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Research Article

Comparative Analysis of Resource Use Efficiency of Cereal Crop Enterprises in Dutsin-Ma Local Government Area of Katsina State

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ABSTRACT

This study examines the resource use efficiency in cereal crop enterprise production in Dutsin-Ma Local Government Area of Katsina State. The two cereal crops selected were Millet enterprise and sorghum enterprise. Data for the study was collected from 80 Millet farmers and 80 sorghum farmers randomly selected in five villages. The data collection was from October to December 2022 cropping season. Production function analysis which incorporates the conventional neoclassical test of economic and technical efficiencies was used as the analytical technique. Profitability analysis was also used to determine the profitable enterprise. Findings revealed that for Sorghum production fertilizer input was optimally utilized by the farmers while other inputs seeds, labor, and farm size were overused. On the other hand in Millet production, all the inputs seed, labor, fertilizer, and farm size were over-utilized. The profitability analysis revealed that the Sorghum enterprise was the most profitable with a mean net farm income value of ₦138,000 per hectare while Millet had a net farm income of ₦63,000/ha. The results show that there is a need for farmers to be advised on the appropriate allocation of resources to boost efficiency and output. This would mean using less seed input, labor, and farm size for Sorghum production, while for Millet production less of all the inputs should be used.

Keywords: Comparative Analysis; Resources Use Efficiency; Cereal Crops Enterprises

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INTRODUCTION

Cereals are the most important source of food for man, early man depended entirely upon cereals as a major source of food, and the transition from hunting to sedentary life revolves around cereals. Most ancient civilizations tend to be on one cereal crop or another as a source of food. Cereal crops include rice, millet, maize, sorghum, wheat, barley etc.

The study focuses on sorghum and millet cereals, sorghum grain ranks fifth in the world after wheat, rice, maize, and barley Food and agricultural organization. Sorghum is a major crop for many poor farmers, especially in Africa, Central America, and Asia (FAO, 2021).

Between 1960 and 1972, sorghum was reported to have accounted for 49% of the total production of cereals in Nigeria and on average 46% of the acreage devoted to its cultivation. Federal office statistic (FOS, 2021). Sorghum is predominantly a starchy food, it has some protein content and a concentration of vitamin B-Complex on the outer bran layer of the grain. Sorghum is locally consumed in the form of indigenous food and drinks, porridge side dishes popped grains. It is a valuable industrial crop for the brewing of alcohol and nonalcoholic drinks as well as

in the bakery and confectionary industry. It is also a significant crop for animal feeds, stalks for thatching houses, and making fences (FAO/ICRISAT, 2020)

There was an indication that rice was the major cereal for early societies in China and Sorghum for early societies in Africa. West Africa Rice Development Association (WARDA, 2021). However, Sorghum ranks Fourth in importance among the World population of cereals after Rice followed by wheat and Maize (WARDA, 2021).

Sorghum forms an important component of Nigeria's diet. The average Nigerian consumes 21kg of Sorghum per year representing a percent of total calorie intake and 23% of total cereal consumption (FAO, 2020). Production is primarily by small-scale producers with an average farm size of 1-2 hectares (WARDA AND NISER, 2021). Similar studies carried out by Ibrahim et at. (2005), in the same ecological zone as this present study revealed that farm size did not significantly affect farmers' output from Sorghum production, the results concluded that an increase in farm size devoted to Sorghum production will boost it's output. Production increases can result from the expansion of cropped areas, FAO & International Crops Research Institute of Semi-Arid Tropic (FAO/ICRISAT, 2019). Nigeria has not been able to attain self-sufficiency in Cereal production despite increasing hectares put into production annually (C B N, 2020).

The constraints to increase food production in the study area are attributed to a combination of various factors such as low and epileptic rainfalls, insufficient crop husbandry practices, labour shortages inadequate credit making the adoption of improved technology beyond the reach of smallholder farmers. Untimely availability and misappropriation of inputs due to unholy political interferences and greed, inappropriate decisions on how best to allocate resources, inadequate use of corresponding production inputs inadequate adoption of improved technologies by farmers, and poor land tenure system. Cereal crops require highly technical management at the farm level. Resource allocation and productivity is an important aspect of increased food production which is also associated with the management of the farmers who employ these resources in production. Farmers might use resources rationally but not at the economic optimal level. Against this backdrop, this study is aimed at comparing resource efficiency between sorghum and rice crop enterprises in the study area. The broad objective of the study is to, compare the efficiency of resource utilization between sorghum and millet enterprises.

