



FACTORS INFLUENCING GROSS INCOME ON SWEET POTATO PRODUCTION IN TORO LOCAL GOVERNMENT AREA OF BAUCHI STATE, NIGERIA

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ABSTRACT: The study examined factors influencing gross income and profitability of sweet potato production in Toro Local Government Area of Bauchi State of Nigeria. Multi-stage sampling techniques were used in selecting six villages purposively and 93 farmers were selected randomly. Data were collected using structured questionnaire; and analyzed using descriptive and inferential statistics, as well as farm budget model. The result reveals that average age of the farmers was 34 years and majorities (80.6%) of the respondent were male with average farming experience of 8 years. Result shows that majority (95.9%) of the farmers had acquired one form of formal education or the other and farmers were operating on small scale production with an average farm land of 1.5 hectares. Also, farmers (86.0%) sourced their production inputs from market and majority (95.7%) of the farmers adopted the use of improved varieties of sweet potato. The total cost and gross income were ₦48,843.19 (\$135.68) and ₦121,017.03 (\$336.16), per hectare, respectively. The net income and return per naira invested were ₦72,173.84 (\$200.48) and ₦1.48, per hectare respectively. This implies that sweet potato production is very profitable in the study area. Result on socio-economic factors influencing gross income shows that price, farm land and quantity of sweet potato were significant ($P < 0.001$) variables that influenced gross income. The R^2 was 0.468 implying that about 46.8% of the variation in the gross income was explained by explanatory variables included in the model. The F-value was 8.098 and significant at $P < 0.001$. The major constraint faced by the farmers include; low/instability in market price; pest and diseases as well as poor/inadequate storage facilities, among others. Thus, the study recommends stabilizing the pricing system for sweet potato through the formation of farmers' group to improve bargain power and market opportunities; provision of practical training and workshops on product development to mitigate problems of storage, pest and diseases in the study area.

Keywords: Improved varieties, Production, Profitability, Sweet potato, Toro

INTRODUCTION

Sweet potato (*Ipomoea batatas* (L.) Lam) is among the most important crop grown in sub-Saharan Africa. Nigeria is one of the largest producers of sweet potato in Sub-Saharan African (SSA) with annual production estimated at 3.46 million tonnes per year (Omoare *et al.*, 2015). Nigeria is the third largest producers of sweet potatoes in terms of quantity after China and Uganda (Kathryn, *et al.*, 2012). Despite this the crop has received little attention by the government perhaps because of its bulkiness, perishability with low shelf life after harvesting which limit its economic viability (Omoare *et al.*, 2015). Sweet potatoes offer a particularly significant potential for increasing food production and income there by reducing poverty and improving food security level in Nigeria (Ahmad *et al.*, 2014). This is due to the crop adaptability to adverse environmental condition, which enable the crop to perform well on a poor soil with little or no fertilizer application. In spite of the role of sweet potato as one of the World's most important food and vegetable crop; playing an important role in combating vitamins and other nutritional deficiencies (Omoare *et al.*, 2015). This is as a result of limited ways and availability of adapted processing technologies in which sweet potatoes can be utilized.

The most commonly cultivated sweet potato varieties in Nigeria are white and yellow/orange-fleshed. Initiatives have spawned to encourage the production and consumption of orange-fleshed sweet potato varieties that are rich in beta-carotene (a carotenoid or plant pigment responsible for the yellow and orange coloration of some tuber varieties) that help fight vitamin A deficiency (Kathryn *et al.*, 2012). Sweet potatoes are often intercropped with other crops as a secondary crop. In the southern part of the country, sweet potatoes are intercropped with other root and tuber crops (Yam, Cassava, and Cocoyam). In the northern part of the country, sweet potato is

intercropped with cereal crops like maize and millet. Sweet potatoes are ready a staple food in the northern part of Nigeria where most of the crops are grown in Kaduna, Kano and Bauchi States as the leading production States. Irrigation makes year-round cultivation possible in the north, where farmers grow less sweet potato and more floury varieties that are in high demand in major urban markets (Kathryn *et al.*, 2012). Sweet potato prices fluctuate over the year, at the peak of harvest between July and January prices are lower. Between February and June when sweet potato is scarce the prices are higher. Orange fleshed sweet potatoes are now sell at higher prices than white fleshed because of its nutritional value. The importance of sweet potato is increasing in Nigeria's farming and food systems because its production has recorded good profit margin and is suitable for income generation (Sunusi and Adesogan, 2014). Toro Local Government area of Bauchi state has a wide range of soil that favors sweet potato cultivation. Sweet potato has wide ecological adaptabilities which enable the crop to perform well under poor soil conditions. Therefore, small-scale farmers can grow sweet potato in poor soil with little or no fertilizers. The optimal growing temperature is 24°C with a short maturation period of (3-8 months depending on the variety), which allows for two or more crop cycles in a year (Ahmad *et al.*, 2017).

