



**ECONOMIC ANALYSIS OF SUGARCANE PRODUCTION IN MAKARFI LOCAL
GOVERNMENT AREA, KADUNA STATE, NIGERIA**

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ABSTRACT

The research assessed sugarcane production in Makarfi Local Government Area of Kaduna State, Nigeria. Multi-stage sampling procedure was used to select 100 sugarcane farmers for the study. Data were collected with the aid of a questionnaire and analyzed using descriptive statistics, gross margin, and regression analysis. The results revealed that the mean age of the sugarcane farmers was 39 years and majority (94%) of the farmers were married. However, 38% and 48% of the farmers had secondary and tertiary education respectively with an average of 6 years farming experience. The average household size of farmers was 9 persons. The total variable cost (TVC) was estimated to be ₦239,479.00. The gross margin was found to be ₦970,521.00/ha. Institutional support for sugarcane production was generally low. Major constraints associated with sugarcane production were inadequate capital and credit, pests and diseases, unavailability of fertilizer at affordable prices, unimproved varieties, and lack of standardized means of measurement. Based on the above findings, this research concluded that sugarcane production in the study area was profitable. It was recommended that the Government should provide adequate support in the form of subsidized inputs for sugarcane production to expand the profitability margin.

Keywords: Analysis, Economic, Government, Sugarcane and Production

INTRODUCTION

Agricultural development is one of the most powerful tools to end extreme poverty, boost shared prosperity, and feed the world population by 2050. Its growth is centered more on raising incomes among the poorest compared to other sectors. Agriculture can help reduce poverty, raise income, and improve the food security of about 80% of the world's poor (World Bank, 2023).

Sugarcane is an important crop because of its strategic position and massive uses for multiple purposes in the daily life of any country as well as for its industrial uses (Zulu *et al.*, 2019). The sugar production industry is one of the most important industries in the whole world, it contributes approximately 80% of the total sugar produced in the world (Ambetsa *et al.*, 2020). About 28.3 million hectares in 90 countries are planted with sugarcane and a total production of approximately 1.69 billion tonnes worldwide has been reported (Ambetsa *et al.*, 2020). The largest sugarcane producers in the world are Brazil and India with an annual production of about 768, 678, 382 metric tonnes and 348, 448,000 metric tonnes per year, respectively (Ambetsa *et al.*, 2020). According to Thibane *et al.* (2023), African countries only contribute 5% of the total world sugar and it is estimated that about 80% is contributed by Sub-Saharan African countries. South Africa (18,000,000 MT), Swaziland (5,300,000 MT), Zambia (3,580,000 MT), Mauritius (3,000,200 MT), Sudan (700,000MT), and Kenya (650,000 MT) are the main African countries producing sugarcane and these countries account for more than half of the total sugarcane production in Africa.

Sugarcane (*Saccharum officinarum*) belongs to the grass family Poacea which is primarily cultivated for its juice. It is a tropical crop that usually takes between 8 and 12 months



to reach complete maturity. Sugarcane has three main products namely: sugar, bagasse, and molasses. Sugarcane contributes about 60% of the total world sugar requirement while 40% comes from sugar beet (Onwueme and Sinha, 1999). Sugarcane serves as a raw material for a variety of products such as confectionaries, brewing beer, pharmaceuticals, and soft drinks (Nasir, 2015). Two types of sugarcane are grown in Nigeria; industrial and soft (chewing) cane. The industrial cane is the tough type generally processed into sugar by the sugar estates. The soft cane is mainly chewed raw for its sweet juice. Some of it is also processed into different crude sugar products. Local farmers grow soft cane all over Nigeria. Soft cane production accounts for about 60% of total sugarcane production in many years in Nigeria (Statistica Atlas, 2020).

