use of legumes in rotation which helps to maintain soil fertility. A good rotation also minimizes exposure of soil to erosion, reduces weed infestation and checks the building up of pests and diseases on the land. Organic fertilization was another land management practice used by 22 percent of the sampled households on an average farm size of 1.29 hectares. The practice was more common in Niger (18 percent) than in Kwara State (4 percent). This could be traced to differences in livelihood strategies between Niger and Kwara State households. Farming households in Niger State tend towards more of animal husbandry as a livelihood option than those in Kwara State. Animal manure was commonly used in the southern part of Niger State, although most households complained of its bulkiness and high cost of application.

Mulching was the least prevalent land management practice among the sampled households. However, 5 percent of the respondents engaged in the practice on an average farm size of 0.57 hectares. The land-intensive strategies are commonly practised on increasingly small land sizes in the area. Land-intensive strategy comprised of increased intercropping and multiple cropping. Intercropping of legumes with maize and or other arable crops is a land-intensive practice that is highly promoted in the area. Intercropping was practised by 34 percent and 39 percent of Kwara and Niger states farming households respectively. Over 73 percent of the households practised intercropping on an average farm size of 0.89 hectares. Intercropping has long been recognized as a common practice among subsistence farmers due to the flexibility of labour used and less risk. Mixed cropping has been shown to lead to better utilization of land, labour and capital. It also results in less variability in annual returns compared with mono cropping (Eneh et al. 1997).

Levels of Crop Production Intensification among the Sampled Farming Households

The analysis revealed that Niger state farming households have the maximum and mean crop production intensification scores of 38.50 and 27.47 respectively, which are higher than the maximum (32.00) and mean (19.57) intensity scores of the Kwara state farming households (Table 4). Field analysis showed a significant difference between the means of the two states at 1 percent level of probability.

Although, the application rate of mineral fertilizers was also low in Niger state, the higher intensity scores may be attributed to the use of animal traction and the application of organic manure to complement mineral fertilizers in some parts of the state. In general, these results suggest that intensification in Niger state area is not occurring out of the need but rather because of the benefits it offers in terms of conserving fallow land and, presumably, in generating higher income using available factor inputs. However, it is clear that intensification is more prevalent among those with the requisite resources, judg-

Table 4: Comparison of the study areas based on crop production intensification scores

Study areas	*No. of household*	*High intensity households*	*Low intensity households*	*Range*	*Min*	*Max*	*Mean*	*Kurtosis*
Niger	108	51(20.2)	57 (22.6)	24.00	14.50	38.50	27.47	0.461
Kwara	144	10 (4.0)	134(53.2)	26.50	5.50	32.00	19.57	-0.296
Total	252	61(24.2)	191(75.8)	33.00	5.50	38.50	22.96	-0.358

Source: Field Survey, 2009/2010
Figure in parentheses are percentages

ing from their better located land and their higher overall wealth.

The Kurtosis value of -0.296 and 0.461 suggests that the variability in crop intensity from one farming household to the next is higher and lower in Kwara and Niger States respectively. The negative Kurtosis value (-0.298) may be due to greater level of inter- household variation in Kwara State in terms of the land size and cropping strategy. In contrast, Niger state is a much more homogenous area from a socio-economic and farming systems stand point. For a normally distributed variable the kurtosis value equals three. The number of households that fall within each of the intensity categories provides additional data with which to compare the two study areas as shown in Table 4. Kwara state has the larger proportion (53.2 percent) of farming households in the low category of intensity, where as Niger state has the least (22.6 percent).The latter also has the greater proportion (20.2 percent) of households in the high category of intensity.

Determinants of Crop Production Intensification of Niger State Maize-based Farming Households

The drivers of crop production intensification among maize-based farming households in Niger State are presented in Table 5.

The coefficient of household income, adoption of land management practices and market access were all found to be significant in explaining the variation in the levels of crop production intensification of households.

Household gross income significantly influenced the crop production intensification at 1 percent level of probability. This indicates that as household income increases, crop production intensification on their farms increases. Thus, the farming household with more requisite resources had higher crop production intensification scores than poor households in the state. This negative and statistically robust relationship between household income and the severity of crop intensification of households suggests that farming households who had large farm income are likely to be more successful in gathering information, purchasing and understanding the use of modern inputs, which in turn enhances their crop production intensity.

The adoption of land management practices is positive and significantly related to crop production intensification at 1 percent level of probability. This implies that the more the number of land management practices adopted by a farming household the more the household crop production intensity. The coefficient of market access is positive and significantly related to crop production intensity at 5 percent level of probability. The further the distance of farmhouse to

Table 5: Tobit regression estimates of Niger State maize-based farming households

Variables	*Coefficients*	*Std. error*	*t-value*	*P[|Z|>z]*
Constant	.7651993***	.0395654	19.34	0.000
Age (X_1)	.0006226	.0007614	0.82	0.415
Education (X_2)	.0020623	.0227382	0.09	0.928
Household size (X_3)	.0003886	.0024345	0.16	0.873
Extension contact (X_4)	-.000669	.0073754	-0.09	0.928
Household income (X_5)	-4.97e-07***	7.29e-08	-6.82	0.000
Land mgt practices (X_6)	-.0624956***	.0170293	-3.67	0.000
Market distance (X_7)	-.0019806**	.0009519	-2.08	0.039
Farm distance (X_8)	.0019686	.0015679	1.26	0.211
Sigma	.0644852***	.003799	16.97	0.000

