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A Comparative Study of Production Efficiencies Under Cowpea-Maize and Groundnut-Millet Intercropping Systems In The North Central Zone, Nigeria

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Abstract
In Nigerian Savanna, mixed cropping is a common practice among the farmers, particularly, the Northern part of Nigeria is known to be characterized by mixture of cereals, leguminous grains and fibre. These combinations are considered as technology by the peasant farmers in an attempt to increase food production. But available studies or records on production efficiencies by the farmers are unavailable and even if they are available, such studies are limited and restrictive, hence, creating a research gap. The research examines the comparative study of efficiencies of cowpea-maize and groundnut-millet intercropping systems in North Central Zone, Nigeria. The specific objectives of the study include; determining the socio-economic characteristics of the farmers, determining the input output relationship in cowpea-maize and groundnut-millet production among the farmers, assessing the technical efficiencies of cowpea-maize and groundnut-millet production among farmers and their determinants, estimating cost and returns in both intercrop systems and to identify the production constraints of cowpea-maize and groundnut-millet intercropping systems in the research area and make recommendations from the findings. Primary data were collected from 360 farmers who cultivate crop in mixtures. Analysis of data collected was done using both descriptive statistics such as frequency, percentage, mean and inferential statistics like correlation and gross margins analysis. The result of the socio-economic characteristics of the farmers showed that the mean age of the farmers was 46 years, majority of the farmers were males, average years of schooling was 15 years, mean family household size of 9, mean farm size of 5.6 hectares, mean years of experience in farming was 27.9, only a few farmers had contact with extension agents; majority had no access to credit facilities. Correlation analysis indicated that there is a positive and significant relationship that exists between inputs and output. The Gross Margin showed that both intercrop systems are viable because the gross margin is positive in the two intercropping systems. Major constraints identified include inadequate capital, inadequate supply of inputs, low product price, lack of credit facilities, amongst others. The research concluded by advocating among other measures that farmers should be encouraged to grow crops in mixtures, by increasing the use of variable inputs at optimal level to overcome the shortfall in technical, allocative and economic efficiencies.
Keywords:*, Mixed cropping, Geuinea Savanna, Cereals and Legumes, Production effieciency*

Introduction

"The importance of agricultural sector is more pronounced in the developing countries including Nigeria where it is the main thrust of employment, food and foreign exchange earnings. Low production and productivity have continued to characterize Nigeria agricultural sector thereby limiting the ability of the sector to perform its traditional role in economic development" (Akpa, 2007). Despite the importance of the oil sector, the Nigerian agriculture still contributes about 41 percent to the Gross Domestic Product (GDP) and provides about 90 percent of the nation's total food requirements (CBN, 2002). However, over the past two to three decades, the dominant role of agriculture in the country, especially in terms of ensuring of food security, has given way to massive importation of basic food items like rice, beans and millet (CBN, 2007).

In order to increase food production, the small scale farmers have to adopt a form of cropping systems that will enhance productivity in agriculture. One way of transforming agriculture is by exposing small-scale farmers to improved agricultural production technologies. This implies that empowerment of small-scale farmers through appropriate agricultural technologies and modern practices can go a long way in reducing poverty and food insecurity among farming communities (Ogungbameru and Idrisa, 2013). Thus, the farmers generally take decisions on the technologies to be adopted and combining crops as risk minimizing measures against total crop failures. CBN, (2005) reported that the gap between demand and supply of food continues to be in the increase. The Nigeria food problem which started in the mid 1960s has continued to deepen several years after independence. Food demand has been growing at the rate of 3.5% per annum while food production has just been growing at the rate of 2% per annum in recent years. But the annual rate of population growth has been as high as 2.9 percent, thus creating a serious food gap (Baiyegunhi, Chikwendu, and Frasei 2010). Going by the rapid rate of population growth in Nigeria, it is logical to conclude that the rate of growth in output of food crops may not be sufficient to satisfy the demand for food by the increasing population (Muhammed-Lawal, Amolegbe, Oloyede and Lawal, 2014). This, however, calls for production mixture expansion strategies. For the legume crops to address the problem of declining levels of soil fertility, growing of cereals and legumes in mixture is widely practiced among farmers. One way of increasing farm output is the cropping systems where crops will continue to be grown in traditional formats with limited scientifically established cultural practices that would exploit interaction between two or more crops for maximum yield and weed suppression.