Sugar extracted from sugarcane is processed to become raw sugar at sugar mills and further purified to refined white sugar using energy-intensive processes. Sugarcane is grown for chewing, drinking juice, raw sugar, and centrifugal sugar. Thick noble canes, which are relatively soft with a high sugar and juice content and low fiber, are best for chewing. With further improvement, all insoluble materials and all impurities are separated from the juice and the resulting product is fine-grained, pale yellow sugar which is further refined to produce white sugar which has become an important item of the human diet. The dark brown viscous liquid separated from the crystalline sugar in the last stage of juice processing is called molasses containing 35% sucrose and 15% reducing sugars. It is an important industrial raw material in producing rum, gin, vodka, ethyl alcohol, acetone, and butanol, also bakers and brewer's yeast are produced from it. It is widely used as a stock feed and preparing silage as additives and used in constructing roads (Davies, 2007).

Bagasse is another by-product of sugarcane used as fuel in sugar factories, in paper manufacturing, cardboard, fiberboard, wallboard and plastic, cattle feed, and in producing furfural (Busar and Misari, 2007). National Sugar Development Council (2002) also observed that bagasse is the fibrous remains after squeezing out the juice from sugarcane. The modern sugar estates use this by-product as fuel for power generation; it has great potential as a fodder crop (NSDC, 2002). Despite the large areas of cultivatable land suitable for the growing of sugarcane and other investments in the sub-sector, Nigeria still imports 90% of its sugar (Flexible Sugar Industry (FSI), (2008). Considering the shortfall in sugarcane production in Nigeria, the government set up and mandated research institutes and agencies such as the National Sugar Development Council (NSDC) to facilitate an increase in sugarcane production and utilization (Babalola *et al.*, 2017).

More so, the level of farmer's participation in sugarcane production in the nation is highly on the decline due to numerous problems faced by local sugarcane producers. Major problems faced by these producers are associated with farming/working equipment and tools. These farming equipment and tools used for sugarcane production are traditional in nature and are energy-sapping and crude. This will in turn lead to low output and hence scarcity (Unguanrими *et al.*, 2019). Also, looking at the ever-increasing population of Nigeria (216 million) which is the largest in Sub-Sahara Africa, the country is reported to be the second largest sugar market in Sub-Saharan Africa behind South Africa. Over half of Nigerian's population live in urban areas and are not necessarily involved in sugarcane production and the urbanization rate and a growing population increase the need and demand for sugarcane production and consumption in Nigeria. The neglect of the country's agricultural sector and weak infrastructure translate into a dependency on sugarcane and raw sugar import and this affects the development of the nation and discourages home production and processing (GAIN, 2023). This decline in production underscores the need to conduct empirical research to ascertain the economic analysis of sugarcane production in



Makarfi LGA of Kaduna State. In an attempt to do this, the study had a broad objective of analyzing the economics of sugarcane production in Makarfi Local Government Area of Kaduna state. The specific objectives are to: describe the socio-economic characteristics of sugarcane producers in the study area; determine the profitability of sugar production in the study area; determine the factors influencing sugarcane production in the study area and examine the constraints militating against sugarcane production in the study area.

Given the importance of sugarcane in global and national food security, several international players have been involved with sugarcane production and processing in Nigeria and at the global level (FAO, 2009, WorldAtlas, 2017 and Statistica Atlas, 2020), this range from multilateral institutions like the World Bank, donor nations, high sugarcane production countries, and Nigeria's West African neighbors with connections to the Nigerian market. The high economic potential of sugarcane crops as an income earner to the producers and state/nation makes it imperative for an effort to be made by researchers to boost its production.

Increasingly, governments have seen the ever-growing demand for sugarcane as an opportunity for revenue and have entered into several intergovernmental and public-private partnerships in sugarcane production, processing, and marketing. Unguwanrimi *et al.* (2019) reported that sugarcane production has become a major source of livelihood for rural farmers in Kaduna state not only in providing them with food requirements but also generating income for farmers through the sales of sugarcane, increasing the number of jobs created particularly at the rural communities and contributing to the growth of the economy by increasing the Gross Domestic Product (GDP) of the country.

