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Comparative Profitability Analysis of Sole and Mixed Sorghum (With Cowpea) Production in Guyuk Local Government Area of Adamawa State, Nigeria

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Abstract

This study was designed to carry out a comparative analysis of the economics of sole and mixed sorghum (with cowpea) production in Guyuk Local Government Area of Adamawa state. Data were collected through the administration of 200 questionnaires to selected sorghum farmers (100 from each of the two systems of sorghum production) using a simple random sampling technique. Descriptive statistics, gross margin and stochastic frontier production function analysis were the analytical tools used. The result shows that most of the sorghum producers (about 74 % and 86 % in sole and mixed system respectively) were aged between 20 -49 years, while about 91 % and 85 % of sole and mixed sorghum farmers respectively had between 5 -1 5 years of experience in sorghum production. Most of the farmers (81 % sole and 80 % mixed) had one form of formal education or the other with males dominating the business. The computed gross margin and net farm income were (₦ 23.880.74 and ₦ 21,046.50) and (₦44,765.22 and ₦ 42,414.30) for sole and mixed sorghum respectively, which indicate that sorghum production is profitable in the area. Major problem identified were Striga infestation, pests and diseases, variability in rainfall, low price of sorghum, lack of storage facility, and shortage/high cost of inputs. Recommendations were directed toward research development of herbicides to prevent and control Striga, access to subsidized farm input and making credit facilities accessible and affordable.

Keywords: Sole, sorghum, profitability, budgetary technique.

Introduction

Sorghum [*Sorghum bicolor* (L.) Moench] locally called guinea corn, is the World's fifth most important cereal, in terms of scale and area of production after wheat, maize, rice and barley (Basavaraja *et al.,* 2005). Areas under sorghum cultivation stood at 43 million hectares while, its production output was put at 59.5 million tonnes in year 2000. About 90 % of the world's sorghum production is concentrated mainly in the developing countries of Africa and Asia (Basavaraja *et al.,* 2005).In Nigeria, the area under sorghum cultivation is estimated to be 6.86 million hectares and it extends from northward of latitude 8° to latitude 14° N (Aba *et al.,* 2004). In 1978 the total sorghum production in Nigeria was estimated at 4.8 million tonnes, this figure rose to about 7.0 million tonnes annually (Obilana, 2005). Also, Nigeria became the highest sorghum producer in West African sub-region accounting for 71 % of the regional total output of sorghum. Globally, the country leads in the production of sorghum for human consumption and has risen from its global 5th position in 1995 to the 3rd largest producer of sorghum after USA and India where more than 90 % of their sorghum harvested is used for animal feeds (FAO, 1995 and Obilana, 2005).

Sorghum is one of the most important staple food in Nigeria. The grain is essentially used for human consumption as well as industrial raw material for beer brewing and for the production of syrup drugs in pharmaceutical industries. The leaves and the stovers are used as livestock feed while the stalks are used for thatching houses and making fences (FAO, 2003). Sorghum is a very valuable industrial crop for brewing alcohol and non-alcoholic beverages as well as in baking and confectionary industries (FAO, 2003). According to the National Research Council, NRC (1996) sorghum has more untapped potentials than any cereal crops.
Sorghum is the most indigenous and important food crop. It is cultivated widely and extensively over the country with wide range of varieties from the local type to the improved species. In 1978, the total sorghum production was estimated at 4.8 million tonnes. This figure has risen to about 7.0 million tonnes annually (Obilana, 2005). Consequently, Nigeria becomes the largest sorghum producers in West Africa sub region accounting for 71 % of the regional total sorghum output. Globally also sorghum production has risen from the world 5th position in 1995 (FAO, 1995) to the 3rd largest producer of sorghum in the world after USA and India (Obilana, 2005).

Sorghum production is an important production in the country, and there is an increase in its production area and output (Table 1). The total production in 1980- 1989 was 10,611,000 metric tonnes with a decline of 5,035,400 metric tonnes and production went up to 20,593,00metric tonnes. Total area under cultivation increased from 4, 987,0000 hectares (1980- 1989) to 9,216,440 in 2000- 2009. So looking at the trend, there is an increase in the total production output in the country (Table 1).

