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ANALYSIS OF SUSTAINABILITY OF SUGARCANE FARMING IN NIGERIA

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ABSTRACT
The study was conducted to analyze sustainability of sugarcane farming in Nigeria. Kano State was purposively selected with a sample size of 54 sugarcane farmers using randomized sampling procedure. The data were analyzed using descriptive statistics, farm budgeting and regression analysis. The result showed that 94% of the respondents were male, with an average age of 39 years. The mean household of the farmers was 8 persons. The average farm size was 2.3ha; it cost ₦33,224.22 to produce sugarcane per hectare with revenue of ₦36,706.17; the gross margin was ₦3,481.95 and the investment rate of return was 0.10. The findings further disclosed that age, household size, education and labour were significant ($P<0.05$) and influenced the output of sugarcane farming in Nigeria. The results also reveal that land, sugarcane setts, fertilizer, insecticide and labour had ratios of 2.57, 33.44, 6.55, 1.630, and 0.27, respectively. The study revealed the constraints to sugarcane production in Nigeria to include, small farm holdings, high cost of inputs, inadequate credit, land tenure problem and poor extension services. It was concluded that even though sugarcane production is profitable, land, sugar cane sett, fertilizer and insecticide were underutilized and labour was over utilized. The study recommended that the farmers should increase the use of the underutilized factors and reduce the over utilized inputs; and also, the Government should review land ownership policies and subsidize farming inputs.

Key words: Elasticity, Flood areas, Inputs, Sugarcane, Sustainability.

INTRODUCTION
Agriculture remains the principal livelihood of poor people in developing countries particularly the rural poor that is widely considered to be the engine of economic growth in the majority of developing countries. Given the past contribution of agriculture to poverty reduction and economic growth, one can start imagining if the current improvements in agriculture of Nigeria have the potential to stimulate further pro-poor growth in the face of existing resource constraints?

Agricultural sustainability in developing countries has emerged as one of the most important issues in agricultural development and natural resources. Globally, agriculture has performed remarkably well over the last 50 years, by keeping pace with rapid population growth and delivering food at progressively lower prices. But this success has been at the expense of the natural resource base, through overuse of natural resources as input or though their use as a sink for pollution. Sani (2017) reported that the sector offers vast opportunities and employs over 70% of the Nigerian labour force in farm and non-farm activities, and added to it, is the provision of the basic food requirements for the country with its over 180 million people as well as providing raw material for local industries. The exportation of agricultural products helped Nigeria in taking gigantic strides towards her economic growth, thereby

culminating in sustainable development. In a nutshell, agriculture is agribusiness contributing to the development of Nigeria in so many ways (e.g., provision of food for an increasing population; provision of raw material to industrial sector; source of employment; source of foreign exchange earnings; contribution to Gross Domestic Product [GDP] and source of market for products of industrial sector).

Yacoubou (2007) maintain that key features of agricultural sustainability include an acceptance of the fact that agricultural strategies should be based on more than simple productivity criteria, that externalities are of great importance, and that intra-and inter-generational equity are key parameters in assessing agricultural change. The ecological impacts of agriculture usually referred to as negative externalities includes land degradation, limits to water availability, loss of biodiversity, declining agricultural genetic diversity and contributions to climate change. These are recognized to be often neglected, occurring with a time lag, affecting groups with little voice in decision-making, and difficulty to track to source. While agriculture also has positive effects on the environment, these are outweighed by the overall impacts. In the context of sustainability, two key questions are addressed, firstly, whether agriculture will be able to meet future global food demand without adversely affecting the resource base. Secondly, what is the optimum approach to enable agriculture provide sufficient food and act as an engine of pro-poor growth despite resource constraints?

Yacoubou (2007) further reported that globally, agricultural production is projected to grow in line with demand, provided that the necessary national and international policies promoting agriculture are in place. For agricultural growth to occur at the rate required to meet future demand, a series of factors will need to be in place. These include availability of land, better use of water resources, capability to accommodate climate change and management of genetic resources. Meeting current and future food requirements will require rapid increases in productivity to avoid an undesirable expansion unto fragile and marginal lands. However increase production need to happen without further damage to the environment. For this to happen, principles of sustainability must be a core part of agricultural policies, to provide incentives and enabling conditions for sustainable resource use. Such principles should also be reflected in macro policies that can potentially influence different groups of poor people, the resources they use and their scope for positive adaptation. Whilst policy reforms are underway in many countries progress has tended to be piecemeal. Lack of significant progress in design and implementation of better policy is due in part to strongly divergent opinion on optimum approaches for agriculture.

