

Economic analysis of yam-cowpea intercropping system in Obi Local Government Area, Nasarawa State, Nigeria

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ABSTRACT: Though Nigeria is blessed with vast land and human resources suitable to produce enough food for her teeming population, low productivity in crop production has constrained her food sufficiency effort; this however calls for crop production mixture expansion strategies. The study evaluates the economics of yam-cowpea intercropping in Obi Local Government of Nasarawa State, Nigeria. The specific objectives were to describe the Socio-economic characteristics of yam-cowpea intercropping farmers; identify the sources of fund; to estimate input-output relationship in yam-cowpea production in the study area; determine the cost and returns on yam-cowpea production; and identify the major constraints to yam-cowpea intercropping system. A multi-stage sampling technique was used to select 80 yam-cowpea intercropping farmers, farm input-output data were collected based on 2015 cropping season with the aid of a structured and validated questionnaire. The results revealed that 83.8% of the respondents were males; most of the farmers (76.4%) had formal education and majority of the respondents (77.6%) had farm size of 0.5 to 2 ha. The results further revealed that majority of the farmers (57.5%) got their finances from their personal savings. The double-log production function analysis reveals that the coefficient of multiple determination, ($R^2 = 0.908$) indicated that 91% of the variation in the value of the output (N/ha) was explained by independent variables. Yam sett and labour were found to be significant at 1% while agrochemical was found to be significant at 5% in increasing the value of the output. The gross margin analysis showed that Gross Margin (GM) was ₦25,455.30 with return per naira invested of 0.11. The study also revealed that high cost of inputs, pests and diseases and inadequate capital were the major constraints to yam-cowpea production in the study area. The study recommended that inputs (yam setts and agrochemicals) supply at subsidized rate to farmers in the area should be enhanced. There is need to make funds accessible and available for the farmers in the study area through the creation of functional rural micro finance institutions.

Keywords: Food crops, gross margin, inputs, output, resources.

INTRODUCTION

Though Nigeria is blessed with vast land and human resources suitable to produce enough food for its teeming population, low productivity in crop production has constrained its food sufficiency efforts. 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 sustain the demand for food by the increasing population (Lawal et al., 2014). The continuous cultivation of a particular piece of land by farmers with little or no measures to improve the soil

condition seriously affects the productivity of the farmer. This however calls for crop production mixture expansion strategies. Intercropping of tubers and legumes is widespread among farmers due to the ability of the legumes to contribute to addressing the problem or declining levels of soil fertility.

Intercropping is a very common feature in the cropping system among the resource poor farmers in the less developing countries of the world. It is thought to have evolved to meet the local situation and condition such as

increase in income, stability and uniformity of yield (Eskandari et al., 2009). Intercropping according to Wikipedia (2013) is a multiple cropping practice involving growing two or more crops in proximity. The common goal is to produce a greater yield on a given piece of land by making use of resources that would otherwise not be utilized by a single crop. The merits of intercropping over sole cropping include security of returns and profitability due to higher combined return per unit area of land (Anil et al., 1998). In addition, the practice controls weed, maintains soil fertility and reduces soil runoff.

Intercropping, according to Parsons (1999) refers to the growing of more than one crop in the same land area in rows or definite proportion and pattern. He further stated that it is a practice often associated with sustainable agriculture and is commonly used in the tropical parts of the world and the system uses the practice of sowing a fast growing crop with a slow growing crops so that the fast growing crops is harvested before the slow growing starts to mature. The earlier harvested crops provide both food and financial income to the farmers for expansion and for carrying out all the needed farm operations for the major crop (Gana and Busari, 1999). The income raises the socio-economic status of small and marginal resource constrained farmers, especially for rural women and youth (Gana and Busari, 2013).

Although there is no recorded history for intercropping, however, considering the available evidence, planting crops as a combined has a long history. Intercropping is a multiple cropping system, in which two or more crops species are planted simultaneously in a field during a growing season. Of course this does not mean that intercropping, plants can be planted at a time together, but it is the purpose that two or more crops are together in one place, during their growing season or at least in a time frame. Therefore it is possible that the plants are different in terms of planting time and a plant is planted after the first plant (Mazaheri et al., 2006).

