ACTA UNIVERSITATIS AGRICULTURAE ET SILVICULTURAE MENDELIANAE BRUNENSIS

Volume 63 76 Number 2, 2015
http://dx.doi.org/10.11118/actaun201563020659

AN ANALYSIS OF YAM PRODUCTION IN NIGERIA

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Abstract

VERTER NAHANGA, BEČVÁŘOVÁ VĚRA. 2015. An Analysis of Yam Production in Nigeria. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis,* 63(2): 659–665.

Yams as a stable food crops do not only serve as integral vehicle for food security, but also as a source of income, and employer of labour in the producing areas in Nigeria. Lack of finance, inadequate farm inputs, storage facilities and high cost of labour are identified as the primary constraints to yam production in the country. This article deals with most of the determinants of yam production, constraints and the importance yam products in Nigeria. The findings of the study suggest that farm size, producer price, fertilizer use, yield (Hg/Ha), and economic growth have a positive influence on yam production in Nigeria. On the contrary, the result shows an inverse relationship between commercial loans and yam production in the country.
There is an urgent need for the Nigerian government to provide a conducive environment and investment climate by subsidising farm inputs and providing affordable loans to the smallholder yam farmers for a sustainable production.

Keywords: yam production, smallholder farmers, constraints, farm inputs

INTRODUCTION

Yams (*Dioscorea* species) are annual root tuber-bearing plants with more than 600 species out of which six are socially and economically important in terms of food, cash and medicine (IITA, 2009). Some of the yam species are water yam (*Dioscorea alata)*, white yam (*Dioscorea rotundata*), yellow yam (*Dioscorea cayanensis)*, Chinese yam (*Dioscorea esculant*) and three-leaf yams (Ike and Inoni, 2006; Olubukola and Bolarin, 2006; Zaknayiba and Tanko, 2013).

They are grown in tropical regions and mostly produced in the savannah region of West Africa, where rainfalls are divided into wet and dry seasons (FAO, 1997). This crop is also grown in Latin American and Caribbean countries like Colombia, Brazil, Haiti, Cuba and Jamaica (FAO, 2013). Nigeria is the largest producer of yams in the world, followed by Ghana, Côte D'Ivoire, Benin, Togo, and Cameroon (FAO, 2013). Yams are mostly marketed as fresh tubers and prepared for consumption. Transportation and marketing are carried out both by farmers and traders (Ike and Inoni, 2006).

Yams are the fifth most harvested crops in Nigeria, following after cassava, maize, guinea corn, and beans/cowpeas. More so, after cassava, yams are the most commonly harvested tuber crops in the country (National Bureau of Statistics, 2012). Yams do not only serve as the main source of earnings and food consumption, but also as a major employer of labour in Nigeria. Despite the importance of yams to people, the attention to its production is still questionable (Verter and Bečvářová, 2014).

Some researchers have empirically investigated factors that determine the level of yam production in Nigeria and elsewhere in the world. For instance, Bamire and Amujoyegbe (2005) find a positive relationship between net returns (profitability) in yams output and land improvement techniques in Nigeria. In the same direction, studies by Zaknayiba and Tanko (2013) reveal that lack of access to inputs, finance, poor producer prices, inadequate of storage facilities, incidences of pests and diseases have negatively affected yam production. Similarly, Ike and Inoni (2006); Maikasuwa and Ala (2013) examine some determinants of yam production in particular regions in Nigeria. They find that the factors of production such as labour, finance and material inputs like fertilizer have influenced yam production in the region. In the same direction, Etim, Thompson and Onyenweaku (2013) investigate the relationship between farm level and output-oriented technical efficiency indices.

Their results suggest that farmers' education, family labour, extension contact and experience of farmers have a positive effect on the farm level technical efficiency and yam output.

