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COMPARATIVE ANALYSIS OF THE PROFITABILITY OF MAIZE AND SORGHUM BASED CROPPING ENTERPRISES IN NIGER STATE, NIGERIA

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Abstract
This study examined the profitability of maize and sorghum based cropping enterprises in Niger State, Nigeria. A multi-stage sampling technique was employed for selecting the respondents and data were collected using structured questionnaires from a total of 360 maize and sorghum- based farming household heads in 9 Local Government Areas across the three agricultural zones of the state. The specific objectives were to estimate the costs and returns of maize and sorghum production under sole and intercropping systems and compare the profitability of these enterprises across the agricultural zones of the State. Descriptive statistics and farm budgeting technique were used to analyze the data collected. The profitability analysis indicate that returns from sole maize cropping enterprise is the lowest but combinations of maize with other crops tends to yield higher returns. Across the State, N1.35, N1.58 and N1.31 was realized for every N1.00 invested in production of maize/sorghum cropping enterprises by farmers in Zone I, Zone II and Zone III of Niger State agricultural zones respectively. The net farm income/ha was N36,735.44 with an average gross margin/ha of N38,378.41 was realized by the maize/sorghum based farmers. The gross ratio of 0.44 and the operating ratio of 0.40 are indicators that maize/sorghum based cropping enterprises was profitable. The study recommended that farmers should be enlightened on the higher returns to investment and profitability of cultivating maize in combination and with other crops instead of sorghum combinations. Appropriate production technologies that reduce labour cost in maize and sorghum production should be adopted by farmers to enhance farmers' incomes and livelihoods.

Key words: Profitability, Maize and Sorghum, Niger State, Nigeria

Introduction

Increasing food availability and incomes and contributing to asset diversity and economic growth, higher agricultural productivity and supportive pro-poor policies allow people to break out of the poverty – hunger – malnutrition trap (Saito, Mekonnen and Spurling, 1994). While farmers have different reasons for the cropping systems adopted and the enterprises combined, two major reasons are most outstanding, and these according to Chukwuji (2008) are net income stabilization and income maximization. Income maximization entails comparison of costs and returns from the different enterprises combined. As a decision guide to farmers towards the realization of their production goals, it is necessary that they know the most reliable number and types of enterprises to combine. These are what many farmers are still uncertain about in their decision making.

Maize and sorghum are traditionally principal staple food crops grown across the entire breadth of Northern Nigeria. They are two cereals most commonly grown together or in combination with other cereals, legumes, roots and tuber crops (Amos, Chikwendu and Nmadu, 2004). Holt (2007) in a special report on Preliminary livelihoods zoning in Northern Nigeria by the United States Agency for International Development Famine Early Warning Systems Network (USAID FEWSNET) described sorghum as the dominant cereal in Nigeria, in terms of staple consumption and demand in processing industries, especially for breweries, which are mostly located in the south. The leaves and grains are also used for livestock feeds and the stalks for thatching houses and making fences. It is a very valuable industrial crop for brewing alcoholic and non-alcoholic drinks as well as in the baking and confectionery industry in Nigeria. According to National Research Council (NRC), 1997, sorghum has greater

untapped potentials than any other crop. It even postulated that if the twentieth century was the century of wheat, rice and maize, then the twenty-first century could well become the century of sorghum.

The practice of intercropping maize and sorghum (two cereals) and intercropping either of these with other crops especially legumes, is common among small scale farmers in Northern Nigeria particularly in the North-central region even though the reasons for such practice may not be clearly known. Researchers, according to Amos *et al*., (2004), are often apt to conduct investigations on sole crop and most recommended technologies available to farmers are often tailored toward sole cropping to the neglect of farmers' goals and strategies. Few studies such as Amos *et al*., (2004), Tanko *et al*., (2011), Ahmadu and Alufohai (2012) and Ojo (2013) have been conducted in Niger state, North Central Nigeria on the efficiency and productivity of arable crop farms and these were mostly focused on sole crops. It is against the backdrop of low agricultural productivity and the indispensable role of the smallholder farmers coupled with the dearth of information on output and profitability of maize and sorghum based cropping enterprises in Niger state that this study sought to estimate the profitability of maize and sorghum-based cropping enterprises across agricultural zones and compare the profitability of maize and sorghum-based cropping enterprises by crop mix/combinations.