Source: Data Analysis, 2010. ***parameter significant at 1 percent, ** parameter significant at 5 percent, * parameter significant at 10 percent
n =144; Log likelihood =190.422; Pseudo R^2= -0.3271; LR chi^2(8) =93.87;Prob>chi^2=0.0000

Table 6: Tobit regression estimates of Kwara State maize-based farming households

Variables	*Coefficients*	*Std Error*	*t-value*	*P[|Z|>z]*
Constant	.7187688	.0363454	19.78	0.000
Age (X_1)	-.000351	.0006044	-0.58	0.563
Education (X_2)	.0217871	.0212239	1.03	0.307
Household Size (X_3)	.0008682	.0016871	0.51	0.608
Extension Contact (X_4)	-.0118604**	.0054317	-2.18	0.031
Household Income (X_5)	-2.02e-07***	5.57e-08	-3.63	0.000
Land Mgt Practices (X_6)	-.1243538***	.0136266	-9.13	0.000
Market Distance (X_7)	-.001422	.001953	-0.73	0.468
Farm Distance (X_8)	.0011576	.0007352	1.57	0.119
Sigma	.0407518	.0027728	14.69	0.000

Source: Data Analysis, 2010. ***parameter significant at 1 percent, ** parameter significant at 5 percent.
N=108; Log likelihood =192.382; Pseudo R^2= -0.3627; LR chi^2 (8)=102.41; Prob>chi^2=0.000

the market, the lower the probability of using the hybrid maize seed in the zone. When households incur high transactions costs in marketing, the total production costs are increased and the product profit margins are reduced. Farmers closer to the markets had a high probability of using improved hybrid maize seed. This result agrees with earlier findings by Reardon et al. (2001), that market access is a major driving force of agricultural intensification. Sustainable crop intensification could occur with concomitant development of markets for the agricultural inputs and products. Improving farmers' access to markets has a potential of improving the household income, increasing agriculture produce demand and triggering sustainable crop production intensification. When farmers sell their agricultural produce competitively they are able to reduce the income constraint hence are able to purchase the external inputs that are required to increase agriculture productivity. Hau and Von Oppen (2002), found that a decrease in distance of farm to market by 10 percent, increases intensification through fertilizer and pesticide use by 5.3 percent and 0.4 percent respectively.

Determinants of Crop Production Intensification of Kwara State Maize-based Farming Households

The factors influencing maize-based production intensification of Kwara State farming households are shown in Table 6.

The coefficient of extension contact, household income and households' adoption of land management practices were the significant variables explaining the variation in the levels of crop production intensification of Kwara state farming households.

Access to the extension services as determined by the number and frequency of visits by the extension agents to the household heads is positive and significantly related to crop production intensity at 10 percent confidence level. Household heads who received frequent visits from the extension agents had much higher crop production intensity value than household heads without frequent visit from the extension agent. Thus, the number of contact with an extension agent in a year influenced the crop production intensity. The results show that the adoption of crop intensification strategies is influenced by the frequency of the households' contact with extension services. Farmers with more contact to the extension agents had higher probability to use inorganic fertilizers. This finding shows that information flow to households is vital for the uptake of crop intensification strategies. The study by Salasyia et al. (2007) agrees that information flow is vital in adoption of agriculture technologies but proposes that informal channels of information by neighbours could be encouraged. Since information flow is vital in adoption of agricultural intensification strategies, this study emphasize the need for household heads to be well informed. Both formal and informal channels of information flow could be used for dissemination of agriculture technology.

Household gross income and the adoption of land management practices are positive and significantly related to crop production intensification of Kwara state households at 1 percent level of probability. This indicates that as household income and the adoption of land management practices increases, crop production intensification on their farms increases. The coefficient of other variables (age of the household head, education of the household head, household size,

market and farm access) were not important in explaining the variation in crop production intensification of Kwara state farming households.

CONCLUSION

The study showed that a typical household in the study area comprised of nine and eleven persons with an average age of the household head of 47.1 and 48.3 years in Kwara and Niger states respectively. The study further revealed that Niger state farming households have higher mean crop production intensification scores than those of Kwara state households. Thus, the level of crop production intensification among Niger state maize-based farming households is higher than those of Kwara state households. The study indicated that household income, adoption of land management practices and access to extension agents were the major drivers of crop production intensification in Kwara state. On the other hand, the study revealed that household income, adoption of land management practices and market access are the important variables among Niger state maize-based farming households. In conclusion, therefore, the level of crop production intensification is generally low among maize-based farming households in the Southern Guinea Savanna ecological zone of Nigeria.

RECOMMMENDATIONS

Policy should target at strengthening maize-based farming households to have improved access to input/output markets as well as provides adequately trained and equipped extension workers for disseminating technology information. This has the potential to increase the intensity and the usage of improved maize-based technology in the study area to attain sustainable maize-based production.