The study will not only bring to light the economic analysis of sugarcane production in the study area but also assist the government in making considerable decisions regarding sugarcane production. Results from this research will assist and create awareness among policymakers in providing the necessary support for sugarcane producers to boost production and generate income. It will also assist the policymakers in designing appropriate public policies and planning as regards to efficient allocation of available resources to boost sugarcane production in Kaduna state and the country at large.

MATERIALS AND METHOD

The Study Area

The research work was conducted in Makarfi Local Government Area of Kaduna State, Nigeria. Makarfi Local Government Area lies between 11⁰22N longitude and 7⁰52E latitude. The Local Government has a total of ten wards namely; Danguziri, Dandamisa, Gubuchi, Gwanki, Gimi, Gazara, Nasarwa doya, Sabon Garin Makarfi, Makarfi, and Mayare. The Local Government Area with its headquarters in Makarfi has an area of 541 km² and a population of 146, 259 as of 2006. Using the 2.5% annual population growth, the population is estimated at 261,803 people in 2023 (NPC, 2023). Agriculture is the major economic activity of the people of Makarfi LGA. Major crops produced are sugarcane, maize, sorghum, rice, and vegetables. There are two distinct seasons in the local government area namely: wet and dry. The wet season is oppressive and mostly cloudy, and the dry season is partly cloudy. Over the course of the year, the temperature typically varies from 53⁰F to 97⁰F and is rarely below 47⁰ above 102⁰F. The hot season lasts from March to May, with an average daily high temperature above 94⁰F. The hottest month of the year in Makarfi is April, with an average high of 96⁰F and low of 70⁰F. The cool season lasts from July to September with an average daily high temperature below 85⁰F. The coldest month of the year in Makarfi is January, with an average low of 54⁰F and a high of 84⁰F (WeatherSpark, 2022).



The Local Government area is blessed with fertile and with several rivers that favor crop farming including sugarcane. During the market day, many merchants of sugarcane come and transport it to other parts of the country and even beyond the Nigerian borders. The estimated land area cultivated for sugarcane production is about 3,100 hectares yielding about 80 to 120 tie (bundles) (about 110000-150,000 tons) of sugarcane per hectare (NSDC, 2020, Statista Atlas, 2020).

Sampling Technique and Sample Size

Sugarcane farmers in Makarfi Local Government Area of Kaduna state constitute the population of this study. A multi-stage sampling technique was employed for this study. In the first stage, three (3) wards out of ten (10) wards (Gwanki, Mayere, and Makarfi) in Markarfi was purposively selected because they are an agrarian community and also due to their involvement in sugarcane cultivation/production and other agricultural activities (KADP, 2019). In the second stage, six villages were purposively selected (two from each of the selected Ward). In the third stage, only 50% of the total number of sugarcane farmers in each of the six villages was randomly selected for this study. This represented a sample size of one hundred (100) respondents.

Method of Data Collection

Data were collected with the aid of a structured questionnaire. The information collected was mainly on the farmer's socio-economic characteristics; age, educational status, farming/production experience, total income from farm activities, total income from off-farm, farm size, access to credit facilities, profitability of sugarcane production, problems and challenges faced in accessing credit, general suggestions by the farmers in ways by which sugarcane production can be improved.

Analytical Techniques

The tools of analysis that were used to achieve the objectives of the study were; Descriptive statistics, Net farm income model, Gross Margin and Multiple Regression analysis.

Descriptive statistics

Descriptive statistics which involved the use of measures of central tendency such as mean, frequency distribution, and percentages was used to describe the socio-economic characteristics of the respondents in the study area.

