Economic Efficiency Of Fadama Telfairia Production In Imo State Nigeria: A Translog Profit Function Approach

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ECONOMIC EFFICIENCY OF FADAMA TELFAIRIA PRODUCTION IN IMO STATE NIGERIA: A TRANSLOG PROFIT FUNCTION APPROACH

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ABSTRACT

The study delved into economic efficiency analysis of Fadama Telfairia farmers in Imo State, Nigeria. Specifically, it identified the production systems; estimated the economic efficiency and their determinants. A multistage random sampling technique was adopted in the selection of 40 Fadama Telfairia farmers from each of the three agricultural zones of the State. A well-structured questionnaire was used to obtain information on socio - economic characteristics and other relevant variables. Descriptive statistics, which subsume frequencies, means and percentages, were used in the analysis of data on socio – economic characteristics cum production systems. Economic efficiency was analyzed using Translog stochastic profit function. The Maximum Likelihood Estimation Technique was employed in estimating the function while t-test statistic was employed in testing their determinants. With respect to production systems, majority (63.33%) of Fadama *Telfairia* farmers practised mixed vegetable production while 36.67% adopted sole Fadama *Telfairia* cropping system. The profit level was influenced by fertilizer price, wage rate and farm size while efficiency was found to be influenced by age, farming experience, membership of cooperative societies, farm and household sizes. The mean economic efficiency was 0.57 and as such, the average Fadama Telfairia would require a cost saving of 42% in order to attain the profit status of the most economically efficient farmer in the sample. Given the fact that ample opportunity exists for improvement in their efficiency, introduction of birth control policies and reviews of Land Use Act of 1990 are among policy options suggested by the study.

Keywords: economic efficiency, Fadama, stochastic frontier, translog

INTRODUCTION

Food production in sub – Saharan Africa is said to be risky since it is based on rain – fed systems and as such developing countries are faced with the challenge of producing adequate food to satisfy her growing population. This has contributed immensely to a widening gap between food supply and demand [Nweke *et al*, 1994; RMSMN, 1993]. However, efforts in the present problematic rain fed agricultural production need to be complemented through dry season farming. This is absolutely necessary because the productive realm of the small scale producer needs expansion to infuse higher productivity [Ater and Umeh, 2004].

Fadamas- the Hausa name for irrigable land- are floodplains and low-lying areas underlined by shallow aquifers and found along Nigeria's river systems [Ingawa *et al*, 2004]. Fadama lands are regarded as very rich agricultural areas. They encompass land and water resources that could easily be developed for irrigation agriculture [World Bank, 1992]. Fadama land covers about 4.9 million hectares in Nigeria [BSADP, 1994]. When Fadamas spread out over a large area, they are often called 'Wetlands'. Wetlands are recognized by the RAMSAR convention (Ramsar is a place in Iran where the convention was signed), as of worldwide significance, because of the biodiversity they support. Nigeria is a signatory to this convention [Blench and Ingawa, 2004].

As a result of the peculiar hydrological characteristics, Fadama soils have the potential to be used for agricultural production in a sustainable way. Such potential is particularly relevant in view of the degradation of the uplands of Nigeria [World Bank, 1992; BSADP, 1994]. The major crops grown in Fadama are vegetables, wheat and rice with initial bias for vegetables [Olugbemi, 1989]. Vegetables, which are rich sources of vitamins, minerals, carbohydrates, protein and dietary fibres are important to the human diet. A balanced diet should contain 250-325g of vegetables and the average human requirement for vegetable is 285g/person/day for a balanced diet [Attavar, 2000]. Over dependence on rain-fed agriculture has led to seasonal vegetable shortage, fluctuation in vegetable prices, nutritional inadequacy, which dry season vegetable production would have solved [Ayoade, 1988]. Outside Nigeria, where fluted pumpkin is frequently eaten by up to 35 million people, and apart from West Cameroon, it is far less well known and, if so, then mainly for its immature edible seeds rather than for its shoots and leaves.

Telfairia occidentalis otherwise called fluted pumpkin is one of the commonest, popular cut herbs grown in southeastern Nigeria and belongs to the cucurbitaceace family. The crop, which originated from West Africa, is a perennial climber grown for its leaves and seeds, which are very nutritious [Greensill, 1968; Schippers, 2000]. Fluted pumpkins can be cultivated on the flat land or on mounds. In home gardens, they are frequently grown along a fence or next to a tree, thus allowing the fruit to hang from a branch. They are also raised along stakes of various types including bamboo [Akoroda, 1990]. *Telfairia* does best at the lower altitudes and medium to high rainfall and will do well on sandier soil provided fertilizer is applied but has a more robust growth in rich well drained soil. When planting for leaves, the usual spacing is 50 x 50cm for a monocrop or occasionally even closer. Some farmers plant in the middle of a 1.20m- wide bed at 40cm intervals, and others plant on a mound next to a stake. There is a clear need for location- specific plant density trials. When seed supply is not a limiting factor, farmers like to plant two (or three) seeds/hole just in case seeds fail to germinate [Odiaka, 1997]. Nitrogen is essential for adequate vegetation and should ideally be given in the form of manure, applied before planting. The use of well- decomposed manure is essential for fruit production and in this case it is recommended that about 1 kg manure/ plant be applied. For maximum leaf yields, it is advisable to top dress with a nitrogen fertilizer immediately after each harvest. The maturity period for vegetative growth is between one to six months while for fruits, it is 6-8 months. Harvesting of shoots up to 50cm long can begin 1 month after germination followed by 3-4 week intervals when new shoots are formed. Fresh shoot yields is usually about 500-1000kg/harvesting/ha, but could be more if the crop receives adequate manure or when fertilizers are applied after each picking [Akinsami, 1975; Schippers, 2000].