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A Comparative Analysis of Crop Production Intensification and its Determinants among Kwara and Niger States Maize-Based Farming Households

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KEYWORDS Crop Production Intensification. Maize-Based Farming Households. Determinants of Crop Production Intensification. Kwara and Niger States Households

ABSTRACT Nigeria has been faced with food supply deficit in the past decades. Continuous increase in population density and the consequent pressures from competing demands for land over time have the tendency of worsening the Nigerian arable land situation in the foreseeable future, if unaddressed. Thus, this study compared crop production intensification and its determinants among Kwara and Niger States maize-based households. A total of two-hundred and fifty-two maize-based households were interviewed using structured questionnaire. Data collected were analysed using crop intensification index and Tobit regression model. Analysis revealed that Niger state households have higher crop intensity scores than those of Kwara state households. The estimated Tobit model revealed that market access, farm income and adoption of land management practices; and extension contact, farm income and adoption of land management practices are the significant variables among Kwara and Niger State maize-based households respectively. For sustainability of maize based production, there is the need for a policy option that addresses the provision of qualitative extension education and farming households' access to market in the study areas.

INTRODUCTION

Agriculture is the main stay of Nigerian economy. It involves small scale farmers scattered over wide expanse of land area, with small holding ranging from 0.5 to 3.0 hectare per farm land. It is characterized by rudimentary farm systems, low capitalization and low yield per hectare (Kolawale and Ojo 2007). The role of agriculture remains significant in the Nigeria economy despite the strategic importance of the oil sector. Agriculture provides primary means of employment for Nigeria and accounts for more than one-third of total gross domestic product (GDP) and labour force. Thus, agricultural development is vital to Nigeria's economic growth, food security and poverty alleviation.

Nigerian agriculture is commonly known to be in crisis. The greatest failure is that food production has not kept pace with population growth. The rate of growth of Nigeria's food production is 2.5 percent per annum in recent years, while food demand has been growing at the rate of more than 3.5 percent per annum due to high rate of population growth of 2.83 percent (Kolawole and Ojo 2007). Food imports including food aid in Nigeria has increased substantially to offset the deficiencies. Hence, there is a gap between what farmers are producing and what consumers are demanding. This has created major macro-economic problems in most developing countries. In the past, such food shortfalls were most commonly met by extending the area put to cultivation rather than by crop production intensification which according to Tiffen et al. (1994) is the use of increased average inputs on small-holding for the purpose of increasing the value of output per hectare. However, in most regions and countries this is no longer possible because agricultural frontiers have closed or declined in many parts of the world (Shriar 2000).

Attainment of food self -sufficiency is a prominent developmental agenda facing most nations of Sub- Sahara Africa. To stem the tide of the current food problem through crop production intensification, the Federal government in 2006 initiated a programme of doubling maize production in Nigeria through promotion of improved production technologies such as fertilizer, hybrid seeds, pesticides, herbicides and better management practices. Since then, several stakeholders have alleged their support for this program. Several improved maize varieties, drought tolerant, low nitrogen-tolerant, Striga-tol-

erant, stem borer resistant and early maturing, have been deployed to address the challenge faced by resource-poor farmers in maize production. Despite these efforts however, marginal increase had been brought about on the yield of most cereal crops (especially maize) and even when such is achieved, it is not sustained for long (FAO 2006). One of the reasons often attributed to decline in productivity is depletion in soil fertility primarily resulting from poor production practices characterized by low use of modern inputs. Given the prime position of maize in the Nigerian economy and given the fact that domestic supply has not been able to meet up with the demand, this study, therefore, measures the levels of crop production intensification and highlights its determinants among Kwara and Niger States maize-based farming households.

METHODOLOGY

Area of the Study: This study was conducted in Kwara and Niger States in the Southern Guinea Savanna ecological zone of Nigeria. The zone is located at longitude 38° 148° E and latitude 78° and 108° N. The savanna ecology can well be called the Corn Belt of Nigeria. The Southern Guinea Savanna of Nigeria has great potential for the expansion of maize production beyond the present level due to its bimodal rainfall pattern, (a short early growing season followed by fairly long late season) high solar radiation and favorable temperature during the growing season. However, the zone is characterized by variable weather, fragile soils with low moisture holding capacity that is prone to drought (Fakorede et al. 2001). The soils are also mainly alfisols that are low in organic matter, especially nitrogen which is one of the most essential units for maize growth and productivity. Thus, the region offers a lot of potential for intensification with a view to bringing about much required growth in the maize sub-sector of the Nigerian economy.

Sampling Procedure and Sample Size: The target population for this study is the farming households involved in maize-based production systems in the Southern Guinea Savanna zone of Nigeria. The zone represents a geographical area that is majorly made up of Kwara, Niger, Kogi, Taraba, Plateau and Benue States. A three-stage sampling technique was used to select sample for the study. The first stage involved a purposive selection of Kwara and Niger States. The two states have the list number of crop farmers in the zone in the year 2007 (NBS 2008). The ADPs zones are four and three in Kwara and Niger states respectively. The second stage involved the random selection of 4 villages from each of the ADPs zone in each of the states. The upgraded 2001 Agricultural Development Projects (ADPs) village listing served as the sampling frame for the selections in the two states. In each village, 10 farming households were selected among the farming households in the areas to make up a sample size of 280. However, only 252 questionnaires were retrieved and analyzed.