In humid tropical regions, intercropping is a common crop production system. It has been posited to allow more efficiency in resource utilization. Ghaffazadeh (1999) reported that "throughout time and around the world, intercrops have been used to better match crop demands to available sunlight, water, nutrients, and labour. The advantage of intercropping over sole cropping (growing a single crop in a field) is that competition for resources between species is less than exists within the same species". Mbah and Muoneke, (2007), asserted that yield advantages resulting from intercropping may be due to component crop having different durations or growth patterns, hence, make major demands on resources at different times leading to better temporal use of growth resources. Intercropping legumes with cereals and or other crops have been a re-organized cropping system practice. Yield advantage and ability to use efficiently environmental resources are some of the reasons for intercropping (Akpan, Chukwu and Olajede 2006). Intercropping results in efficiency of land utilization and improved yields (Mashingaidze, 2004). The authors asserted that growing of cereals and legumes in mixture give higher yields than sole crops due to higher conversion efficiency of resources (light and water).

A survey by Henriette, Van, Blade and Singh (1997) showed that mixed cropping was the predominant system in the Sudan Savannah of Nigeria with millet/cowpea, sorghum/cowpea, sorghum/groundnut and millet. Intercropping of these crops serves as a strategy of maximizing the use of limited farm land, food security of farmers, higher yields, suppressing the germination of striga weed seeds and reducing the level of inorganic fertilizer requirement. Usually, cereal crops like maize, millet and guinea-corn are intercropped with leguminous crops like beans (cowpea), groundnut, pigeon pea and soya bean. In fact, this is the dominant food production system in East Africa.

Millet is grown as a subsistence crop in Nigeria and most of it is used for human consumption (Jirgi *et al.*, 2010). "Intercropping millet with groundnut is a common practice among the traditional farmers of Nigeria savannah. In the developing world, groundnuts are commonly grown in mixtures with other crops, especially by small farmers who use traditional combinations often involving up to 5 – 6 crops. This research sets out to make a comparative study on the efficiency of cowpea-maize and groundnut-millet intercropping systems in North Central Zone, Nigeria and examine the implications of the mixed cropping systems for food security in the region. This will help to identify the rationality behind the strategies employed by farmers to meet their goals, and then avoiding actions which weaken those strategies and encouraging measures to strengthen them. The specific objectives are;

i. examine the socio-economic characteristics of cowpea-maize and groundnut-millet farmers in the study area;
ii. determine the input-output relationship in cowpea-maize and groundnut-millet production among the intercrop farmers in the area of study;
iii. Estimate the returns of cowpea-maize and groundnut-millet intercrop systems in the study area;
iv. identify the production constraints of cowpea-maize and groundnut-millet intercrop systems in the area;

MATERIALS AND METHODS

Area of Study

The area of study is North Central Zone, Nigeria. The North Central Zone comprises six (6) states (Benue, Nasarawa, Niger, Kogi, Kwara, Plateau) and Federal Capital Territory, Abuja. These states are part of Nigerian Southern Guinea and derived savannah of central agro-ecological zone. Agbede and Jayeoba (2011) reported that the North Central Zone has a total land area of 281, 796km^2 and spread from longitude 2^o 30^1 to 10^o 30^1 East and latitude 6^o 30^1 to 11^o 20^1 North. Aboki (2013), reported that the North Central Zone lies within the guinea savannah zone of Nigeria and has estimated population of 21,682,776 as projected by 2006 population census. The vegetation is characteristics of the tropical, deciduous forests that existed centuries ago, with interspersion of thicket, grassland, fringing forests and woodland or gallery forest along the river valleys.