Net farm income model

The Net Farm Income (NFI) was used in determining the profitability of sugarcane production within the study area. The formula for the Net Farm Income Model is as follows;

$$NFI = TR - TC \quad \dots(1)$$

Where:

NFI = Net Farm Income (₦), TR = Total Revenue (₦) and TC = Total cost of production (₦)

$$TC = TVC + TFC \quad \dots(2)$$

Where;

TVC = Total variable cost (₦) and TFC = Total fixed cost (₦)

The fixed inputs such as sprayers and other machinery that were not used up in the production process were estimated using the straight-line depreciation method given by;

$$D = P - S/N \quad \dots(3)$$

Where;

D = Depreciation (₦), P = Purchase value (₦), S = Salvage value (₦) and N = Life span of asset (years).

Return per naira invested (RNI) was obtained by dividing the gross income (GI) by the total cost (TC).

Therefore,



$$RNI = GI/TC \quad \dots(4)$$

RNI = Return per naira (₦), GI = Gross income (₦), TC = Total cost (₦)

The decision rule holds that;

If $RNI > 1$, it implies there is profit in production

If $RNI = 1$, the farmer is at break-even

If $RNI < 1$, the farmers are at a loss

Production Function Model

To determine the factors influencing sugarcane production in the study area, the Cobb-Douglas production function was used. This model can be expressed in its implicit form as follows:

$$\text{Log } Y = \text{Log } a + b_1\text{Log}X_1 + b_2\text{Log}X_2 + b_3\text{Log}X_3 + b_4\text{Log}X_4 + b_5\text{Log}X_5 + b_6\text{Log}X_6 + b_7\text{Log}X_7 + b_8\text{Log}X_8 + b_9\text{Log}X_9 + \text{Log}e \quad \dots (5)$$

Where,

Y = Yield of sugarcane (tonnes)

X₁ = Land (ha)

X₂ = Sett (tonnes)

X₃ = Labour (man/day)

X₄ = Fertilizer (Kg)

X₅ = Age (years)

X₆ = Gender (dummy)

X₇ = Experience (years)

X₈ = Marital Status (dummy)

X₉ = Education (years)

e = Random error term

RESULTS AND DISCUSSION

Socio-economic Characteristics of Sugarcane Farmers

The socio-economic characteristics of the sugarcane farmers in the study were described concerning age, gender, marital status, household size, farming experience, educational level, farm size, mode of land acquisition as well as source of capital and are presented in Table 1. Analysis of the age distribution of the sugarcane farmers showed that the mean age of the farmers involved in sugarcane farming in the study area was found to be 39 years. This implies that sugarcane farmers in the area were active and were in their prime. This is in line with the findings of Issa *et al.* (2020) who reported that younger farmers are more likely to adopt innovations to increase efficiency level than the older ones in production.

Results further showed the sex distribution of the sugarcane farmers in the area were all (100%) males. This implies that sugarcane farming in the area is male dominated business. This may be attributed to the fact that sugarcane is labour intensive and also considering the cultural background of the habitant of the area, females were not involved in such activities. This finding is in line with Issa *et al.* (2020) who reported the predominance of men in his study on profitability of sugarcane farming in Kaduna state. The results also revealed that 94% were married, while only 6% of the sugarcane farmers were single. The household with married status may have labour force advantage, as households with married status are most likely to have a large family labour size than others. Similar results was also observed by Babalola *et al.* (2020) that married sugarcane farmers tend to have easy access to production inputs such as land and large family labour which enhance production. Findings showed that the average household size of sugarcane farmers in the study area was found to be 9 members. Results of the study also revealed that 48% of the farmers involved in sugarcane farming enterprises in the study area attained a tertiary level of education, and therefore, the sampled population can



be considered to be literate. This implies that the prospect of acceptance of innovation by the sugarcane farmers in the area is high and thus this formal educational attainment would not only enhance the adoption of technology, but would also increase the ability of the farmers to understand and evaluate information on new techniques of production. Results further showed that about 48% of sugarcane farmers had an experience of between 1 to 10 years in sugarcane farming in the study area. The mean years of farming experience in the study area for the sugarcane farmers was about 15 years.