Analytical Techniques: Descriptive and inferential statistics, crop intensity index, and Tobit regression model were the analytical tools employed to achieve the research objectives. Following Shriar (2005), intensification activities such as intercropping, use of legume, use of fertilizer, pesticides use per hectare, use of herbicides, ploughing methods, use of organic fertilizer and improved seeds have been assigned a particular weight based on its contribution to production intensity. These led to weight values ranging from 2 to 3.5 points (Table 1).

Table 1: Scale ranges and weights associated with agricultural intensity index

Intensification activity	*Scale range*	*Weight*	*Max. Points*
Scale of cereal/ legume plots	0-3	3.5	10.5
Scale of improve seeds	0-3	3.0	9.0
Scale of Ploughing	0-3	2.5	7.5
Scale of intercropping	0-3	3.0	9.0
Scale of fertilizer use per ha	0-3	3.0	9.0
Scale of pesticides use per ha (excluding herbicides)	0-3	2.0	6.0
Use of organic fertilization	0-1	3.0	3.0
Scale of herbicides use per ha	0-3	2.0	6.0
Total			60.0

Adapted from Shriar, 2005 but modified

As evident from the Table 1, not all farming activities could be assessed in sufficient detail to justify using a 0-3 scaling and that the maximum points attainable by the household from all the intensification activities is 60. The index is stated as:

$$CI_i = \sum_{J=1}^{8} S_j W_j \qquad i = 1 \ldots N \ldots\ldots\ldots\ldots (1)$$

Where

CI is the crop intensification index for the i^{th} household; S is the scale range for the agro-tech-

nology and strategy employed by the i^{th} household and W is the weight of the agro-technology and strategy employed by the i^{th} household

A scale range of 0-1 for the use of organic fertilization implies a yes/No dummy variable. If the household is engaged in the activity he gets 1point and 0 if otherwise. In contrast, a scale range of 0-3 indicates whether the household undertakes the activity and if so, does so at low (1point), medium (2 points), or high (3 points) scale. The multi-level scales (low, medium, high) used in the index are based on the proportion of the total area cropped on which the strategy is practiced except for fertilizer and pesticide scales which are based on the quantities of these items used, calculated on a per hectare basis. Cereal/ legume plots received the highest weighting of 3.5, because production values are likely to be more sustainable over time with legumes (Shirar 2005). The scale of cereal/legume plots involves the intercropping of cereal with any leguminous plants .It takes the value of 0, for no, and 1, 2, 3 for low, medium and high levels of activity respectively.

The scale of improved seeds on the other hand, indicates the proportion of the area cropped on which improve seeds are grown. It takes the value of 0, for no, and 1 (if less than 40 percent is cropped), 2 (if 40-69 percent is cropped), 3 (if 70 percent and above is cropped) for low, medium and high levels of activity respectively.

The primary tillage or cultivation implement used in land preparation in the study area represents the Scale of Ploughing. It takes the value of 0, for no, and 1, 2, 3 for use of cutlasses and hoes, animal traction and tractor respectively.

The scale of intercropping entails the intercropping of maize with other crops apart from legumes. It takes the value of 0, for no, and 1 (if less than 40 percent is intercropped), 2 (if 40-69 percent is intercropped), 3 (if 70 percent and above is intercropped) for low, medium and high levels of activity respectively.

Based on the recommended fertilizer input rate by ADP (2000), fertilizer application rate per hectare of between 50-100kg, 150- 200kg and 250-300kg is hereby regarded as low, medium and high application rate respectively for scale of fertilizer use per hectare.

The quantities of herbicides such as Altrazin, Gramozone, Primextra etc. that are used up in the production processes on per hectare basis represents the scale of herbicide use per hectare. Based on ADP (2000) recommended rate of 4 litres/ hectare, the following classifications are made: 0.1-1.5 litres, 1.6-3.0 litres and 3.1-4.5liters and are thus regarded as low, medium and high application rate respectively.

The scale of pesticides use per hectare involves the quantities of insecticides, fungicides, nematicides etc. that are used up in the production processes on per hectare basis. Based on the ADP, (2000) recommended rate of 4 litres/ hectare, the following classifications are made: 0.1-1.5 litres, 1.6-3.0 litres and 3.1-4.5 litres and are thus regarded as low, medium and high application rate respectively. The scale of organic fertilization is a dummy variable, if the household is engaged in the use of animal dung's and/ or poultry droppings on the farm to raise soil productivity he gets 1point and 0 if otherwise.

Tobit Regression Model: The Tobit model developed by Tobin (1958) described as an extension of the Probit model (Gujarati 2003), used by Adejobi (2004) and Muhammad-Lawal (2008) was adapted for this study. The linear Tobit regression model was used to analyze the effect of certain socio-economic factors on the crop production intensification of farming households. The model was used because the dependent variable crop production intensification scores are censored having values ranging between 0 and 1. The model specification is given as:

$V_j = \beta z_{ij} + e$ 1

$V_j = V_j$ if $V_j > 0$

$V_j = 0$ if $V_j \leq 0$

$j = 1$ 411

V_j^* = Limited or censured dependent variable. It is the measure of severity of household crop production intensification. It is defined as

$(K-Y_j) / K$ 2

Where K = threshold level; V_j = $_j$th household's crop intensity; β = Parameter estimates; z_{ij} = Vector of the explanatory variables.

