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Determinants of Commercial Production of Wet and Dry Seasons Telferia in Eleme, Nigeria

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Abstract: *The study assessed the predictors of commercial scale outputs in wet season vis-à-vis dry season telferia farming. One hundred (100) respondents were drawn using a multistage random sampling technique from farming communities in Eleme, Nigeria. Logistic regression model was adjudged appropriate for the analysis. Results of this analysis showed that women were more likely to produce the vegetable in commercial quantities and more so in the wet season than in dry season. Increased inputs of family labour hours in wet season resulted in marketable surplus whereas extra costs in terms of hired labour was required to produce on a commercial scale in the dry season. Whereas increased seed cost shrank output to subsistence level in wet season, increased sales price motivated commercial production of telferia in dry season. Also, educational experience influenced the choice of commercial scale production in both seasons.*

Keywords: *production, sale, season, surplus, telferia.*

1. Introduction

Telfairia occidentalis commonly called fluted pumpkin is a tropical vine grown in the rain forest zone of West Africa, particularly in southern part of Nigeria. It is mainly cultivated as a leafy vegetable and it is used primarily in soups and herbal medicines or pot herbs (Irvine, 1969). The leaf is of high nutritional, medicinal and industrial values. It is rich in protein (29%), fat (18%), vitamins and minerals (20%). It contains high levels of potassium and iron (Akoroda, 1990), including significant amounts of antioxidants as well as hepato-protective and antimicrobial properties (Nwanna, 2008). Thus, fluted pumpkin contributes reasonably to households nutrition and to livestock rations in Nigeria.

Aside its role as a major source of essential nutrients in diets of Nigerian people, it is serve as a means of livelihood for numerous farmers, especially women who produce and sell the vegetable. In spite of the lofty potential of the vegetable, its supply can barely match the growing consumption of the Nigeria populace. Per capita vegetables and fruits intake in Nigeria is still less than the 400g per day recommended by the World Health Organization as the minimum requirement for the growth and development of the body (Mirmiran, 2009). Moreover, farmers who depend on vegetable as a source of livelihood still live on low and unstable incomes. This problem may be linked to the fact that vegetables are highly perishable due to their short shelf life resulting in sales at reduced prices in a bid to avoid wastage or incurring losses. This situation is often the case in the wet season when vegetable supplies often outstrip immediate demands. Worse still, the storability of vegetables until when needed is often very low in the wet season. Poor storability of fluted pumpkin presents a case in point for the dearth of processing and storage facilities accentuated by poor electricity supply in Nigeria. Although prices of vegetables are high during the dry season, it benefit only a few farmers because the majority opt out of dry season vegetable farming because of high costs of artificial irrigation and hired labour. Consequently, there is a growing need not only for increased fluted pumpkin production, but also the need for a better way to utilise resources, be it human, material and environmental resources at the vegetable farmers' disposal to maximize the livelihood goal.

From the perspective of environmental resources, a step forward in strengthening the role of fluted pumpkin in Nigerian economy is to analyse the seasonal gap that exists in its production due to weather variations with a view to tackling the problem. An investigation of the extent to which certain factors alter outputs differently in wet and dry seasons vegetable production is necessary. It will be necessary because studies that established seasonality as a fundamental problem in vegetable production have not clearly identified determinants of wet season fluted pumpkin outputs vis-à-vis determinants of dry season fluted pumpkin outputs in Nigeria. In order to achieve this, this research determined and compared factors of wet vis-à-vis factors of dry season vegetable outputs. Preliminary steps were, comparison of farm sizes of wet season and dry season vegetable farmers, comparison of wet season and dry season outputs of vegetable farmers, and comparison of wet season and dry season vegetable sales prices.

2. METHODOLOGY

The study was carried out in Eleme, one of the 23 Local Government Areas (LGAs) in Rivers State, Nigeria. The LGA which has two clans, the Odido and the Nchia, is situated east of the Port Harcourt LGA. Eleme covers an area of 138 km^2 and had a population of 190,884 as at the 2006 national population census. Agriculture is the traditional occupation of the Eleme people and predominant crops grown in the area include yams, cassava, oil palm, bitter leaf and fluted pumpkin (telferia). Agriculture is predominantly practised at subsistence scale with surpluses traded at town markets. Eleme is a centre of trade as it has two of Nigeria's petroleum refineries and one of Nigeria's busiest sea ports and the largest sea port in West Africa located at Onne, a famous town with numerous industries. The increasing and competing demands for vegetables by the mass of industrial workers and the rural dwellers themselves make the choice of this study area apt.

