Journal of Agriculture and Environment
Vol. 20 No. 2, 2024: 1-8

Resource use efficiency of sugarcane farming in Karim-Lamido Local Government Area of Taraba State, Nigeria

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ABSTRACT

The study analysed resource use efficiency and production constraints in sugarcane farming in Karim-Lamido Local Government Area of Taraba State, Nigeria. The specific objectives were to describe the socio-economic characteristics of the respondents, determine the resource use efficiency, and identify major constraints to sugarcane production in the study area. A multi-stage sampling procedure was used to select 100 respondents for the study. Data generated were analysed using descriptive and inferential statistics. The results from socio-economic characteristics revealed that 88% of the farmers were male with most of them having average farming experience of between one to nine years. Furthermore, 42% of the sugarcane producers were within the age bracket of 30-39 years, 78% cultivated less than less than two hectares of land, and 34% had non-formal education. Results of the regression analysis revealed that the coefficient of multiple determination (R^2) was 0.878, indicating that 87.8% of the variation in the yield of sugarcane was explained by the explanatory variables included in the model. Out of the variables, land, herbicide, and sugarcane sett were found to be significant at 1% probability level. The efficiency ratios showed that sugarcane sett was over-utilised, while farm size, fertilizer, and herbicide were under-utilised by the farmers in the study area. Insufficient capital and credit facilities, low product prices, and labour shortages were identified as the major constraints to sugarcane production in the study area. The study concluded that resources were not efficiently utilised by farmers and recommended strengthening agricultural extension services, providing loans and credits at subsidised rates, and training farmers on optimal input use.

Keywords: Sugarcane; farming; Production constraints; Input utilisation

INTRODUCTION

Sugarcane is a vital cash crop and a significant raw material in sugar production, contributing substantially to food security, industrial growth, and employment generation. Globally, sugarcane cultivation plays a pivotal role in the agricultural economy of many developing countries, serving as a source of income for farmers and a driver of rural development. In 2022, global sugarcane production reached a record 1.9 billion metric tonnes, reflecting its importance in the global agricultural landscape (ISO, 2022).

In Nigeria, sugarcane production reached an estimated 1.6 million metric tonnes in 2022, positioning the country as the second-largest sugar producer in sub-Saharan Africa, after South Africa (EOS, 2022). Despite this, Nigeria remains heavily reliant on sugar imports, bringing in approximately 1.8 million metric tonnes of raw sugar, primarily from Brazil, which accounted for over 97% of its sugar imports in 2022 (USDA, 2022). The cost of these imports is substantial, with Nigeria spending ₦387.6 billion on brown sugar imports from Brazil, making sugar the second-highest food import item after wheat (USDA, 2022).

Sugarcane farming in Nigeria is predominantly concentrated in states with favourable climatic conditions, including Taraba State. Despite the abundant natural resources and suitable environment for sugarcane cultivation, Nigeria's domestic production is insufficient to meet its demand, and it continues to depend on imports to fill the gap. In Karim-Lamido Local Government Area (LGA) of Taraba State, sugarcane farming is a critical livelihood activity for many farmers. However, these farmers face several challenges, including limited access to quality inputs, low adoption of modern farming practices, and poor extension services. These challenges often lead to suboptimal allocation of resources such as land, labour, capital, and fertilizers, which limits productivity and profitability. Inefficient resource use not only hampers the growth of sugarcane production but also reduces the competitiveness of local farmers in the sugar market (Kumar *et al*., 2022; Brkic *et al*., 2023).

Studies on resource use efficiency in sugarcane production across various regions have shown inefficiencies in the utilization of inputs. Sulaiman *et al*. (2014) assessed resource use efficiency among sugarcane farmers in Kaduna State, Nigeria, revealing significant inefficiencies in resource allocation. Yusuf *et al*. (2017) emphasized the importance of optimal input utilization for enhancing sugarcane productivity, while Musa *et al*. (2019) identified inefficiencies in resource use among farmers in northern Nigeria. Adebayo *et al*. (2021) also underscored the need for efficient resource management in achieving sustainable sugarcane production in Kwara State, Nigeria.

Despite the importance of resource use efficiency in enhancing agricultural productivity, there is limited empirical evidence on how resources are utilized in sugarcane farming, particularly in Karim-Lamido. Most existing studies have focused primarily on production levels and policy frameworks without addressing the critical issue of how farmers can maximize outputs from their limited resources. Understanding the efficiency of resource use is essential for identifying productivity gaps, recommending improvements, and guiding policymakers in designing targeted interventions to enhance the performance of the sugarcane sector. This study seeks to fill this gap by evaluating the resource use efficiency of sugarcane farmers in Karim-Lamido LGA. Specifically, it aims to determine resource use efficiency and identify the major constraints to sugarcane production in the study area.