The farm households' decision to intensify crop production intensification may be related to the characteristics and composition of the household, the size of the farm, capital lay out of the household and the level of transaction costs incurred in the process of using the crop intensification strategy. The household composition and characteristics were captured by number of household members, age, farm and market distances and the number of visits by the extension agents. A negative coefficient implies that the variable is reducing the severity of crop produc-

tion intensification of farming households and vice versa. The following variables affecting crop production intensification of farming households were fitted into the Tobit model:

Z_1 = Age of the household head (years)
Z_2= Education of the household head (dummy)
Z_3= Adjusted household size (number)
Z_4 = Extension contact (number)
Z_5= Household income (Naira)
Z_6= Land management practices (dummy)
Z_7= Market distance (km)
Z_8= Farm distance (km)
μ = error term which explains other effects outside the household's control e.g weather, natural disaster, etc.

RESULTS AND DISCUSSION

The age of the households' heads ranged between 30 and 75 years with an average of 47.1 and 48.3 years in Kwara and Niger State respectively. About 6.4 percent of Kwara State maize based households' heads are above 60 years. While in Niger State 37.6 percent of the maize based households' heads are below 60years of age. About 88 percent of the households' heads in the two states are below 60 years of age. This has implication on the available family labour and productivity of labour.

Sex distribution varies appreciably, 14.3 percent of the households' heads were females, these were made up of 10.3 percent and 4.0 percent Kwara and Niger States maize based households' heads respectively. This may be due to cultural and religious belief of the people in the area, which prohibits woman to go out freely and engage in activities such as farming. Women are usually not allowed to own land and where the woman owns land, they usually delegate its administration to their senior male child or one of their male relations (Table 2).

The average household size is 9 and 11 persons for Kwara and Niger States maize based farming households respectively. Polygamous nature of the people probably explains the large family size recorded in the area. Household size is used as a proxy for labour because individual in the household is a potential source of labour. Their availability reduces labour constraints faced during the peak of the farming season (TeckleWold et al. 2006). Majority of the households' heads (82 percent) are literate with most of them having primary education (32.1 percent) and this is closely followed by Quranic education (30.6 percent). Those who had tertiary education probably constitute the civil servants who engaged in part-time farming in the area. Given this level of literacy, it is expected that information can be disseminated with ease among these farmers.

The primary occupation of the households' heads is predominantly farming (Table 2). Ma-

Table 2: **Socio-economic characteristics of the households' heads in the study area**

Variables	*Kwara*	*Niger*	*Pooled*
i) Age of the Household Head			
21-40 years	38 (15.0)	29 (9.5)	062 (24.6)
41-60 years	90 (35.8)	71 (28.l)	161 (63.9)
61-80 years	06 (6.4)	13 (5.2)	029 (11.5)
Total	144 (57.1)	108 (42.9)	252 (100)
ii) Sex of the Household Head			
Male	118 (46.9)	98 (38.8)	216 (85.7)
Female	26 (10.3)	10 (4.0)	036 (14.3)
Total	144 (57.1)	108 (42.9)	252 (100)
iii)Marital Status of the Household Head			
Married	104 (41.2)	94 (37.3)	198 (78.6)
Single	34 (13.5)	10 (3.9)	044 (17.5)
Widower/Separated	06 (2.04)	04 (1.6)	010 (3.9)
Total	144 (57.1)	108 (42.9)	252 (100)
iv)Household Size			
1- 5	20 (7.9)	06 (5.6)	026 (10.3)
6- 10	71 (28.2)	46 (42.6)	117 (46.4)
11-15	51 (20.3)	48 (44.4)	099 (39.3)
16-20	02 (0.8)	08 (7.4)	010 (3.9)
Total	144 (57.1)	108 (42.9)	252 (100)
v)Education Status of the Household Head			
No formal education	29 (11.5)	17 (6.7)	046 (18.3)
Quranic education	35 (13.9)	42 (16.6)	077 (30.6)
Primary education	46 (18.3)	35 (13.9)	081 (32.1)
Secondary education	21 (8.3)	09 (3.6)	030 (11.9)
Tertiary education	05 (2.0)	02 (0.8)	07 (2.8)
Adult education	08 (3.2)	03 (1.2)	011 (4.4)
Total	144 (57.1)	108 (42.9)	252 (100)
vi)Primary Occupation of the Household Head			
Farming	111 (44.0)	81 (32.2)	192 (76.2)
Agricultural trading	10 (4.0)	09 (3.6)	019 (7.5)
Non-agricultural trading	11 (4.4)	07 (6.5)	029 (9.5)
Business	10 (4.0)	08 (7.4)	015 (5.9)
Civil service	02 (0.8)	03 (2.8)	06 (2.4)
Total	144 (57.1)	108 (42.9)	252 (100)
vii) Experience of the Household Head			
1- 10	06 (2.4)	07 (2.8)13	13 (5.2)
11-20	34 (13.5)	21 (8.3)	55 (21.8)
21-30	42 (16.7)	34 (13.5)	76 (30.2)
31-40	26 (10.3)	30 (11.9)	56 (22.2)
41-50	36 (14.3)	16 (6.3)	52 (20.6)
Total	144 (57.1)	108 (42.9)	252 (100)
viii) Household Head Introduction to Farming			
Inherited	100 (39.6)	83 (32.9)	183 (72.6)
Farm friends	12 (4.8)	10 (3.9)	22 (8.7)
Relations	32 (12.7)	15 (5.9)	47 (18.6)
Total	144 (57.1)	108 (42.9)	252 (100)