Table 1: Sorghum production trend in Nigeria, 1980 -2007

Year	Area (hectares)	Output(tonnes)
1980-1989	4,987,000	10,611,000
1990-1999	7,671,250	5,035,400
2000- 2009	9,216,440	20,593,600

Source: CBN, 2008; NBS, 1982, 1991, 2006
NA = not available

In Adamawa state, sorghum is the most cultivated crop and it is grown on an area of about 70,000 hectares, with 41,000 hectares cultivated under sole and 29,000 hectares cultivated mixed cropping, Adamawa Agricultural Development Programme (ADADP, 1996). The total production of sorghum in the state in 2001 was 72,000 tonnes with an estimated average yield of 1.18 tonnes/hectares National Bureau of Statistics, (NBS, 2002). Also, Guyuk Local Government Area is the most important sorghum producing area in the state, as the soil and climatic condition of the area favour sorghum cultivation (Mirchaulam, 1996). There is also the need to investigate the nature of productivity and efficiency in production among small scale farmers under sole and mixed systems of sorghum production.

The broad objective of the study was to compare the economics of sole and mixed sorghum production in Guyuk Local Government Area of Adamawa state. The specific objectives were to: determine the effect of socio-economic characteristics on the productivity of the farmers under mixed and sole sorghum production systems, estimate and compare cost and return accruing from each of the production systems and identify the constraints associated with sorghum production under each of the production systems.

Methodology

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

The Local Government Area consists of 10 wards namely; Banjiram, Bobini, Chikila, Guyuk, Kola, Dukul, Bodeno, Lokoro, Purokayo and Dumna. It has an estimated land area of 871.9 km^2 with an estimated population of 177,785 people out of which 90, 422 are males while 87,363 are females based on 2006 census (CBN, 2007).Farming is the major occupation of the people of the area with sorghum as the most cultivated crop. Other crops cultivated in the area include maize, rice, millet, sweet potatoes, cassava, cowpea and cotton which is the major cash crop cultivated.

Sources of data and Sampling Procedure
Data for the study were derived from primary source. The data were collected with the use of a structured questionnaire. A simple random sampling technique was adopted at various stages as the selection produres in the selection of 200 respondents comprising of 100 each for sole and mixed sorghum production systems. Thus:
Stage I: 50 % of the 10 wards was randomly selected (that is 5 wards selected).
Stage II: 35 % of the villages in each of the 5 wards were selected using systematic random sampling to come out with 10 villages.
Stage III: 10 % of the total respondents were selected from each village using random sampling to get a total of 200 sorghum farmers and administered questionnaire.

Analytical techniques
The analytical tools used include descriptive and inferential statistics. The descriptive statistics used include mean, frequency distribution and percentages these were used in the analysis of socio-economic characteristics of the respondents.

The inferential statistics used include the gross margin analysis and stochastic frontier was used to obtain the profitability and resource use efficiency respectively.

Gross Margin Analysis

The gross margin was used to estimate respondents' cost and returns in sorghum production in the study area. The gross margin per hectare is the difference between total revenue per hectare (Adebayo, 2005). Gross margin is expressed as:

GM = $\Sigma P_i Q_i – \Sigma K_j X_j$ ………………(3.4)

WhereGM = Farm gross margin (₦/ha),P_i = Unit price of output (kg/₦)Q_i = Quantity of output (Kg/ha)K_j = Unit cost of variable input j (₦/ha)X_j = Quantity of variable input j (kg/ha), $P_i Q_i$ = Total cost associated with variable input j Σ = Summation sign

Farm gross ratio

This is a measure of profitability ratio that give over all success of the farm. The lower the ratio the higher the return per naira. Olukesi; et al (2008)

Compute the ratio as given below:

GR = $\dfrac{TFE}{GI}$

Where   GR – Gross ratio ,TFE – Total Farm expense ,GI – Gross farm Income.

Operating ratio

Operating ratio is directly related to the farm variable input used. Olukosi et al (2008) Stated that a ratio of one reveal break even. The lower the ratio the greater the profitability of the farm business. The ratio is computed.

$$Thus; OR = \dfrac{TOC}{GI}$$

Where   OR – Operating
TOC – Total Operating cost
GI – Gross Income

Returns on capital invested

$$RI = \dfrac{GM}{TVC}$$

Where   RI – Returns on capital invested
GM – Gross margin
TVC – Total variable cost