Published empirical works within the context yam production in Nigeria were mainly field research. To the best of our knowledge, none of these studies used annual time series data to determine the factors that are influencing yam production in the country. The aim of this paper is to analyse some determinants of yam production in a specified period. Special attention is given to the dynamics of production and potential constraints that hinder higher efficiency and sustainability of yam production in Nigeria

Trends in Yam Production

Yam production has gone some dramatic changes in many parts of the world. However, production process from bush clearing, cultivation, chemical application, harvesting and transporting to markets is still labour-intensive (Ennin, Otoo and Tetteh, 2009).

Tab. I presented data available from FAO (2013) which shows the trends in annual yam production in the world and the three largest producers between 1961 and 2012. The area harvested in the world has increased from 1.15 million (Ha) in 1961 to 5.04 million (Ha) in 2012. Yield (Hg/Ha) in the world also increased from 72.35 thousand metric tons in 1961 to 116.65 thousand metric tons in 2012. Over 58. 8 million tons of yams were produced in the world in 2012, out of which 92.2% were from West Africa.

Nigeria accounted for over 65% (38 million metric tons) of the world yam production. Valued at $7.75 billion and cultivated about 2.9 million hectares of land in 2012 (see Tab. I and Fig. 1). While trailing second and third positions by a wide margin were Ghana (6.6 million metric tons) and Côte D'Ivoire (5.8 million metric tons) in 2012. The development of yam output could be partly attributed to the use of modern farm inputs, even though, the inputs are not sufficiently available to farmers. Fig. 1 also shows a fluctuating growth rate of yam production in all the three countries during the period under study. Depending on the variety of yam products, its yield potential ranges from 20–50 tons per hectare. During the bad season, the yield could be around 10 tons per hectare (FAO, 1985).

The growth rate of yams output is far from consistent, especially in Ghana and Nigeria (see Fig. 1), partly due to the unattractiveness of farming and low prices of yams in the market. However, the majority of the rural population still engaged in farming activities because there are no other job opportunities for them apart from yam cultivation in these regions.

Socioeconomic Importance of Yam Production

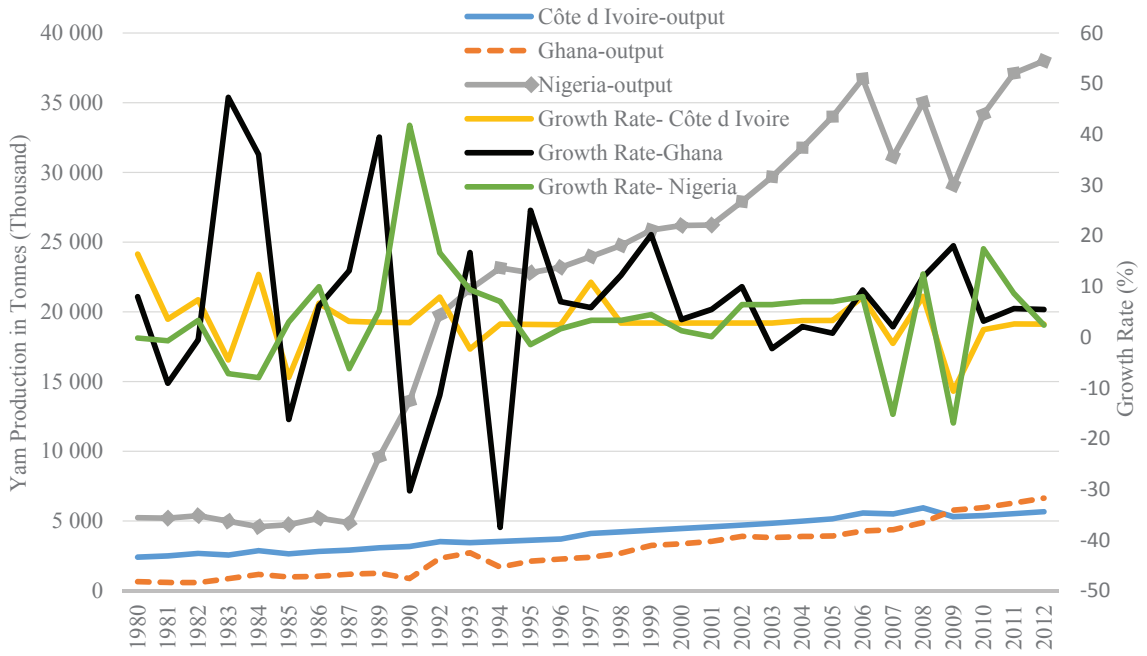
Yams are among major cash and most consumed food crops West African countries (GTZ, 1999) like Nigeria (Babaleye, 2003; National Bureau of Statistics, 2012). Its cultivation is very profitable despite high costs of production and price fluctuations in the markets (IITA, 2013; Izekor and Olumese, 2010). An average profit per yam seed, after harvest and storage in Nigeria, was calculated at over US$13, 000 per hectare harvested (IITA, 2013).