Methodology

The study was conducted in Niger State located with annual rainfall ranges from 1000 to 1500mm with the average of 187 to 220 rainy days and average monthly temperature ranging from 21oC to 37oC. The vegetation of the zone consists of the forest Savannah Mosaic, Southern Guinea Savannah and the Northern Guinea Savannah. With its 25 Local Government Areas (LGAs), it is one of the largest states in Nigeria with a landmass of 86,000km2 (8.6million hectares) which represents about 9.3% of the total landmass of Nigeria. The provisional result of the 2006 National Population Census shows that the State had a population of 3,950,249 persons comprising 2,032,725 males and 1,917,524 females (National Population Commission [NPC], 2006). This represents a percentage share of 51.5% for males and 48.5% for females. Niger State is growing at 3.4%. The World Bank (2013) however projected the population of the State to be 4, 695,604 persons as at 2013 going by the projected growth rate of 2.5% for Nigeria.

Primary data were used for this study and collected using multi-stage sampling technique. This involved the selection of 9 out of 25 Local Government Areas (LGAs) with the preponderance of maize and sorghum based cropping systems production, 3 each from the 3 agricultural zones in the State. In zone I, the selected LGAs were Edati, Gbako and Lavun, selected LGAs in zone II were Bosso, Paikoro and Gurara while the selected LGAs in zone III were Wushishi, Mariga and Kontagora. The next stage was the random selection of 5 villages in each LGA and 8 maize and sorghum based farming household heads in each village giving a total of 360 farming household heads in Niger state.

The data used for this study were derived from a cross sectional household survey through visits, well structured questionnaire, interview schedules, plot measurements and observations undertaken between May 2013 and April 2014. The limited cost-route approach to data collection was adopted. Data collected in the cross sectional household survey included the farmers' socio-economic variables and Input-Output data.

The evaluation of the profitability of the enterprises was achieved by using Farm Budgeting Technique (Gross Margin and Net Farm Income analysis). Costs and returns analysis forms the basis for farm profitability assessment. Gross margin analysis according to Olukosi, Isitor and Ode (2006) is one of the methods of calculating profitability of small scale cropping enterprises. It is a useful planning tool in situations where fixed capital is negligible portion of the farming enterprises as is the case of small scale subsistence agriculture prevalent across Nigeria.

Gross margin is the difference between the Gross Farm Income (GFI) and the Total Variable Cost (TVC) as depicted in Equations (1).

$$GM = GFI - TVC \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where GM = Gross Margin, GFI = Gross Farm Income, TVC = Total Variable Cost.

The net farm income is defined as:

NFI = GM - TFC ……..…….. (2)

Where NFI = Net Farm Income, GM = Gross Margin, TFC = Total Fixed Cost

The profitability of sole maize, sole sorghum, and maize/sorghum intercropping enterprises practiced by respondents was analyzed and compared using the various financial ratios stated in Equations (3), (4) and (5).

i. Gross ratio is a profitability ratio that measures the overall success of the farm. The lower the ratio, the higher the returns per naira.

$$GR = \frac{TFE}{GI} \qquad \text{……..……(3)}$$

Where GR = Gross Ratio, TFE = Total Farm Expenses and GI = Gross Income.
ii. Operating ratio is directly related to the farm variable input usage. The lower the ratio, the higher the profitability of the farm business.

$$OR = \frac{TOC}{GI} \qquad \text{…..……...…..……..(4)}$$

Where OR = Operating Ratio, TOC = Total Operating Cost and GI = Gross Income.
iii. Return on Capital Invested is a profitability index defined as a measure of the amount that accrues to the enterprise as net income for every naira invested. The higher the return to investment, the more profitable the enterprise.

$$RI = \frac{GM}{TVC} \qquad \text{……..(5)}$$

Where RI = Return on Capital Invested, GM = Gross Margin and TVC = Total Variable Cost

Results and Discussion

Profitability of Maize and Sorghum-based Cropping Enterprises by Agricultural Zones

The result from Table 1 show that labour cost account for the bulk of the cost of production across the three agricultural zones of the state. This is at variance with the findings reported by IFPRI (2010) indicating that the largest share of production costs for maize farmers in Kaduna was attributable to tradable inputs, mostly chemical fertilizers (NPK and Urea), followed by herbicides and pesticides. The bulk of the cost of production for the maize/sorghum based farmers in Niger State (40.33%) goes to labour. This implies that high amount of labour input is required for the production of the maize/sorghum based crop enterprises coupled with high cost of labour in Niger State. Only about thirty percent (30%) or less of maize production costs are expended on fertilizers across the agricultural zones and for the various cropping patterns. This may be due to the low level of fertilizer application by the farmers (about 50Kg per hectare) by the maize/sorghum based farmers despite the high fertilizer requirement by maize and sorghum both of which are cereal crops compared with the recommended rate of 300 - 400Kg per hectare for maize and about 100 Kg per hectare for sorghum. The fixed cost

component is a relatively small proportion of the total cost of production across all the 3 agricultural zones.