Results and Discussion

Table 2 revealed that most of sorghum producers are young, with majority 74 % and 86 % of the respondents were within age bracket of 20 – 49 years in sole and mixed sorghum production respectively. Only 26 % and 14 % of sole and mixed sorghum farmers respectively were more than 50 years of age while no farmer was below the age of 20 under both system of sorghum production. It could be asserted that at age of less than 20 years, an individual is yet to commence sorghums production as an occupation. The high percentage of farmers within 20 - 49 years might be due to the fact that, within the age bracket, people are still in their active age and are capable of undergoing the vigorous labour involved in sorghum cultivation. This findings is in agreement with Adeoti (2001) who reported that the average age of farmers in Kwara state was between 20 – 49 this is when the farmers are active and still very productive. As shown in Table 2, 83 and 79 % of the farmers are male while 17 and 21% are female who practice sorghum production under sole and mixed sorghum production systems respectively. The dominance of the male in the sorghum production activities may be due to the fact that it involves more fatigue and stress, and the low percentage of women participating in the sorghum farming may also be explained by socio-cultural factors affecting women and not as a result of technical and managerial inefficiency. Furthermore, male farmers are the most beneficiaries of subsidized fertilizer sales in the study area. This, this conforms to the assertion by Phillis and Umebali (2008) that agricultural policies do not explicitly recognized the role of women farmers. Consequently, development assistance is usually directed to male farmers, regarding women's work on farm as simply "what women do" hence their contribution have remained invisible. Results in Table 2 shows that 83 and 85 % of sole and mixed sorghum producers respectively were married, whereas 10 and 7 % single, 5 and 2 % widow (ers) and 2 and 6 % divorced of the sole and mixed sorghum producers respectively.

Table 2: Distribution based on Socio-Economic Characteristics of Respondents

Variable	Sole farming	System	Mixed farming	System
	Freq	Percentage	Freq	Percentage
Age				
20 – 29	10	10	12	12
30 -39	32	32	35	35
40 -4 9	32	32	39	39
> 49	26	26	14	14
TOTAL	100	100	100	100
Gender				
Male	83	83	79	79
Female	17	17	21	21
Marital status				
Married	83	83	85	85
Single	10	10	7	7
Divorced	5	5	2	2
Widower	2	2	6	6
TOTAL	100	100	100	100
Level of education				
No formal education	19	19	20	20
Primary education	17	17	26	26
Secondary education	31	31	31	31
Tertiary education	33	33	23	23
TOTAL	100	100	100	100
Family Size				
1 -5	31	31	33	33
6 – 10	52	52	47	47
11 – 15	12	12	13	13
>15	5	5	7	7
TOTAL	100	100	100	100
Farming experience				
1 -5	9	9	15	15
6 – 10	29	29	31	31
11 – 15	18	18	14	14
>15	44	44	40	40
TOTAL	100	100	100	100
Farm size				
≤ 1.0	33	33	37	37
1.1- 2.0	39	39	47	47
2.1 – 3.0	10	10	7	7
3.1 – 4.0	7	7	5	5
4.1 – 5.0	8	8	2	2
> 5.0	3	3	2	2
TOTAL	100	100	100	100
Land acquisition method				
Inheritance	69	69	21	21
Gift	9	9	56	56
Purchased	4	4	3	3
Leased/hired	18	18	21	21
TOTAL	100	100	100	100
Occupation				
Farming	71	71	61	61
Others	29	29	39	39
TOTAL	100	100	100	100

Access to credit				
Yes	12	2	3	**3**
No	98	98	97	**97**
TOTAL	**100**	**100**	**100**	**100**
Extension visit				
Yes	8	8	6	**6**
No	92	92	94	**94**
TOTAL	**100**	**100**	**100**	**100**

Source: Field survey 2011

Table 2 revealed that only 19 and 20 % of the sole and mixed sorghum producers respectively had no formal education while the rest had one form of formal education or another. This is an indication that majority of the farmers are literate and could be receptive to agricultural innovation. Njoku (1991) observed that years of formal education has a positive influence on adoption of innovation by farmers. Also, 31 % and 33 % of the sole and mixed sorghum farmers respectively have family size of 1 – 5 people, 69 % and 67 % have family size above 5. This implies that large family size, and indication that some of them may depend on their family for labour. Grater family size increases efficiency because most farmers are financially constrained and thus the availability of family labour will ease hiring of labour (Bayacay and Rola, 2001). Table 2 shows that about 9 % and 15 % of sole and mixed sorghum producers respectively have a farming experience of 1 – 5 years, while 91 % and 85 % of sole and mixed sorghum farmers have farming experience more than five years. This implies that majority of the farmers had sorghum experience to improve their production technique to increase their productivity. These farmers are experiences which could positively influence their management capabilities of the crops. As reported by Adeyumi and Okunmadewa (2001) that the economic efficiency of farmers significantly affects their farming experience, experience. Table 2 reveals 97 % and 98 % of sole and mixed sorghum farmers respectively had farm size ranging from 0.5 – 5 ha while only 3 % and 2 % of sole and mixed sorghum farmers had farm size above 5 hectares. The result reveal that majority of the farmers are small-scale farmers. This may be attributed to high level of poverty where poor farmers can only afford small parcel of land for subsistence farming coupled with inadequate credit facilities necessary to expand their farm lands. According to FOS/FBS (1999) and Awoke and Okoji (2004), small scale farmers are farmers who cultivate between 0.1 – 4.99 hectare and produce on subsistence level.