In Nigeria value addition is the major problems of sweet potato production, women are more involved in processing and marketing of the crop. The problems affecting sweet potato production in Nigeria can be classified as economic and environmental problem. Economic limitations to sweet potato include poor market, lack of transport infrastructure, as well as inadequate research, and policies that enhance sweet potato production (Ahmad *et al.*, 2017). This study will create awareness among farmers on the need for the adoption of improved sweet potato production technologies and the need for more

improved processing technologies. The findings of this study will add important information to academic knowledge; serve as an important document for researchers in the field of sweet potato production and will serve as a guide to extension workers, farmers and policy makers in study area and nation at large.

OBJECTIVES OF THE STUDY

The specific objectives of the study are to:

- i. Describe the socio-economic characteristics of the farmers in the study area.
- ii. Determine cost and return of sweet potato production in the study area.
- iii. Examine factors influencing gross income on sweet potato production
- iv. Identify constraints affecting sweet potato producers.

MATERIALS AND METHODS

Study Area

The study was conducted in Toro Local Government Area of Bauchi State, Nigeria. Toro Local Government Area is found in the western part of Bauchi State, about 98km away from Bauchi metropolis. It is topographically hilly and located on a latitude 10° 06' North and longitude 9° 07' East. It has a generally favourable weather with temperature ranging from 21°C (69.80°F) to 32°C (89.60°F) and average annual rainfall of 820.7mm. Toro Local Government occupies a total land area of about 6,932km². The Local Government has a population 486,100 as of 2016 (Thomas, 2017) with a growth rate of 3.6% and projected population is about 503,600 people at 2019 (NPC, 2006). Most of the people in the study area are farmers growing food crops such as maize, guinea corn, rice, sweet potatoes, cassava, and so on.

They also produce vegetables such as tomatoes and onions. Similarly, they engaged in livestock production such as cattle, sheep and goat.

SAMPLING PROCEDURE AND SAMPLE SIZE

The study used multi-stage sampling procedure. Firstly, three districts were purposively selected comprising Toro, Lame and Jama'a districts. Secondly, two villages were purposive selected from each district making a total of six villages. Finally, 10% of the famers were randomly selected from each village using sampling frame. This making a total of 93 famers as a sample in the study area. The sampling procedure is presented in Table 1.

Table 1: Sampling Procedure

Districts	Towns/Villages	Sampling frame	Sample size (10%)
Toro	Toro	153	15
	Tilde-Fulani	150	15
Lame	Gumau	200	20
	Tulu	149	15
Jama'a	Nabordo	151	15
	Rimin Zayam	130	13
Total		933	93

DATA COLLECTION

The data for this study were collected using structured-questionnaire. The data collected were based on the socio-economic characteristics of the respondent such as household size, age, sex, level of education, farm size, farming experience among others. Also data on production and constraints affecting sweet potato producers were collected.

Analytical Techniques

The data were analysed using descriptive statistics such as frequency distribution, percentage and mean were used to analyse objectives one,

and four. Also, net farm income, and multiple regression were used in analysing objective two and three respectively.

Net farm income

Net Farm Income was used in analysing profitability of sweet potato production. The model is specified as;

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

Where;

NFI = Net Farm Income (₦)

GI = Gross income of sweet potato production

TC = Total costs (variable + fixed costs) of sweet potato production

Depreciation of Fixed Assets

The model is given as;

$$D = \frac{P - S}{N} \quad \dots (2)$$

Where;

D = Depreciation of fixed assets

P = Price of the assets

S = Salvage value

N = Number of years (life span of asset)

Return per naira Invested

Return per Naira invested is the amount a farmer may realised on any naira invested (used) in sweet potato production. It is calculated as;

$$\begin{aligned} RNI \\ &= \frac{NI}{TC} \quad \dots (3) \end{aligned}$$

Where;

RNI = Return per naira invested

NI = Net income

TC = Total cost

Multiple Regressions

Multiple regressions was used to analyse objective three, which deals with factors influencing gross income on sweet potato production. The model is specified as:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + e \quad \dots (4)$$

