International Journal of Innovative Food, Nutrition & Sustainable Agriculture 14(4):1-10, Oct.-Dec, 2026

© SEAHI PUBLICATIONS, 2026 www.seahipublications.org **ISSN: 2467-8481**

DOI:10.5281/zenodo.23411059

Costs And Return Of Maize And Legumes Intercropping Systems In Federal Capital Territory, Nigeria

Peter Daniel[1] & Jegede, Eniola Omotola[2]

Department of Agricultural Economics
Faculty Of Agriculture
University Of Abuja, Abuja, Nigeria

ABSTRACT
The study evaluated the costs and returns of Maize and Legumes Intercropping Systems in the Federal Capital Territory, Nigeria. Primary data were used for this study. A multistage sampling technique was used to select a sample size of three hundred and twenty-two (322) maize-legume farmers in the study area. Data were analyzed using Descriptive Statistics, Farm Budgetary Technique, Financial Analysis. Most of the farmers are male with an average age of 49 years. Most (88.2%) were married and the mean household size was 7 people. The average farmer has 27 years of experience in maize-legume farming. The benefit-cost ratio was calculated to be 1.56, 2.42, and 1.69 for maize-soybean, maize-groundnut, and maize-cowpea enterprises respectively. The gross margin ratio was 0.62, 0.76, 0.66 for maize-soybean, maize-groundnut, and maize-cowpea enterprises respectively. The return on investment was 0.56, 1.42, and 0.69 for maize-soybean, maize-groundnut, and maize-cowpea enterprises respectively showing that the enterprises were profitable. Based on the findings it was recommended that labour-saving processing techniques like the simple shelling equipment for groundnuts should be adopted to reduce be labour costs, extension officers should be employed to advocate for better land, seed, and labour utilization since it had a greater divergence from optimum values, and farmers should adopt the optimum farm plans prescribed, that is, produce the crop mixtures maize/groundnut that fit into the plan based on their resource allocation. Also, governments are advised to develop and implement policies that will help remove the bottlenecks in accessing agricultural loans. Interest-free loans or low-interest loans should be made available to farmers to encourage and increase production.
Keywords: Maize, Legumes, Farmers, Production, Cost, Cropping

INTRODUCTION

1.1. Background to the Study

Agriculture constitutes a significant sector of Nigeria's economy (Adebowale, 2014). The sector is significant in terms of employment of labour and contribution to Gross Domestic Product (GDP). Agricultural exports were the main sources of foreign exchange earnings, (Amaza & Olayemi, 2002) during the 1960s, the growth of the Nigerian economy was derived mainly from the agricultural sector. However, in recent years, there has been a marked deterioration in the performance of Nigeria's agriculture. There is a widening gap between demand and supply for food materials (legumes, cereals, among others) that aggravated the food problem in the country (Olayide, 1982). The decline in export crop production, the low level of agricultural technology, low investments, and inefficient utilization of

farm inputs, drought, and postharvest losses largely contributed to the poor performance of the agricultural sector (Umar, 2011). There is a growing emphasis on the need for rapid development of the agricultural sub-sector in Nigeria, which is today dominated by subsistence farmers. An increase in the productivity of Maize-leguminous crops is required to achieve food self-sufficiency.

Cropping systems in the Nigerian savannas are intensifying because of high population pressure. Increasing crop yield is essential and this will lead to pressure on natural resources and threaten the sustainability of farming systems (Amjadian *et al*., 2013). Where farmers practice intercropping, they mostly intercrop cereals (maize, millet, and sorghum) with soybean, cowpeas, or groundnut. In general, intercropping has been reported to be more productive than monocropping (Ghosh *et al*., 2006). This may be through efficient use of light energy and other growth resources. Also, optimization of land resource use could be achieved when crops are grown under intercropping and plant population density increased. Intercropping offers potential advantages for resource utilization, decreased inputs, and increased sustainability in crop production (Egbe *et al*., 2010). Because of the increasing population farmers are forced to plan their crop enterprises to fit into the limited land they have every year (Ayanwale *et al*., 2013). Cereals like maize, sorghum, and pearl millet can be used for intercropping with legumes (Singh *et al*., 2008) due to their dissimilar growing patterns, morphology, phenology, and nutrient requirement. Legumes, with their adaptability to different cropping patterns and ability to fix atmospheric Nitrogen offer minimum competition for Nitrogen nutrition and greater opportunities to sustain productivity (Sanginga *et al*., 2002).

