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Drivers of Productivity among Irrigated Sugarcane Farmers in Northern Nigeria: A Case Study of Bauchi State, Nigeria.

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ABSTRACT

In light of the influence of the change in climate and the rapid rise in population, irrigation has been identified as a critical component in meeting food demand in northern Nigeria**.** This study assessed the determinants of productivity of irrigated sugarcane farming system (IRFS) in Bauchi State; A three-stage purposive sampling procedure was used to select 108 irrigated sugarcane farmers for the study. Structured questionnaire was employed to collect primary data which were analysed using descriptive statistics, farm budgetary techniques, regression analysis, Likert type scale and Kendall's coefficient of concordance. The analysis revealed the farmers were youths with about 97.2% of them married. The mean formal years of education of 8 years was recorded among the farmers who produced at mean productivity index of 1823.94 kg/ha. The regression results show that farm size (ß = 166.20, p<.05), access to credit (ß = 733.75.0, p<.05), transport cost (ß = 0.01, p<.01), cost of seed (ß = 1.693, p<.05), labour (ß = 0.4, p<.01) and quantity of agrochemical (ß = 1.45, p<.01) were the drivers of productivity among irrigated sugarcane farmers in the study area. The major constraints were inadequate capital and poor access to credit facilities. It was concluded that access to credit, extension services, transportation cost, quantity of seed and agrochemicals were the drivers of productivity among (IRFS) in the study area.

Keywords: Irrigation, Sugarcane, Northern Nigeria, Productivity index, Determinants

Introduction

It is now recognised that agricultural productivity is a significant growth engine that lifts people out of poverty and advances society as a whole. Growth in agricultural output is commonly regarded as the most effective strategy to combat rural poverty and a crucial route out of it. More than growth in other areas of an economy, agricultural expansion lowers poverty therefore one percent increase in agricultural gross domestic product (GDP) per worker yields roughly double the impact on extreme poverty and that raising agricultural productivity helps to lower food prices and increase real rural and urban wage Ivanic and Martin (2018).

Productivity in agriculture can be used to improve long-term sustainability in the relationship between land scarcity and population growth rate. Nigeria, is located on the Gulf of Guinea between latitudes 4° and 14° N and longitudes 3° and 15° E, is blessed with a big landmass appropriate for agricultural production and a varied vegetation. Its land mass, 923,768 km^2, accounts for approximately 14% of the landed area of West Africa. Roughly 13,000 km^3 (1.4%) of the area is submerged in water, while the remaining 98.6% is made up of regions ranging from near-desert conditions in the northern part of the country to deep mangrove forests and dense rainforests in the south. (Ibe and Nymphas, 2010; Balarabe*et al*., 2016).

Nigeria's climate is typified by comparatively high temperatures and varying precipitation levels throughout the year, with two distinct seasons that alternate (rainy and dry). There are some degree of

spatial and temporal differences in the amount and distribution of rainfall across the agro-ecological zones, with the rainy season typically lasting from April to October and the dry season lasting from November to March (Bashir and Kyung, 2018). The country's south experiences the most rainfall on average each year, which lasts eight to nine months and ranges from 1524 to 2035 mm. The central belt has a range of 508 to 1524 mm, whereas the far north has less than 508 mm yearly for fewer than four months and the north experiences less than 508 mm annually for five to six months. This suggests that irrigation is necessary in places with little rainfall for agriculture to function at its best.

Farmers in northern Nigeria were the first to provide water to land traditionally for dry season farming using pump, bucket, and calabash techniques. The farmers did this without receiving any financial support from the government. Nigerians have been irrigation practitioners since 700 AD. The necessity of irrigation, however, became more apparent following the 1970–1975 drought (Bashir and Kyung, 2018).In crop production, irrigation is used as an agro-technical measure to make up for any water deficit that plants need for optimal growth and development due to low rainfall or insufficient distribution of water within the vegetation, which could jeopardize the achievement of expected yields and incomes (Subic*et al*., 2017). Thus, theoretically, the installation of an irrigation system might be regarded as a certain degree of value-added creation at the micro level since it ensures stable and growing yields and revenues (Jelinek and Subic, 2020). One could argue that irrigation increases crop farming's overall sustainability and lowers losses, boost output, productivity income and reduce poverty.

