TARABA JOURNAL OF AGRICULTURAL RESEARCH
ISSN: 978-978-923-450-9
Email: tajar2011@yahoo.com, tajar2011@gmail.com
©tajar publication 2019

FACTORS DETERMINING YIELD GAP AMONG SUGARCANE GROWERS IN KWARA STATE, NIGERIA

[1]Sadiq, M.S., [2]Singh, I.P., [3]Ahmad, M.M. and [4]Lawal, M.
[1]Department of Agricultural Economics and Extension, FUD, , P.M.B. 7156, Dutse, Nigeria
[2]Department of Agricultural Economics, SKRAU, Bikaner, India
[3]Department of Agricultural Economics, BUK, Kano, Nigeria
[4]Department of Agricultural Education, Federal College of Education, Katsina, Nigeria
Corresponding Author's email address: sadiqsanusi30@gmail.com
Received 10th May, 2018 Accepted 06th June, 2019

ABSTRACT

The present study determined the yield gap and the factors causing yield gap among sugarcane farmers in Kwara State of Nigeria using field survey data collected through structured questionnaire complemented with interview schedule from a sample of 105 active farmers selected *via* multistage sampling procedure. The data were collected on a fortnightly basis during the 2018 production season by the researcher in collaboration with trained enumerators. The data collected were analyzed using descriptive and inferential statistics. The empirical findings showed the presence of small yield gap of approximately 11.04% caused by both technological and socio-economic factors. Furthermore, factors identified to be causing yield gap were use of local sucker variety, excess use of family labor, diseconomies of scale, depreciation on capital items, age advancement and poor social capital. Therefore, the study recommended the need for the stakeholders to improve on the already existing measures i.e. available technologies at the disposal of the farmers in order to bring the yield gap to zero level *viz.* introductions of improved sugarcane practices and supportive services that will enhance the value chain of sugarcane production in the study area.

Keywords: Yield Gap; Sugarcane production; Farmers; Kwara State; Nigeria

INTRODUCTION

Nigeria is ranked as one of the most important and largest producers of sugarcane with approximately arable land potential of over 500,000 hectares suitable for sugarcane production which if efficiently managed with adequate resources; the field is capable of producing 3 million tons of refined sugar (Girei and Giroh, 2012). In Nigeria, sugarcane is one of the industrial crops that contributed in elevating the nation's GDP in the agricultural sector (CBN 2010).

Inspite of the fact that sugarcane is a versatile and renewable crop that can be used as a clean source of energy and as a raw material for production of multiple products such as sugar, ethanol and bioelectricity (UNICA, 2016). The production level in Nigeria has not kept pace with the level of consumption *viz*. raw, product and its by-product, despite the thousands of local farmers that are engaged in its production. Therefore, the country has the comparative resource advantage in terms of favourable climatic, edaphic and ecological conditions in the production of sugarcane for self-sufficiency. The most important motive behind sugarcane production is the world demand for sugar which accounts for 80% of sugar production, while the sugar beet accounts for the leftover (FAOSTAT, 2011). The actual sugarcane productivity in Nigeria is below its expected potential yield, thus the reason for the excessive importation of sugar refined products into the country.

Production of sugarcane, the bulk of which comes from small-scattered holdings in Nigeria can only be sustained by enhancing the productivity of the crop as the industrial demand still remains high in the country, Africa and the globe in general. Therefore, to achieve the objective of production efficiency, efficient utilization of scarce resources is necessary. However, most of the research works done on sugarcane production in Nigeria didn't exceed efficiency studies with little or no attempt in

determining the yield gap using the efficiency estimates generated from the neo-classical parametric model.

With the growing population, the demand for sugar and sugar products is expected to rise but the production seems to have stagnated for quite a while as public and private investment in the sector is very low. Most of the sugarcane production was carried out by the two government-controlled estates: Bacita in Kwara State and Numan in Adamawa State both of which are now undergoing a transformation from public to private ownership and are producing below their capacity. In addition, the reports of the Agricultural Production Survey in the years 2010 - 2013, showed that the annual quantity of sugarcane and its products in Nigeria is declining (ADP 2013).