Households demand for yam consumption is very high in Sub-Saharan Africa. Nutritionally, yam is a major staple food consumption, providing food for millions of people in the West Africa. It is eaten in different forms such as fufu (the so-called poundo yam and Amala in Nigeria), boiled, fried and roasted (Aidoo, 2009; IITA, 2009). This root and tuber place in the diet of smallholder farmers cannot be

I: *Annual Yam production in the world, Ghana, Côte d Ivoire, Nigeria, (1961–2012)*

Yams Elements	Areas	1961	1980	1985	1990	1995	2000	2010	2012
Area Harvested (Ha, 1,000)	World	1,151	1,362	1,778	2,247	3,228	4,032	4,942	5,037
Area Harvested (Ha, 1,000)	Côte d Ivoire	150	225	255	319	370	505	830	835
Area Harvested (Ha, 1,000)	Ghana	150	113	178	119	176	261	385	426
Output in MT									
Production (MT million)	World	8.32	12.01	12.11	21.76	33.24	39.55	53.60	58.75
Production (MT million)	Côte d Ivoire	1.15	2.41	2.65	3.17	3.62	4.45	5.39	5.67
Production (MT million)	Ghana	1.10	.650	.987	.877	2.13	3.36	5.96	6.64
Production (MT million)	Nigeria	3.50	5.25	4.74	13.62	22.82	26.21	34.16	38,00
Production (% of the world)	Nigeria	42	44	39	63	69	66	64	65
Yield									
Yield (Hg/Ha)	World	72,345	88,155	68,138	96,902	102,999	98,088	108,471	116,648
Yield (Hg/Ha)	Côte d Ivoire	76,667	106,978	103,781	99,609	97,751	88,172	65,000	67,960
Yield (Hg/Ha)	Ghana	73,333	57,522	55,449	73,451	120,710	128,847	154,841	155,717
Yield (Hg/Ha)	**Nigeria**	**77,778**	**105,382**	**56,405**	**106,771**	**107,734**	**98,984**	**119,073**	**131,034**
Yield (MT/Ha)	**Nigeria**	**7.8**	**10.5**	**5.6**	**10.7**	**10.8**	**9.9**	**11.9**	**13.1**

Source: FAOSTAT, 2013



1: *Trends in Yam Production in Nigeria, Ghana and Côte D'Ivoire (MT'000, %), (1980–2012)*
Source: Authors' Analysis Based on FAOSTAT, 2013

ignored. It contributes over 200 dietary calories per capita per day for over 150 million people in West Africa (Babaleye, 2003). Yams have over 21% dietary fibre and are rich in carbohydrates, vitamin C, potassium, manganese and other essential minerals (IITA, 2009). Many yam belt areas in Nigeria continuously proclaimed "yam is food and food is yam" (Maikasuwa and Ala, 2013). Some family rural dwellers, where yams are grown, eat it all day round. Arguably, because yams are the only available food, especially during the harvesting season.