Where;

Y = Gross income (₦)

X₁= Age (years)

X₂ = Education (years)

X₃ = Experience (years)

X₄ = Selling price (₦)

X₅ = Farm size (hectares)

X₆ = Labour cost (₦)

X₇= Seed cost (₦)

X₈ = Quantity produce (kg)

X₉= Agro-chemicals (₦)

a = constant

b₁- b₉ = Regression Coefficient

e = Error term

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Respondents

The results in Table 2 shows that average age of the farmers was 34 years. This implies that farmers were young and energetic to make meaningful impact on sweet potato production. This result is in line with Ahmad *et al*, (2014) who reported that the average age of sweet potato farmers was 39 years. A similar result was obtained by Sunusi and Adesogan (2014) that majority of the farmers' age falls within active economic age group with the mean age of 35 years, implying that

majority of the sweet potato farmers were middle aged. Also, the results shows that majority (80.6%) of the farmers were male. This implies that sweet potato production is male dominated in the study area and this may be because of the tedious activities involved in sweet potato production. This result conforms to the finding of Sunusi and Adesogan (2014) that majority (90.2%) of the farmers were male. A similar result was obtained by Adeyonu *et al.* (2016) who reported that 74.23% of his farmers were male. Furthermore, majority (95.9%) of the farmers had obtained one form of formal education or the other. This findings contradicted the results obtained by Abdulkarim and Yunana (2015) who reported majority (53.3%) of sweet potato farmers acquired Qur'anic/Arabic education in Zaria LGA of Kaduna State, The result reveals that 48.0% of the respondents engaged in sweet potato production and only 13.3% of the farmers engaged in sweet potato production and marketing. This implies that farmers diversify their source of income with respect to farming activities, through adoption of mixed farming. The results shows that majority (51.0%) of the respondents cultivated sweet potato on a land ranging from 0.5-1 hectares with an average land size of 1.5 hectares. This implies that majority of the farmers were operating on small scale production in the study area. This result is in line with that of Ahmad *et al.* (2014) who reported that mean farm size was 1.52 hectares. The results further reveals an average farming experience of 8years. This contradicts the findings of Omoare *et al.* (2015) who reported that the mean experience of his respondent was 16.4 years. Also, the result disagreed with the findings of Sunusi and Adesogan (2014) that farmers had an average year of experience of 22 years in sweet potato farming.

Table 2: Socio-economic Characteristics of the Respondents

Variables	Frequency	Percentage
< 20	10	10.8
21 - 30	24	25.8

Factors Influencing Gross Income on Sweet Potato Production in Toro Local Government Area of Bauchi State, Nigeria		
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31 - 40	34	36.6
41 - 50	19	20.4
> 51	06	6.5
$\bar{X} = 34^*$ years		
Sex		
Male	75	80.6
Female	18	19.4
Educational Level		
Non-formal education	03	3.2
Primary	38	40.9
Secondary	40	43.0
Tertiary	12	12.9
Occupation		
Sweet potato production only	47	48.0
Mixed farming	26	26.5
Civil service and sweet potato production	12	12.2
Sweet potato production and marketing	13	13.3
Farm Size		
0.5 - 1.0	52	51.0
1.5 - 2.0	27	30.6
2.5 - 3.0	08	11.2
3.5 - 4.0	03	5.1
4.5 - 5.0	03	2.0
$\bar{X} = 1.5^*$ hectares		
Farming Experience		
3 - 5	34	36.6
6 - 8	16	17.2
9 - 11	31	33.3
12 - 14	06	6.5
15 - 17	04	4.3
18 - 20	02	2.2
$\bar{X} = 8^*$ years		

*Means were computed from raw data

Source: Field survey 2019

Sources of Production Inputs

Table 3 reveals that majority (86.0%) of the farmers sourced their production inputs from market. Followed by 78.5% who purchased

inputs from Bauchi State Agricultural Development Programme (BSADP) and only 16.1% sourced their own from research institute. This implies that farmers obtained production inputs from various sources due to reliability and accessibility by the farmers. Thus, this was an indication that no single source of production inputs could be effectively adequate for producers in the study area; rather, all sources of inputs are needed for availability. The result is in line with Okeke *et al.* (2019) who reported that farmers procured production inputs from various sources such as open markets, Agricultural Development Programmes (ADPs), Certified Agro-dealers, among others.