Despite the advantages of cereal-legume intercropping, the prevailing production practice for maize–legume intercropping in Nigeria is traditional. In most cases, maize is grown along with some legumes at an arbitrary spacing that results in low yields (Futuless, 2010). Combinations of certain crops result in increased competition among the component crops and this causes low yields, which may make some crop species unsuitable for intercropping. Increased competition may be for water, nutrients, light, or any combination of the three, ultimately leading to changes in crop productivity levels (Carruthers *et al.,* 2000). Layek *et al.* (2014) reported that several indices such as land equivalent ratio (LER), crop equivalent yield, relative crowding coefficient, competition ratio, aggressivity, actual yield loss, intercropping advantage, and monetary advantage index (MAI) have been suggested to describe the competition and economic advantage of intercropping compared to monocropping. Higher land equivalent ratio (LER >1), indicating an advantage in intercropping, has been reported with maize–soybean intercropping in comparison to monocropping (Matusso *et al*., 2013).

METHODS AND MATERIALS

2.1 The Study Area

The research study was conducted in Federal Capital Territory (FCT), Nigeria. Federal Capital Territory (FCT) is located between Latitudes 8°25′and 9°25′ North of the equator and Longitudes 6°45′ and 7° 45′ East of Greenwich Meridian. The territory covers an area of 8,000 Square Kilometers and occupies about 0.87% of Nigeria and situated wholly within the region generally referred to as the "Middle Belt" (Balogun, 2001). Federal Capital Territory (FCT) is bordered on all sides by four states namely Niger, Nasarawa, Kogi, and Kaduna. The FCT had a population of 776, 298 people in 2006 (NPC, 2006). Currently, the population is about 3,095,000 people in 2019 which is about a 6.03% increase from 2018 (Macrotrend, 2020). The Federal Capital Territory (FCT) is made up of six area councils namely; Abuja Municipal Area Council (AMAC), Gwagwalada, Bwari, Kuje, Kwali, and Abaji. (Figure 3.1).

Federal Capital Territory (FCT) experiences two weather conditions in the year. These are the rainy season which begins around March and runs through October, the dry season (usually characterized by bright sunshine) which begins from October and ends in April. Within these periods, there is a brief period of harmattan occasioned by the North East trade wind, with a resultant dusty haze and intense coldness and dryness. The average annual rainfall is about 1,256 mm per annum. The temperature in the FCT ranges between 30°C – 37°C yearly with an average temperature of 27.3°C. The major occupation of people in the rural areas of FCT is farming. However, others are engaged in other non-farming

employment at the Local Government Area councils. Crops grown in Federal Capital Territory are maize, millet, sorghum, rice, cowpea, groundnut, soybean, eggplant among others.

2.2 Method of Data Collection

Primary data were used for this study. Trained enumerators from Agricultural Development Program (ADP) were contracted for primary data collection using well-structured questionnaires.

2.3 Sampling Techniques and Sample Size

Multi-stage sampling method was used to select the target respondents (maize-legumes farmers). In the first stage, three area councils were randomly selected using the ballot-box raffle draw method, they are Abaji, Gwagwalada, and Kwali. In the second stage, twelve (12) wards were randomly selected using the ballot-box raffle draw method, four (4) wards per area council, they are Adgaba, Ebaji, Bandagi, Yangoji, Tunga Maji, Dobi, Ibua, Kilankwa I & II, Pai, and Wako. In the third stage, twenty-four (24) villages were randomly selected using the ballot-box raffle draw method. From equation (3.1), a proportionate random sampling method (a proportionate of 30% of farmers) was used to select a sample size of three hundred and twenty-two (322) maize-legume (groundnut, soybean, and cowpea) farmers from the sample frame. Using Cochran (1977), the sample size was determined using the formula:

$$n_0 = \frac{Z^2PQ}{e^2} = 322 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3.1)$$

n_0 = Sample Size (Units),

Z^2= Abscissa of the normal curve that cuts off an area α at the tails (1 - α equals the desired confidence level, e.g., 95%), (=1.96)

P = Estimated Proportion of an Attribute that is Present in the Population (=30%),

Q = 1-P = 70%, and

e^2= Desired Level of Precision = 5%.