The United Nations Food and Agriculture Organization (FAO) divided irrigation schemes into three categories according to the size of the land mass; a big irrigation scheme comprises more than 10,000 hectares., between 100 – 1000 ha is classified as medium-scale scheme while the small-scale scheme has less than 100 ha (Moris and Thom, 1990). In Nigeria, irrigation schemes and projects consist of three categories; the public irrigation schemes, which are government-executed schemes, the farmer-owned irrigation scheme, and the floodplains called fadama irrigation scheme and are usually less than 100ha.

According to Ademola, (2019) sugarcane is widely cultivated in Nigeria; it is a very essential commodity consumed by majority of Nigerians. The production of sugarcane through the conventional methods cannot meet up with the demand of the people. While sugarcane can withstand some moisture stress, high yields require a high-water requirement of 1500–2500 mm per season. Oni (2016), pointed out that in the absence of suitable irrigation infrastructure, some climate change scenarios could negatively impact sugarcane productivity and growth. As a result, practical, irrigated farming systems are gradually replacing rain-fed sugarcane cultivation systems.In an effort to make sugarcane growing more financially viable, high efficiency irrigation systems are also replacing low efficiency ones. Nigeria's population is expanding, which is driving up demand for sugary foods. According to the patterns in the sugarcane industry, demand for sugar would likely keep rising to the point where there will be a shortage in Nigeria due to an excess of demand (Lyocks., 2016).

The performance of agricultural use of irrigation water in sub-Sahara Africa, compared to Asia, has been characterized by inefficiency and poor management (Nwa, 2003). However, Nigeria irrigation system has recently started receiving due attention

and there is an observed facelift in its development. Nevertheless, there are still underline challenges that need to be adequately addressed in other to meet up with its developmental objectives such as contributing substantially to the national economy, and rural development. (Bashir and Kyung-Sook, 2023).

Global irrigation practices are essential to the year-round success of the green revolution and the achievement of sustainable development goals in rural development, food security, and socioeconomics. While irrigation is an agro-technical intervention that requires substantial farm investment, its application guarantees high, consistent yields of high-quality crops and fruits, and it also indirectly contributes to increased earnings and sustainability.(Saras*et al*, 2023) observed that major food crops like maize, rice, and sugarcane have had variable production due to unanticipated climate change that has resulted in inconsistent and poor rainfall. This has resulted in a great lose by the farmers and as a result increased rural poverty in some areas. With the unabated population growth, the dire need to meet the growing food demand and the nutritional requirement of the population require bringing more land under cultivation. Consequently, the opportunities for future irrigation water development as the rainfed agriculture cannot sustain the production of growing food demand (Cosmas*et al*., 2010; Olayide *et al*., 2016).

The wealthiest and poorest countries' agricultural productivity gaps are widening and many of the latter are dealing with unstable food supplies and rising food prices. Thus, boosting and expediting sustainable agricultural productivity is essential to a comprehensive plan to fulfil the country's growing food demand. There has been mix reaction by scholars as to whether schemes designed to boost food production in Nigeria achieved the set goals despite the huge investment involved therefore there are needs for information's that will enable stakeholders in development to make informed decision on sustainable agricultural development in the study area and in Nigeria at large. Outcomes of this study will generate information for policy makers, governmental and non-governmental organizations and all those who are yet to embark on IRFS in BauchiState to design and develop effective framework for sustainable livelihood strategies and policies. Also, there are two ways to increase production in order to meet food demand i.e. increasing land under production and increasing productivity.