jority (76.2 percent) depend on farming for their livelihood, while others were traders involved in both agricultural and non-agricultural products. Other sources of livelihood are business and civil service. This result has effect on the cropping patterns and intensity in which the agriculture land is used. The households' heads years of experience ranged between 5 and 45 years, the average farming experience of the farmers is 29.1 and 28.0 years in Kwara and Niger States respectively. This indicates that most of the farming households have been practicing farming for long. The accumulated years of experience may help households in crop selection and enable them to evolve the farming practices that are most suitable to their fragile environment. Households experience is expected to have a considerable effect on their productive efficiency. Majority of the households' heads (72.6 percent) have inherited farming business as an occupation, while the remaining was introduced to it by either friends or relations.

Crop Production Intensification Strategies among Kwara and Niger States Maize-based Farming Households

The crop production intensification strategies in the study area are capital-intensive, labor-intensive and land-intensive, or a combination of these. The capital-intensive strategies commonly used in the study area are the application of inorganic fertilizer, use of improved hybrid maize seed and agro-chemicals. The application rate ha^{-1} of these inputs in the two states was low compared to the recommended rates. An average of 76.9kg and 93.8 kg of NPK fertilizer was applied per hectare by all Kwara and Niger state farming households respectively. This is obviously lower than the recommended rate of 600kg ha^{-1} for maize-based cropping systems (ADP 2001). Given the low inorganic fertilizer application rate, the farming households were unable to maintain or improve the maize production levels and yield. About 36 percent and 53 percent of the farming households used fertilizer mainly for the purpose of direct and immediate supply of needed plant nutrient to growing crops in Kwara and Niger state respectively. This result revealed that fertilizer use was the most prevalent practice among the sampled farming households.

The major agro-chemicals used were attracine, karate and Paraquate which are all insecticides. The mean level of application of the insecticides per hectare was 1.03 litres which is lower than the ADP recommended rate of between 3.0-5.0liters ha^{-1}. About 15 percent and 28 percent of the farming households applied insecticides in Kwara and Niger state respectively.The use of improved hybrid maize seed which is capital-intensive strategy was also higher in Niger state (17 percent) than those of Kwara state farming households (9 percent). Overall, 26 percent of the households used improved hybrid maize seed on an average farm size of 0.87 hectares. This percentage (26 percent) is low given that maize productivity in Nigeria can only be increased through increased productivity and not by land expansion. The improved hybrid seed is a crop production intensification strategy used to improve the yields only when all agronomic aspects of planting, weeding and fertilizer application are strictly followed. The improved hybrid maize seed was not accompanied with the appropriate agronomic management practices that raise the yields by households in the study area (Table 3).

Table 3: Land management practice, percentage use and farm size in maize production

Input use or management practice	*Percentage of household use in maize-based production*			*Average farm size (ha)*
	Kwara	*Niger*	*Total*	
Hybrid maize	09	17	26.0	0.87
Tractor usage	06	03	09.0	2.31
Minimum tillage	47	40	87.0	1.05
Cover cropping	14	36	50.0	1.20
Crop rotation	10	13	23.0	0.65
Organic fertilization	04	18	22.0	1.29
Mulching	03	02	05.0	0.57
Intercropping	34	39	73.0	0.89

Source: Field survey 2009/2010

Tractor usage was another capital intensive strategy used by farming households in the study area. However, it is clear that tractor usage was more prevalent among those with the requisite resources, judging from their better located land and higher overall wealth. This strategy was applied by 3 percent and 6 percent of Kwara and Niger state households respectively. Overall, about 9 percent of all households used tractors on an average farm size of 2.11 hectares. About 23 percent of the households rejected the use of tractor services because of costs implication and the effect on their soils.

The labor-intensive strategies are most common since households in the study area were cash constrained. The households merely added labour in crop production, allowing them to crop more densely, weed and harvest more intensively. Also, due to land constraints, labour/land ratios are rising, and therefore households choose production methods that are as labor-intensive as possible to raise productivity. The households used two or more of the integrated soil management practices on their respective fields. Labour-intensive strategies were mainly soil management practices. These included uses of minimum tillage, crop rotation, cover cropping, animal manure application and mulching.

Minimum tillage was the second most prevalent land management practice after fertilizer use. This strategy is more prevalent in Kwara state. About 47 percent and 40 percent of the farming households used minimum tillage in Kwara and Niger state respectively. Eighty seven percent of the all sampled households practised minimum tillage on an average farm size of 1.05 hectares. Other households that did not practice minimum tillage used animal traction and tractors to till the soil. This practice was more prevalent among low intensity households. Cover cropping; the third most prevalent land management practices in the area was practiced by about 50 percent of the households on an average farm size of 1.20 hectares. Cover cropping was practised by 14 percent and 36 percent of Kwara and Niger states farming households respectively. The major problem with cover cropping practice is the opportunity cost which the households consider to be very high.