MATERIALS AND METHODS

The Study Area

The study was conducted in Karim Lamido Local Government Area (LGA), Taraba State, Nigeria. The area is located at latitude 9°18'00"N and longitude 11°12'00"E, with a land area of 6,626 km² and a population of 224,180 (NPC, 2011). The LGA is situated in the northern part of Taraba State, sharing boundaries with Lau and Ibi LGAs to the south, Kaltungo and Shongom LGAs in Gombe State to the north, Lamurde LGA in Adamawa State to the east, and Alkaleri LGA of Bauchi State and Wase LGA of Plateau State to the west.

This location places Karim Lamido within the northeastern region of Nigeria, a zone known for its diverse agricultural activities (Martins, 1997).

Sugarcane farming is a key agricultural activity in Karim Lamido, providing livelihoods for many farmers, though it is mainly based on traditional farming practices. While there is growing interest in adopting modern techniques, farmers primarily rely on rain-fed irrigation, with water shortages during the dry season posing a challenge. Inputs such as land, labor, fertilizers, and some modern equipment are used, but access to quality inputs like high-yielding varieties remains limited, leading to inefficiencies. The local sugarcane market is informal, with farmers selling to processors or middlemen at low prices due to a lack of established value chains and processing infrastructure, which further discourages efficient resource use and investment.

Sampling Technique and Sample Size

A multi-stage sampling procedure was adopted in selecting sugarcane producers. In the first stage, three major sugarcane-producing wards (Muri A, Karim A, and Darofai) out of the 11 wards in the LGA were purposively selected. The second stage involved a random selection of three villages from each of the selected wards, making a total of nine villages A list of sugarcane producers was obtained from the leaders of sugarcane producer groups and used as the sampling frame for the study. In the third stage, 100 sugarcane producers were randomly selected in proportion to their populations.

Method of Data Collection

Data for the study were collected mainly from primary sources. This was achieved through the administration of a questionnaire, which was designed and distributed to respondents. The questionnaire was also supplemented with personal visits and oral interviews with the farmers on farm household production activities of sugarcane during the 2022/2023 cropping season.

Methods of Data Analysis

Descriptive statistics such as means, percentages, and frequency counts were used to analyse socioeconomic data, while a multiple regression technique was used to estimate the partial regression coefficients from which the marginal input of resource utilisation was applied to estimate the resource use efficiency of sugarcane production. The regression model was specified as follows:

$$\text{Ln}Y = \beta 0 + \beta 1 \text{Ln}\, X1 + \beta 2 \text{Ln}\, X2 + \beta 3 \text{Ln}\, X3 \ldots\ldots + \beta 5 \text{Ln}\, X5 + U \quad \ldots\ldots\ldots\ldots (1)$$

Where:
Ln = Natural logarithm
Y= Output of sugarcane (kg)
X_1 = Farm size (hectare)
X_2 = Quantity of sugarcane Setts (kg)
X_3 = Labour (Manday)
X_4 = Quantity of fertilizer used (kg)

X_5 = Agrochemical (litre)
U = Error term
β_0 - β_5 are parameters to be estimated

To measure the resource-use efficiency of sugarcane production in the study area, the Marginal Value Product (MVP) of the resources used were estimated by multiplying the Marginal Physical Product (MPP) of the inputs with the price of the output. The values were then compared with the cost of the resources - Marginal Factor Cost (MFC) in order to make inference on the efficiency of resource-use. The following was estimated to determine the resource-use efficiency of sugarcane production: -

$$r = \frac{MVP}{MFC} \quad \text{----------(2)}$$

Where:
r = Efficiency Ratio
MVP = Marginal Value Product
MFC = Marginal Factor Cost
If r = 1, resources employed by the farmer were efficiently utilised; if r > 1, Resources employed by the farmers were under-utilised; and if r <1, Resources employed by the farmers were over-utilised.

RESULTS AND DISCUSSION

Socio economic Characteristics of the Respondents

The results on the gender distribution of the respondents, as shown in Table 1, revealed that male farmers constituted the majority (88%), while female farmers accounted for 12% of the sample. This implies that there are more male farmers engaged in sugarcane farming in the study area, possibly because males can exert more physical labour required for such an enterprise.

The age distribution of the respondents reveals that 25% were within the age range of 20-29 years, while 42% were within the age range of 30-39 years. Overall, the mean age was 35 years. This indicated that the majority of the farmers in the study area were in their active age bracket, hence are expected to possess the energy needed to carry out sugarcane farming operations such as planting, cutting, and packing. This is consistent with the findings of Aina *et al*. (2015), who investigated the economics of sugarcane production in Kwara State and revealed that most of the farmers were between the ages of 31 and 40 years.

