WORLD ACADEMIC RESEARCH JOURNALS

World Academic Journal of Agriculture and Global Food Security ISSN 4034-536X Vol.2(3),pp 200-205 July, 2017. Available online at www.worldacademicresearchjournals.org © World Academic Research Journals

Full Length Research Paper

Economics of maize-cowpea intercropped production in Kokona Local Government Area of Nasarawa State, Nigeria

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Received: 30 April, 2017. Accepted: 30 May, 2017

The continuous cultivation of a particular piece of land by farmers with little or no measures to improve the soil condition seriously affects not only the productivity of the farm but sustainability of the practice itself. This calls for assessing the economic viability of production mixture practices that has the capacity to increase productivity and ensure sustainability of the production. Hence, this study was designed to analyze economics of maize-cowpea intercropped production in Kokona Local Government Area of Nasarawa state. Multi-stage sampling technique was used to select 90 maize-cowpea intercropped farmers from which input-output data were collected based on 2014 cropping season with the aid of a structured questionnaire. Data were analyzed using descriptive statistics, gross margin and production function analyses. The results revealed that 89% of the respondents were male and most of the respondents (57%) had formal education and majority of them (53%) had farm size of less than one hectare. High cost of inputs, pests and diseases, and soil infertility were the major constraints to maize-cowpea production. Gross Margin (GM) was ₦13, 068.45 with return per naira invested of 0.14. The Production function analysis revealed that Seed, chemical and labour were significant factors influencing the level of maize-cowpea output in the study area. It is recommended that simple labour-saving technology should be made available and affordable in study area to reduce the production cost for higher efficiency and greater revenue generation.

Keywords: Analysis, gross margin, inter-cropped, maize-cowpea, productivity, Profitability.

INTRODUCTION

The importance of sustainability of agricultural production system is becoming a major concern of agricultural researchers and policy makers in both developed and developing countries (Megudu, 2006). In simplest terms, sustainable agriculture is the production of food, fiber, or other plant or animal products using farming techniques that protect the environment, public health, human communities, and animal welfare. This form of agriculture enables us to produce healthful food without compromising future generation's ability to do the same. Tarawali*et al.* (2002) observed that despite the need to apply inorganic fertilizers for yield improvement, the use of mineral fertilizer in West Africa is limited by lack of capital, inefficient distribution systems and poor enabling policies as well as socio-economic and environmental factors. To promote sustainable agricultural development, Coker *et al*. (2014) reported that the United National Rio plus 20 conference on sustainable development, amongst other time-bound commitments agreed on the need to prepare and implement comprehensive policies and programmes leading to management and utilization of land resources and soil fertility for sustainable agricultural development.

Decreasing in biodiversity due to mono-cropping is leading scientists to explore diverse cropping systems for protection of diversity. Intercropping is being considered to utilize these resources in an efficient way and is also most economical way to increase production per unit area and per unit time. Going by the 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

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(Muhammad-Lawal *et al.,* 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. Onuk (2015) reported that farmers in Northern Nigeria have continued to emphasize growing crops in mixtures despite strong efforts to dissuade them. And that it is obvious that, the growing of crops in mixtures is a logical practices that has evolved over generation and which represents a kind of balance between technical (biological and physical) and human (economic and social) factors. He further reported that intercropping offers farmers the opportunity to engage native's principle of diversity of their farms. It is a system of cultivating a cereal crop as the primary food crop, but on a legume base. Usually, cereal crops like maize, millet and guinea-corn are intercropped with leguminous crops like cowpea, groundnut, pigeon pea and soya bean. Cereal-legume mixture therefore comes handy as a cheaper means of improving soil fertility and productivity. Maize-cowpea intercropping is currently receiving attention because of its unique importance in the world agriculture. Maize-cowpea production is of vital importance on socio-economic and food security (Tsubo and Walker, 2003). This production type is able to lessen amount of nutrients taken from the soil in comparison to a maize mono-crop (Tsubo *et al*., 2005). According to Tsubo *et al*. (2003) higher crop productivity and resource use efficiency was observed in maize-bean intercropping systems than respective sole cropping.