Sampling Technique

A multistage sampling technique was employed to select respondents for the study. The population for the study comprised farmers who are engaged in cowpea-maize and groundnut-millet intercropping systems. The cowpea-maize and groundnut-millet producers were identified. The North Central Zone comprises six (6) states and Federal Capital Territory Abuja, out of these, three (3) states were purposively selected for the study. In each state, six local government areas were selected, in each local government area two villages based on ADP block cell were selected to give a total of twelve (12) and in each village ten (10) farmers were purposively selected to give a total of one hundred and twenty (120) farmers based on ADP extension blocks for that state and this gave a total of Three Hundred and Sixty (360) respondents for the study.

Method of Data Collection and Types of Data

Data for this study were collected from both primary and secondary sources. Primary data were generated through the use of well structured questionnaire/interview schedule administered to cowpea-maize and groundnut-millet farmers in the study area. Secondary data were collected from Agricultural Development Projects (ADPs), Journals, Books, Conference Proceedings and other relevant related publications.

Data Analysis

Descriptive statistics such as frequency counts, mean and percentages were used to achieve objectives i and iv. The production function analysis was used to analyze objective ii. While the Net farm income model and Gross Margin were used to achieve objective iv.

Model Specification

Stochastic Production Frontier Model

The stochastic frontier production function was used to analyze productivity and technical efficiency of cowpea-maize and groundnut-millet farmers. "The stochastic frontier production function is used on the composite error model" (Ewuziem *et al.,* 2010). The empirical model of the stochastic production is specified as thus;

$$\text{Ln } Yij = \alpha_o + \alpha_1 \text{ Ln } X_{1ij} + \alpha_2 \text{ Ln}X_{2ij} + \alpha_3 \text{ Ln}X_{3ij} + \alpha_4 \text{ Ln } X_{4ij} + \alpha_5 \text{ Ln } X_{5ij} + \alpha_6 \text{ Ln } X_{6ij} + \alpha_7 \text{ Ln } X_{7ij} + V_{ij} - U_{ij} \ldots\ldots\ldots\ldots..(1)$$

The subscripts i and j refer to the ith farmers and jth observation respectively while,

Y = Total farm output (kg)
X_1 = Age of farmer (yrs)
X_2 = Cultivated land area of farm size (hect)
X_3 = Labour (man-days)
X_4 = Quantity of seeds planted or inputs (kg)
X_5 = Quantity of fertilizer used (kg)
X_6 = Quantity of herbicides used (litres)

V_{ij} = a random error term with normal distribution N (o,σ^2). It accounts for random variation in output due to factors beyond the control of the farmer (e.g changing weather condition, diseases and pest, and fire outbreaks, theft, price change, changing government policies, among others. Assumed to be identically and independently distributed of the U_i.

U_{ij} = a non-negative random variables called technical inefficiency effects associated with the technical inefficiency in production relative to the stochastic frontier. (e.g age of the farmer, educational level, among others) which are assumed to be independently distributed of the V_i such that U_i is attained by truncation (at zero) of the normal distribution with the variance, σ^2 and mean, U_i (Coelli and Battese, 1996)

Ln = the natural logarithm (i.e to base e)

$\alpha_o - \alpha_6$ = parameters to be estimated.

Determinants of Technical Efficiency

In order to determine factors contributing to the observed technical efficiency in both intercropping systems, the following model was estimated jointly with the stochastic frontier model.

$$TE = \sigma_o + \sigma_1 Z_1 + \sigma_2 Z_2 + \sigma_3 Z_3 + \sigma_4 Z_4 + \sigma_5 Z_5 + \sigma_6 Z_6 + \sigma_7 Z_7 + \sigma_8 Z_8 + V_i - U_i \ldots\ldots (2)$$

Where

TE = Technical efficiency of the i-th farmer, Z_1 = Age of the farmer (yrs)

Z_2 = Household size (number) Z_3 = Farm size (ha) Z_4 = Level of education (yrs)

Z_5 = Farming experience (yrs) Z_6 = Access to credit (access = 1, otherwise = 0);

Z_7 = Membership of cooperative/association (member = 1, otherwise = 0)

Z_8 = Extension visit (number of visits), σ_o = Intercept

$\sigma_1 - \sigma_8$ = Parameters to be estimated $V_i - U_i$ = as defined in the equation (1)

Results and Discussion

Socio-Economic Characteristics of Respondents

The results of the distribution of respondents were based on their socio-economic characteristics and the test of different means (t-test) of the socio-economic characteristics among farmers of the two intercropping systems is presented in Table 1.

