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Economic analysis of mixed sorghum with cowpea production in Guyuk Local Government area, Adamawa State, Nigeria

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Abstract: A study on the economic analysis of sorghum under mixed (with cowpea) cropping system in Guyuk Local Government area of Adamawa State, Nigeria was carried out with a focus on the socio-economic characteristic of the farmers, profitability and resource productivity of mixed sorghum production. Descriptive statistics, budgeting technique and stochastic frontier production analysis were applied to primary data collected from a random sample of 100 mixed sorghum producer. The results shows that 79% of the respondents were male, 80% had formal education and their average farm size 2.5 hectare. A gross margin and net income of ₦44,764.87 and₦ 42,414.01per hectare respectively revealed that mixed sorghum production is profitable. The result of the stochastic frontier production analysis shows that the variance parameter, that is sigma squared (d^2) and gamma (ϒ) were statistically significant at 1% level. The coefficient of farm size and seed were positive and significant at 1% level while family and hired labour were negative and insignificant. Profit level can be increased by increasing the amount of farm size and quantity of seeds and decreasing the use of manual labour. Mean efficiency was 0.8823 meaning that farmer operates at 11.77%below frontier level due to variation in technical efficiency. Major problems identified were pest and diseases, shortage/high cost of input, and shortage of storage facility. Timely supplies of input at subsidized rates and financial support to farmers among others were proffered.

Keywords: Economic Analysis, Mixed Sorghum, Production, Guyuk, Nigeria

1. Introduction

Sorghum [Sorghum bicolor (L) moench] locally called guinea corn is the world's fourth most important cereal in term of production and area (Basavaraja et al., 2005). In Nigeria, the area of sorghum is estimated to be 6.86million hectares and it extend from north ward of latitude 8^0 to 14^0N (Aba et al.,2004)

ADADP (1996) reported that sorghum has the largest hectare of all crops grown in Adamawa State and it is grown on an area of 70,000 hectares with 29,000 hectares in mixture with other crop. The total production of sorghum in the state in 1993 was 105,000 tonnes with an estimated yield of 1.5 tons/ha. Furthermore Guyuk Local Government Area is an important area for sorghum production in the state as the soil and climate condition of the area favours its cultivation (Mirchaulem, 1996).

Cowpea is also an important crop to livelihood of million of relative poor people in Nigeria (Singh et al., 1997). The economic importance and uses of cowpea has led to the expansion of its production in many part of Nigeria (Gibbon and Pain, 1985). However despite the alleged superiority of sole cropping to mixed cropping and despite effort by extension workers throughout the northern states of Nigeria, to impress farmers with this superiority, there has been no apparent shift from crop mixture to sole cropping (Abalu 1997).

Sorghum and cowpea are major food crops of Adamawa state and is being produced in Guyuk Local Government mainly small-scale farmers whose production system are generally characterized by the use of traditional method, poor use of available resources, inadequate, familiarity improved techniques and low yield among others. Added to these there is no adequate information on the economics of mixed sorghum production. However mixed (with cowpea)

sorghum production remains a valuable source of livelihood of the people in the area. It is therefore in view of the importance sorghum and cowpea holds for the small scale farmers and the Nigerian economy that there is a clear need for the conduct of studies on the cost and return of mixed (with cowpea) sorghum production and the scale economics of resource used by the farmers with the aim of improving the enterprise and farmer productivity for an increased food production in the country. The specific objectives of this study were to;

i. describe the socio-economic characteristics of the farmers
ii. determine the profitability of sorghum production and
iii. Estimate the efficiency of production resources utilized.

2. Methodology

2.1. The Study Area

The study was conducted in Guyuk Local Government Area of Adamawa state. The local government area is located between latitude 9^o 30' and 10^o 00' East and longitude 11^o 30' and 12^o 00' North. The area has an average temperature of 26.1^o C in December to January and 33 ^{o}C in April to May (Adebayo, 1999). In addition, the area has an average rainfall of 700 – 800 mm per annum (Adebayo and Tukur, 1999). It shares common boundaries with Numan Local Government to the South, Shelleng Local Government to the East, and Lamurde Local Government to the South-West. It also shares common boundaries with two states; Gombe state to the West and Borno state to the North (Adamawa State Government Dairy, 1994).

2.2. Source of Data and Sampling Procedure

Simple random sampling was used to select five districts out of ten districts in the Local Government Area and two villages were selected from each district giving a total of ten villages. A total of 100 farmers were sampled from the ten villages whose response to structured questionnaires gave rise to the data used for the study. The data was based on mixed (with cowpea) sorghum production for the 2010/2011 cropping season, and relate to the respondent background, input used, output and revenue realized.