Interestingly, Intercropping of cereals and cowpea has been observed to reduce *striga* infestation significantly (Khan *et al*., 2002). This was attributed to the soil cover of cowpea that created unfavorable conditions for striga germination. Besides, the systems control soil erosion by preventing rain drops from hitting the bare soil where they tend to seal surface pores, prevent water from entering the soil and increase surface runoff (Seran and Brintha, 2010). Also, Dahmardeh *et al*. (2010) reported that maize-cowpea intercropping increases the amount of nitrogen, phosphorus and potassium contents compared to mono-crops of maize.

Recent efforts on replenishment of soil fertility in Africa have been through the introduction of legumes as intercrop and/or in rotation to minimize external inputs (Sanginga and Woomer, 2009).However, in rain-fed areas, seeding ratios, species or selections, inter and intra specific competition may have effect on the growth of intercropped species (Carr *et al*., 2004). Additionally, difficulty in mechanization such as sowing, weeding, fertilizing and harvesting are made for uniform fields, therefore, intercropping on large scale using machinery is generally believed to be impossible although there are intercropping examples using modern machines that exist (Baumann, 2001).

Though Nigeria is blessed with vast land and other resources suitable to produce enough food for her population; but low productivity and unsustainable crop production practice has constrained her food sufficiency efforts. The continuous cultivation of a particular piece of land by farmers with little or no measures to improve the soil condition seriously affects not only the productivity of the farmer but sustainability of the practice itself. This calls for production mixture expansion practices that have the capacity to increase productivity and ensure sustainability of the production. Intercropping of cereals and legumes is widespread among farmers due to the ability of legume to addressing the problem or declining levels of soil fertility and enhancing sustainability of production. The economic viability of the production mixture is considered as vital incentive for making the practice popular among farmers, particularly smallholder farmers. Hence this study is aimed at answering the following research questions:

- What are the socio-economic characteristics of maize-cowpea intercropped farmers in the study area?
- What is the input-output relationship in maize-cowpea intercropped production in the study area?
- What is the cost and return to maize-cowpea intercropped production in the study area?
- What are the major constraints to maize-cowpea intercropped production in the study area

Objective of the Study:

The broad objective of the study is to evaluate the economics of maize-cowpea intercropped production in Kokona Local Government Area of Nasarawa state. The specific objectives are to:

(i) describe the socio-economic characteristics of maize-cowpea intercropped farmers in the study area;

(ii) estimate input-output relationship in maize-cowpea intercropped production in the study

(iii) determine the costs and returns of maize-cowpea enterprise in the study area;

(iv) identify the constraints to maize-cowpea intercropped production in the study area

MATERIALS AND METHODS

The study was conducted in Kokona Local Government Area (LGA) of Nasarawa State. Kokona is one of the thirteen (13) LGAs of the State with Garaku town as its headquarters (Figure 1). The LGA is located between latitude $8^0$8'33" and $9^0$10'10" North and longitude $8^0$1'17" to $8^0$7'23"E The study area covers a land area of about 1,844km^2 and with an estimated population of 109,749 inhabitants (NPC, 2006). The rainfall of the area ranges between 180 to 200 mm while the temperature is 30^0C – 34^0C. It comprises of mixed tribes of Gwandara, Mada, Afo, Hausa/Fulani, Eggon and Ninzam. The primary occupation of the inhabitants is farming while the major crops grown are cowpea, maize, sorghum, yam, ground-