A multistage random sampling technique was used in selecting respondents from this study area. In the first stage, five communities were randomly selected from a total of the ten communities in Eleme. In the second stage, 20 fluted pumpkin (telferia) farmers were randomly selected from each of the five communities to give a total of 100 respondents for the study. Questionnaires were administered to the respondents to collect data. Data collected include: the famers' demographic characteristics, farm size in hectares, outputs in bundles of telferia (0.5kg each), sales prices, costs components of vegetable production, etc. Each respondent provided telferia production data for wet and dry seasons separately. Method of data analyses included descriptive statistics, two independent samples t-test, and logistic regression model.

The relationship analysed was adjudged to be intrinsically nonlinear in the parameters. Non linearity may be associated with the fact that small changes in telferia output are not necessarily a function of proportionate changes in independent variables (changes in the farmer's socioeconomic characteristics). However, large changes, for example, a drift from subsistence level of telferia production to commercial level production may be significantly attributed to changes in the farmer's socioeconomic variables specified in the model (7). Based on the preceding hypothesis, a nonlinear function within the framework of a binary response model was employed in analysis. This choice was feasible based on availability of binary dependent variable retrieved from the qualitative responses of the sampled respondents.

The qualitative responses described whether the respondents had large enough outputs that made for marketable surpluses in the particular season of concern or whether they produced only small quantities for subsistence in the given season. A value of 1 was assigned if the qualitative response was commercial level of telferia outputs and 0 if it was subsistence level of telferia outputs. These values conformed to the logit model in which the dependent variable is usually binary or dichotomous and takes one of the two possible responses or values. While still serving as proxies for the quantitative output levels, the binary dependent variable provided appropriate alternative for modeling the relationship that could not be explained by the multiple regression model.

The binary dependent variable is determined by a set of observable predictors (households demographic variables and variables of telferia production). The values of these predictors vary across these observations, accounting for the variation in the response probability of the dependent variable. Drawing from Gujarati's (2004) illustrations, a nonlinear probability (logit) model defining the categorised output level in wet or dry season telferia production was specified as:

$$P_i = E\left(Y = {}^{1}/_{X_i}\right) = \frac{1}{1+e^{-(\beta_0+\beta_1 X_i)}} \quad (1)$$

Where , X_i is array of the explanatory variables and $Y = 1$ implies that the farmer produced saleable surplus of telferia in the given season. For clarity, eqn (1) was represented as:

$$P_i = \frac{1}{1+e^{-Z_i}} = \frac{e^{Z_i}}{1+e^{Z_i}} \quad (2)$$

Where: $Zi = \beta 0 + \beta 1Xi$.

Eqn (2) denotes the (cumulative) logistic distribution function. It can be proven that as Z_i ranges from $-\infty$ to $+\infty$, P_i ranges between 0 and 1 and that P_i is nonlinearly related to Z_i (i.e., X_i). If P_i, the probability that a farmer produced saleable surplus , is given by Eqn(2), then $(1 - P_i)$, the probability that a farmer produced only for subsistence, is

$$1 - P_i = \frac{1}{1+e^{-Z_i}} \quad (3)$$

Hence, it was noted that:

$$\frac{P_i}{1-P_i} = \frac{1+e^{Z_i}}{1+e^{-Z_i}} = e^{Z_i} \quad (4)$$

Now $P_i/(1 - P_i)$ is simply the odds ratio in favor of producing a saleable surplus in the given season—the ratio of the probability that a farmer produced a saleable surplus to the probability that the farmer produced only for subsistence. Thus, if $P_i = 0.8$, it means that odds are 4 to 1 in favour of the farmer producing a saleable surplus in the given season. Now if we take the natural log of eqn. (4), we obtain a very interesting result, namely,

$$L_i = \ln\left(\frac{P_i}{1-P_i}\right) = Z_i \quad (5)$$
$$= \beta_0 + \beta_1 X_i$$

that is, L, the log of the odds ratio, is not only linear in X, but also (from the estimation viewpoint) linear in the parameters. L_i is called the logit, and hence the name logit model for models like eqn. (5).