However, due to limited land supply and reduced land per capita, more land cannot be brought under cultivation to raise output level, increasing productivity remains an option. This cannot be achieved without identifying underlying factors that may affects productivity. It means that achieving productivity depends on identifying some variables that could either limit or improve it. It is in this light that this study seeks to assess factors determining productivity of IRFS in the study area. The specific objectives are to: describe the socio-economic characteristics of sugarcane farmers under irrigated farming systems; determine the productivity of sugarcane production under the system; identify the factors that affect the productivity of irrigated sugarcane farmers in the study area and examine the constraints hindering sugarcane production under irrigated farming systems in the study area.

Methodology

The study Area

The study was conducted in Bauchi State, located in the North-East agro ecological zone of Nigeria. Created in 1976, the State is located between Latitudes 9°30' and

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12°30' North of the equator, and Longitudes 8°45' and 11°0' East of the Greenwich meridian (Ademola., 2019). It is bounded in a clockwise direction by Yobe, Gombe, Taraba, Plateau, Kaduna, Kano and Jigawa States. Bauchi State has twenty (20) Local Government Areas (LGAs), and covers a land area of about 49,259 Km^2 with a projected population of about 7,136,915 in 2024 at 2.8% growth rate per annum (National Bureau of Statistics (NBS), 2016).

BauchiState is heterogeneous in terms of ethnicity, with predominant tribes like Hausa, Fulani, Jarawa, Tangale, Waja, Balewa, Sayawa and Tarewa. The entire western and northern parts of the State are generally mountainous and rockywith Sudan Savannah vegetation, it has an average annual rainfall of 1,300 to 1,600mm per annum which commences in April and ends in October. The residents are into agriculture, trading and livestock rearing Bauchi State Agricultural Development Project (BSADP, 2019).

Sampling Procedure and Sample Size. Three-stage sampling procedure was used for this study. The first stage involved the purposive selection of two (2) LGAs in each of the three (3) agricultural Zones in the state to make a total of six (6) LGAs selected. The second stage involved purposive selection of two (2) villages from each of the selected LGAs to make up a total of twelve (12) villages considered for this study as shown in table 1 and Figure 1. The purposive selections were made due to the level of sugarcane irrigation activities in those areas. In the final stage, Yamane, T. (1967), at 5% precision level was used to select a sample size for this study. This is given as: Where

$$n = \frac{N}{1+Ne^2} \qquad (1)$$

n = Sample size, N = Finite population, and e = limit of tolerable error (5% precision level).Table1 and figure 1 below shows the sample outlay and descriptive map of the study area.

Table 1: Sample outlay of the respondents in the study area

Agricultural zones	LGA's	Villages	Sample frame	Sample size
	Bogoro	Badagari	11	8
Bauchi South		Bungu	14	10
	Dass	Wandi	12	9
		Baraza	10	7
	Ningi	Kudu	14	10
Bauchi Central		Yamma	12	9
	Dambam	Zaura	11	8
		Danbam	13	10
	Zaki	Maiwa	14	10
Bauchi North		Makawa	12	9
	Gamawa	Gadiya	10	7
		Tumbi	15	11
Sub-total	**6**	**12**	**148**	**108**