The results of the net farm income analysis for maize/sorghum based cropping enterprises are presented in Table 1. The results indicate that maize/sorghum production in the study area was profitable. The net farm income/ha was ₦36,735.44 with an average gross margin/ha of ₦38,378.41 was obtained. The positive net farm income shows that returns far exceed the costs which indicate that maize/sorghum based enterprises is profitable in Niger State. This result agrees with Tanko *et al.* (2011) and Ibrahim, Adebayo, Alegieuno and Ibrahim (2011) who all reported that maize based production is very profitable.

Table 1 also indicates that the returns on investment was ₦1.48 for maize/sorghum crop based farms across Niger State indicating that for every ₦1.00 invested in production of a hectare of maize/sorghum cropping system, ₦1.48 was realized. Across the various agricultural zones of the state, ₦1.35, ₦1.58 and ₦1.31 was realised for every ₦1.00 invested in production of maize/sorghum cropping system by farmers in Zone I, Zone II and Zone III of Niger State respectively. Also, the gross ratio of 0.44 and the operating ratio of 0.40 are indicators that maize/sorghum based cropping systems production was profitable. These results agree with the findings of Olukosi *et al.* (2006) who stated that the lower the gross and operating ratios, the higher the profitability of the farm enterprise and vice versa.

Profitability of Maize and Sorghum-based Cropping Enterprise by Crop Mix

The results from Table 2a and Table 2b show that the highest returns on investment was 1.7 indicating that for every ₦1.00 invested in production of a hectare of maize/other crops cropping system, ₦1.70 was realized. Though the returns from sole maize cropping system is the lowest with ₦1.33, combinations of maize with other crops tends to yield higher returns. This is in consonance with the findings of Abu (2009), Tanko *et al.* (2011), and Ibrahim *et al*. (2011). This may be the incentive for farmers' tendency to grow maize in combination with other crops more frequently than sorghum is combined with other crops. Return on investment of ₦1.40 was realized for sole sorghum which agrees with Baiyegunhi and Fraser (2009) who from their study of sole sorghum production in three villages of Kaduna state reported a return on investment of ₦1.45. The seemingly low level of profitability of sole sorghum enterprise can be attributed to the low yields and relatively high production costs.

Conclusion and Recommendations

Maize could be considered a more versatile crop than sorghum in terms of the preference and suitability of being combined with different kinds of crops ranging from other cereals, vegetables, roots and tubers to leguminous and even tree crops. Combinations of maize with other crops tend to yield higher returns than Sorghum combinations. High amount of labour input is required for the production of the maize and sorghum based crop enterprises. Based on the findings of this study the following policy recommendations were made. Farmers should be enlightened on the higher returns to investment and profitability of cultivating maize in combination and with other crops instead of sorghum combinations. Appropriate production technologies that reduce labour cost in maize and sorghum production should be adopted by farmers. This is likely to enhance farmers' incomes and livelihoods thereby curb the incidences of widespread hunger, unemployment and poverty.

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Table 1: Profitability of maize and sorghum - based farmers in Niger State according to agricultural zones.

Cost Items & Revenue	Zone I (n = 120)		Zone II (n=120)		Zone III (n=120)		Pooled (n=360)	
	Cost (₦/ha)	% of Total cost	Cost (₦/ha)	% of Total cost	Cost (₦/ha)	% of Total cost	Cost (₦/ha)	% of Total cost
Variable Cost								
Labour cost	11,288.59	40.09	10,728.95	37.62	11,743.43	41.55	11,320.32	40.33
Inorganic Fertilizer cost	8,540.07	30.33	8,284.58	29.04	7,724.54	27.33	7,945.73	28.31
Organic Manure	386.54	1.37	398.55	1.39	425.84	1.51	416.08	1.48
Seed/planting materials	1,743.47	6.19	2,555.80	8.96	3,315.89	11.73	2,271.72	8.09
Agrochemicals	4,539.21	16.12	4,947.82	17.34	2,689.78	9.52	4,058.94	14.46
Total Variable cost(a)	26,497.88	94.11	26,915.70	94.37	25,899.48	91.65	26,012.79	92.69
Fixed Cost								
Farm tools (Depreciation)	764.44	2.72	996.16	3.49	1117.11	3.95	985.91	3.51
Maintenance of Implements	481.24	1.71	388.17	1.36	994.12	3.52	687.17	2.45
Interest Charges	411.89	1.46	218.72	0.76	249.07	0.88	379.89	1.35
Total Fixed Cost(b)	1,657.57	5.89	1,603.05	5.62	2,360.30	8.35	2,052.97	7.31
Total Cost (TC) = (a+b)	28,155.45	100	28,518.75	100	28,259.78	100	28,065.76	100
Returns								
Gross Farm Income (GFI)	63,919.58		69,310.60		59,943.50		64,391.20	
Gross Margin (GM)	35,764.13		42,394.90		34,044.02		38,378.41	
Net Farm Income (NFI)	34,106.56		40,791.85		31,683.72		36,735.44	
Return on investment (ROI)	1.35		1.58		1.31		1.48	
Gross Ratio (GR)	0.44		0.41		0.47		0.44	
Operating ratio (OR)	0.41		0.39		0.43		0.40	