As observed by Adebayo and Onu (1999) that land ownership is one of the socio-economic characteristics of farmers which affect their productivity. Analysis of 4.8 below shows that 78 % and 77 % of the sole and mixed sorghum farmland respectively was inherited while only 22 % and 23 % was either leased or purchased. The implication of majority using inherited land is that it would lead to fragmentation of farmland as a result of sharing among siblings hence reducing the size of farmland for agricultural practices. Table 2 reveals that 71 % and 61 % of sole and mixed sorghum producers respectively of the respondents took farming as their full time main occupation while 29 % and 39 % of sole and mixed sorghum farmers respectively engaged in other activities like trading, civil service, carpentry etc and practice farming on part-time. This implies that the majority of the respondents depend mainly on farming as their major source of income to cater for themselves and their families. Table 2 reveals that only 2 % and 3 % of the sole and mixed sorghum farmers respectively obtained loan. The remaining 98 % and 97 % of the sole and mixed sorghum producer did not obtain loan. They complained that both interest rate and transactional cost of agricultural loans was high especially from formal lender. So their main source of capital is personal savings. This implies that most farmers might not be able to take advantage of economies of scale and hence cost inefficient. This finding is in agreement with Stephen (2006) who reported that 96.58 % of farmers in Adamawa state depend on personal saving. Extension is one of the major tools through which new innovations are transferred to the practicing farmers which usually have significant effect on the economic efficiency level of farmers. The study shows that extension visit in the study area was very poor as only 8 % and 6 % of sole and mixed sorghum farmers respectively were visited by extension agents and 92 % and 94 % of sole and mixed sorghum farmers respectively which constitute the majority were no visited. The use of agricultural technologies is believed to be a strategy for making small scale economically viable (Bzugu and Gwary, 2005). So implies that the level of efficiency of sorghum producers might be static since the extension workers were not visiting the farmers.

Cost and Return in Sole and Mixed Sorghum Production Systems
The distribution of cost and returns involved in the production of sole and mixed sorghum production systems is presented in Table 3. The table revealed that, the average total cost of respondents' production per hectare was ₦ 19610.57 and ₦ 18234.78 out of which ₦16776.33 and ₦ 15883.88 were variable costs accounting for 85.54 % and 87.10% of the total cost for sole and mixed sorghum production respectively. This was largely attributed to the high cost of labour in the study area and having converted family labour by cost at prevailing market price rate. This finding is inconsonance with Ohajianya (2003), who reported that labour cost is a major component of the total cost of rice farming. The fixed costs were ₦ 2834.24 and   ₦ 2350.90 which accounted for 14.46 % and 12.90 % of the total cost for sole and mixed sorghum production respectively. The average outputs of the respondents were 813.14

kg and 485.19 kg per sole and mixed sorghum production systems respectively. Also, the revenue generated were ₦ 40657.07 and ₦ 60649.1 per hectare for sole and mixed sorghum production respectively.The table reveals that sole sorghum production had gross margin and net farm income of ₦ 23,880.74 and ₦ 21,046.50 per hectare respectively. Also, mixed sorghum production had gross margin and net farm income of ₦ 44,765.22 and ₦ 42,414.32 per hectare respectively. The study therefore revealed that, the business of cultivating mixed sorghum is more profitable compared to sole sorghum cultivation considering the net profit from the two enterprises. Thus: -

Sole Sorghum	Mixed sorghum
$\pi_1 = 20,237$	$\pi_2 = 42414.44$
$S^2_1 = 1699.18$	$S^2_2 = 5553.46$
$N_1 = 100$	$N_2 = 100$
Z - computed 2604.20; Z - tab 1.96	

Based on the result, Z computed is greater than Z tabulated (2604.20 > 1.96). The Ho is rejected, while the alternative is accepted, meaning that at 5% level of significance the business of cultivating mixed sorghum is more profitable than that of sole sorghum production.