2.5 Method of Data Analysis

The following analytical tools were used to achieve the stated objectives in this study:

2.5.1 Descriptive Statistics

This was used to examine the socio-economic characteristics of farmers in the study area. Descriptive statistics following Igwe & Onyenweaku (2013) was used for the analysis. Descriptive statistics involve the use of mean, frequency, graph, pie chart, and percentages to describe the gender, marital status, household size, age, level of education among others of the maize-legume farmers in the study area.

2.5.2 Farm Budgetary Technique

Costs and return analysis in maize-legume production as stated in specific objectives one (i) was calculated using farm budgeting techniques following Alabi *et al*. (2013). The net farm income for the enterprise combinations (Maize-Soybean, Maize-Groundnut, and Maize-Cowpea enterprises) was calculated as follows:

$$GM_{ij} = TR - TVC \dots\dots\dots\dots\dots\dots\dots\dots (3.3)$$

$$NFI_{ij} = GM - TFC \dots\dots\dots\dots\dots\dots\dots\dots (3.4)$$

$$TR = P \times Q \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3.5)$$

Where;

GM_{ij} = Gross Margin (N),

TVC = Total Variable Cost (N),

NFI_{ij} = Net Farm Income (N),

TR = Gross Revenue (N),

TFC = Total Fixed Costs (N),

P = Price of Output (N/Kg), and

Q = Output Produced (Kg).

2.5.3 Depreciation of Assets

Depreciation is on fixed assets like hoes, sprayers, and classes. It forms the fixed cost component. The straight-line method of evaluating depreciation was used to obtain fixed costs for the durable farm tool. The straight-line depreciation method is specified as:

$$D = \frac{P - S}{N} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.6)$$

Where:
D = Depreciation on Production Asset (Naira),
P = Original Cost of Production Asset (Naira),
S = Salvage Value of Asset (Naira), and
N = Number of Years of Life of the Asset.
This was used to achieve part of specific objective two (ii)

2.5.4 Financial Analysis

Benefit-Cost Ratio (BCR), Return on Investment (ROI), and Gross Margin Ratio (GMR) following Ben-Chendo *et al*. (2015) was used to determine the profitability of maize-legume enterprises in the study area. This was used to achieve part of objective one (i) for the enterprise combinations (Maize-Soybean, Maize-Groundnut, and Maize-Cowpea enterprises).

$$\text{Benefit} - \text{Cost Ratio } (BCR_{ij}) = \frac{\text{Total Revenue}}{\text{Total Cost}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.7)$$

$$\text{Return on Investment } (ROI_{ij}) = \frac{\text{Net Farm Income}}{\text{Total Cost}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.8)$$

$$\text{Gross Margin Ratio } (GMR_{ij}) = \frac{\text{Gross Margin}}{\text{Total Revenue}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.9)$$

2.5.5 Principal Component Analysis (PCA)

Maize-legume farmers were asked to rate the challenges they encounter on a four-point Likert scale. The constraints faced by maize-legume farmers as stated in specific objectives six (vi) were analyzed using principal component tools (PCA). The Model of Principal Component (PCA) is stated thus:

$$r = r_1, r_2, r_3, \ldots, r_p \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.18)$$

$$\partial_k = \partial_{1k1}, \partial_2 K, \partial_3 k, \ldots, \propto pk \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.19)$$

$$\partial_K^T r = \sum_{j=1}^{p} \partial_{Kjrj} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.20)$$

$$\partial_K^T Var = [\partial_K^T R] \; is \; Maximum \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.21)$$

Subject to

$$\partial_K = 1 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.22)$$

$$\text{and Cov} = [\partial_1^T \partial - \partial_2^T \partial] = 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.23)$$

The Variance of each of the Principal Component are:

$$Var[\partial_k R] = \lambda_k \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.24)$$

$$S = \frac{1}{n-1}(R - \bar{R})(R - \bar{R})^T \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.25)$$

$$S_i = \frac{1}{n-1}\sum_{i=1}^{n}(R_i - \bar{R}_i)(R_I - \bar{R}_i) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.26)$$

Where,
R = Vector of 'P' Random Variables,
∂_k = Vector of 'P' Constraints,
λ_k= Eigen Value,

T = Transpose, and
S = Sample Covariance Matrix.