Though there is a wide range of development for sugarcane plantations in Nigeria and to meet the domestic and foreign demand, the problem of production efficiency continued to affect the progress due to the differences among the sugarcane producing farmers in the country. The sustainability of the revived sugarcane plants in the study area can only be achieved by productivity enhancement of the raw material as the available arable land is shrinking due to pressure and demand for different agricultural and non-agricultural purposes.

Furthermore, yield gap due to technical inefficiency in sugarcane production at micro level continues to worsen due to insufficient returns to defray the cost of production and the inability to generate savings for the marginal to small-scale holders who have keyed into the enterprise of sugar production in the study area. This has forced the sugarcane farmers in the study area to resort to enterprise substitution from the capital intensive to a less capital intensive agricultural enterprise in the study area.

Kusnet (2006) reported that over the past decade, smallholder farmers did not seem to be enjoying productivity gains despite the existing technology and affirmative supports given by agricultural financial institutions. Hayami and Ruttan (1985) affirmed that improving smallholder sugarcane farmers' productivity is very vital for economic growth and development. Therefore, to enhance agricultural production and productivity, the farm scarce resources have to be efficiently used. There are positive indications that technically efficient use of scarce resources will help in optimizing the sugarcane yield using minimum input level and the available technology at farmers' disposal, thereby bring the yield gap to the barest minimum level and possibly zero levels, which in turn will aid farmers towards doubling their income.

The strategy of bridging the yield can bring in additional production with lesser efforts at the local level and can improve the efficiency of production. While efforts are being made to raise the yield ceiling, there is even a more pressing need to address the problem of yield gaps (Duwayri *et al*., 1998 as cited Paul and Chandel, 2010). The difference between the actual and potential yield of sugarcane in the study area and the country in general which led to increased importation forms the basis for this research. Therefore, this research was conducted to determine the yield gap and identify factors that have causal effects on sugarcane yield gap in the studied area.

RESEARCH METHODOLOGY

Kwara State of Nigeria lies between longitudes 4^0 20$^{'}$ and 4^0 25$^{'}$ East of the Greenwich meridian and latitudes 8^0 30$^{'}$ and 8^0 50$^{'}$ North of the equator. The population of the state is approximately 2.3 million and has a landmass of approximately 36,825 square kilometres with varying physical features like hills, lowland, rivers etc. Its vegetation is derived savannah with two distinct wet and dry seasons, with mean annual precipitation and monthly temperature of 1000-1500mm and 25^0C-34^0C, respectively (Anonymous, 2010). The major occupation of the inhabitants is agricultural activities complemented by trade, artisanal, *Ayurvedic* medicine etc. The present research used undated data elicited through structured questionnaire complemented with interview schedule from 105 active sugarcane farmers during the 2017 production season using multi-stage sampling design. In the first stage, one agricultural zone, namely zone B was purposively selected due to its comparative advantage in the production of sugarcane. In the second stage, two LGAs *viz.* Edu and Patigi which made-up the selected agricultural zone was automatically selected as

both have the potentials in the production of sugarcane in the studied areas. Because of the limited number of villages producing sugarcane in the selected LGAs all the villages were considered. Therefore, a total of seven villages: five (5) villages (Lafiagi, Shonga, Bacita, Kanko and Mamu) from Edu LGA and two (2) (Lade and Lalagi) from Patigi LGA were the areas of coverage. In the last stage, fifteen sugarcane farmers from each of the selected villages were randomly selected: seventy-five (75) and thirty (30) active farmers from Edu and Patigi LGAs respectively. Thus, a total of 105 active farmers were chosen for the study.

For reliability test of the questionnaire, the questionnaire was pre-tested in a pilot survey made up of 15 farmers from the sampling population and the estimated Cronbach Alpha value was 0.86, indicating high reliability and consistency of the questionnaire. With the aid of trained enumerators, ex-post data of 2017 sugarcane cropping season were collected in the year 2018. The first and the second objectives were achieved using yield gap index and stochastic production frontier model in conjunction with multiple linear regression model (OLS) respectively. The physical potential yield (frontier) of ith farmer was generated using Equation 2 and 3.