Table 2a: Profitability of maize and sorghum enterprises according to crop mix

	Sole Maize (n = 47)		Sole Sorghum (n=26)		Maize/Sorghum (n=138)	
Cost Items & Revenue	Cost (₦/ha)	% of Total cost	Cost (₦/ha)	% of Total cost	Cost (₦/ha)	% of Total cost
Variable Cost						
Labour cost	10800.62	37.74	10561.17	41.03	10976.34	39.91
Inorganic Fertilizer cost	8394.79	29.33	7201.81	27.98	8355.76	30.38
Organic manure	543.65	1.89	298.43	1.15	425.36	1.54
Seed/planting materials	3833.56	13.39	3108.86	12.07	1971.65	7.16
Agrochemicals	3463.86	12.10	2830.07	10.99	4104.22	14.92
Total Variable Cost(a)	27,036.48	94.48	24,000.34	93.24	25,833.33	93.94
Fixed Cost						
Farm tools (Depreciation)	715.26	2.49	821.36	3.19	791.67	2.87
Maintenance of Implements	372.89	1.30	594.50	2.30	467.08	1.69
Interest Charges on loans	489.66	1.70	322.74	1.25	406.82	1.47
Total Fixed Cost(b)	1577.81	5.51	1738.60	6.75	1665.57	6.05
Total Cost(a+b)	28,614.29	100	25,738.94	100	27,498.90	100
Returns						
Gross Farm Income (GFI)	62865.50		57088.41		66906.10	
Gross Margin (GM)	35829.02		33088.07		41072.77	
Net Farm Income (NFI)	34,251.21		31,349.47		39,407.20	
Return on investment (ROI)	1.33		1.40		1.59	
Gross Ratio (GR)	0.45		0.44		0.43	
Operating ratio (OR)	0.42		0.41		0.40	

Table 2b: Profitability of maize and sorghum enterprises according to crop mix continued.

	Maize/Other crops (n=86)		Sorghum/Other crops (n=40)		Maize/Sorghum/Other crops (n=23)	
Cost Items & Revenue	Cost (₦/ha)	% of Total cost	Cost (₦/ha)	% of Total cost	Cost (₦/ha)	% of Total cost
Variable Cost						
Labour cost	11304.28	38.52	10912.27	41.57	12482.44	47.88
Fertilizer cost	8305.10	28.30	6452.44	24.58	7857.43	30.14
Organic manure	414.65	1.41	302.96	1.15	422.38	1.62
Seed/planting materials	2037.72	6.94	3014.82	11.48	2221.95	8.52
Agrochemicals	5647.33	19.24	3880.22	14.78	1429.65	5.48
Total Variable Cost(a)	27,709.08	94.41	24,562.71	93.58	24,413.85	93.65
Fixed Cost						
Farm tools (Depreciation)	734.33	2.50	892.86	3.40	852.51	3.27
Maintenance of Implements	435.24	1.48	397.96	1.51	397.42	1.52
Interest Charges on loans	461.55	1.57	393.75	1.50	404.72	1.55
Total Fixed Cost(b)	1631.12	5.55	1684.57	6.41	1654.65	6.34
Total Cost(a+b)	29,340.20	100	26,247.28	100	26,068.50	100
Returns						
Gross Farm Income (GFI)	74736.10		58701.30		64422.60	
Gross Margin (GM)	47027.02		34138.59		40008.75	
Net Farm Income (NFI)	45,395.90		32,454.02		38,354.10	
Return on investment (ROI)	1.70		1.41		1.64	
Gross Ratio (GR)	0.39		0.44		0.42	
Operating ratio (OR)	0.37		0.41		0.40	