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Analysis of pumpkin (*Telferia occidentalis*) production: The basis for poverty eradication in the humid tropical zone of Nigeria

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Received 15 July 2004, accepted 23 September 2004.

Abstract

This paper analyses factors that significantly affect production cost, gross margins and returns associated with telferia production in the hot humid tropical zone of Nigeria. Farm level data, obtained through participatory interviews of 150 farmers, were used for the study. Ordinary least squares (OLS) multiple regression technique using different functional forms were specified to determine the impact of the selected variables on telferia output. Also cost and returns analyses were used to ascertain the performance of telferia farms in the area. The results show that female farmers and family labour predominate in these farms. Variable cost of production constituted a little over 70% of the total production cost while credit and farm size were responsible for the severe production drawbacks. On this basis, a number of recommendations, ranging from some governmental intervention to private initiatives of the farmers, are specified if the telferia production enterprises are to contribute sustainably to the growth of the agricultural sector of the nation's economy.

Key words: Gross margin, farmers, labour, production cost, returns.

Introduction

Agricultural crops can be categorized into six broad sub-groups: perennials, grains, tubers, oil and seeds, plantains and vegetables. Their percentage contributions to the overall aggregate crop agricultural productivity from 1970 to 1997 are presented in Table 1. From the table it can be seen that by the end of the 1995 to 1997 period the tuber crop constituted over 55% of the total crop productivity while the grains and perennials percentage shares were 24.87 and 9.36 respectively over the same period. The least contributors were plantains (1.69%), oil and seeds (2.86) and vegetables (3.31%). When the 1995-1997 period contributions are compared to the initial period of 1970-1974, the situation for the least contributors seems to indicate very minimal changes. However, the gap between the largest contributors had widened significantly. Variability in the contributions to aggregate agricultural productivity among the individual crops was also highest among the three largest contributors - tubers, grains and perennials. Vegetables, which are one of the least contributors to total agricultural productivity, tended to show declining productivity during the 1995-1997 period. The production is undertaken by traditional production modes which have over the years developed with minimum adjustments to the limits set by the environment. Overall, vegetables also constitute an important crop in the farming system as they are grown both in sole and mixed crop production systems.

Table 2 presents the different types of vegetables that are grown in the five geographical zones of the country and the leading state producers in each of the zones. From the table it can be seen that the production of vegetables such as lettuce, onion, watermelon, tomato, potato and cucumber are concentrated in the savanna sub-zones (Sahel, Sudan and Guinea). The production of waterleaf (*Talinum triangulare* wild), avocados, maize, green amaranth (*Amaranthus*) and pumpkin is concentrated in the tropical high forest and the swamps. In the savanna sub-zones, production is dependent mainly on irrigation while production is

rainfed in the tropical and mangrove forest areas, and in fadama like soils during dry seasons. In fact, the advantage of irrigation facilities in the savanna sub-zones partly accounts for the relatively large vegetable farms in the area when compared to the tropical and mangrove zones.

Although a good number of studies on agronomic practices in vegetable production is central to these discussions and many studies have germinated in Asia and Africa ^{3, 6, 12, 13}, there is little empirical research on economic returns from these vegetable crops. In fact, for telferia particularly, its production practices, processing and marketing have received negligible attention. Yet vegetable crops are grown by nearly all the farm families in the humid tropical zone of Nigeria. What one finds in the existing literature is related more to the kind of studies identified earlier in rural practices. Yet, the majority (over 85%) of the extreme poor who live both in micropolitan and macropolitan cities in the tropical high and mangrove forest and practice farming are not only women, and pumpkin is grown either as sole crop or in some mixed combinations with other crops.

Therefore, if the fight to alleviate poverty is to be won and sustainable farm family incomes are to be enhanced in this region, the need to evolve studies beyond the crop agronomic patterns must be undertaken, especially for crops that form the fulcrum of production of the extreme poor ^{4, 5}. The objectives of this paper are therefore three-fold and explicitly focus on: 1) identifying relevant factors which influence pumpkin production with the aim of determining their explicit production cost, 2) estimating the returns and gross margins as well as other performance indicators associated with pumpkin production in sole crop farms and 3) making recommendation for sustainable pumpkin production that could enhance the income capacity of these pumpkin producers above average income in the humid tropical environment of Nigeria.

Table 1. Percentage contribution of agricultural commodities by group to total agricultural productivity in Nigeria (1970-1997).