Model Specification

Stochastic Production Frontier Function: Following Ali and Jan (2017), the stochastic production frontier function is given below:

$$Y_i = f(X_{ij};\beta) + V_i - U_i \quad (i = 1,2 \ldots\ldots n) \ldots\ldots\ldots (1)$$

$Y_i = Output\ of\ the\ i^{th} farmer;$

$X_{ij} = Vector\ of\ the\ actual\ j^{th}\ inputs\ used\ by\ the\ i^{th} farmer;$

$V_i = Uncertainty\ which\ is\ beyond\ the\ control\ of\ the\ i^{th} farmer;\ and,$

$U_i = Risk\ which\ is\ attributed\ to\ the\ error\ of\ the\ i^{th} farmer;$

The model is such that the possible productionY_i, is bounded above by the stochastic quantity, $f(X_i;\beta)\exp(V_i)$ (that is when $(U_i = 0)$ hence, the term stochastic frontier. Given suitable distributional assumptions for the error terms, direct estimates of the parameters can be obtained by either the Maximum Likelihood Method (MLM) or the Corrected Ordinary Least Squares Method (COLS). However, the MLM estimator has been found to be asymptotically more efficient than the COLS (Coelli, 1995), thus, been preferred for empirical analysis.

The technical efficiency of i^{th}farmer is specified below:

$$Te_i = \exp(-U_i) \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

That is;

$$Te_i = \frac{Y_i}{Y_i^*} = \frac{f(X_{ij};\beta)\exp(V_i - U_i)}{f(X_{ij};\beta)\exp(V_i)\exp(-U_i)} = exp{-}U_i \ldots\ldots (3)$$

Te_i=Technical efficiency of the $i^{th} farmer$; Y_i= Observed output; and, Y_i^*= Frontier output. The technical efficiency of a farm ranges from 0 to 1. The maximum efficiency in production has a value of 1.0 while lower values represent less than maximum efficiency in the production. For the present research the Cobb-Douglas functional form of the stochastic production frontier function used is stated below:

$$lnY_i = ln\beta_0 + \sum \beta_j lnX_{ij} + V_i - U_i \ldots\ldots\ldots (4)$$

Where Y_i = Farm output (kg) from i^{th}farmer; X_i= Vector of farm productive inputs used: X_1= Sucker (kg); X_2= NPK fertilizer (kg); X_3= Urea fertilizer (kg); X_4= Herbicides (litre); X_5=Family labour (man-days); X_6= Hired labour (man-days); X_7= Depreciation on capital items(₦); and X_8= Farm size (hectare); V_i = random variability in the production that cannot be influenced by the i^{th} farmer also known as uncertainty; U_i= deviation from maximum potential output attributable to technical inefficiency also known as risk. β_0=intercept; β_j=vector of production function parameters to be estimated;$i = 1,2,3 \ldots\ldots n\ farmers$; $j = 1,2,3 \ldots\ldots\ldots m\ inputs$.

The inefficiency model is:

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 \ldots\ldots\ldots + \delta_n Z_n \ldots\ldots (5)$$

Where Z_1 = Age (year); Z_2 = Marital status (married =1, otherwise = 0); Z_3 = Educational status (formal = 1, otherwise = 0); Z_4 = Household size (number); Z_5 = Farming experience (year); Z_6 = Land ownership (yes =1, otherwise = 0); Z_7 = Non-farm income (yes =1, no = 0); Z_8 = Extension contact (yes = 1, no = 0); Z_9 = Co-operative membership (yes =1, no = 0); Z_{10} = Access to credit (yes =1, no = 0); Z_{11} = Sickness of farm family member (number); Z_{12} = Security threat (yes = 1, otherwise = 0); δ_0 = intercept; and, δ_{1-n} = parameters to be estimated.