However, the primary research carried by LSMS-ISA (Living Standards Measurement Study-Integrated Surveys on Agriculture) in Nigeria showed that the consumption patterns of yams differ from the poor and rich people. Relatively, richer households were found to be consuming more yams, but selling less harvested than poorer households. Poorer households consumed fewer yams, arguably because they heavily depended on yam for income than their richer counterparts who have other sources of earning (National Bureau of Statistics, 2012).

Yam plays significant roles in the social-cultural activities in Sub-Saharan Africa such as Nigeria and Ghana. For instance, some households used it during marriage and fertility ceremonies. More so, the festival takes place yearly to celebrate its harvest, and other social ceremonies (IITA, 2013; Izekor and Olumese, 2010; Bamire and Amujoyegbe, 2005; Aidoo, 2009).

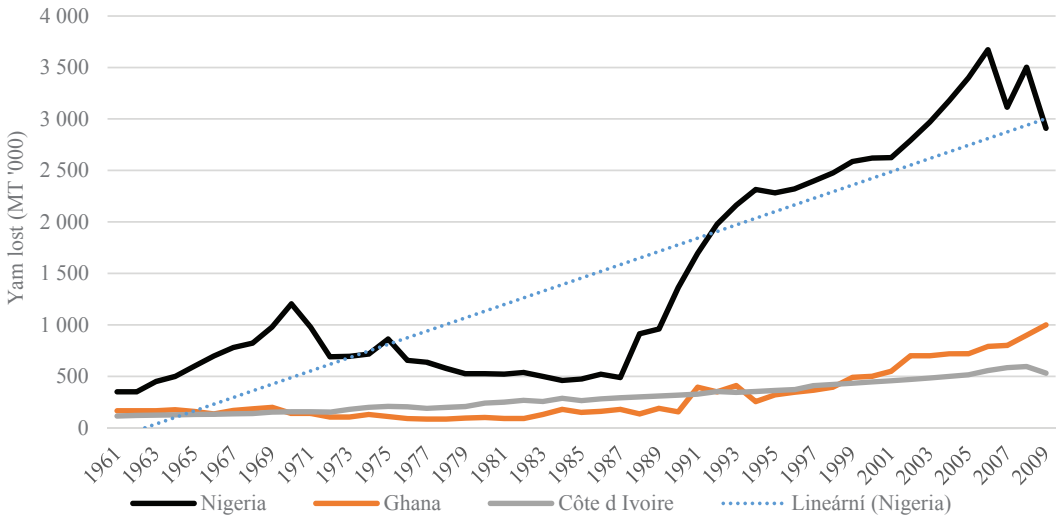
In Nigeria just like in many sub-Saharan African countries, agriculture is the largest employer of labour. According to the National Bureau of Statistics, about 60% of the Nigeria labour force were in agriculture, and they had contributed over 40% to the country's annual average of real GDP (National Bureau of Statistics, 2012). Arguably, yam is the major sources of employment generation for family members in rural areas. A study conducted by Okeoghene, Egbodion and Ose (2013) confirmed that over 65% of smallholder farmers used family labour in Delta State, Nigeria.

Constraints to Yam Production

Some studies (Ayanwuyi *et al.*, 2011; Kleih *et al.*, 2012), stressed that low soil fertility, lack of improved yam varieties, poor road networks, high cost of labour and lack of finance to carry out necessary farming activities were the constraints to productivity.

Yams like many other crops in Nigeria are labour intensive. The high cost of labour has been among the major constraints to yam production. It has constrained smallholder yam farmers from enhancing productivity (Ayanwuyi, Akinboye and Oyetoro, 2011; Migap and Audu, 2012). The labour cost of yam production from mounding to staking, especially in the forest areas account for approximately 40% of cultivation costs. In addition, about 50% of the expenditure goes to the planting process (IITA, 2009). In order to cut labour cost, most family members practically do all the production and marketing activities themselves (Ike and Inoni, 2006). Okeoghene, Egbodion and Ose (2013), confirmed that over 65% of smallholder farmers used family labour in Delta State, Nigeria.