Intercropping is the growing of two or more crops on the same piece of land within the same year (Sullivan, 2003). Intercropping is advocated due to its benefits for yield increase on a given piece of land by making use of resources that would otherwise not be utilized by a single crop (Gana and Busari, 2003). One of the goals of intercropping is to control weed (Poggio, 2005) and control legume root parasite infections (Fernandez-Aparicio et al., 2007). Careful planning is required for the practice of intercropping arable crops. This includes taking into account the soil, climate, crops, and varieties. It is particularly important not to have crop competing with each other for physical space, nutrients, water or light. Example of intercropping strategies are planting a deep rooted crop with a shallow-rooted crop or planting a tall crop with a shorter that requires partial shade. When crops are carefully selected, other agronomic benefits are also achieved (Gana, 2013). Adetiloye et al. (2006) defined intercropping as an agricultural practice that

involves the growing of two or more crops on the same piece of land within a cropping season.

Yam (*Dioscorea Spp.*) is a tuber crop that stores its food in the underground tissues. In Nigeria, yam is widely cultivated in the agro-ecological zones covered by the humid rain forest, the derived Guinea Savannah and the Guinea Savanna (Adetiloye et al., 2006).

According to Eneji (2009), the domestication of yams in Africa, Asia and tropical America took place separately with different species involved. More than ninety-five percent (95%) of the world's yam are currently grown in Sub-Saharan Africa, with the remainder grown in the West Indies and part of Asia and south Central America. The author further reported that, there were more than 600 yam species grown throughout the world, but in West Africa, the three major species are: white yam, yellow yam and water yam. Yam is a preferred staple food crop in West Africa and also has a prominent Socio-cultural role in various communities in West-Africa. White yam, a native of West Africa is grown in greater hecterage than any other yam species in the world. It is the most favoured yam specie in West Africa because it possesses a highly viscous starch, which is suitable for pounded yam preparation. Ekine and Okeke (2013) reported that in terms of cultivation and utilization, white yam (*Dioscorea rotundata*) and water yam (*Dioscorea alata*) are the most important food yams. They further stated that in Africa, consumer demand for yam is generally very high and despite its high cost of production, yam cultivation is very profitable. Pounded yam is one of the most popular and prestigious food in West African sub region (Onwueme, 2008).

In Africa, the production of yam is largely confined to the "yam zone" comprising of Nigeria, Cameroon, Benin, Togo, Ghana and Cote d'Ivoire, where approximately ninety percent (90%) of the world's production takes place (Eneji, 2009). As revealed by Food and Agriculture Organization of the United Nations (FAO, 2000) statistic, 96% of the 37.5 million tonnes of yam produced worldwide were in Africa. The leading producer was Nigeria with 26 million tonnes followed by Ghana with more than 3 million tonnes and Cote d'Ivoire with 2.9 million tonnes.

Cowpea on the other hand (*Vigna unguiculata*(L) walp) is an annual legume. It is commonly referred to as southern pea, black eye pea, crowder pea, lubia, niebe or frijole. Cowpea originated in Africa where it is widely grown. The crop is grown in latin America and South East Asia. The history of cowpea dates to ancient West Africa cereal farming, five to six thousand years ago, where it was closely intercropped with sorghum and pearl millet (Eneji, 2009). Cowpea is considered to be the most important staple food grains in the dry savannah of tropical Africa for both the rural and urban dwellers (Chege, 2004). It is rich quality protein and has content almost equivalent to that of cereal grains and it a source of quality fodders for livestock and provides cash income