S/No	Crops	1970-74	1975-79	1980-84	1985-89	1990-94	1995-97
1	Perennials	15.84	26.23	27.85	16.34	11.46	9.36
2	Vegetables	3.73	4.22	3.83	2.67	16.34	2.31
3	Grains	29.43	28.30	30.71	32.15	25.12	24.87
4	Tubers	42.51	34.01	30.74	43.82	56.44	57.60
5	Oil and seeds	5.23	3.18	3.55	2.65	2.16	2.86
6	Plantain	3.16	4.04	4.03	2.35	1.74	1.69

Source: Adapted from Central Bank of Nigeria (CBN) Statistical Bulletin, Vol. 7, No. 1, June 1996, pp. 124-125 and CBN (Bullion) Vol. 24, No. 3, July/September, 2000.

Table 2. Geographical zones of vegetable growing areas in Nigeria.

Zone	Crops	Leading producers (States)
Sahel savanna	Lettuce, onion	Borno, Yobe
Sudan savanna	Watermelon, carrot, tomato	Katsina, Kano, Kaduna, Bauchi, Gombe, Sokoto, Zamfara
Guinea savanna	Onion, watermelon, tomato, maize, potato, cucumber	Plateau, Niger, Adamawa, Kwara, Taraba, Benue, Nasarawa
Tropical high forest	Waterleaf, green amaranth, pumpkin, avocado, maize	Cross River, Anambra, Kogi, Ekiti, Osun, Oyo, Ogun
Mangrove	Waterleaf, pumpkin, garden egg	Lagos, Delta, Bayelsa, Rivers, Akwa Ibom

Source: Compilation based on various resource and population maps of Nigeria.

Methodology

The production function stipulates the relationship between resources and output. This forms the basis for determining the levels of resources that are used to produce various levels of output, which in turn are used to obtain the explicit cost production data. The output (s) when defined and in the presence of known output prices determine the revenues arising from the production process⁸. Information from the cost and the total value data are compared to obtain the gross margins. When the total variable production costs are subtracted from the total revenue data the gross margin is obtained and when the total cost are subtracted from the total revenue data, profits from the farm enterprise are obtained. Mathematically, the above discussions can be summarized thus:

where GM = gross margin, TVP = total value product, TT = profit, TVC = total variable cost, TC = total cost, Σ = summation of all the values of resources used in production while in the case of cost it is the summation of all the values of inputs expended to produce the output. $N = 1, 2, \dots, n$ = total number of resources used or output produced from the given bundle of resources.

Quite a good number of studies have concentrated on determining factors which affect agricultural productivity^{1,2}. All these studies have shown the underlisted factors specified below as being contributory to agricultural factor productivity. These include technology, climate, inputs and their associated prices as well as policy formulation and implementation.

The effect of factors such as farm size, labour, fertilizer use, seed cost and capital on total productivity of telferia are being investigate in this study. These factors, to a large extent, are internal to the farm and severely affect the production system. One factor

credit (capital) however, has both internal and external implications. The implicit form of the regression model used to capture these factors is as presented below:

$$TELO = (TELAND, TELAB, TEFAP, TELSED, TELCRE) \quad (3)$$

TELQ = (TELAND, TELAB, TELPA, TELSED, TELCRE) (3), where TELQ= output of telferia per farmer in kg, TELAND= farm size per farmer (hectares), TELAB=labour in mandays used in production per farmer, TELSED= seed cost per farmer in Naira, TELCRE= cash available (credit) for operational expense per farmer in Naira. In explicit form:

$$\text{TELQ} = B_0 + B_1 \text{TELAND} + B_2 \text{TELAB} + B_3 \text{TEFAP} + B_4 \text{TELSED} + B_5 \text{TELCRE} + E_{\text{L}} \dots \quad (4)$$

In this study, farm level data on resource use, prices and output were obtained from 150 farmers, located over the entire hot humid tropical zones identified in Table 2. Specifically, information were obtained from selected farmers residing in Calabar North and South, Odukpani, Akpabuyo Local Government areas in Cross River State and Uyo, Eket and Ikot Ekpene Local Government areas in Akwa Ibom State. The population frame was obtained from the Cross River State Agricultural Development Project (CRADP) and Akwa Ibom Agricultural Development Project (AKADEP). The study lasted for over one year and covered both the rainfed and dry season production systems. The farmers were selected purposefully based on the fact that they practice both types of cropping systems. Equations (1) and (2) presented above are used to achieve objectives (2) and part of (1) while equation (4) is used to ascertain factors which influence telferia production in the area of study.