According to Directorate of Food and Infrastructural Development (2002), global agriculture has performed remarkably well over the past half century. Since the 1960s the world food system has responded to a doubling of the world population from 3billion to 6 billion, providing more food per capital at progressively lower prices. It is important to increase sugarcane production in Nigeria due to the ever increasing population, increasing demand for sugar and also because of its numerous uses. Sugar is one of the most valuable products of the plant world obtained from *Sacharum Spp*. It is a necessary food for man and also a perfect energy producing agent. Sugar industry play an important role in a nation's development by servicing as source of income, food supply to man, source of employment, source of raw materials to industry and it is also advocated because of its potential yields. Some sugar industries in Nigeria closed down due to the fact that most of the local farmers have stopped sugarcane production because of some reasons like farm size being small and therefore not economical to use tractors, high cost of inputs and high cost of labour. Further to these constraints, the production of the produce seems not to meet the increasing demand thereby

making large-scale production of sugarcane imperative. This situation has been attributed to the relative neglect to agriculture by decision makers and major operators in both the public and private sectors of the economy. Therefore, this study was to: determine the profitability of sugarcane production in the study area; estimate the elasticity of input in small scale sugarcane production in the study area; identity the factors influencing sustainable sugarcane production in the study area and ascertain the major problems associated with small-scale sugarcane production in the study area.

Kano State in general was a true representation of Nigerian States in terms of sugarcane farming because the State is endowed with the potentials to guarantee abundant sugarcane supply and coupled with the gigantic Tiga dam in Kano; sugarcane farming would be moved to the next level if potential investments are made in the sugarcane production. Fouconnier (1999) revealed that sugarcane became established as a domestic garden crop by Neolithic horticulturalists in what is now called New Guinea. Sugarcane is indigenous to tropical South Asia and South East Asia. Different species originated in different locations with *saccharum barberi* originating from India and *Saccharum edule* and *Saccharum officinarum* originating from New Guinea. The Arabs in the 18th century introduced sugar to the Mediterranean, Mesopotamia, Egypt, North Africa and Spain. By the 10th century, sources stated that there was no village in Mesopotamia that did not grow sugarcane. It was among the early crops brought to the Americans by Portuguese. Brazil is the biggest grower of sugarcane, which goes for sugar and ethanol for gasoline. Sugarcane is grown in over 100 countries with an estimated total production of 1.591 million metric tons in 2007.

Njoku (1999) reported the primarily grown for chewing and for livestock feeds. In Nigeria, as in other tropical countries, sugarcane is the major raw materials for sugar production. In Nigeria, two sugar estates (Becita and Numan in Kwara and Adamawa States, respectively) cultivate sugarcane on a relatively large scale while the majority of small holder farmers of 0.2-5ha farm size grow sugarcane for chewing. Alabi *et al.* (2006) opined that sugarcane was grown annually on 25-30,000 hectares in Nigeria, of which industrial cane covers about 12,000 hectares.

Sugarcane is utilized mainly as a source of sugar for various uses consumed directly as household sugar or may be used in sweet confectionaries and syrups. In West Africa, a significant proportion of the sugarcane is consumed directly as raw cane which is being chewed. Alabi *et al.* (2006) emphasized that the leaves of sugarcane are sometimes used as forage for animals. Filter press mud is left after filtration of the needs which settles out in the clarification process. Sugarcane also acts as an agent of nitrogen fixation. Some sugarcane varieties are known to be capable of fixing atmospheric nitrogen in association with a bacterium. According to Akinsoye (1996) the cane is also processed into white sugar, brown sugar, jaggery and also used to produce motor fuel. The cane is also considered as a type of fruit being used for fresh juice.