Fig. 2 shows estimated data by FAO (2013) on the volume of yam lost in metric tons in Nigeria, Ghana and Côte D'Ivoire between 1961 and 2009.



2: *Annual quantity of yam lost in Nigeria, Ghana and Côte D'Ivoire (MT'000), (1961–2009)*
Source: FAO, 2013

Nigeria lost an annual average of 10% within the period under study. The country recorded the highest yam lost in 2006 with over 3.7 million metric tons. Inadequate preservation, storage and processing facilities, marketing and market access to yam products are attributed to yam waste or lost in the country. Arguably, this partly discourages rural smallholder yam farmers from fully taking part in the cultivation.

Pests' related issues have also been identified as major constraints to yam production. These include parasitic nematodes; insects such as leaf and tuber beetles; fungi such as leaf spot, tuber rot, and other viruses (Asante *et al.*, 2007; IITA, 2009; Zaknayiba and Tanko, 2013). Insufficient farm inputs and modern technologies are also constraints to yam production in developing countries like Nigeria, Ghana, Côte d'Ivoire, Benin and Togo. Consequently, the majority of smallholder yam farmers in these areas still used traditional farming methods such as hand hoes, axes, woods and cutlasses for farm related activities mostly. More so, insufficient chemicals and fertilizer applications and the declining of soil fertility are identified as the factors that are constraining output growth in recent time.

The financial resource is another major constraint to yam production as farmers are poor, and they suffered from limited access to credit facilities, thereby impeding higher productivity and output (Izekor and Olumese, 2010). Lack of adequate provision for agricultural loans from the financial institutions to producers has constrained a sustainable yam cultivation in Nigeria. This issue is partly attributed to some factors such as the risk involved in yam production, the difficulty of estimating returns on investment and inability of many yam producers to provide the required collateral securities (Migap and Audu, 2012). Lack of political will by the government on policies related to yam production in the country also constrained yam production in Nigeria.

Presently, wealthy farmers have started using modern farm inputs such as fertilizer, machinery, insecticides to boost productivity and enhance the quality of yam cultivation in the areas. Whereas the majority poor smallholder yam farmers are still using traditional methods of farming (Verter and Bečvářová, 2014).

MATERIALS AND METHODS

For the purpose of empirical analysis, annual time series data for the period 1981–2012 were obtained from the Food and Agriculture of the United Nations (FAO), and Central Bank of Nigeria (CBN) statistical bulletins. Econometric software Gretl 1.9.14 was used for the multivariate regression analysis.

Model Specification

The model specified the quantity of yam production being explained by the area harvested (farm size), yield per hectare, fertilizer application, real gross domestic product, producer price, and commercial loans to root and tuber. Thus, the econometric model 1 is mathematically specified as follow:

$$QYP_t = \beta_0 + \beta_1 AH_t + \beta_2 YIELD_t + \beta_3 FERT_t + \\ + \beta_4 RGDP_t + \beta_5 CLRT_t + \varepsilon_t, \quad (1)$$

where
QYP ..... the annual quantity of yam production measured in metric tons,
AH ..... the area harvested measured for farm size,
YIELD ..... the annual yam yield measured in Hg/Ha,
FERT ..... the total varieties of fertilizers applied in yam farms,
RGDP ..... the real gross domestic product, captured for economic growth in Nigeria,

CLRT.....the commercial loans to root and tuber (proxied for loans to smallholder yam, farmers) and
ε..... is the error term.

Thus, the econometric model 2 is mathematically specified as follow:

$$\ln QYP_t = \beta_0 + \beta_1 \ln PP_t + \beta_2 \ln NIFER_t + \beta_3 \ln YHH_t + \varepsilon_t, \quad (2)$$

where
lnQYP.....the natural log of yam production in Nigeria measured in tonnes,
lnPP.....the natural log of producer prices calculated in standard local currency (SLC), price received by smallholder yam farmers at the point of initial sales (prices paid at farm gate),
lnNIFER .the natural of nitrogen fertilizer consumption measured in tons, and
lnYHH.....the natural log of the yam yield (Hg/Ha).