MATERIALS AND METHODS

The Study Area

Katsina State is the study area. The state lies between longitudes 11^0 and 13^0 East of Greenwich meridian and latitudes 6^0 and 9^0 north of the equator. It covers a land mass of 23,938 square kilometers with a projected population of 10,368,500 by the National Population Commission of Nigeria & National Bureau of Statistics (NPC & NBS, 2022). The state shares a boundary with Kaduna in the south, Niger Republic to the north, Zamfara to the west, and Jigawa and Kano States to the east (KTS official website, 2021).

The weather in Katsina State generally varies according to the season of the year. It is generally cool in the morning, hot in the afternoon, and cool in the evening. The Harmattan period (November-February) is usually cooler, windy, and dust as a result of northeast trade wind (KTG, 2000). The State has about 863,000 farm families and a cultivated land area of 1.64m ha (KTS official website, 2021). The crops grown in the area include Cotton, Cowpea, Sorghum, Millet, Groundnut, Rice, Maize, Wheat, and some vegetables. Livestock such as cattle, sheep, goats, and poultry are also kept. Katsina State is also blessed with agro-allied industries such as flour mills, cotton crushing companies, cotton ginneries, and oil mills (KTS official website, 2021) This study was conducted in Dutsin-Ma Local Government Area (L.G.A) of Katsina State. Fifty farmers were randomly selected from five locations in the local government area. These are Karofi, Kuki, Dabawa, Badole, and Turare Primary data were collected using questionnaires, which were administered to the respondents in the study area between October and December 2022.

The study focused on two cereal crops in the area which includes the Sorghum crop enterprise and the millet crop enterprise. The sampling procedure involved a multistage sampling technique in which firstly Dutsin-ma district was purposely selected from the Dutsin-ma Local Government Area due to the prevalence of cereal crop production in the area. Secondly, five villages; Karofi, Kuki, Dabawa, Badole, and Turare were purposely selected from this district. Thirdly thirty-two farmers (32) were randomly selected, comprising 16 Millet farmers and 16 sorghum farmers from each village bringing the total number of sampled farmers to one hundred and sixty (160).

Data was collected in the 2022 cropping season. Data used for the study was sourced primarily, and generated through well- structured questionnaire. Data was analyzed through descriptive statistics, regression analysis, and farm budget techniques. A regression model was used to examine the input-output relationship given by the implicit form:

$Y= F(X_1, X_2, X_3, X_4, X_5, ;e)$ ……..(1)

Where;

Y= Output of Rice and Sorghum respectively in (Kg)

X_1 = Seeds used in (Kg)

X_2 = Labour in man-days

X_3 = Fertilizer used in (Kg)

X_4 = Farm size in (Ha)

X_5 = Capital items in ₦ (Depreciated cost of fixed cost items) e = error term.

Four functional forms were tried, and were expressed in the explicit form;

The functional form producing the best fit was chosen as the lead equation based on the following criteria:

The number of estimators that are statistically significant, the value of F-statistics, the magnitude of the coefficient of multiple determination R(explanatory power of the model), and the statistical significance of the magnitudes of the coefficients and the signs on the estimated parameters. The Cobb-Douglas production function was chosen as the lead equation for sorghum while the Linear function was chosen as the lead equation for rice.

Efficiency of resource use was determined by the following ratios:

r = MVP/MFC…….. (2)

MFC = Marginal factor cost,

MVP= Marginal value Product

r = Efficiency ratio: where;

If r = 1, the resource is efficiently utilized If r > 1, the resource is underutilized If r is < 1, the resource is overutilized,

Farm Budgeting techniques

GM = GFI-TVC …… (3)

Where

GM = Gross margin

GFI = Gross farm Income

TVC = Total variable cost

Net farm income = Gross margin -Total cost

RESULTS AND DISCUSSION

Socio-economic characteristics of respondents the results in Table 1 revealed that 48% and 47% of the respondents under Sorghum and Millet enterprise fell within the age range of 25-40 years. These distributions indicate that the youths are highly involved in cereal crop production in the study area. The average household size was 11 persons for both enterprises. Millet enterprise revealed that 10% were females and 90% were males, while the Sorghum enterprise revealed that 15% were females and 85% were males.