For estimation purposes, we write eqn. (5) as follows:

$$L_i = \ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 X_i + \mu_i \quad (6)$$

To estimate (6), we need, apart from X_i, the values of the regressand, or logit, L_i. This depends on the type of data we have for analysis. We distinguish two types of data: (i) data at the individual, or micro, level which was the case in this study, and (ii) grouped or replicated data. Therefore, if we have data at the micro, or individual, level, we cannot estimate eqn (6) by the standard OLS routine. An appropriate solution is to use the maximum likelihood (ML) method to estimate the parameters. The software package, STATA 12.0 used in this study have inbuilt routines including ML method to estimate logit model at the individual level.

Explicitly, the logit transformation (6) for the probability of telferia being produced on a commercial scale was specified as:

$$\ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \mu \quad (7)$$

Where:

$\ln\left(\frac{P_i}{1-P_i}\right)$ = natural log of the odds ratio in favour of producing a saleable surplus in the given season as illustrated earlier

X_1= Age of the farmer (years)

X_2 = Educational level of the farmer (years)

X_3 = Gender (1= male, 0 = female)

X_4 = Marital Status (1= married, 0 = single)

X_5 = Price in the given season (₦)

X_6 = Farm size (hectares) in the given season

X_7 = Labour/ hours (man-days)

X_8 = Labour cost

X_9 = Pod cost (₦)

X_{10} = Seed cost (₦)

X_{11} = Fertilizer (kg)

µ = Stochastic term

Apriori, X_1,……, X_{11}>0,

Decision rule: accept if $H_o < 0.1$, otherwise reject

3. Results and Discussions

Figure 1 present a descriptive statistics of the socioeconomic characteristics of the sampled telferia farmers. Eighty two percent (82%) of the telferia farmers were women implying that telferia farming is a gender skewed occupation in the area. Also, most (76%) of them were married and surprisingly, majority (65%) of them were principally engaged in non-farming occupation. Thus, telferia production was a secondary occupation to augment main source of income. Perhaps of the farmers majority (75%) did not employ irrigation technology because it was merely a secondary occupation. Majority (67%) produced marketable surplus (0.5 to 1.0 tonnes) of vegetable in the wet season whereas only 42% of the famers produced commercial quantities in the dry season.

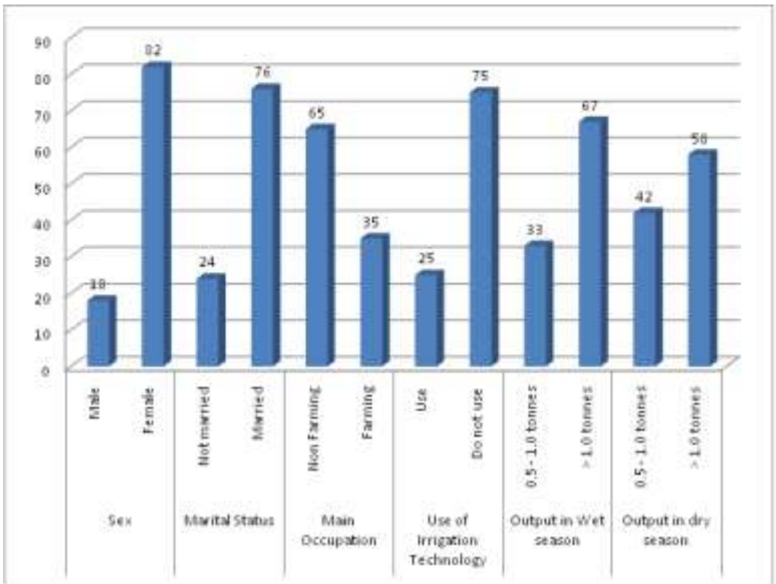

Figure1. *Descriptive statistics of socioeconomic variables by percent of respondents*