RESULTS AND DISCUSSION

3.1 Socioeconomics Characteristics of Maize-Legume Farmers in the Study Area

The socio-economic characteristics of maize-legume farmers are presented in Table 4.1.

The results show that about 51.87% of the sampled respondents were between the ages of 21 and 50 years, while 48.14% were between 51 and 70 years of age. The mean age of all respondents was 49 years. This shows that maize-legume production in the study area was undertaken by active, energetic, and young farmers. This agrees with the findings of Igwe *et al*. (2013) and Ibrahim *et al* (2019) who posited in their studies that farmers were relatively young and in their active age.

About 81.92% of the sampled farmers had less than 10 members as household size. Averagely, sampled farmers had 7 people per household. This finding agrees with the findings of Nasiru *et al*. (2012) and Ibrahim *et al* (2019) who reported that 51.7% of the sampled farmers had household sizes of 10 to 19 members, while 15% had household sizes above 20 members.

Furthermore, a greater proportion of the respondents (73.91%) had farming experience less than 30 years. The average farming experience was 27 years. This result agrees with that of Mafimisebi *et al.* (2013) who reported in his findings that 9.2% of respondents had less than 5 years of farming experience.

The results further show that 28.26% of the respondents had farm sizes ranging between 0.1-0.9 hectares, while 51.55% of the respondents had farm sizes ranging between 1.0- 1.9 hectares. The mean farm size in the area was found to be 1.98 hectares. This implies that the majority of the maize-legume crop farmers in the study area were small-scale farm holders. This agrees with the finding of Fasasi (2007) and Ibrahim *et al* (2019) who reported that the highest percentage of food produced in Nigeria comes from small-scale farmers. Table 4.1 further revealed that 58.69% of the respondents earned between ₦400,001 – ₦800, 000 as annual farm income, while the average annual farm income of the farmers was estimated to be ₦343, 143.82. This suggests an average monthly income of ₦28,595.31. This depicts that most maize-legume farmers were low-income earners.

Table 4.1: Socio-Economic Profiles or Characteristics of the Maize-Legume Farmers in the Study Area

Variables	Frequency	Percentage	Mean
Sex			
Female	44	13.66	
Male	278	86.34	
Age (Years)			49
21 – 30	28	8.70	
31 – 40	64	19.88	
41 – 50	75	23.29	
51 – 70	155	48.14	
Household Size (Units)			**7**
1 – 5	80	24.84	
6 – 10	216	67.08	
11 – 20	24	7.45	
20 – 30	2	0.62	
Farm Experience (Years)			**26.80**
1 – 10	19	5.90	
11 – 20	92	28.57	
21 – 30	127	39.44	
31 – 40	68	21.12	
41 – 50	16	4.97	
Farm Size (Ha)			**1.98**
0 – 1.0	91	28.26	
1.1 – 1.9	166	51.55	
2.0 – 5.0	58	18.01	

5.1 – 10	7	2.17	
Annual Income			**343,143.82**
1 – 400,000	85	26.39	
400, 001 – 800, 000	189	58.69	
800, 001 – 1, 000, 000	48	14.90	
Total	322	100	

Source: Field Survey (2021)

3.3 Gross Margin Analysis of Maize- Legumes Production in the Study Area

Table 2 shows the result of the costs and returns of maize-legumes production in the study area. From the results, total labour cost accounted for 35.64% of the total cost of the production of maize and soybeans, while rent on land accounted for 35.86% of the total cost of production of maize and soybeans. This implies that a greater percentage of the costs of were cost renting land and hiring of labour. This shows that the cost of acquiring land for agricultural purposes is high in the study area. Also, the result implies that the cost of hired labour is on the high side in the study area. Meanwhile, inputs like seeds, fertilizer, and agrochemicals were available to the farmers at less expensive prices compared to the other two enterprises, hence the least percentage (22.77%) of the total variable cost was spent on them.