Source: Bauchi State Agricultural Development Project (BSADP), 2019

The sampled local Government Areas is as presented in Figure I below

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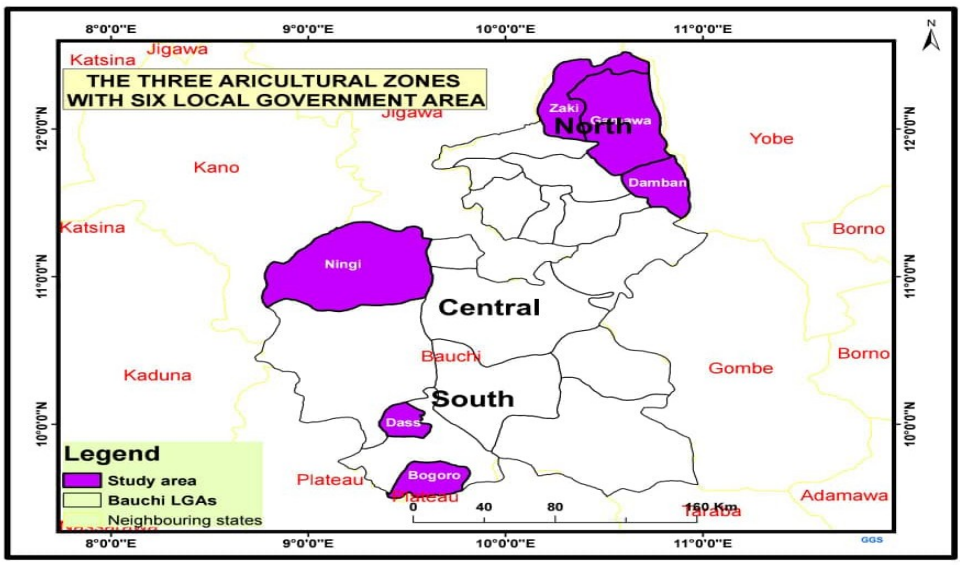


Fig 1. Map of Bauchi State showing the Study Area

Method of Data Collection and Analysis. Well trained enumerators were used to assist the researcher in the data collection. The data were collected with the aid of structured questionnaire Information on the socio-economic characteristics of the respondents, income levels of respondents, and production data of irrigated sugarcane enterprise were collected. Descriptive statistics, Regression model, Likert scale and Kendell's concordance was used to analyse the data.

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Model Specification

Productivity index: The productivity index model is specified as:

Productivity Index (P_y) = $\frac{P_i}{A_i}$ *in* Kilogramme per Hectare (2)

Where

P_i = Output of the Farmer in Kilogramme, A_i = Area of Farm-land Cultivated in Hectares

The specification of the regression models:

$$P_y = bo + b_1X_1 + b_2X_2 + b_3X_{13} + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + b_{12}X_{12} + b_{13}X_{13} + \mu_0 \quad (3)$$

Where: P_y = Productivity index), $b_1 - b_{13}$ = parameters measured, X_1 = Age (years) X_2 = Marital Status, X_3 =Level of Education (years), X_4 = Household Size, X_5 = farming experience (years), X_6 = Farm size (ha), X_7= Extension access, X_8 = Access to credit, (dummy, 1 0 otherwise) X_9 = Transport cost (₦), X_{10} = quantity of seed (₦), X_{11} =quantity of Labour (naira/man-day), X_{12} =quantity of Fertilizers (₦). X_{13} =Quantity of agrochemicals (liters) bo = constant, and μ_0 = disturbance term.

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Likert type rating scale

The 3-point Likert type rating was used to examine the constraints associated with irrigated sugarcane production farming system. The model entails defining a scale of statement that mirrors the respondent's perception towards an underlying variable and establishing a score reflecting a quantitative measurement of the perception of each farmer. Their responses were very Severe (VS), Severe (S) and Not Severe (NS) with the corresponding values of 3, 2 and 1, respectively. The mean score value of less than 2.0 was taken as not severe constraint, while mean score value equal to 2.0 and or greater than 2.0 was taken as severe constraint to sugarcane production in the study area. Therefore, mean score for 3-point Likert scale is computed thus:

Mean score = $\frac{\Sigma fx}{n}$ (4)

Kendall's coefficient of concordance

In examining the constraints hindering sugarcane production under irrigated farming system, the Kendall's coefficient was applied. Kendall's coefficient of concordance (W) is given by the relation:

$$W = \frac{12S}{P^2 (n^3 - n)} - P^T \quad (5)$$

Where

W = Kendall's coefficient of concordance; P = number of respondents ranking the constraints,

n = number of quality perceptions' = correction factor for tied ranks, S = sum of squares statistics over the row sum of ranks (Ri);The sum of square statistics (S) is given as:

$$S = \sum_{i-1}^{n} (Ri - R)^2 (10)$$

Where: R_i = row sums of rank;R = mean of R_i

Results and Discussion

Socio-economic characteristics of the farmers

Age of the respondents**:** The age distribution of the farmers is as presented in table 2. The result revealed that the farming household were aged between 26 – 55 years with a mean age of 42 years implying that most of respondents were in their most productive stage in life. Farmer's age attests to the quality and quantity of work done in the farm, this was corroborated by Tashikalma *et al*. (2014) noted that famers within 31 – 50 years are in their productive years. On gender of respondents, the study showed that all (100.0%) the sampled irrigated sugarcane farmers were males. This could be due to its tedious nature of irrigated sugarcane production. In most rural settings, especially in the northern area, roles are ascribed based on gender differences, as males are known to be engaged in strenuous agricultural production. This finding is in agreement with Girei and Giroh (2012) who made similar observation among sugarcane farmers under the out-growers scheme in Adamawa State

Furthermore, the marital status of the household heads shows that **a**bout (97.2%) of the irrigated farmers were married. Anaryu (2017) noted that marriage connotes responsibility and maturity and could translate to social capital for farmers in terms of access to enhanced credit facilities.

Also, the mean years spent in formal education by respondents was 8 years, meaning that most of the respondents had one form of formal education or the other with at least primary education. This attribute is needed for agricultural development as it enhances farmers' decision-making process for adoption of new technologies. On farming experience**, t**he result revealed an average farming experience of about 12 years. The average household had 12 persons per family. This

is quite large. Sugarcane farming is very tedious therefore, some scholars opine that large households serves as asset for ready family labour that could enhance the capacity for timeliness of operation among other reasons. The average farmer cultivates an average of 2.3 ha. This finding is in consonance with that of Anaryu *et al.* (2017) who reported most farmers practicing irrigation cultivated less than 3 hectares.

Table 2: Distribution of the Respondents based on Socio-Economic Characteristics

Variables	Frequency	Percentage (%)
Age (years)		
< 26	5	4.6
26 – 35	25	23.2
36 – 45	38	35.2
46 – 55	32	29.6
> 55	8	7.4
Mean	**42**	
Sex		
Male	108	100.0
Female	0	0.0
Marital status		
Single	3	2.8
Married	105	97.2
Education (years)		
Non-formal	41	37.9
Primary	22	20.4
Secondary	30	27.8
Tertiary	15	13.9
Mean	**8**	
Experience (years)		
< 6	27	25.0
6 – 10	34	31.5
11 – 15	21	19.4
16 – 20	14	13.0
> 20	12	11.1
Mean	**11.6**	
Household size (number)		
< 6	21	19.4
6 – 10	36	33.3
11 – 15	20	18.5
16 – 20	13	12.1
> 20	18	16.7
Mean	**12**	
Farm size (hectares)		
0< 3	87	80.5
3.1 – 5.0	11	10.2

> 5.0	10		9.3
Mean		**2.3**	
Farmland acquisition			
Inheritance	79		73.1
Purchase	18		16.7
Rent	13		12.1
Gift	13		12.1

Output and productivity

The mean productivity and output of the farmers from irrigated sugarcane production is as shown in table 3. The minimum and maximum output of the respondents under the system was 160 kilogramme, and 10,000 kilogrammes respectively with a mean of 2,421.5 kilogrammes. However, the mean productivity index was 1823.94kg/ha with a minimum of 160kg/ha and a maximum of 8000kg/ha.The top producers of sugar cane, in order of production, on a worldwide basis are Brazil, India, China, Thailand, Pakistan and Mexico with theoretical maximum yield is 280MT/ha/yr. Nigeria and Northern African countries, average more than 100MT (Wada *et al*., 2017). However Ojo *et al* (2009) reported a (3000- 20000)kg/ha implying that the results obtained in the study area is within the national average.