Yield Gap Index

The Yield Gap (YG) analytical tool as developed by the International Rice Research Institute (IRRI) and modified by Gomez (1977) was used. It has been used by a number of researchers to analyze similar objectives (Madhavswamy and Sheshareddy, 1987; Joshi *et al*., 2003; Liang *et al*., 2006; Job, 2006). The experimental yield was excluded given that virtually almost all the farmers used local variety in the cultivation of sugarcane in the studied area. The specified multiple linear regression model using OLS estimation is shown below:

$YG_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 \ldots\ldots\ldots + \delta_n Z_n$ …... (6)

Where YG_1= Yield Gap; and the explanatory variables remained as defined in the inefficiency model (Equation 5).

Potential yield is the frontier yield while the actual yield is the observed yield obtained from the farm using the available existing technology at the disposal of the farmer. Therefore, the YG between potential yield and actual yield is more important because it signifies the quantum of increase in total sugarcane production that could be achieved in the short-run by managing the factors causing it. To determine the quantum of increase in sugarcane yield by managing these yield gaps, yield gap percentages were calculated over the actual farm yield in the following manner:

$$YG(\%) = \left(\frac{YG}{Actual\ farm\ yield}\right) \times 100 \ldots\ldots (7)$$

RESULTS AND DISCUSSION

Sugarcane Yield Gap in the Study Area

The yield gap of sugarcane that occurred due to technical inefficiency in the studied area is shown in Table 1. The results showed the yield gap index for the overall studied area to be 11.04% indicating the extent of deviation of the actual yield from the potential yield level. Therefore, it can be inferred that the yield gap is caused by technical and socio-economic factors and can be addressed through technological transfer i.e. introduction of innovation and social capital. However, the LGA-wise results showed the yield gap for Patigi to be marginally greater than that of the Edu by approximately 0.171%, thus implying that the farmers in the latter were a little more technically efficient than their counterparts in the former. Furthermore, the village-wise results showed Kanko and Bacita villages to have the highest yield gap while Shonga recorded the least yield gap in the studied area.

Table 1: Yield gap index of sugarcane farmers in the studied area

Items Villages	Actual Yield(kg)	Potential Yield(kg)	Yield Gap(kg)	Yield Gap index (%)
Shonga	6097.64	6468.10	370.46	6.08
Lafiagi	6080.39	6690.45	610.06	10.03
Mamu	5620.42	6332.34	711.92	12.67
Lade	5668.75	6306.57	637.82	11.25
Lalagi	5898.78	6551.01	652.23	11.06
Bacita	5471.95	6198.07	726.12	13.27
Kanko	5643.75	6423.40	779.65	13.81
LGAs				
Edu	5787.98	6424.46	636.48	10.99
Patigi	5765.98	6409.89	643.91	11.17
Overall	**5782.12**	**6420.58**	**638.46**	**11.04**

Source: Field survey, 2018

Factors Determining Yield Gap among Sugarcane Farmers in the Studied Area

The diagnostic tests of estimated OLS results showed that the residual is not homoscedasticity and not normally distributed as indicated by the significance of the Bruesch-Pagan LM test and Chi^2 test at 10% degree of freedom (Table 2). However, these are not problems that will warrant invalidation of the results given that the model captured both quantitative and qualitative data and also data in their natural form are mostly not normally skewed (Yu *et al*. 2001). The most important diagnostic test under this circumstance is the multicollinearity test, and the variance inflation

factors (VIF) indicate the absence of collinearity between the explanatory variables as all the predictor VIF values were less than 10.0 benchmark. Furthermore, the results showed the predictor variables with significant influence on sugarcane farmers' yield gap to be sucker, urea fertilizer, family labour, hired labour, depreciation on capital items, farm size, age, marital status, education, farming experience, extension contact, co-operative membership, access to credit and sickness of household member as indicated by their respective estimated coefficients which have their probability levels less than 10% degree of freedom.