Crop rotation was the fourth most common land management practices among the sampled farming households. About 23.4 percent of the sampled respondents practised crop rotation on an average farm size of 0.65 hectares. It involved the alternation of legumes and non-legumes or the use of legumes in rotation which helps to maintain soil fertility. A good rotation also minimizes exposure of soil to erosion, reduces weed infestation and checks the building up of pests and diseases on the land. Organic fertilization was another land management practice used by 22 percent of the sampled households on an average farm size of 1.29 hectares. The practice was more common in Niger (18 percent) than in Kwara State (4 percent). This could be traced to differences in livelihood strategies between Niger and Kwara State households. Farming households in Niger State tend towards more of animal husbandry as a livelihood option than those in Kwara State. Animal manure was commonly used in the southern part of Niger State, although most households complained of its bulkiness and high cost of application.

Mulching was the least prevalent land management practice among the sampled households. However, 5 percent of the respondents engaged in the practice on an average farm size of 0.57 hectares. The land-intensive strategies are commonly practised on increasingly small land sizes in the area. Land-intensive strategy comprised of increased intercropping and multiple cropping. Intercropping of legumes with maize and or other arable crops is a land-intensive practice that is highly promoted in the area. Intercropping was practised by 34 percent and 39 percent of Kwara and Niger states farming households respectively. Over 73 percent of the households practised intercropping on an average farm size of 0.89 hectares. Intercropping has long been recognized as a common practice among subsistence farmers due to the flexibility of labour used and less risk. Mixed cropping has been shown to lead to better utilization of land, labour and capital. It also results in less variability in annual returns compared with mono cropping (Eneh et al. 1997).

Levels of Crop Production Intensification among the Sampled Farming Households

The analysis revealed that Niger state farming households have the maximum and mean crop production intensification scores of 38.50 and 27.47 respectively, which are higher than the maximum (32.00) and mean (19.57) intensity scores of the Kwara state farming households (Table 4). Field analysis showed a significant difference between the means of the two states at 1 percent level of probability.

Although, the application rate of mineral fertilizers was also low in Niger state, the higher intensity scores may be attributed to the use of animal traction and the application of organic manure to complement mineral fertilizers in some parts of the state. In general, these results suggest that intensification in Niger state area is not occurring out of the need but rather because of the benefits it offers in terms of conserving fallow land and, presumably, in generating higher income using available factor inputs. However, it is clear that intensification is more prevalent among those with the requisite resources, judg-

Table 4: Comparison of the study areas based on crop production intensification scores

Study areas	*No. of household*	*High intensity households*	*Low intensity households*	*Range*	*Min*	*Max*	*Mean*	*Kurtosis*
Niger	108	51(20.2)	57 (22.6)	24.00	14.50	38.50	27.47	0.461
Kwara	144	10 (4.0)	134(53.2)	26.50	5.50	32.00	19.57	-0.296
Total	252	61(24.2)	191(75.8)	33.00	5.50	38.50	22.96	-0.358

Source: Field Survey, 2009/2010
Figure in parentheses are percentages

ing from their better located land and their higher overall wealth.

The Kurtosis value of -0.296 and 0.461 suggests that the variability in crop intensity from one farming household to the next is higher and lower in Kwara and Niger States respectively. The negative Kurtosis value (-0.298) may be due to greater level of inter- household variation in Kwara State in terms of the land size and cropping strategy. In contrast, Niger state is a much more homogenous area from a socio-economic and farming systems stand point. For a normally distributed variable the kurtosis value equals three. The number of households that fall within each of the intensity categories provides additional data with which to compare the two study areas as shown in Table 4. Kwara state has the larger proportion (53.2 percent) of farming households in the low category of intensity, where as Niger state has the least (22.6 percent).The latter also has the greater proportion (20.2 percent) of households in the high category of intensity.

Determinants of Crop Production Intensification of Niger State Maize-based Farming Households

The drivers of crop production intensification among maize-based farming households in Niger State are presented in Table 5.

The coefficient of household income, adoption of land management practices and market access were all found to be significant in explaining the variation in the levels of crop production intensification of households.

Household gross income significantly influenced the crop production intensification at 1 percent level of probability. This indicates that as household income increases, crop production intensification on their farms increases. Thus, the farming household with more requisite resources had higher crop production intensification scores than poor households in the state. This negative and statistically robust relationship between household income and the severity of crop intensification of households suggests that farming households who had large farm income are likely to be more successful in gathering information, purchasing and understanding the use of modern inputs, which in turn enhances their crop production intensity.