Table 3. Mean sugarcane output and productivity index of the respondents in kilogram

IRFS Outcomes	Minimum	Maximum (Kg)/Ha	Mean (Kg)/Ha
Output	160 (Kg)	10000 (Kg)	2,421.5 (Kg)
Productivity index	160(Kg)/Ha	8000(Kg)/Ha	1823.94(Kg)/Ha

Drivers of Productivity among Irrigated Sugarcane Farmers in the Study Area.

Table 5 presents the results of the regression model of the effect of socio-economic, institutional and input variables on IRFS productivity. The R^2 value was 0.5678with an (Prob> F= 0.000) which was statistically significant at 1 % indicating that about 57 percent of variation in productivity is explained by the model. Estimates of the specified explanatory variables, Showing that Farm Size(ß = 166.20, p<.05), Access to credit (ß = 733.75.0, p<.05), Transport cost (ß = 0.01, p<.01), Seed (ß = 1.693, p<.05), Labour(ß = 0.4, p<.01) and quantity of agrochemical (ß = 1.45, p<.01) were statistically significant.

This result reveals that the major factors affecting productivity of the farmers were mostly institutional (Access to credit) and input variables such as farm size, Seed, labour, agrochemicals. The findings show that increase in transportation cost have negative effect on the farmers productivity. However, increased access to credit and quality inputs was highly needed to enhance the farmers productivity under the system. Mgbenka *et al.* (2015) identified access to credit and extension contact to be paramount among other factors in maximizing productivity. So also, Giroh (2012) in his study on efficiency of latex production and labour productivity in rubber plantation in Edo and Delta States, revealed that extension services among other factors enhances the allocation efficiency of rubber production in the study area.

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Table. Linear Regression of the Drivers of productivity Among IRFS farmer

Productivity index	Coef.	St.Err.	t-value	[95% Conf	Interval]
Age	15.91	16.60	0.96	-17.06	48.87
Marital Status	-293.26	326.76	-0.90	-942.05	355.54
Level of Education	26.27	66.27	0.40	-105.32	157.85
Household Size	-25.33	20.04	-1.26	-65.12	14.47
Farming Experience	-5.21	17.42	-0.30	-39.79	29.37
Farm Size	124.69*	65.16	1.91	-254.06	4.69
Extension Visit	402.24	265.63	1.51	-929.65	125.18
Credit Access	711.43**	320.85	2.22	74.37	1348.49
Transportation Cost	-0.011***	0.002	-5.39	-0.007	0.015
Seed quantity	1.78 ***	0.65	2.76	3.06	0.499
Labour quantity	0.39***	0.08	4.85	0.23	0.55
Fertilizer quantity	0.155	0.58	0.27	-0.10	1.31
Agrochemical	1.385 ***	0.45	3.10	0.50	2.27
Constant	1130.48	827.65	1.37	-512.83	2773.80

Mean dependent var	1823.94	SD dependent var	1531.76
R-squared	0.62	Number of obs	108.00
F-test	11.81	Prob> F	0.000
Akaike crit. (AIC)	1813.08	Bayesian crit. (BIC)	1850.63

*** *p<.01*, ** *p<.05*, * *p<.*

Constraints associated with Irrigated Sugarcane Production in Bauchi State.

Major constraints associated with sugarcane production perceived to be severe under the system includes inadequate capital and access to credit facilities ($\bar{X}$= 2.41), poor access to training on sugarcane production ($\bar{X}$= 2.31) and inadequate extension services ($\bar{X}$= 2.24) ranked 1st, 2nd and 3rd, respectively.

This implies that inadequate capital and access to credit facilities, inadequate extension services, high cost of farm inputs and poor access to training on sugarcane production are the major constraints associated with sugarcane production under irrigated farming system in the study area. According to Oravee (2015) lack of funding in the river basin and rural development lead to ineffectiveness of the scheme. Other severe constraints are, Inadequate or poor access to farm inputs, High cost of farm inputs, Problems of pests and diseases infestation, Unavailability of improved sugarcane seedlings, Poor market policies and linkages and Low demand for sugarcane by consumers.