Table 1: Age distribution of Sugarcane farmers in the study area

Variables (n=100)	Frequency	Percentage	Mean
Age			
25-31	35	34	39
32-38	16	16	
39-45	23	23	
46-52	17	17	
Sex			
Male	100	100	
Marital Status			
Married	94	94	
Single	6	6	
Household Size			
< 5	20	20	9
5-10	45	45	
11-15	17	17	
Education qualification			
No-formal education	10	10	
Primary education	4	4	
Secondary education	38	38	
Tertiary education	48	48	
Farming experience			
1 – 5	23	23	15
6 – 10	25	25	
11 – 15	16	16	
16 – 20	11	11	
21 – 25	10	10	
26 – 30	10	10	
31 – 35	03	03	
36 – 40	02	02	
Total	100	100	
Farm size			
0.5-1.0	37	37	1.6
1.5-2.4	45	45	
2.5-3.0	18	18	
Total	100	100	
Land Acquisition			
Inheritance	70	70	
Purchase	20	20	
Lease	7	7	
Gift	3	3	
Source of capital			
Personal savings	57	57	
Friends and family	11	11	
Borrowing	32	32	

Source: Field Survey, 2023



The finding implies that the farmers in the study area were experienced sugarcane farmers. Analysis of the farm size further showed the mean farm size of the respondent to be 1.6ha. This indicated that most sugarcane farmers operated on small-scale enterprises. The result was consistent with the description of a smallholder farmer. Findings further showed that, majority (70%) of sugarcane farmers in the study area acquired their farmlands through inheritance, while 20% got their farmland outright, and 7% obtained their land by through lease or rent. The majority (57%) of the sugarcane farmers in the study area acquired capital from personal savings while 32% of the sugarcane farmers obtained theirs through borrowing. This implies that majority of the sugarcane farmers in the study area did not have access to credit from formal sources. According to Wada *et al.* (2017)., this could be because of administrative bottlenecks, or collateral requirement by formal source, while the high interest rate charged by money lenders could be one of the reason for that.

Profitability Analysis of Sugarcane Production in the Study Areas

The result in Table 2 shows the cost and return of sugarcane production per hectare. The total cost of sugarcane production was estimated to be ₦1,210,000. The total variable cost was ₦239,479. The total fixed cost was ₦42,250; that is the cost of land. The total fixed cost and variable cost used in the analysis were defined to include inputs such as land preparation, planting, fertilizer application, manure, weeding, agrochemicals, replacement and other labour. From this analysis, it was observed that the estimated total revenue in the study area was ₦1,210,000 per hectare. This was obtained by multiplying the sugarcane output per ha by a unit price. By subtracting total variable cost and total fixed cost (i.e., total costs) from the total revenue respectively, the net farm income of sugarcane farmers in the study area per hectare was realized to be ₦950,741 while the gross margin was ₦970,521/ha by subtracting the total revenue from total variable cost as presented in Table 3. Hence, it is vivid to say sugarcane production in the study area was profitable. Issa *et al.* (2021) found similar result.

Table 2: Average cost and return of sugarcane production

Variables	Value (₦/Ha)	Percentage (%)
A. VARIABLE COST COMPONENTS		
i. Land preparation	23,390	9.77
ii. Sett	29,420	12.29
iii. Fertilizer	37,579	15.69
iv. Manure	20,225	8.45
v. Weeding	44,940	18.77
vi. Agrochemicals	8002	3.34
vii. Replacement	25,673	10.72
viii. Other labour costs	50,250	20.98
Total Variable Cost (TVC)	239,479	100.01
B. FIXED COST		
Cost of Rent Farm Land	42,250	16.29
Total Fixed Cost (TFC)	42,250	16.29
Total Cost (TVC + TFC)	259,259	
C. RETURNS		
Unit price	2,200	
Output/ha	550 ties	
Total Revenue (TR)	1,210,000	
Gross Margin (GM)	970,521	
Net Farm Income (NFI)	950,741	
ROI	4.67	

Source: Field Survey, 2023



Factors Influencing Sugarcane Production in the Study Area

Table 3 revealed the factors influencing the production of sugarcane using logistic regression analysis. The F ratio test was 40.085 significant at $p < 0.001$. This indicates that all the variables included in the model are jointly significant in predicting the factors influencing sugarcane production in the study area. The result showed that gender and marital status were statistically significant and contributed positively in influencing the sugarcane production of farmers in the study area. The coefficients of these significant variables provide the marginal effect of the independent variables on the dependent variable. The marginal effects give the expected change in the probability of a particular contribution to credit facilities with respect to a unit change in an independent variable.