The result revealed that majority (83.0%) were within the productive age of 30 – 59 years with most (37%) farmers falling between the age ranges of 40 – 49 years. The mean age of the farmers was found to be 46years; this implies that the farmers were in their active age group. A total of 79.4 percent had formal education, while 20.6 percent had informal education. The analysis indicated that those who had formal education up to tertiary level spent on the average 17 years in school, while those who stopped at secondary level spent 12 years. Education is one of the most important variables that influence farmers' decisions in agricultural production. Ogundari *et al* (2006) noted that education is needed to enhance productivity among farming households in Nigeria. It is likely that good education propels head of households to adopt innovations and technologies that are vital to enhance productivity.

The results in Table 1 showed that majority (44.4%) had household size of 7 – 12 members; those who had less than 7 household size constituted 43.3 percent; those with household size of 13 – 18 had 8.3 percent; those with household size of 19 – 24 had 1.9 percent; the least (1.7%) had household size of 25 – 30 members. The mean family household size is 9.11. The significance of household size in agriculture is associated with availability of labour for farm production. The result on years of farming indicated that most (33.6%) farmers had farming experience of 26 – 35 years; those with 36 – 45 years of farming experience had 24.7 percent; those who had 16 – 25 years of farming experience had 17.5 percent; the least (13.9%) are farmers with 46 – 55 years of experience in farming. The mean years of experience in farming is 27.9 in both intercrop systems with these years of experience, it could be said that farmers in the intercropping systems in the area of research were sufficiently experienced. Majority (75.3%) of the respondents had no contact with extension agents, while only 24.7 percent had extension contact. According to Obwona (2000), “extension service is very essential to the improvement of farm productivity and efficiency among farmers”. The implication of this is that only a few of the respondents had access to extension agents, who are the main source of farmers information on improved agricultural technologies. Also, Umar *et al* (2009), noted that higher extension contacts would increase adoption of improved production technologies.

Majority (84.2%) had no access to credit, while only 15.8 percent had access to credit. The implication of this is that access to formal credit by farmers was generally low in both intercropping systems. Further analysis revealed that most (86.9%) of the farmers inherited land, 9.7 percent use communal land, 0.03 percent cultivate on personal land, while the rest of the respondents use family and other land. Most (77.5%) farmers had farm size of less than 4 hectares; 0.3 percent had farm size of 7 – 9 hectares; 0.02 percent had farm size of 10 – 12 hectares, while others (0.02%) had farm size of 12 – 15 hectares. The analysis indicated the characteristics of peasant farming that has continued to dominate Nigeria agricultural sector, thereby limiting the ability of the sector to solve the problem of food security for the Nigerian ever increasing population. The result indicated that the size of land holdings was significantly different in both systems (t=1.41; P>0.01), this is because the Nigeria farmers cultivate on small land holdings.

Table 1: Socio-economic characteristics of farmers by farming system

Variable	Cowpea/maize intercropping system (N = 180)		Groundnut/millet intercropping system (N = 180)		t-test
	Frequency	Percentage	Frequency	Percentage	
Age					
< 30	10	06.0	12	07.0	
30 – 39	26	14.0	51	28.0	
40 – 49	75	42.0	58	32.0	
50 – 59	48	27.0	39	22.0	
60 and above	21	11.0	20	11.0	
Mean	46.83	-	46.34	-	0.42
SD	10.07	-	11.10	-	
Gender					
Male	147	82.0	162	90.0	
Female	33	18.0	18	10.0	