The study revealed that farmers operated small-scale farm holdings. The Sorghum enterprise was characterized by 88.7% of farmers having farm sizes of between 3-4 hectares and 11.3% having greater than 4 hectares. The millet enterprise revealed smaller farm sizes for farmers showing 38% having between 1-2 hectares and 61.3% having between 3-4 hectares. The level of education is very low with almost 15% of farmers in Sorghum enterprise having tertiary education and 12% of farmers in millet enterprise having tertiary education at all. While 41% and 35% of both enterprises revealed that they had Arabic education. The low level of education may have tremendous implications on the adoption of innovation because this is a disadvantage to adoption. Nevertheless, the youthful nature of most of the farmers may be an innovation advantage, since youths are said to be less risk-averse and may have better exposure to new ideas (Obeta & Nwagbo, 2017).

Production Input-output Relationship

Following the apriori econometric criteria for the selection of the form producing the best fit. The linear functional form was the lead equation for the Sorghum enterprise while the cobb-Douglas functional form was the lead equation for the Millet enterprise.

From Table 2, the linear functional form revealed that about 76.4% of the variation in Sorghum output was explained by the factor inputs as indicated by the value of the R^2. The variables labor (X_2) and cost of capital items (X_5) had positive coefficients and were statistically significant at 1% and 10% respectively. The variables seeds (X_1) and farm size (X4) had negative coefficients and were significant at 1% and 10% respectively. Fertilizer (X_3) had a positive coefficient but was not found to be significant at all.

From Table 3, the cobb-Douglas production function revealed that about 78.6% of the variation in Millet output was explained by the factor inputs as indicated by the R^2 value. The factor inputs labor (X_2) and capital items (X_5) had positive coefficients and were significant at 1%. Seeds (X_1), farm size (X_4), and fertilizer (X_3) had negative coefficients, with fertilizer (X_3) and farm size (X_4) being significant at a 1% level of significance.

These positive coefficients imply a direct relationship between input and output and that an increase in the quantity of these inputs would increase the output.

The significant factor inputs imply that they are the major determinants of output. The negative coefficients imply an inverse relationship between the factor inputs and output.

Efficiency of Resource Use

The marginal contributions of production resources in terms of the physical and value products and the level of input utilization depicting efficiency levels were revealed in Tables 4&5 respectively. The use of an extra unit of fertilizer input in Sorghum production has the highest input of 1.254 and N80.76 in addition to Sorghum output and revenue respectively. Followed by labour, while a unit increase in seeds and farm size would result in a reduction in the returns of Sorghum output.

From Table 5, in Millet enterprise, the use of an extra unit of labor input has the highest contribution of 2.632 and 65.8 in addition to Millet production. In the case of the Millet enterprise, unit increases in seeds, fertilizer, and farm size would only result in a reduction in the returns of Millet output. In comparing efficiencies of resource utilization in the cereal crop enterprises under study, findings revealed that for Sorghum production fertilizer input was optimally utilized by the farmers, whereas seeds, labor, and farm size were overused.

Profitability Analysis

Table 6 revealed the findings of the gross margins and net farm incomes from the two enterprises respectively. The findings revealed that the sorghum production enterprise contributed greater revenue of a mean value of ₦138,000.00/ha as compared to the sorghum enterprise of ₦63,000/ha, these findings revealed that farmers should be advised to embrace Sorghum cultivation seeing they have a better understating and application of resource allocation to boost production, However, it also goes to say that to raise output in rice production farmers should be advised on the use of less of seeds input, labor input, and farm size. While for the sorghum enterprise.