The positive significance ($p<0.01$) of the sucker is an indication that the use of local sucker variety widens the yield gap of sugarcane due to its low productivity. Therefore, the marginal and elasticity implications of a unit increase in the quantity of local sucker variety in sugar cane production will increase the quantity of sugarcane yield gap by 3.71kg and 0.668% respectively. The negative significance ($p<0.05$) of urea fertilizer indicates that the productivity of the fertilizer used due to appropriate dosage in its application reduced farmers' yield gap in sugarcane production in the studied area. Thus, the marginal and elasticity implications of a unit increase in the quantity of urea fertilizer applied in sugarcane production will decrease sugarcane farmers' yield gap by 11.47kg and 0.428%. However, NPK fertilizer and herbicides were found not to be significant because the quantities applied were inadequate but if sufficiently applied it will reduce the yield gap of sugarcane farmers in the studied area.

The family labour used in sugarcane production was in excess, thus affecting sugarcane productivity in the studied area as indicated by the positive significance ($p<0.10$) of the estimated coefficient. Therefore, the marginal and elasticity implications of an additional family man-day will widen the farmers' yield gap by 16.72kg and 0.268% respectively. However, the productivity of the hired labour was found efficient as evident by the significance of the estimated coefficient ($p<0.01$), an indication of judicious utilization in sugarcane farm operations, thus increasing sugarcane yield in the studied area. Therefore, the marginal and elasticity implications of additional man-day of hired labour in sugarcane production will decrease the yield gap of the sugarcane farmers by 15.22kg and 0.503% respectively. The positive significance ($p<0.05$) of the depreciation on capital items shows that decline in the productivity efficiency of the capital items due to wear and tear used in the manual operations on the sugarcane farms contributed in the widening the yield gap of sugarcane farmers in the studied area. Therefore, the marginal and elasticity implications of a unit increase in capital item depreciation will contribute in widening the yield gap of sugarcane farmers in the studied area by 0.022kg and 0.102% respectively.

The positive significance ($p<0.01$) of operational holding implies that the productivity of the land is low probably due to poor soil nutrient, thus contributing in widening of the yield gap. Therefore, the marginal and elasticity implications of a unit increase in the operational holding will increase the farmers' yield gap by 407.01kg and 0.616% respectively. The decline in the labour productivity as a farmer advanced in age due to decline in physical strength to perform the rigorous manual operations associated with the local sugarcane cultivation as evident by the positive significance ($p<0.01$) of the age coefficient affects sugarcane yield, thus widening yield gap in the studied area. In addition, the tendency of aged farmers being conservative especially apprehensive of risk-taking and innovation is likely to affect the yield level, thus widening the yield gap. Therefore, the marginal and elasticity implications of a unit increase in the age of a farmer will lead to an increase in the yield gap by 72.27kg and 2.03% respectively. The negative significance ($p<0.01$) of the marital status coefficient indicates that married farmers had better yield due to social and economic power benefits than their counterparts with the status of single. Therefore, the marginal and elasticity implications of being a female farmer will decrease the yield gap by 2317.16kg and 1.275% respectively. Being educated will aid in reducing yield gap given that education is very significant in skill acquisition, technology transfer, farmers' capacity building in planning and risk-taking, and adoption of modern technology and the ability to adapt to the complexities associated with new innovation. Therefore, the marginal and elasticity implications of a farmer being educated will