Marital status					
Married	165	92.0	164	91.0	
Single	6	3.0	16	09.0	
Divorce	9	5.0	0	00.0	
Educational qualification					
Informal	62	35.0	12	07.0	
Primary	40	22.0	57	32.0	
Secondary	47	26.0	22	12.0	
Tertiary	31	17.0	54	30.0	
Others	0	00.0	35	19.0	
Family size					
<7	80	41.0	76	42.0	
7 – 12	78	44.0	82	46.0	
13 – 18	15	08.0	15	08.0	
19 – 24	3	04.0	4	02.0	
25 – 30	3	03.0	3	02.0	
Mean	9.24	-	8.97	-	0.238
SD	15.79	-	5.89	-	
Years of farming					
<16	45	25.0	18	10.0	
16 – 25	46	25.6	75	42.0	
26 – 35	48	26.7	41	23.0	
36 – 45	27	15.0	36	20.0	
46 – 55	14	7.8	10	05.0	
Mean	26.99	-	28.76	-	-1.37
SD	12.06	-	13.72	-	
Extension visit					
No	37	20.0	52	29.0	
Yes	143	80.0	128	71.0	
Membership cooperative					
No	93	52.0	104	58.0	
Yes	87	48.0	76	42.0	
Credit access					
No	124	69.0	179	99.0	
Yes	56	31.0	1	01.0	
Access to non-farm income					
No	124	69.0	137	76.0	
Yes	56	31.0	43	24.0	
Farm acquisition					
Inherited	149	82.0	164	91.0	
Communal	20	11.0	15	08.0	
Family	1	01.0	1	01.0	
Personal	9	05.0	0	0.0	
Others	1	01.0	0	0.0	
Farm size					
< 4	155	86.0	124	68.0	
4 – 6	15	08.0	45	25.0	
7 – 9	2	01.0	9	05.0	
10 – 12	7	04.0	1	01.0	
13 – 15	1	01.0	1	01.0	
Mean	9.24	-	2.19	-	1.41
SD	15.79	-	1.41	-	

Source: Field survey, 2015

Correlation Analysis between Inputs and Output in Cowpea-Maize and Groundnut Intercropping Systems

Table 2 presents the relationship between inputs and output in both systems. The result revealed a positive and significant relationship which exist between farm size ($P<0.05$), quantity of seed, labour, chemicals and fertilizers under both systems.

The inputs used in the production of cowpea-maize and groundnut-millet by farmers in the area of study were presented in Table 2. The finding revealed that all the inputs have positive and significant relationship with output in both intercrop systems. This implies that farm size, quantity of seed, labour, agrochemicals and fertilizer are significant at 1 percentage ($P<0.01$). However, labour and quantity of fertilizer are positive and significant at 1% ($P<0.01$) under groundnut-millet intercrop. While farm size ($P\leq0.01$) under cowpea-maize, quantity of seed, labour, agrochemicals and fertilizer are positive and significant at 1% ($P<0.01$). However farm size, quantity of seed and agrochemicals under groundnut-millet intercrop are positive and significant ($P<0.05$). The positive relationship between farm size and output implies that as the farm size increases, output in both intercrop systems increases. The positive relationship between quantity of seeds planted and output in both intercrop systems is likely due to the fact that planting appropriate or recommended seed rate gives adequate plant population, resulting in higher output. The positive relationship between the quantity of labour used and the output in both intercrop systems is due to the expectation that the more labour is available for farm work, the more potential to cultivate larger hectrage of farm land and carry out farm operations appropriately, hence, increased output. Also the quantity of fertilizer and agrochemicals had positive relationship with output in both intercrop systems. This is likely due to the fact that majority of the farmers were educated and therefore might have sufficient knowledge in the application of recommended doses.

Table 2: Correlation analysis between inputs and output in cowpea-maize and Groundnut – millet intercrop production systems

Item	Cowpea- maize system		Item	Groundnut – millet system	
Input	Output	Correlation coefficient	Input	Output	Correlation coefficient
Farm size (2.47ha)	2621	0.627***	2.19ha	2658	0.336**
Seed (44.82kg)	2621	0.613***	44.15kg	2658	0.299**
Labour	2621	0.315***	65.59m/days	2658	0.708***
(65.88m/days)	2621	0.314***	3.61ltrs	2658	0.190**
Chemicals (6.71ltrs)	2621	0.776***	80kg	2658	0.334***
Fertilizer (215kg)					

*** significant at 0.01 (1%) ** significant at 0.05 (5%)

Source: Data Analysis, 2015

The Results of Cowpea-Maize and Groundnut-Millet Profitability Analysis

The costs and returns of cowpea-maize and groundnut-millet intercropping systems in the area of study is summarized in Table 3 on the basis of intercrop system.