RESULTS AND DISCUSSION

Stationarity Test

Given that time series data is prone to spurious regression results, we have carried out a unit root test prior to estimating the econometric model. Tab. II shows both Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) unit root tests. Apart from FERT and NIFER, which were stationary without difference, all other variables have become stationary after first difference. Given that all the variables have become stationary, we then proceed to run ordinary least squares (OLS) regression as presented in Tabs. III and IV.

Estimated Regression Model

Diagnostic tests for the OLS regression were run, and the results indicated that all the classical assumptions of the linear regression model were fulfilled. Given that all the classical assumptions were satisfied, we have continued with the OLS estimation results as presented in Tabs. III and IV. Tab. III provides robust evidence that the quantity of yam production has a positive relationship with the area harvested or farm size (AH), statistically significant at the 1% level. This implies that as farm size increases, total yam output may increase, holding other things equal.

The results in Tab. III also provide a robust relationship between fertilizer application (FERT) and annual quantity of yam output in Nigeria (statistically significant at the 0.01 level). This implies that an increase in fertilizer use is likely to increase yam production in the country. This result conforms to the findings of Ike and Inoni (2006); Maikasuwa and Ala (2013), who also find a connection between fertilizer consumption and yam production in Nigeria. Similarly, economic growth (RGDP) also suggest a positive influence on yam production in Nigeria (statistically significant at the 0.05 level). Economic growth is an indication that if all things being equal, both yam producers and consumers would have more access to finance that would enable them to consume, save and invest in yam related activities.

However, contrary to our prior expectation, the result shows a negative relationship between commercial loans to root and tuber (CLRT) and yam production in Nigeria (statistically significant at the 0.05 level). Arguably, since the majority of yam farmers are poor, they do not have access the loans.

II: *Unit root test*

Variable	Level	ADF Stat	Critical Values		Order of integration	PP Stat	Critical Values		Order of integration
			1%	5%			1%	5%	
QYP	Level	–0.410	–3.709	–2.983	1(1)	–0.336	–3.709	–2.983	1(1)
	First diff	–7.342***	–3.716	–2.986	1(0)	–7.109***	–3.716	–2.986	1(0)
AH	Level	–1.422	–3.709	–2.983	1(1)	–0.869	–3.709	–2.983	1(1)
	First diff	–5.521 ***	–3.716	–2.986	1(0)	–5.495***	–3.716	–2.986	1(0)
CLRT	Level	–1.470	–3.709	–2.983	1(1)	–1.022	–3.709	–2.983	1(1)
	First diff	–8.385***	–3.716	–2.986	1(0)	–9.426***	–3.716	–2.986	1(0)
RGDP	Level	–0.073	–3.709	–2.983	1(1)	–0.084	–3.709	–2.983	1(1)
	First diff	–10.43***	–3.716	–2.986	1(0)	–8.111***	–3.716	–2.986	1(0)
FERT	Level	–3.645**	–3.709	–2.983	1(1)	–3.619**	–3.709	–2.983	1(0)
lnQYP	Level	–1.040	–3.709	–2.983	1(1)	–1.054	–3.709	–2.983	1(1)
	First diff	–5.612***	–3.716	–2.986	1(0)	–5.696***	–3.716	–2.986	1(0)
lnYHH	Level	–1.402	–3.709	–2.983	1(1)	–1.645	–3.709	–2.983	1(1)
	First diff	–8.742***	–3.716	–2.986	1(0)	–7.828***	–3.716	–2.986	1(0)
lnNIFER	Level	–3.529**	–3.709	–2.983	1(1)	–3.586**	–3.709	–2.983	1(0)
lnPP	Level	–1.035	–3.709	–2.983	1(1)	–1.088	–3.709	–2.983	1(1)
	First diff	–7.875***	–3.716	–2.986	1(0)	–7.476 ***	–3.716	–2.986	1(0)