The level of education of an individual affects their productivity by enhancing their abilities to obtain and apply relevant information that will enhance their production activities. The distribution of the sugarcane producers based on educational status revealed that 34% had no formal education. Further levels of formal education of the respondents were primary education (30%), secondary education (16%), and tertiary education (20%). This indicated that most (66%) of the sugarcane farmers have attained different levels of formal education and hence can source and adopt relevant information that could boost their production.

The distribution of the respondents based on farming experience revealed that the majority (73%) of the respondents had less than 9 years of experience in sugarcane farming. The mean farming experience was 7 years. This indicated that the respondents are moderately experienced in sugarcane farming. This is expected to give them the opportunity to acquire more knowledge and skills in agricultural production. The more experienced a farmer is, the more they are better informed about improved production practices and more likely to adopt

them. This disagrees with the assertion by Girei and Giroh (2012), who reported that sugarcane producers under the out-growers scheme in Numan LGA of Adamawa State had between 16-20 years of farming experience.

The results in Table 1 further indicate that the majority (78%) of the respondents had less than 2 ha of land for sugarcane cultivation, while a small proportion (14%) had farm size above 3 ha. The mean farm size was estimated at 1.50 ha, indicating that most of the respondents cultivated sugarcane on a small-scale basis.

Table 1: Socio-economic characteristics of the respondents

Status	Frequency	Percent	Mean
Gender			
Male	88	88	
Female	12	12	
Age (years)			
≤ 29	25	25	
30 – 39	42	42	35
40 – 49	24	24	
≥ 50	09	09	
Educational Qualifications			
No Formal education	34	34	
Primary education	30	30	
Secondary education	16	16	
Tertiary education	20	20	
Farming Experience (years)			
≤ 9	73	73	
10 – 19	25	25	10
≥ 20	02	02	
Farm size (ha)			
Less than 2.0	78	78	
2.1- 3.0	8	8	
3.1- 4.0	10	10	1.50
Above 4.0	04	04	

Source: Field Survey, 2023

Input-output Relationship in Sugar Cane Production

The results of the regression analysis (Table 2) revealed that the double logarithm function provided the best fit based on economic, econometric, and statistical criteria, and thus, was selected as the lead equation. The regression results for the explanatory variables, namely farm size, quantity of sugarcane setts, and agrochemical, had positive coefficients and were statistically significant at 1%. This implied that an increase in the use of these inputs will result in an increase in sugarcane output. Specifically, the positive coefficients indicated that a 1% increase in farm size, quantity of sugarcane setts, and agrochemicals will lead to a 0.47%, 0.65%, and 0.29% increase in sugarcane output, respectively.

The coefficient of determination (R^2) was 0.878, meaning that 87.8% of the variation in sugarcane output among the farmers was explained by the variables included in the model. This suggests that the data adequately fits the selected regression model. Furthermore, the

value of the F-statistic was statistically significant at 1%, indicating the appropriateness of the selected functional form.

Table 2: Input-output relationship of sugarcane farming in the study area

Variable	Coefficient	Standard Error	t-Statistic
Farm size	0.472281***	0.085507	5.523323
Quantity of setts	0.654878***	0.087389	7.493828
Labour	-0.073367	0.084023	-0.873176
Fertilizer	0.017536	0.058153	0.301545
Agrochemical	0.292401***	0.050846	5.750761
R- Squared	0.879707		
Ad. R-Squared	0.873024		
F-Statistic	131.6351***		

Source: Field Survey, 2023

Note: ***Significant at 1% ($P < 0.01$)

Resource-use Efficiency of Sugarcane Production

The result of the marginal analysis of input utilisation, as shown in Table 3, revealed that farm size, fertilizer, and herbicide were underutilised, as indicated by their efficiency ratios being greater than one. In contrast, sugarcane setts were over-utilised, as indicated by their efficiency ratios being less than one. Although these inputs are important determinants of sugarcane output in the study area, their usage should be increased to attain the point of optimality. Adjustments in the use of these inputs would enable farmers to achieve yields that maximise profit. This finding aligns with several studies in agricultural economics that emphasize the importance of optimal input utilisation.

Table 3: Marginal efficiency of input utilization of sugarcane farming in the study area

Inputs	MVP	MFC	Efficiency	Inference
Farm size	154500	35863.51	4.31	Under-utilized
Quantity of setts	2889.99	28948.96	0.09	Over-Utilized
Fertilizer	5919.45	3335.55	1.71	Under-utilized
Agrochemical	95650.28	8910.35	10.73	Under-utilized

Source: Field Survey, 2023

Constraints Associated with Sugarcane Production

Sugarcane production in the study area faced significant constraints. The findings, as shown in Table 4, indicated that insufficient capital and credit facilities, low product prices, and labour shortages were reported by 48, 28, and 17% of respondents as constraints, respectively. These results aligned with the findings of Adebayo *et al*. (2021) who reported insufficient access to financial resources and labor as major barriers to increased sugarcane productivity in various Nigerian regions. Additionally, Adedeji *et al*. (2022) stressed that fluctuating market prices and the lack of proper credit facilities continue to undermine farmers' ability to invest in necessary inputs, thus limiting production potential. Furthermore, a recent study by Ibrahim *et al*. (2023) found that labor shortages during critical planting and

harvesting periods remain a significant challenge, particularly in rural areas, where migration and aging farm populations exacerbate the issue.