contribute to decreasing farmer's yield gap by 841.74kg and 0.271% respectively. The negative significance ($p<0.05$)) of farming experience coefficient implies that the ability of the experienced farmers to be efficient in resource allocation and the opportunities to correct observed past errors contribute in decreasing sugarcane yield gap. Thus, the marginal and elasticity implications of an additional year of experience in sugarcane cultivation will contribute in decreasing yield gap by 62.40kg and 0.189% respectively. The negative significance ($p<0.01$) of extension contact implies that farmers with extension contact will have a better yield than their counterparts with none due to the adoption of innovative technologies and exposure to the innovative world. The marginal and elasticity implications of a farmer having extension contact will contribute in decreasing yield gap by 1952.34kg and 0.114% respectively. The negative significance ($p<0.01$) of access to credit coefficient implies that the farmers with access to credit had better purchasing power with respect to the procurement of farm operational inputs as compared to their counterparts with none, thus making them have a better yield. Therefore, the marginal and elasticity implications of a farmer having access to credit will decrease his yield gap by 2372.10kg and 0.104% respectively. The positive significance ($p<0.05$) of the co-operative coefficient showed how the weakness of the co-operative association due to inefficiency in the utilization of the pecuniary advantages affects the yield level of member farmers. Therefore, the marginal and elasticity implications of a farmer being a member of a co-operative association will lead to an increase in his yield gap by 1598.49kg and 0.066% respectively. The negative significance ($p<0.01$) of the sickness of household member coefficient means that farmers with no health challenges in their household will have their efficiency not affected *viz.* decline in quantity and quality of family labour that will be released for farm operations, extra cost to be incurred on hired labour and medic expenditures which have negative effects on capital investment; thus enhancing their sugarcane yield. Therefore, the marginal and elasticity implications of a farmer with no ailing member in his household will lead to a decrease in his yield gap by 231.80kg and 0.366% respectively.

The security threat in the studied area is insignificant thus the reason for non-significance of its estimated coefficient. However, the negative sign of the security threat coefficient implies that farmers with no security challenges *viz.* herdsmen cattle incursion, communal conflicts, land disputes will record better productivity in sugarcane production in the studied area. Also, the income stream earned by farmers from non-farm income was minimal, thus the reason for non-significant of the estimated coefficient. However, the negative sign associated with the non-farm income means that farmers with diversified income will record better productivity in sugar cane production owing to boosting of on-farm capital investment, thus narrowing their yield gap.

Table 2: Determinants of yield gap among sugarcane farmers' in the study area

Variable	Coefficient	t-stat	Elasticity	VIF
Constant	1122.71(708.657)	1.584^{NS}	-	-
Sucker	3.71379(1.02358)	3.628***	.66829	3.015
NPK	−1.91634(2.40806)	0.7958^{NS}	-.09018	1.995
Urea	−11.4652(4.61122)	2.486**	-.42786	1.955
Herbicide	−54.9417(43.8743)	1.252^{NS}	-.09007	2.148
Family labour	16.7205(10.0412)	1.665*	.26754	4.176
Hired labour	−15.2158(5.04166)	3.018***	-.50299	2.196
Farm size	407.006(91.6208)	4.442***	.61573	3.856
Capital item Dep.	0.02168(0.008275)	2.620**	-.10191	3.359
Age	72.2741(12.5221)	5.772***	2.0316	2.036
Marital status	−2317.16(417.090)	5.556***	-1.2746	1.388
Education	−841.738(190.461)	4.419***	-.27119	1.397
Household size	34.5244(24.6241)	1.402^{NS}	.17565	2.117
Farming Experience	−62.4031(31.3318)	1.992**	-.18876	1.967
Land ownership	189.326(174.971)	1.082^{NS}	.05101	1.258
Non-farm income	−88.7802(436.617)	0.2033^{NS}	.00371	3.395
Extension contact	−1952.34(350.871)	5.564***	-.11378	2.503
Co-operative mem.	1598.49(779.496)	2.051**	.06548	8.378
Access to credit	−2372.10(751.285)	3.157***	-.10409	7.782
Sickness	−231.800(82.5011)	2.810***	-.36567	1.387
Security threat	−558.993(417.254)	1.340^{NS}	-.01911	1.906
R^2	0.850			
Adjusted R^2	**0.815**			
F-Statistics	**23.85[1.71E-26]*** **			
Breusch-Pagan test	**35.39[0.018]** **			
Normality test (χ^2)	**7.729[0.0209]** **			

Source: Field survey, 2018

*, **, *** and ^{NS} means significance at 10%, 5%, 1% and non-significant respectively

Note: ( ): values in parenthesis are standard error; [ ] values in square brackets are probability levels