Note: The asterisks (**, ***) denote statistical significance at 0.05, and 0.01 levels respectively

III: *Estimated OLS regression model 1*

Dependent variable: QYP				
Variable	**Coefficient**	**Std. Error**	**t-ratio**	**p-value**
Const	–34166.7	256503	–0.1332	0.89510
AH	8.50454	1.29742	6.5550	< 0.00001***
YIELD	142.67	20.4297	6.9835	< 0.00001***
FERT	5.55805	1.82502	3.0455	0.00541***
RGDP	13.2248	5.81004	2.2762	0.03166**
CLRT	–0.856786	0.346845	–2.4702	0.02068**
R-squared	0.856829	Adjusted R-squared	0.828195	
F. Statistics	29.92324	P-value (F)	8.69e-10	
Durbin-Watson	1.903009			

Note: The asterisks (**, ***) denote statistical significance at 0.05, and 0.01 levels respectively

IV: *Estimated OLS regression model 2*

Dependent variable: lnQYP				
Variable	**Coefficient**	**Std. Error**	**t-ratio**	**p-value**
Const.	0.0198232	0.0228597	0.8672	0.39349
lnPP	0.214137	0.0685378	3.1244	0.00423***
lnNIFER	0.105996	0.0567099	1.8691	0.07249*
lnYHH	0.379976	0.130276	2.9167	0.00704***
R-squared	0.528191	Adjusted R-squared		0.475767
F. Statistics	10.07550	P-value (F)		0.000126
Durbin-Watson	1.888266			

Note: The asterisks (*, ***) denote statistical significance at 0.1, and 0.01 levels respectively

Consequently, commercial loans to root and tuber seem not to induce yam production in the country. Studie by Zaknayiba and Tanko (2013) indicate that lack of access to finance and other inputs have negatively affected yam production in the country.

Tab. IV shows a positive relationship between the producer price and the volume of yam production, as well and between annual yield (Hg/Ha) and yam output, highly significant at the 1% level. This implies that an increase in the producer price will induce smallholder farmers to increase productivity. A 1% increase in the producer price is likely to induce farmers to increase production by 0.214%. Similarly, a 1% increase in yield (Hg/Ha) is likely to increase annual total output by 0.106%. Studies by Zaknayiba and Tanko (2013) also confirms that producer prices have an influence on yam production in Nigeria. However, Nitrogen fertilizer consumption does not pass the 5% significance level. This may be because there are many varieties of fertilizer used in cultivation. Nevertheless, Tab. III provides evidence of aggregate fertilizer consumption (e.g. NKP, urea, and potash) has a strong positive relationship with the annual yam output.

CONCLUSION

The paper analyses some determinants of yam production, the importance of yam products, and constraints to production in Nigeria. The results show a positive relationship between the quantity of yam output and the explanatory variables such as the area harvested (farm size), producer price, fertilizer application and economic growth. Contrary to our prior expectation, the result shows an inverse relationship between commercial loans to root and tubers and yam production in Nigeria.

Yam products have some socioeconomic importance in Nigeria. For instance, some households used it during marriage and fertility ceremonies. They also celebrate its harvest and used it for other social ceremonies. Yams are among the most major cash and food crops in the country.

Lack of finance, inadequate modern farm inputs, storage and processing, and high cost of labour, appeared to be the major constraints to yam production in Nigeria. In order to improve yam production, the government of Nigeria should provide a conducive environment and invest heavily in yam cultivation by providing farm tools to smallholder farmers at subsidized rates. In addition, the government should provide more loans to farmers at zero or low-interest rate. Yam processing industries should be created for sustainable cultivation and higher productivity. Possibly, this will go a long way in accelerating yams value added chain for the betterment of smallholder farmers and traders, thus partly ensuring food security in the country.

Acknowledgement

The authors are thankful to the IGA FRRMS MENDELU (No. 14/2014) for the financial assistance during the paper preparation.

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