The result in Table 4.2 further shows that an average farmer in the study area incurred a total variable cost (TVC) of ₦58,363.05, and had a gross margin of ₦93,610.26. The gross margin ratio was 61.59%. This means that there is a return of 61kobo for every one naira invested in maize-soybeans production, this implies that the production of maize and soybeans is a profitable enterprise in the study area. This is in line with the results of Sadiq *et al.* (2013). The result of the costs and returns of maize-groundnut production in the study area also in Table 4.2 shows that rent on land made up 37.52% of the total cost of the production of maize and groundnut, 29.90% of the total cost was spent on acquiring labour, while 26.31% of the total cost was spent on production inputs. This implies that the cost of acquiring land for agricultural purposes is high in the study area. Also, the result implies that the cost of hired labour in the study area is on the high side. Inputs like seeds, fertilizer, and agrochemicals were available to the farmers at less expensive prices compared to the cost of acquiring labour or hiring land under the same enterprise.

Also, an average farmer in the study area incurred a total variable cost (TVC) of ₦54,996.92 and had a gross margin of ₦170,765.34. The gross margin ratio was 75.63%. This means that there is a return of 75kobo for every one naira invested in maize-groundnut production, this implies that the production of maize and groundnut is a profitable enterprise in the study area. This result agrees with the findings of Adesoji *et al.* (2016). The result of the costs and returns of maize-groundout-soybean production shows that rent on land made up 40.85% of the total cost of the production of maize-cowpea, while 26.89% and 26.73% of the total cost was spent on labour and inputs respectively.

An average farmer incurred a total variable cost (TVC) of ₦48,682.14, and a gross margin of ₦96,198.81 in the production of maize-cowpea. The gross margin ratio suggests that the production of maize-cowpea is a profitable enterprise in the study area. This finding aligns with the results of Buah *et al.* (2009). The total revenue for maize-soybean, maize-groundnut, and maize-cowpea enterprise was estimated to be ₦151,973.31, ₦225,762.25, and ₦144,880.95 respectively. The benefit-cost ratio was calculated to be 1.56, 2.42, and 1.69 for maize-soybean, maize-groundnut, and maize-cowpea enterprises respectively. The return on investment was 0.56, 1.42, and 0.69 for maize-soybean, maize-groundnut, and maize-cowpea enterprises respectively. This implies that maize-soybean, maize-groundnut, and maize-cowpea production in the study area are profitable enterprises. The findings are in line with the results of Mercy (2017) and Ibrahim (2019).

Table 2: Gross Margin (Per Hectare) Analysis of Maize-Legumes Intercropping System

Items	MS (₦)	% of Total Cost	MG (₦)	% of Total Cost	MC (₦)	% of Total Cost
Input Costs						
Maize Seed Cost	4,085.18		3,827.95		4,841.00	
Soybean Seed Cost	2,840.72					
Groundnut Seed Cost			3,097.46			
Cowpea Seed Cost					3,659.52	
Fertilizer (KG)	12,238.06		13,131.00		11,667.43	
Agrochemical (Litre)	3,056.22		4,492.20		2,730.69	
Total Input Costs	**22,220.18**	**22.77**	**24,548.60**	**26.31**	**22,898.65**	**26.73**
Labour Cost						
Land Preparation (Mandays)	7,078.36		6,255.90		5,412.70	
Planting (Mandays)	2,009.54		1,588.97		1,310.48	
Fertilizer Application (Mandays)	2,282.79		2,352.09		2,126.98	
Manure (Mandays)	704.15					
Agrochemical Application (Mandays)	2,742.76		1,890.38		1,692.06	
Weeding (Mandays)	8,415.67		6,686.03		5,492.06	
Harvesting (Mandays)	5,410.56		3,409.07		2,840.21	
Threshing (Mandays)	4,340.72		3,115.06		2,562.96	
Storage	1,800.00		2,600.00		1,600.00	
Total Labour Cost	34,784.55	35.64	27,897.50	29.90	23,037.46	26.89
Transportation Cost	1,358.32		2,550.82		2,746.03	
Fixed Cost						
Rent on Land	35,000.00	35.86	35,000.00	37.52	35,000.00	40.85
Depreciation						
Sprayer	2,145.75		1,891.20		993.65	
Hoe	1,500.86		798.40		529.31	
Cutlass	576.57		587.06		456.58	
Total Depreciation	**4,223.18**		**3,276.66**		**1,979.55**	
Total Fixed Cost (A)	**39,223.18**		**38,276.66**		**36,979.55**	
Total Variable Cost (B)	**58,363.05**		**54,996.92**		**48,682.14**	
Total Cost (A+B)	**97,586.23**		**93,273.57**		**85,661.69**	
Revenue						
Maize Sold (₦)	101,235.09		154,519.06		88,386.24	
Maize Consumed (₦)	19,080.07		20,744.10		18,730.16	
Soybean Sold (₦)	25,908.57					
Soybean Consumed (₦)	5,749.57					
Groundnut Sold (₦)			33,666.06			
Groundnut Consumed (₦)			16,833.03			
Cowpea Sold (₦)					29,100.53	
Cowpea Consumed (₦)					8,664.02	
Cowpea Sold (₦)						
Total Revenue (₦) (C)	**151,973.31**		**225,762.25**		**144,880.95**	
Gross Margin (D = C – B)	**93,610.26**		**170,765.34**		**96,198.81**	
NFI (F = D – A)	**54,387.08**		**132,488.68**		**59,219.27**	
B/C	**1.56**		**2.42**		**1.69**	
ROI	**0.56**		**1.42**		**0.69**	
GMR	**0.62**		**0.75**		**0.66**	