Gibbon and Pain (1995) reported that the surplus residue can be important in generating electricity and used for paper and cardboard manufacturing. Hamidu (1995) stated that human labour account for almost 100% of all farm operations in a non-mechanized system of peasant cultivation. Hence, costs accounts for greater portion of the variable costs and also reported that farmers complained that hired labour is scarce expensive and unreliable.

Naturally, sugarcane is produced in flood areas such as the *Fadama* of Northern Nigeria with total minimum of 1500mm of rainfall especially during the growing season or supplement. There are large scale irrigated estates at Becita in Kwara State and another large scale scheme at Numan in Adamawa Stata where there are sources of water from the river Nigeria, Sokoto

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Benue and Rima Rivers. Akinsoye (1996) stated that approximately, 40% of the sugar which is consumed in Nigeria is from these establishments. All sugarcane are produced form the riverine areas due to the fact that the crop requires temperature between 23-38 degree during growth implying that mean temperature should not fall below 21 degree centigrade.

According to Davies (1999), sunlight on day length is also important for photosynthesis and sucrose formation and night period of 11.511.25 hours. Sugarcane varies from 35-50 tons of cane per hectare per annum obtainable in the northern areas from rain fed and with irrigation 70-100 tons per hectare per annum. Also, the byproducts of sugarcane processing are biogases, filter press mud, molasses, beet pulp, etc. The author further revealed that the ideal climatic condition for the growth of the crop is a long warm, dry cool but sunny climate with plentiful supply of water where the average annual precipitation is less than 16000-17000 and where pronounced dry season exists. The crop requires temperature between 32-38 degrees centigrade during growth (the mean should not fall below 21 degrees) and sunlight for effective photosynthesis and sucrose accumulation. It was also reported that 35-50 tons of cane per hectare are being obtained in the northern area from rain fed canes. In some other 60-100 tones has been recorded while the irrigated cane yields have been in the region of 70-100 tons per hectare per annum from the plant cane. Sugarcane is classified into two types viz: thick and thin canes. Thick cane (noble canes) are mostly 5cm in diameter, gives higher yield but need more fertile land and do not resist long drought (Gibbon and Pain (1995) and further maintained that thin canes are much hardier and can withstand poorer soil and long dry season, but gives lower yield.

Several reasons have been said to have account for the sugarcane problem. The most important of these are labour, soil, water, land tenure, capital, disease and pests, poor extension services, transportation and climate etc one major problem in sugarcane production is that it requires much labour, however with increasing mechanization. Labour alone accounted for 50% of production cost (Irvine, 1999). According to Fouconier (1997), frost and water availability are the main technical constraints to growing of sugarcane, with the intensive dry season in Nigeria, early flowering has proved as a problems since this greatly reduce yields (Irvine, 1979).

MATERIALS AND METHODS

The Study Area

Kano State is situated in the Sudan Savannah agro ecological zone of Nigeria located between latitude 9º 30 North and longitude 9 º 34 to 9 º 30 and 10º33 to 12 º 37 North and longitudes 7º 340 to 9 º 250 east. The State is bordered with Katsina State to the North-West and Bauchi and Kaduna States in the South (KNSG, 2004). 30,13km Square out of which agricultural land is put at 18,684 km square while forest and grazing land has 1,447 km square. The 2006 population census estimated Kano State population at 9,383,682 people (NPC, 2006). The climate of the study area is tropical dry climate with a mono modal rainfall distribution averaging 600mm per annum with most of rains occurring between May and September. Average temperature was 29º c occurring in March and April. The soil are light, free draining and loamy with lightly amenable to intensive cultivation.

The Dawaki Tofa Local Government Area of Kano State is a major sugarcane producing area of Kano State. The area lies along latitude 10º 7 north and longitude 9º 49 east with altitude of 690.2m above sea level. The area falls within western part of Kano State. The vegetation of Dawaki Tofa Local Government Area is open Savanna with some trees up to 5m or more in height. The trees occur in single or in cluster and the space in between and burning

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has reduced the vegetation in some placed shrubs. Grasses in such area may reach up to 3.5m or more in height. The soil is characterized by stony sand on basement complex and the surface soil is free draining sandy loam and moderately deep.