2.3. Technique of Data Analysis

Descriptive and inferential statistics were employed. Budgeting technique was used to ascertain the profitability of mixed (with cowpea) sorghum enterprise. It is stated as follows

GM = TR – TVC
NI = GM – TVC
Where
GM = Gross Margin (₦)
TR = Total Revenue (₦)
TVC = Total Variable cost (₦)
NI = Net farm Income (₦)
TFC = Total Fixed Cost (₦)

The variable cost were cost of seed, fertilizer, herbicides, labour, ploughing while fixed cost were rent on land and fixed assets (depreciation).

The stochastic frontier production function was used to examine input – output relationship and inefficiency model was used to determine resource use efficiency.

The stochastic frontier production function used was specified as;

$\text{Log } Y_1 = B_0 + B_1 \text{ Log } X_1 + B_2 \text{ Log } X_2 \ldots\ldots\ldots\ldots B_6 \log X_6 + V_1 - U_1$

Y= Output of sorghum and cowpea in Kg
X_1 = Farm size in hectare
X_2 = Quantity of fertilizer in Kg
X_3 = Quantity of sorghum and cowpea seeds planted in Kg
X_4 = Quantity of herbicide used in liters
X_5 = Amount of family labour used in man-day
X_6 = Amount of hired labour used in man-day
V_1 = Random noise (White noise) which are $N(0,\delta^2, V)$
U_1 = Inefficiency effect which are non-negative half normal distinguish $N(0,\delta^2, U)$

The inefficiency model defined by

$U_1 = d_0 + d_1Z_1 + d_2Z_2 \ldots\ldots\ldots\ldots d_7Z_7$

Where
U_1 = Inefficiency effect
Z_1 = Age of the farmer (in years)
Z_2 = literacy level (in years)
Z_3 = Farmer experience (in years)
Z_4 = Extension contact (1 – contacted, 0 – otherwise)
Z_5 = Gender of the farmer
Z_6 = Family size (total number of person in household)
Z_7 = Access to formal credit

3. Results and Discussions

3.1. Socio – Economic Characteristics of the Respondents

As shown in Table 1. 86% of the farmers were between the age of 20 – 49 years old, indicating they are young and in their productive age. Male folks (79%) dominated the enterprise in the area while majority (80%) had attended formal school and so they could accept new technology and the farmers are generally experienced in their management practice. This finding is consistent with the assertion of Adewumi and Okunmadwa (2001) that economic efficiency level of farmers is significantly affected by farming experience.

3.2. Costs and Returns Associated with Mixed Sorghum Farming In the Study Area

Result of the costs and returns – analysis on Table 2. Indicated that mixed sorghum production with an average gross margin and net farm income of ₦44,764.87 and ₦42,414.01 per hectare respectively. This reveals a gross margin and net return of ₦3.01and ₦2.33to every naira invested respectively. Cost of production inputs revealed

that labour ranks highest with an average cost of ₦11,099.40 which constitutes about 70% of the total cost of production. This indicates the importance of this input in traditional agriculture. From the same table it shows that total cost of production per hectare is about 30% of the estimated income giving 70% turn over and thus a reasonable profitable venture.

Table 1: *Socio-economic characteristics of the respondents*

Variable	Frequency	Percentage
Sex		
Male	79	79
Female	21	21
Total	**100**	**100**
Age	**(Years)**	
< 40	47	47
40 – 49	39	39
50 and above	14	14
Total	**100**	**100**
Household size		
1 – 5	33	33
6 – 10	47	47
□ 10	20	20
Total	**100**	**100**
Educational level		
Non formal education	20	20
Primary School	26	26
Secondary school	31	31
Tertiary	23	23
Total	**100**	**100**
Main occupation		
Farming	61	61
Other	39	39
Total	**100**	**100**
Farming Experience (Years)		
1 – 5	15	15
6 – 10	31	31
□ 10	54	54
Total	**100**	**100**

Source: Field Survey, 2011

Table 2*: Estimated cost and return from mixed sorghum farming in the study area.*

Items		Value	Percentage
A.	**Variable cost**		
	Seed	1,202.16	7.57
	Pesticide	98.72	0.62
	Herbicide	907.56	5.17
	Fertilizer	1,377.58	8.67
	Transportation	1,722.75	7.38
	Storage	25.71	0.16
	Labour	11,099.40	69.88
	Total variable cost (TVC)	**15,883.88**	**100**
B.	**Fixed cost**		
	Rent on land	431.88	18.38
	Fixed tools (Depreciation)	1,919.02	18.62
	Total fixed cost (TFC)	**2,350.90**	**100**
	Total cost (TVC – TFC)	**18,234.78**	
C.	**Returns**		
	Average output (Kg)	485.19	
	Average price (₦/Kg)	125.00	
	Total Revenue	60,648.75	
	Gross margin	44,764.87	
	Net farm income (NFI)	42,414.01	
	Gross margin on Naira invested	3.01	
	Net farm income on Naira invested	2.33	
	Farm	gross ratio	0.30
	Operating ratio	0.26	

Source: Computed from field survey 2011

3.3. Production Function

Table 3 reveals the result of the stochastic frontier production function analysis which shows that the variance parameters sigma squared (σ^2) and gamma (ϒ) were statistically significant at 1% level. The coefficient of farm size and seed were positive and significant at 1% level while family labour and hired labour were negative and insignificant. Profit level can be increased by increasing the farm size and quantity of seeds used and also decreasing the use of manual labour.