Table 3: Factors influencing sugarcane production in the study area

Variable	Coefficients	Standard Error	t Stat	P-value
Constant	1.846878***	0.118842	15.54059	0.000
Age	0.002166 ^{NS}	0.003666	0.590845	0.556
Education	0.008575 ^{NS}	0.014322	0.598706	0.551
Experienc	0.001597***	0.00055	2.9058	0.006
Farm size	-0.10462 ^{NS}	0.096781	-1.08097	0.283
Fertilizer	0.000441***	0.000153	2.87827	0.005
Man_days	0.008029***	0.002847	2.820234	0.006
Qty planted	0.00308***	0.001028	2.996247	0.004
Agrchemical	1.98E-07 ^{NS}	PP1.21E-06	0.164293	0.869
Marital status	0.1021202***	L0.051662	1.97827	0.051
R ²	0.800			
Adjusted R ²	0.780			
F	40.085***			0.000

*** Significant at 1%, ** Significant at 5%, * (Significant at 10%) Source: Field Survey, 2023

CONCLUSION AND RECOMMENDATIONS

Based on the results it was concluded that sugarcane production in the study area was profitable despite the constraints associated with its production as depicted by the net farm income (NFI) of ₦201,391 and gross margin of ₦243,641/ha. Thus, the study recommended that government and nongovernmental organizations should give adequate support in terms of credit/finance, and inputs to the sugar farmers since inadequate credit and inputs are the major challenges facing the farmers in the study area. Also, farmers should form a formal and strong sugarcane farmers association that would represent their interests. This would help them to have better access to institutional supports, enhance their linkages, and command good prices for their produce.

REFERENCE

Adejobi, A.O., Babatunde, R.O. and Idowu, E.O. (2011). Weight and measurement issues in retail marketing of fresh tomatoes: evidence from Osun State. *Journal of Agricultural Science*, 6(4):20-26.

Ambetsa, F. L., Mwangi, S. C. and Ndirangu, S. N. (2020). Technical efficiency and its determinants in sugarcane production among smallholder sugarcane farmers in Malava sub-county, Kenya. *African Journal of Agricultural Research*, 15(3):351-360.

Asian vegetables research development center (AVRDC) (2006), Vegetable matter. AVRDC the World Vegetable Center, Shanghai Taiwan.

Babalola, D. A., Okoruwa, V. O., Omonona, B. T. and Oni, O. A. (2017). Assessment of the influence of Government intervention program on sugarcane production in Nigeria: Evidence from Jigawa State: *Journal of Research and Development*, 1(1):5- 13.

Busari, L. D. and Misari, S. N. (2007). The traditional method of processing Mazarkawaila and Alewa” from