Method of Data Analysis

The farm budgeting, gross margin and regression analysis was used to determine sustainability of sugarcane farming in Nigeria.

RESULTS AND DISCUSSION

Profitability of Sugarcane Production

The finding on costs and returns of sugarcane farming was presented in Table 1. The investigation demonstrates that the total cost of sugarcane production is 33, 24.22/ha. The total cost is made up of the variable cost of land sugarcane sett, insecticide, herbicide, fertilizer, manure and labour. The farm labour constituted the highest cost component with 40.119%. This result is in line with the report of Sani *et al.* (2014) that labour constitutes the cost component of production in agriculture. Also, Godi (2004) had reported that labour has been found to constitute a large proportion of total costs of production in Nigeria. The study reveals gross income of 36,706/ha for sugarcane production in Nigeria. The value was obtained by multiplying the quantity of sugar cane by the market unit price. The gross margin which is the net income in the absent of fixed cost is N3, 481.95/ha. The benefit cost ratio (BCR) and the returns on Naira invested (RNI) were 1.10 and 0.10, respectively. The BCR and the returns on Naira invested indicate the point of breakeven and the magnitude of profit on each naira invested. Even though the production of the sugar enterprise is profitable, the revenue generated is minimal.

Table 1: Costs and Returns on Sugarcane Production per Hectare

Cost/revenue item	Quantity	Unit price (₦)	Value (₦)	%
Land	1	9,520	9,520	28.65
Sugarcane setts	28.37	38.68	1,097	3.30
Insecticide	1.56	1,449.73	2,261.58	6.81
Herbicide	0.75	1,205.50	904.13	2.72
Chemical fertilizer	99.62	56.26	5,604.62	16.87
Organic fertilizer	48.76	9.96	485.65	1.45
Labour	-		13,351.24	40.19
Total cost	-		33,224.22	100.00
Gross income	470.17	78.07	36,706.17	
Total revenue			36,706.17	
Gross margin			3,481.95	
Benefit cost ratio			1.10	
Returns on Naira invested			0.10	

Factors that Influences Sustainability of Sugarcane Production in Nigeria

Regression provides an overall measure of the extent to which variation in one variable determines the variation in another variable. The coefficient of determination (R^2) measures the proportion of the total change in dependent variable due to variation in independent variable. This was used to determine the effects of production factors on output of sugarcane in the study area. As presented in Table 2, the data collected on the variables was regressed against the output of sugarcane for different functional forms of the regression model. And

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based on the number of significant variables, mathematical signs of the significant variables, and the magnitude of the coefficient of determination (R^2), the functional form (semi-log) with better result was chosen as the lead equation as shown in Tables 2. The result shows that age, household size, education and labour were significant at P<0.05. And the coefficient of multiple determinations is 55.3%. this means that the significant variables influences the output (production) of sugarcane and the implication of the result respective to the arithmetic signs is that, the older the age of a sugar cane farmer and increase in labour used in the production process, the less (negative coefficients) the output of sugarcane would be realized. However, the larger the family size, and the more educated a farmer is, the more the output of sugarcane. This finding agrees with the assertion of Alabi *et al.* (2006) who reported that active age is desirable on the farms because as economically active, they may be willing to assume greater risk by trying improved production techniques in anticipation of profit than the older and much younger ones who are often more risk aversive. Agricultural production processes labour constitutes the highest cost components (Sani *et al.,* 2014) and it's over utilization reduces the total value obtained from farming enterprise.