Source: *Microsoft Excel analysis from field survey data, 2015*

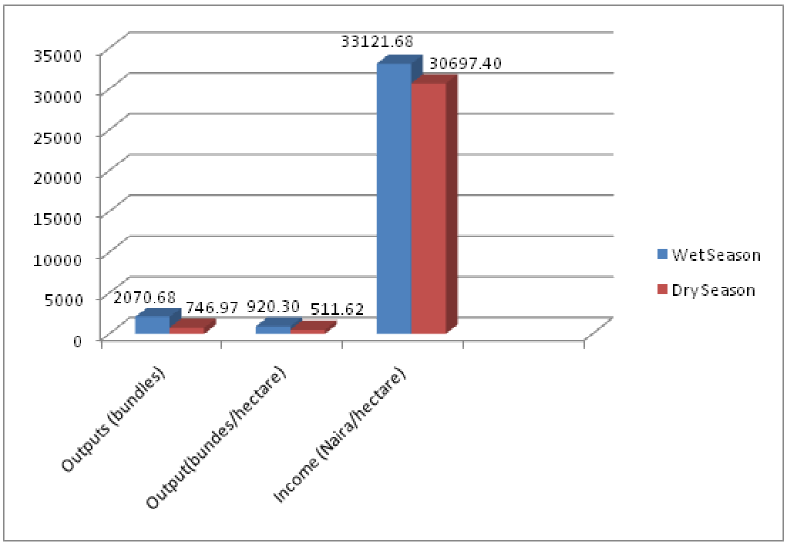

Figure2. *Comparative Statistics of the Economic Outcomes of Wet versus Dry Season Fluted Pumpkin Production*

Source: *Microsoft Excel analysis from field survey data, 2015*

Figure 2 depicts that the average size of land cultivated in the wet season was 2.25 hectares. This size was significantly (t=8.45 at 0.01level) greater than the mean size of land cultivated in dry season (1.46 hectares). Also there was significant difference (t= 43. 60 at 0.01 level) in the means vegetable outputs produced in the wet season (2070.68 bundles) and dry season (746.97 bundles). Each bundle weighed an average of 0.5kg. Comparing weighted averages of the output and sales on per hectare basis showed further that there is distinction in wet and dry season outputs. Greater outputs in the wet season could be associated with favourable weather (abundant rainfall) which contrasted with drought in the dry season necessitating use of irrigation which most (75%) of the farmers could not afford. The statistics is in line with Moti's (2007) findings which affirmed that season of the year has a tremendous effect on the output of vegetable produced.

3.1. Determinants of Marketable Surplus in Wet Versus Dry Season Telferia Production

Table 1 presents results of the logistic regression model. The table highlights the determinants of farmer's output of marketable surplus in wet season *vis a vis* determinants of marketable surplus in dry season telferia production. Given log likelihood statistics, 63.37 and 70.58 of wet and dry season respectively which were significant at 0.01 level it can be inferred that all the predictors in each of the two models have a joint and significant effect on the farmers decision to produce marketable surplus as against subsistence production. The Psudo R^2 values of both seasons 0.4583 and 0.5115 can be rounded off to 1 in each case, implying that the log odd in favour of commercial scale of telferia production is significant.

Table1. *Logistic regression results identifying determinants of wet season versus dry season telferia outputs*

	Wet season		**Dry Season**	
Variable name	**Coefficient**	**Z-test**	**Coefficient**	**Z-test**
Age	-0.0265	-0.89	0.0144	0.46
Education	0.4199	4.59*	0.3970	4.34*
Gender	2.8508	2.89*	3.7310	3.19*
Marital status	0.1529	0.18	-0.6663	-0.07
Sales price	-0.0527	-1.29	0.0363	1.74***
Farm size	0.9718	1.32	-0.2142	-0.43
Labour hours	1.3281	2.08**	0.6929	0.96
Labour cost	0.0008	0.47	0.0042	1.96*
Pod cost	0.0024	0.87	-0.0004	-0.015
Seed cost	-0.0153	-2.19**	-0.0100	-1.46
Fertilizer cost	0.0006	0.24	0.0315	0.03
Constant	-6.1913	1.14	-10.4229	-3.22
Pseudo-R	***0.4583***		***0.5115***	
Likelihood Ratio	***63.37****		***70.58****	