(Langyintuo et al., 2006). Cowpea is an important legume grown in the semi-arid tropics, covering Africa, Asia, southern Europe and Central South America (Davis et al., 2013). It is one of the ancient crops known to man and is cultivated primarily for gain, but also as vegetable (leafy green, green pods, shelled dried peas and fresh shelled green peas), a fodder and cover crop. Moreover, cowpea forage is significant to animal feeds mainly during the dry season when the demand for the feeds is at its peak. Its ability to replenish soil nitrogen gives it a key position in the modern crop farming system in rotation with the other crops, with the view for long term sustainable agriculture development prospect. Due to the increase in the demand for the crop, arising from the growing population in the country, Nigeria remains the largest producer and consumer of cowpea both in West Africa and in the world. In Nigeria, the greatest production of cowpea comes from the northern region. The north produces about 1.7 million tonnes from 40 million hectares. This represents over 60% of the total production (Coker et al., 2014). Sole cropping system with the use of improved technologies can yield 1,500 to 2000 kg of cowpea. However, 200 to 250 kg/ha yield is obtained by small scale farmers who are domestic producers in the country (Wakili, 2013).

Hence, the research specific objectives are to: (i) describe the socio-economic characteristic of yam-cowpea intercropped farmers in the study area (ii) identify the sources of fund for yam-cowpea intercrop farmers in the study area (iii) estimate input-output relationship in yam-cowpea production in the study area (iv) determine the costs and returns on yam-cowpea production in the study area and (v) identify the major constraints to yam-cowpea intercropping system in the study area.

METHODOLOGY

The study area

The study was conducted in Obi Local Government Area (LGA), Nasarawa State. The LGA is located in the Southern part of Lafia and lies between latitude 8°21' and 8°40' in the North and longitude 8°69' and 8°8' in the East. Its headquarter is in the town of Obi. It covers land area of about 967 m² and a population of 148,874 based on the 2006 census and a projected population of 190,558 applying a 2.8% growth for 2016 (NPC, 2006). The Local Government Area is characterized by long period of rainy season (March to October). The mean annual rainfall is about 1270 to 1540 mm for period of over seven to eight months (April to October) of rainy season with five months of dry wind spell with Harmattan starting from November to late March and annual temperature ranging from 22.7 to 36.8°C (Nasarawa State Meteorological Department, 2008). The major tribes are Alago, Migili, Gwandara, Eggon, others include Tiv, Kwalla, Hausa, Fulani and Igbo. The main predominant occupation of the inhabitants is farming. About 70% of

the populations of the area are farmers while 30% constitutes civil servants, student, business men and women. The economic activities is largely agrarian with the majority of the people as subsistence farmers who cultivate crops such as yam, rice, maize, cassava, sorghum, millet, cowpea and a few other crops. Obi local Government Area has five (5) districts which include Obi, Agwatashi, Adudu, Daddere and Riri (Ladan and Oyigbenu, 2000).

Sample size and sampling technique

A multi-stage sampling technique was used for this study. Obi Local Government Area consists of five (5) districts. First, from these districts, four (4) districts were selected using Simple random Sampling. Secondly, two (2) villages were randomly selected from each of the four (4) districts. The villages selected include: Doyan Abakwa, Doyan Jukun, Owolosofo, Obi Town, Madaki, Galadima, Oleye and Okayarda. Finally, ten (10) yam-cowpea farmers were purposively selected from each selected village which gave a total of eighty (80) respondents that were interviewed for the study.

Data collection

Primary data were collected with the aid of structured questionnaire and personal interview. Data were collected on socio-economic characteristics of respondents, sources of funds, input/output in production and constraints encountered by yam-cowpea intercropped farmers

Analytical techniques

Descriptive statistics such as frequency distribution, mean and percentages were used to analyze objectives (i), (ii) and (v) of the study. The estimation of yam-cowpea production costs and returns in objective (iv) was computed using gross margin analysis.

The gross margin budgetary technique was given as

$$GM/ha = TR/ha - TVC/ha \text{ -----Eq. 1}$$

Where GM = Gross Margin (₦/ha), TR = Quantity of Output (₦/ha) and TVC = Quantity of Input (₦/ha).

$$RNI = \frac{GM}{TVC} \text{ -----Eq. 2}$$

Where RNI = Return per Naira Invested, GM = Gross Margin (₦/ha) and TVC = Total Variable Cost (₦/ha).