Table 1: Socio-economic characteristics of respondents

Variables	Millet		Sorghum	
	Frequency	Percentage	Frequency	Percentage
Age				
25-40	39	48	38	47.5
41-55	35	44	28	35
≥ 56	6	8	14	17.5
Total	80	100	80	100
Educational Status				
No formal Educ.				
Arabic Educ.	28	35	33	41.25
Primary Educ.	22	27.5	18	22.5
Secondary Educ.	20	25	17	21.25
Tertiary Educ.	10	12.5	12	15
Total	80	100	80	100
Gender				
Male	72	90	68	85
Female	8	10	12	15
Total	80	100	80	100
Farm Size (Ha″s)				
≤ 1				
1-2	31	38.75		
3-4	49	61.25	71	88.7
≥ 4			9	11.3
Total	80	100	80	100
Household size				
≤10	30	37.5	15	18.75
11-15	45	56.25	55	68.75
≥ 16	5	6.25	10	12.5
T0tal	80	100	80	100

Source: Field survey 2022

Table 2: Estimated linear function for Sorghum enterprise

Variables	Regression coefficient	T-Values	R^2	F-ratio
Constant	-725.322	-3.867*	0.764	35.956
Seeds (Kg) (X_1)	-4,266	-3.583**		
Labour (X_2)	0.679	6.396***		
Fertilizer (Kg) (X_3)	1,254	-0.798		
Farm size (Ha's) (X_4)	-0.262	-1.762*		
Capital iterms (₦) (X_5)	2,432	1.718*		

Source: Field survey 2022. Note ***, ** and *Imply statistical significance at 1%, 5% and 10% levels respectively.

Table 3: Estimated Cobb-Douglas function for Millet enterprise

Variables	Regression coefficient	T-Values	R^2	F-ratio
Constant	4.321	3.038***	0.786	33.873
Seeds (Kg) (X_1)	-7.642E03	-0.678		
Labour (X_2)	0.467	5.286***		
Fertilizer (Kg) (X_3)	0.196	-2.322*		
Farm size (Ha's) (X_4)	-7.819E-02	-1.008*		
Capital items (₦) (X_5)	0.432	1.356*		

Source: Field survey 2022. Note ***, ** and * imply statistical significance at 1%, 5% and 10% levels respectively.

Table 4: Efficiency of resource use in Sorghum enterprise

Resource	MPP(b_i)	MVP(b_i . py)	MFC (₦)	MVP/MFC
Seeds	-4,266	-266.21	80	-3.33
Labour	0.679	37.48	1000	0,0375
Fertilizer	1,254	80,76	130	0.6212
Farm size	-0.262	-9.6	3000	-0.0032

Source: Field survey 2022.

Table 5: Efficiency of resource use in Millet enterprise

Resource	MPP(b_i)	MVP(b_i . py)	MFC (₦)	MVP/MFC
Seeds	374.89	-9372.25	50	-187,445
Labour	2.632	65.8	1000	0.0658
Fertilizer	-4.516	-112.9	130	-0.8685
Farmsize	437.77	-10,944.25	3000	-3.6481

Source: Field survey 2022

Table 6: Profitability Analysis of Sorghum and Millet Crop Enterprise

Mean value/ha	Sorghum (₦)	Millet (₦)
Gross farm income	286000	199382
Total cost	85500	79340
Fixed cost	23000	23000
Variable cost	62500	56340
Gross Margin	223500	143042
Net farm Income	138000	63000

Source: Field survey 2022

CONCLUSION

In a comparison of efficiency levels of cereal crops under study, the Sorghum production enterprise was seen to be more efficient in resource utilization. The study revealed that the inputs in Sorghum production were at least more sub-optimally utilized as compared to the Millet enterprise. Sorghum production was also seen to be more profitable.

These findings revealed that farmers should be advised to embrace Sorghum cultivation seeing they have a better understating and application of resource allocation to boost production, However, it also goes to say that to raise output in Sorghum

production farmers should be advised on the use of less of seeds input, labor input, and farm size. While for the Millet enterprise, efficiency level. The study revealed that the majority of the farmers were non-literate, thus advising the farmers on the appropriate allocation of„ resources will require the cooperation of the farmers themselves, the efforts of the research institute, the private sector, the Government, and most importantly the extension agents. The extension agents should be on hand to assist farmers in making and implementing the right decisions towards the allocation of these resources.

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