**0.01 significant level, **0.05 significant level, and ***0.1 significant level*

Source: *Results of Stata-12.0 analysis of field survey data, 2015*

The logistic regression results (table 1) showed that; number of years of formal education, gender of the farmer, labour hours input, and seed cost significantly influenced the farmers' choice of level of output. That is, whether a farmer produced telferia in commercial quantity or at subsistence level. Given that the logit estimates based on log of the odds ratio in favour of producing a saleable surplus, antilog of the coefficients of the significant variables gave a better interpretation of the of their predictive power of the likelihood that a farmer produced a marketable surplus of telferia. Antilogarithm of the coefficient (0.4199) of education in wet season production was 1.5218 implying that a telferia farmer with an additional year of educational experience is at least 1.5 times likely to generate marketable surplus as opposed to producing at a subsistence level in the wet season. Again antilog of the coefficient of gender (2.8508) is 17.3016 implying that if the telferia farmer is a woman (dummied as 1) as against being a man (dummied as 0), she is more than 17times likely to produce saleable surplus than a man in the wet season. The antilog of the coefficient (1.3281) of labour hours which was the last significant variable in wet season telferia farming was 3.7738, that is, an additional hour of labour input is approximately 4 times likely to translate into marketable surplus as opposed to subsistence output in wet season telferia production.

In the dry season telferia production, number of years of formal education, gender, labour cost and market price were the significant predictors of the likelihood that a farmer produced on a commercial scale as opposed to subsistence level. An additional year of educational experience is approximately 1.5times (antilog of coefficient of education = 1.4874) likely to yield output on a commercial scale than a subsistence output level. This result affirmed the finding of Ibekwe and Adesope (2010) that education had a positive relationship with dry season telferia outputs at 0.05 level of significance.

This result compares with effect of education on wet season telferia production. If the telferia farmer is a woman, she is approximately 42 times more likely to produce on a commercial scale of output in the dry season than a man, given that the antilog of the coefficient (3.7310) of gender in dry season is 41.7208. A naira increase in labour cost is likely to cause a change from subsistence to commercial production of telferia, given that the antilog of the coefficient (0.0042) of labour costs was 1.0042. Similarly, the antilog of the coefficient of sales price is 1.0370, implying that if the sales price of a bundle of telferia increases by a naira telferia outputs was likely to change from subsistence to commercial level. The results showed that telferia being produced on a commercial scale (either in wet or dry season) is a function of education, gender and labour.

Considering the antilog of the coefficient of gender in relation to those of other regressors in both seasons, it can be inferred that being a woman is the lead determining factor that telferia would be produced on a commercial scale. Further revealing was the fact that gender impact on scale of output was more intense in the dry season than in wet season telferia production. In another way, labour also had a contrasting effect on scale of telferia production in wet season versus dry season. Whereas increased labour hours translated into marketable surplus in wet season production, increased spending on labour (increased labour costs) translated into saleable surplus in dry season production. The difference in labour effects on wet versus dry season output is traceable to the fact that production of marketable surplus in wet season depended on increased use of labour hours contributed by the family whereas production of marketable surplus in dry season depended on increased number of paid labour (higher labour cost). This finding is somewhat in line with those of Dicta, Toritseju and Ewolor (2014) which was essentially resource use efficiency of wet season telferia production in Delta State. Their study found that at 0.05 level of significance, a unit increase in family labour contributed 27 units to telferia outputs whereas increased hired labour had no significant effect on telferia output.

Finally, sales price per bundle of telferia was a significant determinant of the scale of production in the dry season but did not influence scale of output in wet season telferia production. It was expected that increased sales prices in dry season would lead to production on a commercial scale, provided that the telferia producers aimed at profit maximization.

4. Conclusion and Recommendations

Telferia production was essentially a gender based occupation in the study area, women were more likely to produce the vegetable in commercial quantities and more so in the wet season than in dry season. Increased inputs of family labour hours in wet season resulted in marketable surplus whereas extra costs in terms of hired labour was required to produce on a commercial scale in the dry season. Whereas increased seed cost shrank output to subsistence level in wet season, increased sales price motivated commercial production of telferia in dry season. Years of educational experience influenced the choice of commercial scale production in both seasons.

Public enlightenment on the place of vegetables in household food security and income generation is a desideratum and gender focussed interventions is very imperative. Such intervention can be in form of greater outreach of extension services and government agricultural enlightenment programmes. Dry season vegetable output can be increased through increased public investment in irrigation technology to augment telferia farmers' labour cost and place production on increasing levels of commercial scale. Promotion of improved telferia seed multiplication service as an agribusiness venture for upcoming entrepreneurs will reduce the disincentive created by high seed cost on commercial production of telferia.

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