Table 2: Factors that influences Sustainability of Sugarcane Farming in Nigeria

Predictors	**Functional forms**		
	Linear	**Semi-log**	**Cob-Douglass**
Constant	8935	22296	5.300
	(2.80)	(2.05)	(4.42)
Age (X_1)	-109.95	-9755	-0.9264
	(-1.76)	(-1.94)*	(-1.67)
Household size (X_2)	255.2	3890	0.4955
	(1.48	(1.51)*	(1.75)
Experiences (X_3)	90.2	2313	0.1439
	(0.75)	(0.62)	(0.35)
Farm size (X_4)	-233.6	-1712	-0.0811
	(0.32)	(-0.44)	(-0.19)
Education (X_5)	-99.5	173	-0.0759
	(-0.30)	(0.08)*	(-0.33)
Sett (X_6)	-4.50	-540	-0.1504
	(-0.38)	(0.27)	(0.69)
Fertilizer (X_7)	-1.959	-472	0.0064
	(-0.34)	(-0.17)	(0.02)
Labour (X_8)	-56.11	-4146	-0.4307
	(-1.45)	(-1.30)*	(-1.23)
Insecticides (X_9)	23.9	532	0.0080
	(0.06)	(0.17)	(0.02)
R^2	50.0%		52.1%

Figures in parentheses are t-ratios; * Significant at P<0.05

Elasticity of Resources Use Efficiency in Sugarcane Production

Economic theory postulates that a farm maximizes profit with respect to input if the ratio of its marginal value product (MVP) to its marginal factor cost (MFC) is equal to unity (Sani and Haruna, 2014). A ratio of less than one shows over utilization of the input, and so profit would be increased by decreasing the quantity use of the input and vice versa. The MVP

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and MFC with respect to each input (farm size, sugarcane sell, fertilizer, labour insecticide) were obtained by taking the first order partial derivatives of the total value (revenue) and cost functions, when other inputs use hold at their geometric means. The ratio of the MVP and MFC of the inputs were then used to determine their efficient in the production of sugarcane in the area. According to the results in Table 3, the marginal value products of land, sugarcane sett, fertilizer, labour and insecticide are 760, 239, 2096, 184 and 236. This means that a unit increase in the use of these factors except labour will increase the value of the output by their respective MVP. The efficiency ratios of the land sett, fertilizer, labour and insectaries are 2.57, 33.44, 6.55, 0.27 and 1.63. By the ratios, there is underutilization of land, sett fertilizer and insecticide in production of sugarcane in the study area (efficiency ratio greater than 1.00). However, there is over utilization of labour (ratio less than unity). The implication of the result is that output of sugarcane can be increased with increase in the utilization of land, sugarcane sett, fertilizer and insecticide, and reduction in the use of labour.

Table 3: Elasticity of Resources use Efficiency in Sugarcane Farming

Input	**MVP (N)**	**MFC (N)**	**Ratio**
Land	760	295	2.57
Sugarcane sett	23983	717	33.44
Fertilizer	2096	320	6.55
Labour	184	669	0.27
Insecticide	236	144	1.63

Source: Field Survey, 2010.

Constraints in Sugarcane Production

The results of Table 4 shows that small farm size were constrained with high cost of inputs, inadequate credit loan, and poor extension service constituted the same proportion of 48.15% each. Land tenure problem and inadequate processing/marketing facilities represented 18.52% and 1.85%, respectively. Small farm size may be the problem of land tenure system. Most of the lands for agricultural purpose and even for sugarcane production are by inheritance. This encourages land fragmentation among family and community members thereby leaving them small portions of farmland. The implication of this is that the cultivation of sugarcane will continue to be in a small sealed and the farmers will continue to remain peasant farmers (Philip, 1997).

Table 4: Constraints Sugarcane Production in Nigeria

Constraints	**Frequency**	**%**
Small farms size	26	48.15
Land tenure problem	10	18.52
High cost of inputs	26	48.15
Inadequate credits	26	48.15
Inadequate processing and marketing facilities	01	1.85
Poor extension services	26	48.15
Total	**95**	**100.00**

CONCLUSION AND RECOMMENDATIONS

The production of sugarcane is profitable; however, the rate of return on investment is low. Age of the farmers, household size, educated and labor influences the output of sugarcane. Land, sugarcane sett, fertilizer and insecticide are underutilized, and labour is over-utilized in the study area. Therefore their increased utilization will increase the output, and reduction in the use of labour will optimize output. The limiting factors in the production of sugar cane in the area are small for holding, high cost of inputs, inadequate credit/loan and poor extension services. The study recommends that the sugarcane farmers in the study area should increase the utilization of land, sugar cane sett, fertilizer and insecticide in other to increase output and the use of labour for sugarcane production should be reduced to optimize output.

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