Table 4: Constraints of sugarcane farming in the study area

Constraints	*Frequency	Percentage
High cost of inputs	28	28
Pest and diseases	12	12
Inadequate credit facilities	48	48
Labour shortage	17	17
Insufficient extension visits	11	11
Inadequate farm inputs	10	10
Land tenure	07	07
Security challenges	04	04
Inadequate transport facilities	06	06
Total	136*	

Source: Field Survey, 2023
Note: *Multiple responses

CONCLUSION

The study concluded that the respondents did not optimally utilize resources in sugarcane farming. Farm size, fertilizer, and agrochemical were underutilized while overutilization of sugarcane setts was reported. Male farmers dominated the production enterprise. Farm size, quantity of sugarcane setts, and agrochemicals were the factors that influenced sugarcane output. It was found that sugarcane production was not free of constraints as the respondents identified insufficient capital, low product prices, and labour shortages as challenges they faced, highlighting the need for strategic interventions to enhance input utilization and address production challenges.

Based on the findings of the study, The study recommended that farmers optimize the use of fertilizers and herbicides to enhance sugarcane yields and profitability, with support from extension services for efficient input usage. Additionally, government and financial institutions should improve access to affordable credit to help farmers invest in necessary production inputs. Lastly, promoting mechanization in sugarcane farming can reduce reliance on manual labor, address labor shortages, and improve operational efficiency.

REFERENCES

Adebayo, A., Ola, T., & Bello, M. (2021). Resource management for sustainable sugarcane production in Kwara State, Nigeria. *Journal of Agricultural Sciences, 12*(3), 45-58.

Adedeji, B. F., Yusuf, R. A., & Lawal, O. K. (2022). Market dynamics and the financial challenges of sugarcane farmers in Nigeria**.** *African Journal of Rural Studies*, *15*(4), 120–135.

Aina, J.O., Akintayo, O., & Adeyemi, F. (2015). Economics of sugarcane production in Kwara State, Nigeria. *International Journal of Agricultural Economics, 8*(2), 101-112.

Brkic, M., Smith, J., & Taylor, P. (2023). Challenges and opportunities in resource use efficiency for sugarcane production. *Agricultural Systems Research, 14*(1), 78-92.

EOS (Economic Observatory System). (2022). Nigeria's sugarcane production statistics. *Economic Review of Sub-Saharan Africa, 28*(4), 23-29.

Ibrahim, M.A., Sulaiman, T., & Bello, A. (2023**).** Labor shortages and their impact on rural sugarcane farming: Evidence from Nigeria**.** *International Journal of Agricultural Policy and Research*, *8*(2), 56–72.

Girei, A.A., & Giroh, D.Y. (2012). Sugarcane production under out-grower schemes in Numan LGA, Adamawa State, Nigeria. *Nigerian Journal of Agribusiness Studies, 6*(1), 37-49.

ISO (International Sugar Organization). (2022). Global sugarcane production statistics. *Annual Sugar Report, 36*(4), 12-18.

Kumar, R., Singh, H., & Patel, A. (2022). Constraints and resource allocation in sugarcane farming. *Journal of Agricultural Economics and Management, 18*(3), 90-102.

Martins, O. (1997). Agroecological zones of Nigeria. *Journal of Geography and Environmental Studies, 5*(2), 65-74.

Musa, H., Sani, L. & Danladi, A. (2019). Resource use inefficiencies in sugarcane farming in northern Nigeria. *African Journal of Agricultural Research, 14*(5), 203-211.

NPC (National Population Commission). (2011). Population statistics of local government areas in Nigeria. *Census Data Publication.*

Sulaiman, M.S., Idris, A. & Abubakar, R. (2014). Resource use efficiency among sugarcane farmers in Kaduna State, Nigeria. *Journal of Agricultural Research, 19*(1), 15-21.

USDA (United States Department of Agriculture). (2022). Nigeria's sugar import statistics. *Global Agricultural Trade Reports, 45*(6), 33-40.

Yusuf, B., Ali, M., & Olaniyi, T. (2017). Enhancing sugarcane productivity through optimal input utilization. *Agricultural Productivity Journal, 13*(2), 56-69.