Table 6: Respondents' Constraints to Sugarcane Production under the System

Constraints	WS	WM	Rank	Remark
Inadequate capital and access to credit facilities	260	2.41	1st	Severe
Inadequate extension services	242	2.24	3rd	Severe
High cost of farm inputs	235	2.18	5th	Severe
Unavailability of improved sugarcane seedlings	219	2.03	7th	Severe
Poor market policies and linkages	216	2.00	8th	Severe
Inadequate and high prizes of labour	206	1.91	11th	Not Severe

Poor access to training on sugarcane production	250	2.31	2nd	Severe
Poor road networks from farms to market	211	1.95	10th	Not Severe
Inadequate storage facilities for sugarcane	186	1.72	14th	Not Severe
Inadequate or poor access to farm inputs	237	2.19	4th	Severe
Lack of standardized means of measurement	178	1.65	16th	Not Severe
Poor value addition for sugarcane production	196	1.81	12th	Not Severe
Problems of pests and diseases infestation	228	2.11	6th	Severe
Shortage of land for sugarcane farming	170	1.57	17th	Not Severe
Low demand for sugarcane by consumers	216	2.00	8th	Severe
Problem of drought	194	1.80	13th	Not Severe
Insufficiency of irrigation water	185	1.71	15th	Not Severe
Irrigated System (n = 108)				

Source: Field Survey, Note: VS= Very Severe (3), S= Severe (2), NS = Not Severe (1), WM = Weighted Mean and WS = Weighted Sum. The bench means score Value is 2.0.

Test of Concordance

The result of the Kendall coefficient of concordance as presented in table 7show that the sum of mean rank of the constraints in IRFS was 150.01 which is lower that the chi-square value of 286.52 at 1% level of probability with Kendall *W* value of 0.166. This simply means that there was a general agreement among the respondents with respect to their perceptions as measured on the Likert scale.

Table 7: Kendal Coefficient estimates of the constraints to irrigated Sugarcane Production

Constraints	Irrigation Mean Rank (n=108)
Inadequate capital and access to credit facilities	11.70
Inadequate extension services	10.65
High cost of farm inputs	10.32
Unavailability of improved sugarcane seedlings	9.43
Poor market policies and linkages	9.11
Inadequate and high prizes of labour	8.57
Poor access to training on sugarcane production	11.09
Poor road networks from farms to market	8.88
Inadequate storage facilities for sugarcane	7.52
Inadequate or poor access to farm inputs	10.42
Lack of standardized means of measurement	6.92
Poor value addition for sugarcane production	8.13
Problems of pests and diseases infestation	9.86
Low demand for sugarcane by consumers	9.15
Shortage of land for sugarcane farming	5.89
Problem of drought	7.99
Insufficiency of irrigation water	7.38
Sum of mean rank	150.01
Kendall *W*	0.166
Chi-square	286.52***

Conclusion

The study concluded that the farmers output and productivity in the study area were within the estimated national average for the country although there is room for development. Access to credit, extension services, transportation cost, quantity of seed and agrochemicals were the drivers of productivity in (IRFS) in the study area.

The estimated mean productivity index under the system was 1823.94kg/ha, the farmers were youthful, energetic and productive. The Perceived major constraints associated with (IRFS) by the farmers includes inadequate capital and access to credit facilities, poor access to training on sugarcane production and inadequate extension services. Based on these findings, the study recommended that farmer should form cooperative associations and leverage on social capital network to enhance access to quality inputs, credit facility and extension services to boost their productivity.

References

Anaryu, B., Wahu, J., Moses, D. and Jimjel, Z. (2017). Cost and return analysis of sugarcane production in Mubi North Local Government Area of Adamawa State, Nigeria. *Rep*
Bauchi State Agricultural Development Project (BSADP).

Balarabe M, Abdullah K, Nawawi M, Khalil AE (2016). MonthlyTemporal-Spatial Variability and Estimation of Absorbing AerosolIndex using Ground-Based Meteorological Data in Nigeria. Atmospheric and Climate Sciences 6:425-444

Bashir A., and Kyung-Sook C., (2023).A review of the evaluation of irrigation practice in Nigeria: Past, present and future prospects. *African Journal of Agricultural Research* 13(40), pp. 2087-2097.