Results and Discussion

Socio-economic characteristics of telferia growers (Table 3) indicate that over 93% of the telferia growers are women. Cultivation during the rainfed season is predominantly in personal farms as well as in farms identified as belonging to their husbands (for the married women) and in the combinations shown in Table 3. During the dry season, however, production is in fadama-like soils and on soils close enough to stream/rivers or wells where watering cans can

Table 3. Selected characteristics of telferia growers in Cross River and Akwa Ibom States.

S/N	Characteristics	Frequency	Percentage (%)
1	SEX DISTRIBUTION		
	Male	10	6.7
	Female	140	93.3
2	AGE DISTRIBUTION		
	20	10	6.3
	21 – 30	20	13.3
	31 – 40	45	30.0
	41 – 50	49	32.7
	50	26	17.3
3	MARITAL STATUS		
	Married	90	60.0
	Widow/Divorced	40	26.7
	Single	20	13.3
4	MAJOR CROP COMBINATION OF FARMERS		
	Yam/Cassava/Maize/Vegetables +	50	33.3
	Cassava/Maize/Melon/Vegetables +	60	40.0
	Yam/Melon/vegetables +	50	33.3
	Cocoyam/Melon/Maize/Vegetables +	60	40.0
	Telferia/Waterleaf/Maize	40	26.7
	Telferia/Cassava*/Pepper	30	29
	Telferia +	1	100
5	FERTILIZER SOURCES		
	Open market	50	33.3
	CRADP/Ministry of Agriculture	80	53.3
	Does not apply fertilizer	20	13.4
6	EDUCATIONAL LEVEL		
	Less than or completed primary school	70	46.7
	Greater than primary school but less than WACS/TC II	40	26.7
	WASC/TCII but less than OND/NCE	10	6.7
	NCE/OND	20	13.2
	Tertiary institution	10	6.7

% is more than 100 because farmers involved grow multiple combinations in their farms. All the interviewed farmers had to have at least one combination of telferia farm before they are included in the sample. It is this group which constituted the basis for this analysis. Sources: From 2000 population sample of telferia farms used for the study.

be used for water supply. No irrigation facilities exist in the entire area. Table 3 also shows that married couples and widowed/divorced women constitute the bulk of telferia growers and those in the age brackets of 31 through 50 years account for over 63% of its production. Educationally, majority of them are illiterates as over 70% of them have not gone beyond primary school education. Evidence from this table tends to support the following: 1) telferia production is an important agricultural production activity for women in the zone and since it is grown all year round it can be used to spread farm family incomes for this group of farmers throughout the year and 2) the crop can be used as a basis for evolving realistic policies that will improve the income capacities of these rural poor because of its dominance in the various identified crop combinations. Policies, for instance, geared towards assisting these farmers to reduce losses through adequate storage facilities and efficient transportation network to ensure timely delivery of the output in areas of high demand if developed could result in higher average prices for the farmers which in turn could generate higher (increased) income for this group of farmers.

Table 4 examines the various sources of resource acquisition by telferia growers in the area. The major sources for land, seeds, labour, credit and fertilizer respectively are from lease (53.3%), open market (43.3%), family labour (60%), own savings (100%) and both the Ministry of Agriculture and open markets 40%. The major handicaps to sustainable farm expansion are embedded in the structure, conduct and performance of indigenous traditional farming system. This study reveals that these farmers are credit short and are constrained from expanding their operations, especially in the dry season because of lack of irrigation facilities. Labour migration to urban cities in search of better job opportunities and the increasing school enrollments that involve teenagers who constitute the bulk of teenage farm family labour is causing changes in the structure and composition of labour

Table 4. Source of telferia resource acquisition by farmers.

S/No	Source	Frequency	Percentage
1	LAND		
	Inheritance	30	13.3
	Purchase	10	6.7
	Lease	80	53.3
	Share cropping	30	13.3
	Gift	10	6.7
2	PLANTING SEEDS		
	Open market	65	43.3
	Friends/Relatives	25	16.7
	CRADP/Min. of Agriculture	0	0
	From previous year's yield	60	40.0
3	NUMBER OF FARM PLOTS		
	1	20	13.3
	2	75	50.0
	3	40	26.7
	4	15	10
4	LABOUR		
	Family labour only	90	60
	Family labour + Hired labour	45	30
	Hired labour only	15	10
5	CREDIT		
	Own savings	150	100
	Osusu (informal)	50	33.3
	Bank (formal)	-	-
6	FERTILIZER**		
	Open market	20	13.3
	GRADP/Min. of Agriculture	30	20.0
	Both sources above	60	40.0
	Does not apply	30	20.0

**Used more than one source to procure their fertilizer resources.

Source: From 2000 population sample of telferia farmers used for the study.

available for the farming system in general and the telferia industry in particular.