The adoption of land management practices is positive and significantly related to crop production intensification at 1 percent level of probability. This implies that the more the number of land management practices adopted by a farming household the more the household crop production intensity. The coefficient of market access is positive and significantly related to crop production intensity at 5 percent level of probability. The further the distance of farmhouse to

Table 5: Tobit regression estimates of Niger State maize-based farming households

Variables	*Coefficients*	*Std. error*	*t-value*	*P[|Z|>z]*
Constant	.7651993***	.0395654	19.34	0.000
Age (X_1)	.0006226	.0007614	0.82	0.415
Education (X_2)	.0020623	.0227382	0.09	0.928
Household size (X_3)	.0003886	.0024345	0.16	0.873
Extension contact (X_4)	-.000669	.0073754	-0.09	0.928
Household income (X_5)	-4.97e-07***	7.29e-08	-6.82	0.000
Land mgt practices (X_6)	-.0624956***	.0170293	-3.67	0.000
Market distance (X_7)	-.0019806**	.0009519	-2.08	0.039
Farm distance (X_8)	.0019686	.0015679	1.26	0.211
Sigma	.0644852***	.003799	16.97	0.000

Source: Data Analysis, 2010. ***parameter significant at 1 percent, ** parameter significant at 5 percent, * parameter significant at 10 percent
n =144; Log likelihood =190.422; Pseudo R^2= -0.3271; LR $chi^2(8)$ =93.87;Prob>chi^2=0.0000

Table 6: Tobit regression estimates of Kwara State maize-based farming households

Variables	*Coefficients*	*Std Error*	*t-value*	*P[|Z|>z]*
Constant	.7187688	.0363454	19.78	0.000
Age (X_1)	-.000351	.0006044	-0.58	0.563
Education (X_2)	.0217871	.0212239	1.03	0.307
Household Size (X_3)	.0008682	.0016871	0.51	0.608
Extension Contact (X_4)	-.0118604**	.0054317	-2.18	0.031
Household Income (X_5)	-2.02e-07***	5.57e-08	-3.63	0.000
Land Mgt Practices (X_6)	-.1243538***	.0136266	-9.13	0.000
Market Distance (X_7)	-.001422	.001953	-0.73	0.468
Farm Distance (X_8)	.0011576	.0007352	1.57	0.119
Sigma	.0407518	.0027728	14.69	0.000

Source: Data Analysis, 2010. ***parameter significant at 1 percent, ** parameter significant at 5 percent.
N=108; Log likelihood =192.382; Pseudo R^2= -0.3627; LR chi^2 (8)=102.41; Prob>chi^2=0.000

the market, the lower the probability of using the hybrid maize seed in the zone. When households incur high transactions costs in marketing, the total production costs are increased and the product profit margins are reduced. Farmers closer to the markets had a high probability of using improved hybrid maize seed. This result agrees with earlier findings by Reardon et al. (2001), that market access is a major driving force of agricultural intensification. Sustainable crop intensification could occur with concomitant development of markets for the agricultural inputs and products. Improving farmers' access to markets has a potential of improving the household income, increasing agriculture produce demand and triggering sustainable crop production intensification. When farmers sell their agricultural produce competitively they are able to reduce the income constraint hence are able to purchase the external inputs that are required to increase agriculture productivity. Hau and Von Oppen (2002), found that a decrease in distance of farm to market by 10 percent, increases intensification through fertilizer and pesticide use by 5.3 percent and 0.4 percent respectively.

Determinants of Crop Production Intensification of Kwara State Maize-based Farming Households

The factors influencing maize-based production intensification of Kwara State farming households are shown in Table 6.

The coefficient of extension contact, household income and households' adoption of land management practices were the significant variables explaining the variation in the levels of crop production intensification of Kwara state farming households.

Access to the extension services as determined by the number and frequency of visits by the extension agents to the household heads is positive and significantly related to crop production intensity at 10 percent confidence level. Household heads who received frequent visits from the extension agents had much higher crop production intensity value than household heads without frequent visit from the extension agent. Thus, the number of contact with an extension agent in a year influenced the crop production intensity. The results show that the adoption of crop intensification strategies is influenced by the frequency of the households' contact with extension services. Farmers with more contact to the extension agents had higher probability to use inorganic fertilizers. This finding shows that information flow to households is vital for the uptake of crop intensification strategies. The study by Salasyia et al. (2007) agrees that information flow is vital in adoption of agriculture technologies but proposes that informal channels of information by neighbours could be encouraged. Since information flow is vital in adoption of agricultural intensification strategies, this study emphasize the need for household heads to be well informed. Both formal and informal channels of information flow could be used for dissemination of agriculture technology.

Household gross income and the adoption of land management practices are positive and significantly related to crop production intensification of Kwara state households at 1 percent level of probability. This indicates that as household income and the adoption of land management practices increases, crop production intensification on their farms increases. The coefficient of other variables (age of the household head, education of the household head, household size,

market and farm access) were not important in explaining the variation in crop production intensification of Kwara state farming households.

CONCLUSION

The study showed that a typical household in the study area comprised of nine and eleven persons with an average age of the household head of 47.1 and 48.3 years in Kwara and Niger states respectively. The study further revealed that Niger state farming households have higher mean crop production intensification scores than those of Kwara state households. Thus, the level of crop production intensification among Niger state maize-based farming households is higher than those of Kwara state households. The study indicated that household income, adoption of land management practices and access to extension agents were the major drivers of crop production intensification in Kwara state. On the other hand, the study revealed that household income, adoption of land management practices and market access are the important variables among Niger state maize-based farming households. In conclusion, therefore, the level of crop production intensification is generally low among maize-based farming households in the Southern Guinea Savanna ecological zone of Nigeria.

RECOMMMENDATIONS

Policy should target at strengthening maize-based farming households to have improved access to input/output markets as well as provides adequately trained and equipped extension workers for disseminating technology information. This has the potential to increase the intensity and the usage of improved maize-based technology in the study area to attain sustainable maize-based production.

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