Table 3: Sources of Production Inputs (n = 93)

Source of Input	Frequency*	Percentage*
Market	80	86.0
BSADP	73	78.5
Research institution	15	16.1
Cooperative societies	60	64.5

*Multiple responses were obtained

Source: Field Survey, 2019

Types of Technologies/Practices Adopted

The result in Table 4 reveals that majority (95.7%) of the farmers adopted the use of improved varieties of sweet potato. Followed by 83.9% of the farmers who used fertilizer application techniques. Also, the result shows that 82.8% and 81.7% adopted vine cutting and planting spacing, respectively. The spacing techniques used by majority of the farmers were 30cm x 100cm on ridges and spacing at 25 cm x 100 cm on mounds. While vine cutting they used 4 node cuttings and 2 node inserted into the soil; 8 node cuttings and 4 nodes inserted into the soil. The implication of this result is that majority of the farmers adopted multiple forms of technologies and practices for higher

production. The result shows that 76.3% and 75.3% of the farmers adopted the use of agro-chemicals and harvesting/storage techniques, respectively. This result is in agreement with Okeke *et al.* (2019) that farmers adopted various forms of technologies and practices on sweet potato production comprising fertilizer application (91%); planting spacing/distance used (81%); vine cutting (81%) and improved varieties (79%) in the study area.

Table 4: Types of Technologies/Practices Adopted by the Farmers (n = 93)

Technologies/Practices	Frequency*	Percentage*
Treated seedlings	57	61.3
Fertilizer application	78	83.9
Agro-chemical	70	75.3
Early planting	59	63.5
Planting spacing	76	81.7
Improved varieties	89	95.7
Vine cutting technique	77	82.8
Harvesting and storage techniques	71	76.3

*Multiple responses were obtained

Source: Field Survey, 2019

Costs and Return on Sweet Potato Production per Hectare

The result in Table 5 shows that variable cost constituted the greater proportion of the total cost of production which was estimated at 97.9%, specifically cost of fertilizer which covered 52.3% of the total cost which was the prominent. The cost of labour was the second with 24.0%, followed by cost of agro-chemicals with 10.4%, other cost 6.2% and seed cost 5.0%, of the total cost. The total variable and total fixed cost were ₦ 47,856.39 and ₦ 987.00 per hectare, respectively. The total return and net income were ₦ 121,017.03 and ₦ 72,173.64 per hectare, respectively. The return per naira invested was 1.48 per hectare. This implies that in every naira invested the farmer realized a

return of ₦ 1.48. Thus, sweet potato production is a profitable business in the study area. This result is in conformity to Abdulkarim and Yunana (2015) who reported that the average gross return was ₦93,642.90 per hectare, indicating profitability in sweet potato production. A similar, result was obtained by Ahmad *et al.* (2014) who reported an average net farm income and rate of return on investment of ₦44,222.10 and ₦2.51 per hectare, respectively. In line with this, Omoare (2017) reported a net income of ₦46,841.93 per hectare on sweet potato production in Osun State. It can be noted that sweet potato enterprise is a profitable agribusiness.

Table 5: Average Cost and Returns for Sweet Potato Production per Hectare

Items	Amount (₦)	% Total Cost
Variable cost		
Seed	2,465.00	5.04
Fertilizer	25,553.76	52.31
Agrochemicals	5,087.20	10.40
Labour	11,738.60	24.03
Other cost	3,011.83	6.20
Total variable cost	47,856.39	
Fixed Assets		
Depreciation on assets	987.00	2.02
Total fixed cost	987.00	
Total cost	48,843.39	
Gross income	121,017.03	
Net income	72,173.64	
Return per naira invested	1.48	
Total		100.00

Currency Exchange Rate as of 2019

₦1.00 = ₦ 360.00

Source: Field Survey, 2019

Factors Influencing Gross Income on Sweet Potato Production

The result in Table 6 shows that price had positive coefficient and significant at 5% implying that the higher the price, the more the