MG = Maize-Groundnut Enterprise
MS = Maize-Soybean Enterprise
MC = Maize-Cowpea Enterprise

Source: Field Survey (2021)

3.3 Principal Component Analysis for Constraints Faced by Maize-Legume Farmers in the Study Area

This is a statistical technique for converting a large number of interrelated variables into a smaller number of uncorrelated variables (Lake *et al*., 2000). The number of principal components maintained using the

Kaiser criterion was three, as shown in Table 4.11, where the Eigen Values were 1 or higher. The component captured in the model has clarified 63 percent of the variations in the constraints at this component. At the 1% level of significance, the Kaiser-Meyer-Olkin tests of sampling adequacy (KMO) of 0.735 and the Bartlett test of sphericity of 1080.353 were important, demonstrating the feasibility of using the data set for factor analysis. Based on the expectations of maize-legume farmers, herdsmen and farmer conflicts were ranked first in order of significance, accounting for 33% of all constraints in the model. Inadequate funds and bureaucracy in obtaining credit were ranked second and third, respectively, and each explains 19 percent and 12 percent of all constraints included in the model, based on maize-legume farmers' perceptions.

Table 3: Principal Component Analysis of Constraints Faced by Maize-Legume Farmers in the Study Area

Component Mean (Std Dev)	Eigen-Value	Difference	Proportion	Cumulative
Herdsmen's and Farmer Clashes	3.25	1.37	0.33	0.33
Inadequate Funds	1.89	0.70	0.19	0.51
Bureaucracy in Accessing Credits	1.19	0.20	0.12	0.63
Inadequate Fertilizer	0.99	0.20	0.10	0.73
Pest and Diseases	0.79	0.20	0.08	0.81
Poor access to Extension Agent	0.59	0.14	0.06	0.87
Distance to the Market	0.44	0.07	0.04	0.91
Lack of Access to Land	0.37	0.06	0.04	0.95
High Cost of Labour	0.31	0.13	0.03	0.98
High Cost of Maintenance	0.18	.	0.02	1.00
Bartlett Test of Sphericity				
Chi-Square = 1080.353* **				
Rho = 1.0000				
KMO = 0.735				

Source: Field Survey (2021)

4 CONCLUSION

From the study, it can be concluded that maize-soybean, maize-groundnut, maize-cowpea are profitable enterprises in the study area. Most of the farmers were male with an average age of 49 years. Most were married and had a mean household size was 7 and of average farming experience of 27 years. The benefit-cost ratios was calculated to be 1.56, 2.42, and 1.69 for maize-soybean, maize-groundnut, and maize-cowpea enterprises respectively. The gross margin ratio was 0.62, 0.76, 0.66 for maize-soybean, maize-groundnut, and maize-cowpea enterprise respectively. The return on investments was 0.56, 1.42, and 0.69 for maize-soybean, maize-groundnut, and maize-cowpea enterprises respectively. Herdsmen and farmers' clashes, Inadequate funds, and Bureaucracy in accessing credit were the major production challenge faced by maize farmers.