Girei, A.A. & Giroh, D.Y. (2012). Analysis of the factors affecting sugarcane (*Sacch arumofficinarum*) production under the out-growers scheme in Numan Local Government Area, Adamawa State.*Journal of Education and Practice* 3(8):195-200.

Giroh, D.Y. (2012). Efficiency of latex production and labour productivity in rubber plantation in Edo and Delta States, Nigeria.Unpublished Doctoral Thesis, ModibboAdama University of Technology, Yola, Adamawa State.

Ibe, O. &Nymphas, E. (2010).Temperature variations and their effects on rainfall in Nigeria. In: Dincer I, Hepbasli A, Midilli A, Karakoc T, ed. Global Warming. Green Energy and Technology.Springer, Boston, MA.https://doi.org/10.1007/978-1-4419-1017- 2_38.

Lyocks, J. S. (2016). Factors influencing participation of farmers in brown sugar processing in selected Local Government Areas of Kaduna State, Nigeria. A dissertation submitted to the school of Postgraduate Studies, Ahmadu Bello University, Zaria, in partial fulfilment of the requirements for the award of the degree of Master of Science (MSc.) in Agricultural Extension and Rural Sociology

Mgbenka, R.N.,Mbah, E.N. and Ezeano, C.I. (2015). A review of smallholder farming in Nigeria: need for transformation. *Agricultural Engineering Research Journal*, 5(2), 19-26.

National Bureau of Statistics (NBS) (2016).Social and economic statistics in Nigeria. Annual Report, 2016;59-91.

Moris JR, Thom DJ (1990). Irrigation Development in Africa: Lessons ofExperiment Studies in Water Policy and Management. No 14, Westview press Inc, Colorado, USA.

National Population Commission (NPC) (2006). Nigeria's national census data. National Population Commission, Abuja.

Oni, T. O. (2016). Economics analysis of profitability and competitiveness of sugarcane enterprise in Nigeria.*Journal of Development and Agricultural Economics*, 8 (6) 160 – 171Oravee (2015).

Ojo M.A, Mohammed U.S., Ojo, A.O, Baba K.M, and Anjorin S.T.(2009) Productivity and Production Efficiency Among Small Scale Irrigated Sugarcane

Farmers in Niger State, Nigeria: A Stochastic Translog Frontier Function Approach. *Journal of Agriculture, Forestry and the Social Sciences* 7(1)DOI:10.4314/joafss.v7il.60301

Saras, J. Z., 1Oladimeji, Y. U., 1Sani, A. A. and 2Suleiman, R. (2023) Profitability and Constraints of Peri-Urban Vegetable Production in Kaduna State, Nigeria. *Nigerian Journal of Agriculture and Agricultural Technology (NJAAT)* 3(1)

Singh, A., Kumar, R., Tiwari, A.K. & Sharma, B.L. (2018).Nutrient content under partial reclaimed sodic soil in Eastern Uttar Pradesh.*Agrica* 7 (1) 57–59.

Subic, J., Kljajic, N. &Jelocnik, M. (2017).Renewable Energy Use in Raspberry Production. *Ekonomikapoljoprivrede*, 64(2):821-843.

Yamane, T. (1967).*Statistics: An Introductory Analysis*, 2nd Editions., New York: Harper and

Row.Tashikalma, A.K., Sani, R.M &Giroh, D.Y. (2014). Comparative profitability analysis of selected rain-fed and irrigated food crops in Adamawa State, Nigeria. *Global journal of pure and applied sciences*, 20:77-87.

Wada, A. C., Abo-Elwafa, A., Salaudeen M. T., Bello L. Y. and Kwon-Ndung E. H. (2017).Sugar cane production problems in Nigeria and some Northern African countries.*International Standard Journal*.5(3). P 141-160.