Costs and returns (value) of telferia production: Table 5 presents information on the explicit cost of production on a per hectare basis. From the table, it can be seen that fixed and variable costs constitute 24.96% and 54.70% of the total cost (a little over 75% of total cost) of production respectively. The estimate for variable cost of production found in this study is at variance with those estimated from other studies for other agricultural crops⁸⁻¹¹. This difference is probably due to the labour intensive nature of production because this factor alone accounts for over 54% of the total production cost. On the whole, the total cost of production as shown in Table 5 was ₦34,367 per hectare. Table 6, on the other hand, presents information on the value of telferia production. From the table, it can be discerned that the value of production was from two sources i.e., sale of the leafy part of telferia and pods. From the sale of the telferia leaves which was harvested in ten batches over the production span, a total of ₦45,175 was realized while the pods generated ₦9,000. Total revenue from one ha of telferia farm was then a combined total of ₦54,775. Based on the results of Tables 5-7 performance indicators were obtained. The gross margin/ha was ₦28,975 and profits/ha ₦20,408. Other indicators investigated were the benefit/cost ratio, profit margin and rate of capital turnover. The benefit cost ratio was 1.59 which shows that the telferia enterprise was able to cover its cost of production since the enterprise was able to generate more income than its cost. In fact, the profit margin indicated that 37 Kobo was profit from every one Naira of value generated. The rate of turn-over was 81%. All these indicators show that telferia production is a viable production enterprise. Based on the above findings, it is our suggestion that since over 85% of the peasant poor are engaged in agriculture and practice telferia farming,

Table 5. Production cost per ha of telferia farm at 2001 market prices.

S/No	Item description	Unit cost	Total cost	% of total
1	AVERAGE FIXED RESOURCE COST (FRC)			
	a) Land*	5,000		
	b) Equipment**	3,567	8,567	24.9
2	AVERAGE VARIABLE RESOURCE COST (VRC) ⁺			
	Labour			
	a) Land clearing	3,000		
	b) Land preparation	4,200		
	c) Sowing	600		
	d) Wedding	6,000		
	e) Harvesting/Assembling	2,000	18,800	54.7
3	AVERAGE FERTILIZER COST			
	a) Chemical	4,500		
	b) Manure (poultry and others)	1,000	5,500	16.0
4	AVERAGE SEED COST		1,500	4.4
	Average total variable cost		25,800	75.1
	Total cost		34,367	100

*Calculated based on the opportunity cost of leasing on an annual basis in the area.

**Equipment cost includes hoes, knives, cutlass, basins, baskets and spades with a mean useful life span of two years, except for hoes and basins where straightline method depreciation was adopted.

+Land clearing and preparation were estimated at ₦150 per manday while sowing and harvesting were based on ₦100 per manday. Source: From 2000 population sample of telferia farmers used for the study.

Table 6. Value of production per ha of telferia based on 2001 market prices (₦).

Batch*	Unit of measurement	Unit cost	Output	Total revenue ₦
1	kg	30	30	900
2	kg	35	80	2,800
3	kg	30	120	3,600
4	kg	25	180	4,500
5	kg	20	300	6,000
6	kg	20	650	13,000
7	Kg	15	450	6,750
8	kg	20	300	6,000
9	kg	20	140	2,800
10	kg	25	120	3,000
11	kg	35	35	1,225
	Pods	80	120	<u>9,600</u>
				<u>54,775</u>

*Approximately ten harvests were done with the first one beginning after three weeks of planting and thereafter every four to five weeks. First harvest was carried out during the second week in April. About 80% of the pods are marketed while the balance is left for planting in the next season. Average number of pods produced a per ha is 150. Source: From 2000 population sample of telferia farmers used for the study.

Table 7. Performance indicators from telferia production.

S/NO	Indicator	Performance
1	Gross margin	₦28,975/ha
2	Profit*	₦ 20,408/ha
3	Benefit/Cost ratio	1.59
4	Profit margin	₦ 0.37
5	Rate of capital turn-over (%) ⁺	81

*Profits/ha was assumed to be equivalent to return to total assets which was then used to estimate the profit margin. ⁺Total farm assets were estimated based on the remaining value of the assets utilized in production.