Challenges Respondents Experienced in Sorghum Production

The various challenges experienced by sorghum farmers in the study area are reflected in Table 4 accordingly. The study revealed that, the challenges experienced by farmers cultivating sorghum as sole are *Striga* infestation (15.96 %), variability in amount of rainfall (14.47 %), shortage /high cost of input (13.73 %), inadequate agriculture credit (11.13 %) and low market price of sorghum (10.56 %). The farmers identified *Striga* infestations, it affect majority of farmers and has no chemical to control it. The farmers also complained of high cost of input such as fertilizer and herbicides as majority of farmers cannot afford to purchase the right quantity needed to increase sorghum production. This finding corroborates Kwaghe *et al.* (2000) who reported high cost of important farm inputs militating against efficient farming. Some of the identified problems agreed with the findings of Tashikalma *et al.* (2010). The table also reveals that the major problem facing farmers cultivating sorghum under mixed farming are pest, disease and worms (13.76 %), shortage/high cost of inputs (13.43 %), lack of storage facility (12.58 %), inadequate farm credit (12.25 %) and variability in amount of rainfall (11.74 %). Most of the cowpea grown with sorghum is disposed off immediately after harvest to avoid pest infestation coupled with the problem of lack of storage facility.

Table 3: Average cost and returns per hectare of sorghum Production

Production variable	Sole Cropped Value (₦/ha)	Mixed Cropped Value (₦/ha)
A. Variable Cost		
Seed	808.93	1202.16
Pesticide	-	98.72
Herbicide	1210.15	907.56
Fertilizer	1622.04	1377.58
Transportation	905.93	1172.75
Storage	30.77	25.71
Labour	12,016.35	11,099.40
Total variable cost (TVC)	**16,776.33**	**15,883.88**
B. Fixed Cost		
Rent on land	1057.07	431.88
Farm tools	1777.17	1919.02
Total Fixed Cost	**2834.24**	**2350.90**
Total cost of production (A + B)	**19,610.57**	**18,234.78**
C. Returns		
Average output	813.14 kg	485.19 kg
Average price (₦/kg)	50.00	125.00
Total revenue	40657.07	60649.1
Gross Margin (GM)	**23,880.74**	**44,765.22**
Net farm Income (NFI)	**21,046.50**	**42,414.32**
Gross margin on naira invested	1.42	3.01
Net farm income on naira invested	1.07	2.33

Farm Gross ratio(GR)	0.48	0.30
Operating ratio (OR)	0.41	0.26

Source: Field survey 2011

Conclusion

Findings from this research revealed that, sorghum production is a profitable venture, despite the series of challenges identified. The study revealed that, the mixed sorghum production is more profitable compared to sole sorghum production. This study also indicated that, the output of sole sorghum fall by 31.03 % from the maximum possible level due to inefficiency while the output of mixed sorghum fell by 11.77% from the maximum level due to inefficiency. This implies that there is potential for raising sorghum production by 31.03 % for sole sorghum and 11.77 % for mixed sorghum production systems in the study area through better use of available resources, given the current state of technology.

Table 4: Problems Associated with Sorghum Production

S/No.	Problem	Sole			Mixed		
		Freq.	%	Rank	Freq.*	%	Rank
1	Shortage/high cost of input	74	13.73	3	80	13.43	2
2	Inadequate farm credit	60	11.13	4	73	12.25	4
3	*Striga* infestation	86	15.96	1	60	10.08	7
4	Shortage of labour	54	10.02	5	62	10.40	6
5	Variability in amount of rainfall	78	14.47	2	70	11.74	5
6	Pest and diseases	40	7.42	7	82	13.76	1
7	Birds invasion	30	5.57	9	42	7.05	8
8	Low price of sorghum	57	10.58	5	32	5.37	9
9	Lack of storage facility	28	5.20	10	75	12.58	3
10	Inadequate extension support	32	5.94	8	20	3.36	10
	Total	539*	100%		596*	100%	

Source: Field Survey , 2011
* = multiple responses

Recommendations

Based on the findings of this study, it is obvious that, the various challenges experienced by the sorghum producers which consequently constrained increased sorghum production in the study area. To address these bottlenecks and subsequently increase the farmer productivity, the following recommendations are proffered.

  i. Research effort should be intensified to develop herbicides to prevent and control Striga infestation.
  ii. Government should ensure adequate and timely supply of farm inputs such as fertilizer; herbicide and pesticides at subsidize rates and also, make credit facilities accessible and affordable.
  iii. Farmers should form cooperative societies to ease input procurement and to take advantage of the existence of fadama programmes the study area.
  iv. Farmers should be encouraged to use improved seed varieties to reduce Striga infestation.
  v. Communities should provide accessible roads linking farms, community and the market so as to ease the cost of transportation.
  vi. Policies to improve farmers' education should be intensified by the government and private sector as this would go a long way to aid farmers in production. This is because farmers make better technical decision if they acquire basic education and have greater farming experience.
  vii. There should be a labour saving device/technology to reduce the over dependence of most farmers on manual labour for sorghum production.

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