However, double-log production function model was used to estimate the input-output relationship of yam-cowpea production (objective iii). The model is specified as follows.

$$\text{Log}(Y) = \beta_0 + \beta_1 \log(x_1) + \beta_2 \log(x_2) + \beta_3 \log(x_3) + \beta_4 \log(x_4) + \beta_5 \log(x_5) + e$$

Where Y= Value of output (₦/ha), X_1 =Value of seed (₦/ha), X_2 = Yam sett (₦/ha), X_3 = Agrochemical (₦/ha), X_4 = Labour (Mandays/ha), X_5 = Value of fertilizer (₦/ha), B_0 = Constant term, β_1 - β_5 = Regression coefficient and e = Error term.

RESULT AND DISCUSION

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 yam-cowpea intercropping was dominated by males (83.8%) as against females with 16.3%. This could be attributed to the laborious nature of yam production which most females cannot contend with. The findings are in consonance with the findings of Ebewore et al. (2013) whom reported that yam production is labour intensive that is why it is dominated by males. Also, most of the respondents 73.8% are within the age bracket of 31 to 50 years, with a mean age of 38 years, which was in agreement with some studies (Adesehinwa and Bolorunduro, 2007; Oyegbami et al., 2010). Their studies indicated that the majority of the respondents interviewed had abled aged bracket of 31 to 50 years. This implies that most of the farmers were youth; an economic active age that can contribute immensely and productively to agriculture production.

The result also shows that most of the farmers (81.3) were married while others are single, divorce, or widow(er). This finding agrees with that of Oderhohwo (2008). The implication of the findings is that marriage remains a value culture in the study area. The high percentage of married respondent is due to the fact that they derived enough income from the production of yam and cowpea to support their families. As regards to farming experience, 30% had farming experience of 11 to 15 years, 26.3% had 16 to 20 years and 12.5% had experience of above 20 years, the mean years of farming experience of the farmers was computed to be 9.7. This indicates that yam-cowpea farmers in the study area were relatively experienced implying a significant level of specialization and expertise in production.

On the household size, majority of the respondents 76.3% had household size ranged between 1 to 10 persons with a mean of 7.9 indicating that the study area had low household size. Banmeke, (2003) asserted that family size is an important index in any rural development intervention which can affect the outcome of such intervention.

Analysis of the nature of farming of respondents showed that majority of the yam-cowpea intercropping farmers (73.8%) were fulltime farmers, 17.5% were part-time farmers while 8.8% considered farming as a hobby. Majority of the respondents (76.4) had formal education.

Table 1. Distribution of respondents according to socio economic variables.

Variable	Frequency	Percentage	Mean value (\bar{X})
Gender			
Male	67	83.8	
Female	13	16.3	
Total	80	100	
Age			
< 20	1	1.3	
21-30	13	16.3	
31-40	31	38.8	
41-50	28	35.0	38.0
51-60	4	5.0	
>60	3	3.8	
Total	80	100	
Marital Status			
Married	65	81.3	
Single	10	12.5	
Divorce	3	3.8	
Widow(er)	2	2.5	
Total	80	100	
Farming Experience			
1-5	1	1.3	
6-10	24	30.0	
11-15	24	30.0	
16-20	21	26.3	9.7
20 and above	10	12.5	
Total	80	100	
Household size			
<5	26	32.5	
6-10	35	43.8	
11-15	9	11.3	
16-20	10	12.5	7.9
>20	0	0.0	
Total	80	100	
Nature of farming			
Part-time	14	17.5	
Full-time	59	73.8	
Hobby	7	8.8	
Total	80	100	
Level of Education			
Non formal education	19	23.8	
Primary	9	11.3	
Secondary	27	33.8	
Tertiary	25	31.3	
Total	80	100	
Farm Size			
≤1	29	36.3	
2	33	41.3	
3	13	16.3	
4	4	5.0	
5	1	1.3	
Total	80	100	

Source: Field survey, 2016.