CONCLUSION AND RECOMMENDATIONS

Based on these findings it can be inferred that there exist small yield gap in sugarcane production in the study area which is caused by technological and socio-economic factors. However, the identified factors which constrained the farmers from maximizing potential yield in sugarcane productions in the studied area were the use of local sucker variety, excess and inefficient family labour, and ineffective co-operative institution. Nevertheless, stakeholders need to improve on the existing available technology in the study area so that the yield gap of sugarcane in the studied area is brought to the barest minimum and if possible eradicated *viz.* introduction of improved sucker varieties coupled with proper training from extension services, enhancing the value chain of sugarcane inorder to make proper utilization of the family labour and encourage formation of viable social organization which will enable the farmers to harness the potentials of their social capital.

REFERENCES

Agricultural Development Project (ADP)(2013). *Agricultural Production Survey Report*.

Ali, A. and Jan, A.U.(2017). Analysis of technical efficiency of sugarcane crop in Khyber Pakhtunkhwa: A stochastic frontier approach. *Sarhad Journal of Agriculture*, 33(1):69- 79.

Central Bank of Nigeria (CBN)(2010). Statistical *Bulletin* (liquidity and the sector credit allocation). 34 (1):1 – 57

Coelli, T.J.(1995). Recent developments in frontier estimation and efficiency measurement. *Australian Journal of Agricultural Economics*, 39:219-245

Food and Agricultural Organization of United Nations (FAOSTAT)(2011). *Animal Feed Resources Information System, 10(54): 1 – 7*

Girei, A.A. and Giroh, D. (2012). Analysis of the factors affecting sugarcane (*Saccharum*

officinarum) production under the out grower's scheme in Numan Local Government Area Adamawa State, Nigeria. *Advances in Agriculture, Sciences and Engineering Research*, 2.

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

Girei, A.A. and Giroh, D.Y.(2012). Profitability analysis of sugarcane (*Saccharum officinarum*) production in Numan Local Government

Area Adamawa State, Nigeria. *Journal of Research in National Development*, 10(3):141-145.

Gomez, K.A.(1977). On-farm assessment of yield constraints: Methodological problems. *In:Constraints to High Yields on Asian Rice Farms: An Interim Report, International Rice Research Institute*, Los Baños, Philippines.

Hayami, Y. and Ruttan, V.(1985). *Agricultural Development:An International Perspective. Revised and Expanded Edition*. Baltimore: Johns Hopkins University Press.

Job, E.(2006). Yield gap of rice in Alappuzha district of Kerala. *Journal of Tropical Agriculture*, 44:88-90.

Joshi, P.K., Kumar, A., Jha, A.K. and Saxena, R.(2003). *Prioritization of production constraints concepts and methods*. Task Force on Prioritization, Monitoring and Evaluation, National Centre for Agricultural Economics and Policy Research, New Delhi.

Kusnet, D.(2006). *Agricultural Financial Support to Farmers*. New Delhi Publisher Liang Weili, LuHongzhan, Xia AiPing, Wang GuiYan, QinFengShu, Yang ZhenQi and

LuYuHai (2006). A preliminary analysis on the yield gap of winter wheat between demonstration plots and farmer's field. *Journal of Food, Agriculture and Environment*, 4(3/4):143-146.

Madhavswamy, G. and Sheshareddy, S.(1987). Yield gap and constraint analysis in sorghum production in scarce rainfall zone of Rayalaseema. *Andhra Agricultural Journal*, 34: 45- 50.

Paul, D. and Chandel, B.S.(2010). Improving milk yield performance of crossbred cattle in North-Eastern States of India. *Agricultural Economics Research Review*, 23:69-75

United Nation Industrial Company Association (UNICA)(2016). Harvest and processed cane, with priority on Ethanol production, South Central 2015/2016. Pp.1 – 4

Yu, C.M. Hossain, S. and Hook, L.S.(2001).*An Introduction to Econometrics using SHAZAM*. McGraw-Hill (Malaysia) Sydney Bhd. Pp. 15-27