5.0 RECOMMENDATIONS

The gross margins were greatly influenced by high labour costs during the production, therefore there is a need to reduce labour requirements for instance through labor-saving mechanical technologies to offset rising labour costs, adoption of labor-saving processing techniques like the simple shelling equipment for groundnuts. In addition, increased mechanization for ploughing and weeding and also less labor-demanding legume varieties should be developed. Also, governments are advised to put policies in place that will help remove bottlenecks in accessing agricultural loans. Interest-free loans or low-interest loans should be made available to rice farmers to increase productivity. Herdsmen and farmers' clashes remain one of the greatest threats to farmers. It is therefore recommended that security agencies in various local government areas be deployed to protect farmers' life and farm produce.

REFERENCES

Adebowale, S. (2014). Agricultures contribution to Nigeria's economy in 2012. A report retrieved 10/11/2020 from www.theageonline.com.ng/agriculture-contributed-n348-7b-nigerias-economy-2012-report/

Adesoji, A. G., Abubakar, I. U. & Labe, D. A. (2016). Economic Performance of Maize under Incorporated Legumes and Nitrogen in Northern Guinea Savanna Zone of Nigeria. *Asian Journal of Agricultural Research,* 10, 38-46.

Alabi, O.O, Coker, A.A.A, & Idegbesor, M.E, (2013). Net Farm Income Analysis of Maize Production in Gwagwalada Area Council of Abuja, *Journal of Agriculture, Forestry and The Social Sciences* (11)1:

Amaza, P. S. & Olayemi, J. K. (2002). Analysis of Technical Inefficiency in Food Crop production in Gombe State, Nigeria. *Journal of Applied Economic Letters*. 9 (1):51-54.

Amjadian, M., Latift, N., Farshadfar, M. & Gholipoor, M. (2013). Study of intercropping corn and soybean in various planting dates. *International Journal Agriculture and Crop Science* 5:2365–2371.

Ayanwale, A., Abdoulaye, T., Ayedun, B. & Akinola, A. (2013). Baseline Report of the Sudan Savannah Zone of the Kano -Katsina-Maradi Pilot Learning Sites of the Sub Saharan Africa-Challenge Program (SSA CP) Baseline Report.

Ben-Chendo, G.N., Lawal, N., Osuji, M.N., Osugiri, I.I., & Ibeagwa, B.O., (2015). Cost and Returns of Paddy Rice Production in Kaduna State of Nigeria. *International Journal of Agricultural Marketing*. 2(5):084-089

Carruthers, K., Prithiviraj, B., Fe, O., Cloutler, D. Martin, R. C. & Smith, D. L. (2000). Intercropping corn with soybean, lupin and forages: Yield component responses. *European Journal of Agronomy*. 12:103–115

Egbe, O. M., Alibo, S. E. & Nwueze, I. (2010). Evaluation of some extra-early-and early- maturing cowpea varieties for intercropping with maize in southern guinea savannah of Nigeria. *Agriculture and Biology Journal of North America* 1(5):845–858. HYPERLINK "https://doi.org/10.5251/abjna.2010.1.5.845.858" https://doi.org/10.5251/abjna.2010.1.5.845.858 .

Fasasi, A. (2007). Technical Efficiency in Food Crop Production in Oyo State, Nigeria. *Journal of Human Ecology*. 22. 10.1080/09709274.2007.11906028.

Felix, M. Judith, M.J., & Munashe, S. (2013). Modeling a small farm livelihood system using linear programming in Bindura, Zimbabwe. *Res. J. Manag. Sci*. (2): 20–23.

Futuless, K. N. (2010). Evaluation of maize-soybean intercrop as influenced by sowing date of soybean in Northern Guinea Savanna. *New York Science Journal* 3(10):97–102.

Igwe. K.C., & Onyenweaku, C.E., (2013). A linear programming approach to food crops and livestock enterprises planning in Aba agricultural zone of Abia state Nigeria. *American J. Exp.Agric*. 3(2): 412-431.