Source: Survey Data

policies should be designed to expand and encourage production of telferia if the standard of living of the rural population is to be enhanced. Policies for sustainable development in this direction are the provision of an accessible credit delivery network at affordable interest rates, an efficient transportation system to transfer output from the surplus to deficit areas as well as opening up land markets which hitherto had been beyond the reach of the women farmers who are responsible for telferia production.

Regression results: Three functional forms (linear, semi-log and Cobb-Douglas) were estimated and the results are presented in Table 8. The Cobb-Douglas function was selected as the lead equation because of the magnitude of the coefficients, signing of the parameters and other statistical properties of the model that were superior to the other models specified in the study. For example, in this model the coefficient of multiple determination (R^2) which shows the goodness of fit and the level of variability in telferia output that is explained by the explanatory variables was highest when compared to the other models used. Also the

Table 8. OLS estimates of the influence of the selected factors on telfaria production.

Model type (Functional forms)			
Variables (1)	Linear(2)	Semi-log (3)	Cobb-Douglas (4)
Constant (B_0)	262.21* (106.26)	56.821* (19.421)	2.641* (0.064)
Farm size (B_1)	7857* (0.1256)	2.593** (1.644)	.8294* (0.0241)
Labour (B_2)	325.204 (494.20)	1.66* (0.608)	.686* (0.0042)
Fertilizer (B_3)	-28.921 (21.46)	1.286 (1.078)	-2.67** (1.6)
Seed cost (B_4)	-98.54* (38.631)	-1.903* (0.034)	-0.0219* (0.012)
Credit (B_5)	519.85 (402.62)	1.844* (0.567)	2.12** (0.108)
R^2	0.651	0.758	0.873
R^2	612	0.721	0.835
F	22.61	32.25	39.34
Quasi function	718.47	65.710	0.9435

Values in parentheses are standard errors of the coefficients.

*Coefficient significant at the 1% level

**Coefficient significant at the 5% level

Source: Analysis from survey data

F-statistics, which shows the overall fitness of the model, was highest for the Cobb-Douglas functional form. The results of the quasi-function indicate that telferia production enterprises are decreasing returns to scale farm enterprises in the Cobb-Douglas model. From this table (column 4), it can be seen also that farm size, aggregate labour and seed cost were each significant at the 1% level while fertilizer and credit were significant at the 5% level. In fact, the signs on fertilizer and seed cost coefficients were negative implying that an increase in any one of them will result in the reduction of telferia output. On the other hand, expansion of farm size, increase in labour supply and credit are critical variables that will stimulate production increases.

Recommendations and Conclusions

A number of recommendations emanates from the study. First, since about 93% of telferia farmers in the area are women and over 85% of the poor live in micropolitan areas and are women there is

therefore the need to evolve programmes and policies based on telferia production enterprises so as to enhance the incomes of not only the rural poor but also women. The current initiatives to eradicate poverty can be achieved by designing programmes for telferia production expansion. Similar programmes could also be applied to macropolitan farmers since majority of them produces telferia and constitutes a substantial proportion of the urban farmers in small scattered plots. Specific programmes to achieve the above recommendations should be based on improving and supplying the critical factors such as credit, land and labour in telferia production as they constitute serious bottlenecks to farm expansion. The study also showed the complete absence of irrigation facilities and therefore suggests the need to assist these farmers to acquire this essential input particularly in the dry season when the demand for vegetables is relatively high.

Secondly, there is the need for the government to provide facilitative structures such as improved market information flow, good road network and adequate transportation (specific to vegetables) so as to carry the product from the rural areas to the far away markets where the demand is high. In fact, because of the perishable nature of vegetables, the percentage of spoilage is high and farmers suffer severe losses. Attempts to assist them in this direction is therefore a sine-qua-non.

Thirdly, telferia growers should organize themselves into cooperative associations to manage the production, processing and marketing of their products with the aim of using these structures to seek for loans from the formal sector, especially the special group lending schemes of the Central Bank of Nigeria. Finally, since a large proportion of the vegetables is sold off the farm under conditions of near perfect competition in the face of organized oligopsonistic markets (buyers) who transport the product to far away markets, the farmers should organize themselves as well, so as to have some market power that will enable them to bargain for relatively higher and more remunerative prices.

In conclusion, adoption of these recommendations could go along way towards enhancing incomes of telferia farmers, thus contributing to poverty reduction and increased agricultural productivity.

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