gross income. Also, quantity produced had a positive coefficient and significant at 1%. This implies that the more quantity of sweet potato produced the more the gross income per hectare. Farm size had positive coefficient and significant at 5%, implying that increase in farm land may lead to increase in gross income all things been equal. This result is in line with Omoare (2017) and Lirag (2019) that the coefficients on farm land were significant at $P < 0.001$ and $P < 0.05$, respectively and positively influenced the gross income on sweet potato production. On the other hand, results showed an inverse relationship between gross income and years of experience. The negative sign for the years of experience might be due to the fact that farmers with more years of experience are used to obsolete methods of farming and poor varieties which do not encourage high gross income. A similar results was obtained by Lirag (2019) that years of farming experience had negative coefficient and not significant in influencing gross income on sweet potato production. The R^2 was 0.468 which implies that about 46.8% of the variation in the gross income was explained by explanatory variables included in the model. While F-value was 8.098 and found significant at 1%. This implies that all explanatory variables considered influenced the gross income on sweet potato production. This is in line with the findings of Lirag (2019) and Ahmad *et al.* (2014) who reported that the value of R^2 suggests that the independent variables used in the model accounted for the total variation in gross income.

Table 6: Result on Factors Influencing Gross Income on Sweet Potato Production

Variables	Coefficients	T-values	Prob. Level
Constant	96187.262	0.903	0.369
Age (X_1)	-1155.733	-0.741 ^{NS}	0.461

Education (X ₂)	-5063.099	-1.379 ^{NS}	0.172
Experience (X ₃)	-3333.609	-0.885 ^{NS}	0.379
Price (X ₄)	45.127	1.969 ^{**}	0.050
Farm size (X ₅)	378.3641	0.710 ^{***}	0.000
Labour cost (X ₆)	-0.271	-0.337 ^{NS}	0.737
Seed cost (X ₇)	-20.614	-1.203 ^{NS}	0.232
Quantity produce (X ₈)	3325.380	3.210 ^{***}	0.000
Agro-chemicals (X ₉)	-3.617	-0.478 ^{NS}	0.634
R ²	0.468		
R adjusted	0.410		
F-value	8.098 ^{***}		

*** = 1%; ** = 5%

Source: Field survey, 2019

Constraints Affecting Sweet Potato Farmers in the Study Area

Table 7 shows that majority (81.7%) of the farmers complained on low/instability in market price as the most serious constraint affecting sweet potato income. This implies that at harvest period, prices are low while at lean period prices are high and this might affected the profit level. This result is in agreement with Lirag (2019) who reported that price fluctuations affected the profitability of sweet potato production. In addition, 75.0% of the farmers pointed out that pest and diseases as the serious constraint affecting sweet potato production. This result is in conformity to Omoare (2017) who reported that 68% of the farmers attested pest and diseases as constraint affecting sweet potato production in Osun State. The result also reveals that 74.2% of the farmers complained on poor/inadequate storage facilities. Also, some farmers complained on high cost of farm inputs (59.1%); untimely supply of input (48.4%); inadequate input (43.0%); and high cost of labour (37.6%). In a study carried out by Omoare (2017) that inadequate finance (83.2%) was the serious constraint and ranked first affecting sweet potato production. The author added that inadequate extension service support (80.4%);

inadequate market information (74.0%); pest and diseases (68.0%) and high cost of labour (57.2%) were among the problems pointed out by the sweet potato farmers in the study area.

Table 7: Constraints Affecting Sweet Potato Farmers in the Study Area (n = 93)

Constraints	Frequency*	Percentage*
Inadequate input	40	43.0
High cost of input	55	59.1
Untimely supply of input	45	48.4
Pest and Disease	70	75.0
Low and instability of market price	76	81.7
High cost of labour	35	37.6
Poor/inadequate storage facilities	69	74.2

*Multiple responses were obtained

Source: Field Survey, 2019

CONCLUSION

The study assessed factors influencing gross income on sweet potato production and profitability. Explanatory variables such as price, farm land and quantity of sweet potato had positive significant influence on the gross income realised from sweet potato production. The total cost and total return were ₦48,843.39 and ₦ 121,017.03, respectively per hectare. Thus, sweet potato production is profitable agribusiness and worth undertaking in the study area. However, low and instability of market price; pest and diseases; poor/inadequate storage facilities and high cost of farm inputs were some of the constraints affecting sweet potato production in the study area.

RECOMMENDATIONS

Based on the findings of the study, the following recommendations were suggested:

- i. Farmers should be encouraged to form agricultural cooperative or farmers groups to source inputs and market their products collectively.
- ii. Extension agents should intensify practical training programme on pest and diseases management using recommended agrochemicals.
- iii. Farmers should be encourage to adopt improve sweet potato storage techniques in order to reduce postharvest loss.
- iv. Provision of inputs such as seeds, fertilizers, agro-chemicals and implement at the right time.

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