The costs and returns in cowpea-maize and groundnut-millet intercropping systems were estimated to determine how profitable are the intercropping systems. The analysis of costs and returns presented in Table 3 showed a pool gross margins of N75,945 for cowpea-maize and N62,073 for groundnut-millet intercropping systems per hectare. The result of the analysis further revealed that the mean gross margin under the two intercrop systems differ significantly, however, the two enterprises are profitable. Though the result on elasticity of production and returns to scale earlier mentioned indicated that groundnut-millet farmers had higher returns to scale, the gross margin (75,945) for cowpea-maize is higher than that of (N62,073) groundnut-millet probably because of differences in the prices of cowpea-maize and groundnut-millet crops.

With respect to total variable costs (TVC) the cowpea-maize had a total TVC of N53, 556 as against the total TVC of N35,214 in groundnut-millet intercrop per hectare. The result showed that hired labour costs (N16,611) for cowpea-maize and (N20,493) for groundnut-millet intercrops constituted the highest proportion of the total costs for each intercrop system. This result agrees with the findings of Ani *et al* (2010), on the economic efficiency of soybean production in Benue State. They reported that average cost incurred on hired labour constituted the highest proportion of the average total variable costs of production of leguminous crops. However, the result of the analysis further revealed that both systems do not show significant difference in profitability. Though there is significant difference in total revenue, quantity of seed cost, fertilizer cost and agro-chemical cost have higher values in cowpea-maize intercrop system than the groundnut-millet intercrop system. The result of the analysis generally revealed that intercropping with leguminous and cereal crops are viable because the gross margin is positive in the two intercropping systems. This implies that farmers, will be encouraged to continue with intercropping systems in the study area not only for insurance of food insecurity but also for the monetary benefits. This is in agreement with Ani *et al* (2010), asserting that, apart from provision of food, there must be other corollary benefits perceived by farmers before they take to the production of a particular crop.

Table 3: Gross Margin of Cowpea-Maize and Groundnut-Millet Intercrop Systems (1ha)

Items	**Cowpea-maize intercrop**	**Groundnut-millet intercrop**	**t-test**
Total revenue	129,790 (107,024)	97,287 (87,8361)	3.118***
Seed cost	6,361 (7,724)	4,862 (5,945)	2.031**
Hired Labour cost	16,611 (27,604)	20,493 (22,979)	-1.33

Fertilizer cost	12,665 (14,320)	4,483 (78,351)	6.681***
Agrochemical cost	4,903 (6,849)	1,998 (2,133)	5.44***
Total variable cost	53,556 (51,956)	35,214 (43,492)	1.661
Gross margin	75,945 (83,321)	62,073 (66,659)	1.694

Source: Data Analysis 2015
*** significant at 0.01 (1%) ** significant at 0.05 (5%) The values in parenthesis are t-values

Constraints of Farmers under Cowpea-Maize and Groundnut-Millet Intercropping Systems

Table 4 present a summary of the factors that constitute major constraints in the production of cowpea-maize and groundnut-millet intercropping systems in North Central Zone, Nigeria. The constraints identified by farmers, were rated as very serious, serious, less serious and not serious and mean score for each constraint was recorded. There were multiple responses in each case. Table 4 revealed that the most commonly experienced constraint was inadequate capital in both intercrop systems indicating a mean score of 91.4 percent. This implies that majority of the farmers in both intercrop systems had no access to credit probably because of their poor base resources which does not allow them to make savings. The implication of this is that, farmers under the two systems may find it difficult to acquire farm inputs such as seeds, fertilizers, agrochemicals, labour and even farm expansion may be difficult for the farmers and this may likely endanger sustainable food security for the nation.