Table 2. Distribution of respondents based on sources of fund.

Sources of fund	Frequency	Percentage
Personal savings	46	57.5
Friends and relatives	9	11.3
Agricultural bank	4	5.0
Local money lenders	13	16.3
Cooperative society	8	10.0
Total	80	100.0

Source: Field Survey, 2016.

Table 3. Input-output relationship of Yam-Cowpea intercrops.

Parameters	Unstandardized Coefficient (Beta)	Std Error	Standardized Coefficient (Beta)	t-value
Constant	1.972	0.523		3.771
Seed (₦/ha)	0.098	0.108	0.088	0.912 ^{NS}
Yam sett (₦/ha)	0.433	0.075	0.424	5.761 ^{***}
Agrochemical (₦/ha)	0.302	0.123	0.271	2.452 ^{**}
Labour (₦/ha)	0.196	0.070	0.187	2.794 ^{***}
Fertilizer (₦/ha)	0.066	0.053	0.062	1.246 ^{NS}

R= 0.953;
R² = 0.908; Adjusted
R square = 0.902;
F-value = 147.553^{***}

Source: Field survey, 2016. ***= significant at 1%; ** =significant at 5%; NS= not significant.

This may probably have positive influence on adoption of innovation. The study also revealed that large proportion of the respondents (77.6%) had farm size of less than or equal to one-to- two hectares of land, 16.3% had farm size of three hectares, 5% and 1.3% cultivated about four and five hectares of land respectively. This shows that the farm sizes are relatively small. This agrees with the findings of Ebewore et al. (2013). They opined that relatively small farm size is disadvantageous to a large extent, as farm size determines output level.

Respondents' sources of fund

The sources of fund for the respondents are presented in Table 2. The study revealed that majority of the respondents (57.5%) obtained their capital from their personal savings. 16.3% of the respondents got their capital from local money lenders, 11.3% obtained capital from friends and relatives, while 10% and 5% of the respondents got their capital from cooperatives and Agricultural Bank respectively. This disagree with the findings of Abdulkarim (2015) who stated that local money lenders use stringent policy measures in recovering their money, which had the lowest proportion with 1.2%.

Input-output relationship of Yam-Cowpea intercrops

The result presented in Table 3 showed that the coefficient of multiple determinations (R²) was 0.908, indicating that 91% of the variation in the dependent variables was explained by the independent variables. The F-test values of 147.533 significant at 1% indicates a significant estimation and a significant R². The result revealed that the regression coefficient for yam sett was 0.433. This implies that if yam sett is increased by 1%, the value of output (₦/ha) will increase by 0.43% and it is significant at 1%. The regression coefficient for agrochemical was 0.302. This implies that if agrochemical is increased by 1% the value of output (₦/ha) will increase by 0.30% and it is significant at 5%. Likewise the regression coefficient for labour was 0.196 which indicates that if labour is increased by 1% the value of output (₦/ha) will increased by approximately 0.20% and is significant at 1%.

Costs and returns to Yam-Cowpea intercrop production

The cost and return analysis of yam-cowpea intercrops farmers is presented in Table 4. Findings from the study revealed that planting materials (yam setts) accounted

Table 4. Cost and returns of Yam-Cowpea intercrop production.

Item (Variable Costs/ha)	Value (N)	Percentage
Labour	24,595.50	10.63
Planting materials (yam sett and seeds)		
i. Yam	188,726.54	81.60
ii. Cowpea	706.30	0.31
Agrochemicals	4,472.33	1.93
Fertilizer		
i. NPK	1,230.56	0.53
ii. Urea	8,099.20	3.50
iii. Organic Matter	419.84	0.18
Transportation	3,048.53	1.32
Total Variables Costs (TVC)	231,299.12	100.0
Revenue/ha		
Yam	464,204.83	
Cowpea	21,647.29	
Total Revenue (TR)	485,852.12	
Gross Margin/ha(TR/ha-TVC/ha)	25,455.30	
Return per Naira invested (RNI)	0.11	