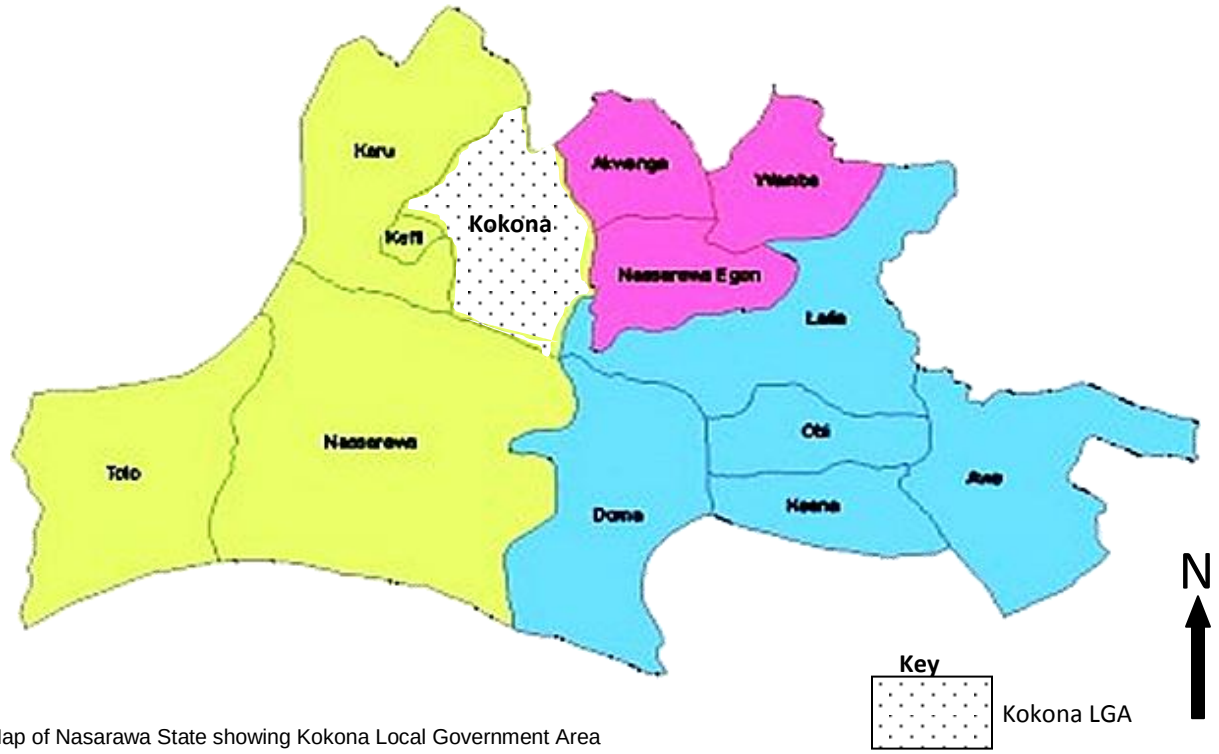

Figure 1. Map of Nasarawa State showing Kokona Local Government Area

-nut, pepper, sweet potatoes, amongst others.

Sampling technique and sample size

The multi-stage sampling procedure was adopted for this study. Firstly, five (5) districts were randomly selected from Kokona Local Government Area. From these five districts, ten (10) villages were randomly selected; that is two (2) villages from each district. The basis for the selection is that villages in each district and number of intercrop farmers are not significantly different. The villages selected included; Agaza, Agbowa, AngwanKuka, Arusu, Bokoko, Dari, Erigo, Igwo, Sabon-Gida and Sabon-Ruwa. Finally, nine (9) maize-cowpea intercrop farmers were purposively selected from each selected village, which gave a total of 90 respondents that were interviewed for the study.

Data collection

Primary data were collected with the aid of structured questionnaire Data were collected on inputs and output quantities as used by the farmers and, their costs and revenue in maize-cowpea intercropped production as well as constraints encountered by maize-cowpea intercropped farmers.

Analytical techniques

Descriptive statistics were used to analyze objectives (i) and (ii) of this study. The estimation of maize-cowpea intercropped production's costs and returns (that is objective iii) was done using the gross margin analysis. The gross margin budgetary technique is specified as:

$GM/ha = TR^{-ha} - TVC^{-ha}$ …….. 1

Where,

GM = gross margin (₦/ha)

TR = total revenue (₦/ha)

TVC = total variable cost (₦/ha)

$ROI = \frac{GM}{TVC}$ …….. 2

OCR = TVC/TR ……..... 3

ROI = Return on investment (Return/₦ Invested)

OCR = Operating cost ratio

The production function modelwas used to estimate the input-output relationship of maize-cowpea production (objective iv). Three functional forms; linear, semi-log and Cobb Douglas were estimated. The Cobb-Douglas production function was chosen as a lead equation based on the number of significant variables, though the R^2 for Cobb-Douglas, Semi-Log and linear models were not significantly different. The model is specified as follows:

Double-Log (Cobb-Douglas) equation:

$Log(Y) = \beta_0 + \beta_1 log(X_1) + \beta_2 log(X_2) + \beta_3 log(X_3) + \beta_4 log(X_4) + e$

Where

Y= value of Output (₦/ha)

X_1= value of seed (₦/ha)

X_2 = labour (Mandays/ha)

X_3 = value of fertilizer (₦/ha)

Table 1. Distribution of respondents according socio-economic variables

Variable	Frequency	Percentage
Gender		
Male	76	89.4
Female	9	10.6
Total	85	100
Age (years)		
<20	1	1.2
21-39	10	11.8
31-40	31	36.5
41-50	27	31.8
51-60	10	11.8
>60	6	7.1
Total	85	100
Marital Status		
Married	75	88.2
Single	5	5.9
Divorce	0	0
Widow(er)	5	5.9
Total	85	100
Farming Experience (years)		
1-5	1	1.2
6-10	23	27.1
11-15	19	22.4
16-20	12	14.1
20 and above	30	35.3
Total	85	100
Household size (Number)		
<5	16	18.8
6-10	36	42.4
11-15	18	21.2
16-20	9	10.6
21 and above	6	7.1
Total	85	100
Nature of Farming		
Part-time	6	7.1
Full-time	76	89.4
Hobby	3	3.5
Total	85	100
Level of Education		
Non formal education	37	43.5
Primary	23	27.1
Secondary	11	12.9
Tertiary	14	16.5
Total	85	100
Farm Size (Ha)		
$\leq$ 1	45	52.9
2-3	39	45.9
4 and above	1	1.2
Total	85	100

Source: Field survey, (2015)

X_4 = value of Agrochemical (₦/ha)
β_0 = constant term
$\beta_1 - \beta_4$ = regression coefficients
e = error term

RESULTS AND DISCUSSION

Socio-economic characteristics of respondents

The socio-economic characteristics of the respondents in the study area were presented in Table 1. The study revealed that maize-cowpea intercropped production was dominated by male (89.4%) as against female with 10.6%. This result agrees favourably with the findings of Bakoji (2013) who noted that 77.8% of maize-cowpea intercropped farmers in Akko Local Government Area of Gombe State were male. Also, most of the respondents (68.3%) were within the age range of 31-50 years. This implies that majority of the farmers were youth, and in their economic active age that can make maximum productive contribution to agricultural production. The result also showed that most of the farmers (88.2%) were

Table 2a. Input-Output Relationship of Maize-cowpea Intercropped Production (Double-Log)

	Unstandardized Coefficient		Standardized coefficients	
	B	Std. Error	Beta	t-value
Constant	0.431	0.283		0.131
Seed (₦/ha)	0.707	0.140	0.466	5.038***
Fertilizer (₦/ha)	0.085	0.061	0.104	1.402NS
Chemical (₦/ha)	0.201	0.051	0.293	3.948***
Labour (Mandays/ha)	0.218	0.073	0.160	3.000***
R^2 = 0.894				
Adj R Square = 0.88				

Source: Field survey, 2015 *** = significant at 1% NS = not significant

Table 2b. Input-Output Relationship of Maize-cowpea Intercropped Production (Semi-Log)

	Unstandardized Coefficient		Standardiz-ed coefficients	
	B	Std. Error	Beta	t-value
Constant	0.431	0.283		0.131
Seed (₦/ha)	22.043	5.196	0.278	3.289***
Fertilizer (₦/ha)	0.701	0.334	0.132	1.798*
Chemical (₦/ha)	20.548	10.573	0.313	0.551NS
Labour (Mandays/ha)	2.652	1.323	0.179	3.765***
R^2 = 0.810				
Adj R Square = 0.804				

Source: Field survey, 2015 *** = significant at 1% NS = not Significance

Table 2c. Input-Output Relationship of Maize-cowpea Intercropped Production (Linear)

	Unstandardized Coefficient		Standardiz-ed coefficients	
	B	Std. Error	Beta	t-value
Constant	0.541	0.325		0.328
Seed (₦/ha)	1.312	0.017	1.496	4.038***
Fertilizer (₦/ha)	2.043	1.016	3.203	0.402NS
Chemical (₦/ha)	0.301	0.462	0.538	1.201*
Labour (Mandays/ha)	- 0.518	0.178	0.061	0.271NS