Inadequate supply of farm inputs was identified by the respondents with a mean score of 90.0 percent. This means that intercrop farmers in the study area had little access to farm inputs such as fertilizer, agrochemicals, seed, among others. The implication of this is that the lack of inadequate farm inputs may hamper the attainment and sustenance of food security. Low product price and poor marketing with a mean score of 86.9 percent and 59.2 percent respectively were reported as constraints. The implication of this is that low prices offered to farmers may discourage them from mass production of food crops as they may be compelled to sell at low price. Lack of credit facilities with mean of 76.7 percent was also identified by the respondents; financial services such as savings and credit provide opportunities for farmers to improve their agricultural output. The implication is that the lack of access to credit by farmers would weaken their ability to expand their output.

Poor storage facilities by the farmers with a mean score of 76.4 was identified. The implication here is that since farmers had no adequate storage facilities, they are forced to sell at cheap prices during harvest time for fear of damage and pests/insects infestation. Other severe constraints indicated by the farmers include infrastructure, inadequate farm equipment. Among the less severe problems confronting the intercrop farmers in the study area were high cost of transportation, in compartibility of existing practices, poor access roads, poor government policy and inadequate modern knowledge of farming.

Table 4: Constraints of Farmers under Cowpea-Maize and Groundnut-Millet Intercropping Systems

Constraints	Intercropping system	Frequency	Percentage	Intercropping system	Frequency	Percentage	Mean	Ranking
	Cowpea-Maize N=180			Groundnut-Millet N=180				
Inadequate capital		168	93.3		161	89.4	91.4	1
Inadequate supply of inputs		154	85.6		170	94.4	90.02	2
Low product price		160	88.8		153	85.0	86.9	3
Lack of credit facilities		145	80.5		131	72.8	76.7	4
High cost of inputs		130	72.2		142	78.9	75.5	6
Poor storage facilities		135	75.0		140	77.8	76.4	5
High cost of labour		142	78.9		115	63.9	71.4	7
Inadequate infrastructure		108	60.0		120	66.7	63.4	8
Inadequate farm equipment		105	58.3		110	61.1	59.7	9
Poor marketing		110	61.1		103	57.2	59.2	10
High cost of transportation		120	66.7		85	47.2	57.5	11
Incomportability of existing practices		72	40.0		89	49.4	44.7	12
Poor access roads		80	44.4		73	40.6	42.5	13
Poor government policy		57	31.7		95	52.8	42.3	14
Inadequate modern knowledge of farming		65	36.1		78	41.7	38.9	15

Multiple response Source: Data Analysis, 2015

Summary and Conclusion

In the area of study, findings revealed that most farmers had experience in farming, though years of experience in farming were found to differ statistically. Since years of experience in farming form the basis of farm production, the farmers were expected to utilize inputs efficiently and have better output. Since the technical efficiency was found to differ among farmers under both intercrop systems, the production of food crops by the farmers can only be guaranteed in the short-run. This is because both farmers in both intercrop systems are operating below the frontier of efficiency. However, there is still hope for improving their efficiency level to guarantee sustainable production of food crops in the medium and long run. The farmers' efficiency can only be improved if they will accept and adopt the best agricultural innovations. Since the allocative efficiency was found to be significantly different, it implies that the farmers in both intercrop systems are currently efficient in allocating costs, which guarantees crop production in the short run.

The results from the study indicated that from the gross margin analysis, the two intercrop systems are profitable. This means that farmers in the area of study will be encouraged to continue to grow crops in mixtures. The growing of crops in mixtures should involve an intergrated and policy approach that will promote education among intercrop farmers. This is because education was found as significant variable influencing technical, allocative and economic efficiencies in crop production. This can be achieved, for example, through the introduction of adult literacy programmes by state and federal governments.

The research highlighted the importance of growing crops in mixtures. It also highlighted the comparative efficiencies of cowpea-maize and groundnut-millet intercrop production. Some studies have been done on cereal-legume intercropping systems but none seemed to do a comparative analysis of the production efficiencies. Also none of the studies in the study area linked the implications of their findings to food security of the country, thereby creating information gap that needs to be filled. This is what this study has attempted to fill.

In order to provide solutions to the various constraints faced by the farmers to enable them achieve technical, allocative and economic efficiencies, it is important to conclude that the existing resources should be more optimally utilized. This will lead to substantial gains in output and decrease in cost could be attained given the existing technology.

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