Sources: Field survey, 2016.

most to the total variable cost of production with 81.60%, followed by labour 10.6%, fertilizer 4.21%, Agrochemicals 1.9% Transport 1.32%, while cost of seed had the lowest proportion of 0.31%. This finding agrees with that of Ebewore et al. (2013). They asserted that yam setts constitute the highest component of the total variable cost, representing 25.11% of the cost expended by yam farmers in Ika South Local Government Area of Delta State. However, these findings are not in consonance with the findings of Bamire and Segun-Olasanmi (2010) who indicated that labour accounted for the highest proportion of the total variable cost, representing about 50% and 43% of the cost incurred by Male and Female maize–cowpea intercrop farmers respectively in Oyo State. The average gross margin (GM) was ₦25,455.30 per hectare. The returns per Naira invested (RNI) was 0.11, that is for every 1 Naira invested there was a gain of 11Kobo. These positive values showed that yam–cowpea intercrop production in Obi Local Government Area of Nasarawa state is a profitable enterprise.

Constraints associated with Yam–Cowpea production

Presentation in Table 5 revealed the problems associated with yam-cowpea farmers in the study area in decreasing

magnitude of importance. The result on constraints to yam-cowpea production in the study area indicates that high cost of inputs with 66.3% is the major constraints that affect yam-cowpea intercrop farmers in the study area. This finding agrees with that of Abubakar et al. (2005), in their study to determine the profitability in yam production in Northern part of Taraba State, Nigeria. They ascertained that the cost of input used in production is high. They further indicated that high cost of inputs serve as disincentive as it negatively affects producers' profit margin from marketable surplus. Other constraints identified to have contributed negatively to Yam-cowpea production includes; pest/diseases and inadequate capital accounted for 46.3% and 41.3% respectively. Inadequate/lack of extension contact and government policy ranked equally and accounted for 37.5% each. Poor marketing outlet and inadequate storage facilities account for 28.8% and 25.0% respectively. Soil infertility and high cost of transportation which are closely related constitutes 15.0% and 13.8% respectively. Others (insecurity, theft, ethnic crisis) were ranked the least in the order of magnitude of importance with 5.0%.

Conclusion

The study shown that men participated more in yam-

Table 5. Constraints faced by Yam-Cowpea farmers in the study area.

Constraints	Frequency	Percentage	Rank
High cost of input	53	66.3	1 st
Pest and diseases	37	46.3	2 nd
Inadequate capital	33	41.3	3 rd
Inadequate/lack of extension contact	30	37.5	4 th
In consistent government policy	30	37.5	5 th
Poor marketing outlet	23	28.8	6 th
Inadequate storage facilities	20	25.0	7 th
Soil fertility	12	15.0	8 th
High cost of transportation	11	13.8	9 th
Others	4	5.0	10 th

Source: Field survey, 2016. *Multiple responses were recorded.

cowpea inter-cropping compared to Women. Yam-cowpea production required much yam setts as indicated by the proportion of yam setts contribution to the total variable cost of production. Yam setts (₦/ha), labour (man-days/ha) and agrochemical (₦/ha) were the significant factors that influenced the value of yam-cowpea output (₦/ha) in the study area. The positive value of the average gross margin per hectare (₦ 25,455.30) showed that yam-cowpea intercropping is a profitable enterprise. Based on the findings of the study, the following recommendations were made:

1. Farmers should be mobilized to form co-operatives societies that will facilitate the provision of credits and other agricultural inputs at affordable prices.
2. There is need by development agencies to encourage more female farmers in yam-cowpea intercrops system by better extension service.
3. Improved planting materials (Yam setts and seeds), fertilizers and agro chemicals (pesticides, Insecticides and Herbicides) supply at subsidized rate to farmers in the area should be enhanced.
4. Adequate funds should be made accessible and available for farmers in the study area through the creation of functional rural agricultural microfinance institutions.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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