Ibrahim, H.Y., & Omotesho, A.O., (2011). Optimal farm plan for vegetable production under Fadama in North Central Nigeria. *Trakia J. of Sci*. 9(4): 43-49.

Ibrahim, F., Oformata, A.O., Jirgi, A., & Adewumi, A., (2019). Optimum production plan for maize-based crop farmers in Niger State, Nigeria. *Agro-Science*. 18:35-40

Layek, J., Ramkrushna, G. I., Das, A., Ghosh, A., Krishnappa, R., Panwar, A. S., Azad Thakur, N. S., Ngachan, S. V., Zodape, S. T., Buragohain, J. & Mawlong, B. (2014). Seaweed sap as organic bio-stimulant for rice and maize production. Research Bulletin No. 82. ICAR Research Complex for NEH Region, Umiam, Meghalaya, India.

Lithourgidis, A., Dordas, C., Damalas, C., & Vlachostergios, D. (2011) Annual intercrops: an alternative pathway for sustainable agriculture. *Aust. J. Crop. Sci*., 5:396

Macrotrend (2020) Abuja, Nigeria Metro Area Population 1950-2020 retrieved from HYPERLINK "https://www.macrotrends.net/cities/21976/abuja/population" https://www.macrotrends.net/cities/21976/abuja/population on 8th May, 2020.

Mafimisebi T.E., Babalola O.M. & Mafimisebi O.E. (2013). Fundamentals of cattle marketing in Southwest, Nigeria: analyzing market intermediaries, price formation and yield performance. Invited Paper Presented at the 4th International Conference of the African Association of Agricultural Economists, September 22-25, 2013, Hammamet, Tunisia

Matusso, J. M. M., Mugwe, J. N. & Mucheru-Muna, M. (2013). Effects of different maize (Zea mays L.) soybean (Glycine max (L.) Merrill) intercropping patterns on yields and land equivalent ratio. *Journal of Cereals Oilseeds* 4(4):48– 57.

Nasiru M., Haruna U. & Garba A. (2012). Economics of livestock marketing in Gamawa Local Government Area, Bauchi State, Nigeria. 8th AFMA Congress, November 25-29, 2012, Nairobi, Kenya. No. 159412. African Farm Management Association (AFMA)

Ojehomon, V.E.T., Ayinde, O.E., Adewumi, M. O. & Omotesho, O.A. (2013). Determinant of Technical Efficiency of New Rice for Africa (NERICA) Production: A Gender Approach, *Ethiopian Journal of Environmental Studies and Management* (6)5:23-30

Olayide, S.O., & Heady, E.O., (1982). *Introduction to Agricultural Production Economics*. Ibadan University Press Publishing House, University of Ibadan, Ibadan, Nigeria.

Oviasogie, D.I. (2005). Productivity of Yam-Based Farming System in Edo State, Nigeria. MSc Thesis, Department of Agricultural Economics, Federal University of Technology, Akure, 105 pp

Peter, D.O., Olohungbebe, S.A., & Rahji, M.A.Y., (2020). Profitability and Technical Efficiency of Rice Production in Abuja, Nigeria. *Nigerian Journal of Scientific Research*, 19 (1): 21-27.

Sanginga, N., Okogun, J., Vanlauwe, B. & Dashiell, K. (2002). The contribution of nitrogen by promiscuous soybean to maize-based cropping in the moist savanna of Nigeria. *Plant Soil* 241:223–231.

Singh, K. (2008). Optimum Land Use Pattern and Resource Allocation in a Growing Economy. *Indian J. Agric. Econ*.33(1):44-58.

Singh, D., Singh, R., Rao, V. U. M. & Shekhar, C. (2008). Evaluation of spatial arrangements of soybean (Glycine max) and pigeon pea (Cajanuscajan) in intercropping system. *Haryana Agricultural University Journal of Research* 38(1/2):33–36.

Sofi, N.A., Ahmed. A., Ahmad M. & Bhat B.A. (2015). Decision making in agriculture: a linear programming approach. *International Journal of Modern Mathematical Sciences*, 13 (2):160-169

Umar, S. A. (2011). Resource-use Efficiency in Small-scale Sorghum Production: A Caseb Study of Katagum Local Government of Bauchi State. *Journal of Arid Agriculture* 20 (1) 0189-7551