Source: Field survey, 2015

married while others were single or widow(er). As regards to farming experience, 22.4% had farming experience of 11-15 years, 14.1% had 16-20 years and 35.3% had experience of above 20 years. This shows that maize-cowpea farmers in the study area were relatively experienced in the maize-cowpea mixture. On the household size, majority of the respondents 61.2% had household size ranged between 1-10 persons indicating that farmers in the study area had low household size. Analysis of the nature of farming of respondents showed that majority of the maize-cowpea intercropped farmers (89.4%) were full-time farmers, 3.5% were part-time farmers while 3.5% considered farming as a hobby. Majority of the respondents (56.5%) had formal education. This may probably have positive influence on adoption of innovation. The study also revealed that a large proportion of the respondents (52.9%) had farm size of less than or equal to 1 hectare.

Input-output relationship of maize-cowpea intercrops

Table 2a and 2b showed that the coefficient of multiple determinations (R^2) were 0.894 and 0.810 indicating that 89% and 81% of the variations in the dependent variables were explained by the independent variables included in the model respectively. Table 2c revealed that fertilizer and labour were not significant in the Input-Output Relationship of Maize-cowpea Intercropped Production (Linear). The result further revealed that 1% increase in the quantity of seeds would result in significant increase of 0.71% in the quantity of output of maize –cowpea enterprise in the study area. Table 2 also shows that regression coefficients for chemical and labour were 0.20 and 0.22, which indicates that if chemical and labour were increased by 1%, the quantity or the value of the output would significantly increase by 0.20% and 0.22% respectively. However, fertilizer input

Table 3. Costs and returns to Maize-Cowpea Intercropped Production per Hectare

Item	Mean Value (₦)	% of Total Variable Cost
Variable Costs/ha		
a. Labour	54,094.12	56.56
b. Planting material (seed)	2,645	2.8
c. Agrochemicals	7,152.94	7.5
d. Fertilizer	25,629.4	27
e. Transportation	6,111.76	6.4
Total Variable Costs (TVC)	95,633.26	100
Revenue/ha: (GI)	108,702	
Gross Margin (TR-TVC)	13,068.45	
Return per Naira invested	0.14	
Operating cost ratio (OCR) = TVC/GI	0.88	

Source: Field survey, 2015

Table 4. Constraints Faced by Maize-Cowpea Farmers in the Study Area

Constraints	Frequency	Rank
High cost of inputs	82	1st
Pests and diseases	79	2nd
Soil erosion	47	3rd
High cost of transportation	31	4th
Inadequate storage facilities	29	5th
Poor/inadequate extension visit	26	6th

Source: Field survey, 2015

did not show significant influence on output of maize-cowpea enterprise probably due to availability of nutrients supplied by cowpea as leguminous crop. Dahmardeh *et al*. (2010) reported that maize-cowpea intercropping increases the amount of nitrogen, phosphorus and potassium contents compared to mono-crops of maize.

Costs and returns to maize-cowpea intercropped production

Table 3 showed the costs and returns analysis of maize-cowpea intercropped farmers. The study revealed that labour contributed most to the total cost of production with 56.56% followed by fertilizer with 27% while seed had the least costof production at 2.6%. This finding agreed with that of Bamire and Segun-Olasanmi (2010) who found that labour constituted the highest component of the total variable cost, representing about 50% of the cost expended by maize-cowpea intercropped farmers in Oyo State. This implies that maize-cowpea production is labour intensive. However, these findings disagree with the findings of Bakoji (2013) who indicated that cost of fertilizer had the highest proportion with 47.63% of the total variable cost while transportation had the lowest proportion of 0.20%.

The average gross margin (GM) was ₦13, 068.45 per hectare. The return per Naira invested was 0.14, that is, for every 1 Naira invested there will be a gain of 14 Kobo. These positive values showed that maize-cowpea

RECOMMENDATION

Based on the findings thestudy recommends that, efforts should be directed towards subsidizing cost of inputsfor farmers. Furthermore, labour-saving technology should be made available in the study area to reduce the production cost for greater revenue generation in order to encourage sustainable practice of cowpea-maize intercropping among farmers.

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