- sugarcane. National Cereal Research Institute, Agricultural Information Documentation and Dissemination, No, 1, Pp 1 -21.
- Davies N. (2007). Developing world agriculture, Booker Tate Ltd. London, 350.
- Flexible sugar industry (FSI), (2008). www.ezu-likegroup.com Retrieved 20/10/2023.
- Food and Agricultural Organization, FAO (2006). More fruit and vegetables.
- Food and Agricultural Organization (FAO) (2009). Food Outlook. Global Market Analysis of Sugar. Available from www.fao.org/3/ai482e/ai482e07.htm. Retrieved 12/10/2023.
- GAIN (Global Agriculture Information Network). (2008). Nigeria sugar annual. Global Agricultural Information Network report (USDA foreign agricultural service). GAIN Report: 18008.
- Gebhardt, C. (2016). The historical role of species from the Solanaceae plant family in genetic research. *TAG. Theoretical and applied genetics. Theoretische und angewandte Genetik*, **129**(12):2281–2294. <https://doi.org/10.1007/s00122-016-2804-1>
- Haruna, U., Sani, M. H., Danwanka, H. A. and Adejo, E. (2012). Economic Analysis of Fresh Tomato Marketers in Bauchi Metropolis of Bauchi State, Nigeria. *Nigeria Journal of Agriculture, food and environment*, **8**(3):1-8
- Issa, F.O., Kagbu, J. H., Sanusi, S. and Oba, A. I. (2020). Profitability of Sugarcane Production in Makarfi Local Government Area of Kaduna State, Nigeria. *Journal of Applied Agricultural Research*, **8**(1):12-23.
- Isa, H. M., Manga, A. A. and Hussaini, M. A. (2017). Response of Tomato (*Solanum lycopersicon* L.) to Antitranspirants and Moisture Stress in Kano, Sudan Savanna of Nigeria. *Journal of dryland Agriculture*, **3**(1): 48 – 58
- Kaduna State Agricultural Development Programme (KADDP) (2013). Agricultural Production Report.
- Nasir, I. A. (2015). Maintaining the regeneration of sugarcane callus for a longer span. *African Journal of Agriculture Research*, **6**(1):113-119.
- National Population Commission NPC, “(2006) census” Headquarters Block 14 Lulu's street PMB 281, Abuja Nigeria.
- National Sugar Development Council (NSDC, 2002). Nationwide survey on industrial and domestic consumption of sugar in Nigeria. Pp 1 – 11.
- Onwueme, I. C. and Sinha, T. D. (1999). Center for Tropical Agriculture — Field Crop Production in Tropical Africa”. CTA, Wageningen, Netherlands, pp401411
- Shing-jy, J. T. and Hsiao-Feng, L. (2003). **Handbook for Vegetable Preservation and Processing**. Edited by Y.H Hui, Sue Ghazala, Dee M. Graham K.D. Murrell, and Wai- kit Nip CRC press.
- Statista Atlas (2020). Sugar production worldwide 2009/10-2019/20 <https://www.statista.com/statistics/249679/total-production-of-sugarworldwide/> Accessed 12/10/2023
- Unguanrими, Y. A., Sada, A. M., Musa, J., Halimat, G. S. and Ugama, G. N. (2019). Assessment of Brown Sugar Processing in Kaduna State. *Journal of Scientific and Engineering Research*, **6**(10):1-5
- Taiwo, O. A. (2020). Economic Analysis of Tomato Marketing in Ondo State, Nigeria. *Journal of Horticultural Science*, **6**(2):2581 – 2586.
- Thibane, Z., Soni, .S, Phali, L. and Mdod, L. (2023). Retraction notice to "Factors impacting sugarcane production by small-scale farmers in Kwazulu-Natal Province-South Africa" *Heliyon* **9** (11):e22372.
- Wada, A. C., Abo-Elwafa, A., Salaudeen, M. T., Bello, L. Y. and Kwon-Ndung, E. H. (2017). Sugarcane production problems in Nigeria and some Northern African countries. *Direct Research Journal of Agriculture and Food Science*, **5**(3):141-160.
- WeatherSpark, (2022) <https://weatherspark.com/>
- World Atlas Top sugar cane producing countries in 2017 <https://www.worldatlas.com/articles/top-sugarcane-producing-countries.html> Accessed 14/10/2023.
- World Bank (2023). Food and Agriculture. (<https://www.worldbank.org/en/topic/agriculture/overview>)
- Zulu, N., Sibanda, M. and Tlali, B. (2019). Factors Affecting Sugarcane Production by Small-Scale Growers in Ndwedwe Local Municipality, South Africa. *MDIP Agriculture* **9**(170):1-14.