The result of the inefficiency model in table 3 indicates that all parameters are carrying the expected sign and are statistically significant at 1%. A negative sign in the inefficiency model indicates that the associated variable has a positive effect on efficiency while a positive sign implies that the associated variable has a negative effect on

efficiency. Farming experience is negative and significant, meaning that as the farming experience of sorghum farmers in the study area increases, their technical inefficiency will decrease. This is in harmony with the study of Ogundari and Ojo (2007) which also show a decrease in the technical inefficiency of farmers as their farming experience increases. The coefficient of literacy level is negative and significant showing that an increase in education will result to an increase in efficiency. This is in agreement with the study of Shehu et.al. (2007) which shows a decrease in technical inefficiency as the literacy level of small scale rice farmers increases.

Table 3: *Maximum likelihood estimate of the Cobb- Douglass stochastic frontier production and inefficiency model for mixed sorghum farmers*

Variable	Parameter	Co-efficient	t – value
Constant	B_0	2.872	22.836***
Farm size (X_1)	B_1	0.533	5.347***
Fertilizer (X_2)	B_2	- 0.016	-1.893*
Seed (X_3)	B_3	0.259	3.109***
Herbicide (X_4)	B_4	- 0.019	1.624
Family labour (X_5)	B_5	-0.010	-0.879
Hired labour (X_6)	B_6	-0.003	-0.377
Inefficiency model			
Constant	d_0	- 3.080	2.782***
Age	d_1	- 2.728	- 1.916*
Literacy	d_2	- 0.0954	- 0.823*
Farming experience	d_3	- 0.538	- 1.820***
Extension contact	d_4	- 0.442	- 0.794
Gender	d_5	0.007	0.148
Family size	d_6	0.395	1.562
Variance parameter			
Sigma squared	d^2	0.552	3.195***
Gamma	Υ	0.701	5.247***

Source: Components from stochastic frontier result
*** = Significant at 1%
** = Significant at 5%
* = Significant at 10

Table 4 reveals the technical efficiency rating of the mixed sorghum farmer which shows that the technical efficiency of the farmer is less than 1(100%) hence the variation in technical efficiency exist among them. It means that farmers in the study area are producing below maximum efficiency. The minimum efficiency of mixed sorghum farmer is 0.5549 while the maximum efficiency is 0.9761 and their mean efficiency is 0.8823, an indication that farmers operate 11.77% below frontier level due to variation in technical efficiency.

Table 4. *Frequency distribution of technical efficiency rating of the mixed sorghum farmers.*

Efficiency	Frequency	Percentage
< 0.40	–	–
0.40 – 0.49	–	–
0.50 – 0.59	4	4
0.60 – 0.69	3	3
0.70 – 0.79	5	5
0.80 – 0.89	27	27
0.90 – 1.00	61	61
Total	**100**	**100**
Minimum efficiency	**0.5545**	
Maximum efficiency	**0.9761**	
Mean efficiency	**0.8823**	

Computed from stochastic frontiers result

3.4. Constraints Associated With Mixed Sorghum Production

Problems of mixed sorghum production in the study area is as given in table 5. The major constraint as faced by the farmer include pest and disease (13.76%), shortage/high cost of inputs (17.43%), lack of storage facilities (12.58%), variability in amount of rainfall (11.74%), Striga infestation (10.08%) while shortage of labour , bird invasion, low price of sorghum were not left out. Other problems which the respondent indicated include inadequate extension support and low price of sorghum.

Table 5: *Problems associated with mixed sorghum production*

Nature of problem	Frequency	Percentage	Rank
Pest and disease	82	13.76	1
Shortage/high cost of inputs	74	13.43	2
Lack of storage facilities	28	12.58	3
Inadequate farm credit	60	12.25	4
Variability in amount of rainfall	78	11.74	5
Shortage of labour	54	10.40	6
Striga infestation	86	10.08	7
Bird invasion	30	7.05	8
Low price of sorghum	57	5.34	9
Inadequate extension support	32	3.36	10
	*596	100%	

Source: Field Survey, 2011
* Multiple responses

4. Conclusion

Mixed (with cowpea) sorghum production is a profitable venture in the area. To improve profit and resource use, quantity of seeds used and farm size should be increased under the present production scenario (technology) in which the farmers operate. It is therefore recommended that improved seeds and other production inputs should be made available to farmers at the right time and resources needed to cultivate farmland (necessarily to increase hectarage) should be given to them like credit, loan subsidy etc. there is the need for adequate extension service which will help farmers to improve their productivity. All these will boost production and in the long run improve the living standard of farmers leading to increase in sorghum and cowpea production as well as food supply in the Nation.

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