There are four major approaches to measure and estimated efficiency [Dey *et al, 2000*]. These are the non-parametric programming approach , the parametric programming approach [Aigner and Chu, 1968; Ali and Chaudhry, 1990], the deterministic statistical approach [Afriat, 1972; Richmond, 1974; Schmidt, 1976;] and the stochastic frontier production function approach [Aigner *et al*, 1976; Aigner *et al*, 1977; Meeusen and Van Den Broeck, 1977]. Among these, the stochastic frontier production function and non-parametric programming, known as data envelopment analysis (DEA), are the most popular approaches. The stochastic frontier approach is preferred for assessing efficiency in agriculture because of the inherent stochasticity involved. [Fare *et al*, 1985; Kirkley *et al*, 1995; Coelli *et al*, 1998]. Economic efficiency however depends on market forces, which in turn are influenced by the sectoral and marketing policies of the country. However economic efficiency was measured based on the estimation of a Translog profit function in which certain restrictions were imposed [Ali *et al*, 1990]. Empirical literature has shown that efficiency could be measured from a production function or a profit function approaches. The profit function approach is much more helpful when individual or sole enterprises are considered.

MATERIALS AND METHODS

The study area was Imo state Nigeria and lies between latitude between latitude 5^0 10' and 6^0 35' north of equator as well as between longitude 6^0 35' and 7^0 31' east of the Greenwich Meridian. It is wherefore in the tropical rain forest zone. The agroclimate is typically tropical and annual rainfall ranges from 2.0 cm to 2.5 cm per year. The wet season lasts from April to September while the remaining months are dry (Fadama period) when the Fadama cultivation takes are Oguta and Abadaba lakes. There are about 12, 000 farm families in the state [Imo ADP, 1994].

A multistage random sampling technique was used where 40 Fadama Telfairia farmers were selected from each of the three agricultural zones of the state. The data for the study were collected with a well structured questionnaire which subsume quantity of *Telfairia* produced (in kilogram), revenue from the output (in Naira), size of land cultivated (in hectares), labour inputs (in man days), farming experience (in years), other farm costs and materials in *Telfairia* production such as fertilizer both in physical and monetary value. Descriptive statistics were employed in the identification of the production systems. Translog stochastic profit function frontier was used in determining the economic efficiency.

The profit function model for the economic efficiency analysis can be specified as follows:

Π = $\Pi/p = f_i (q_i Z)$ exp e_i ………………………………(i)

e_i = Vi - Ui ……………………………………………(ii)

Where Π = Normalised profit of the ith farm

q_i = Vector of variable inputs

Z = Vector of fixed inputs

e_i = Composite error term

The transcendental logarithmic model for estimating economic efficiency of Fadama *Telfairia* farmers was stated as follows:

$\text{In } \Pi p^* = \text{In } A^* + \alpha_1 *\text{Inq}_1 + \alpha_2 *\text{Inq}_2 + \alpha_3 *\text{Inq}_3 + \alpha_4 *\text{In } q_4 + \alpha_5 *\text{In } q_{5+} 0.5\alpha_{11} *\text{In } (q_1)^2 + 0.5\alpha_{22} *\text{In } (q_2)^2 +0.5\alpha_{33} *\text{In } (q_3)^2 +0.5\alpha_{44} *\text{In } (q_4)^2 + 0.5\alpha_{55} *\text{In } (q_5)^2 + \alpha_{12} *\text{In } (q_1) *\text{In } (q_2) + \alpha_{13} *\text{In } (q_1) *\text{In } (q_3) + \alpha_{14} *\text{In}$

$(q_1) *In (q_4) + \alpha_{15} *In (q_1) *In (q_5) + \alpha_{23} *In (q_2) *In (q_3) + \alpha_{24} *In (q_2) *In (q_4) + \alpha_{25} *In (q_2) *In (q_5) + \alpha_{34}$ $*In (q_3) *In (q_4) + \alpha_{35} *In (q_3) *In (q_5) + \alpha_{45} *In (q_4) *In (q_5) + V_i – U_i$ ……………………………………… ……………………………………………(iii)

Where Πp^* = Normalized profit in Naira per Fadama *Telfairia* farm

q_1^* = Normalized price of seeds in ₦/kg; $\partial\Pi/\partial q_1 < 0$

q_2^* = Normalized price of fertilizer in ₦/kg; $\partial\Pi/\partial q_2 < 0$

q_3^* = Normalized price of labour inputs in ₦/kg; $\partial\Pi/\partial q_3 < 0$

q_4^* = Hectarage of land cultivated (Ha)

q_5^* = Annual depreciation on fixed inputs in Naira

$\in_I$ = Error terms

The choice of translog stochastic profit function was based on its inherent advantage as well as suitability in estimating sole enterprises and analyzing interactions among input variables and the output. The determinants of economic efficiency were modeled in terms of the socio- economic variables of the farmers specified as follows:

$$\mu = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \in_i \quad \text{(iv)}$$

Where:

μ	=	Efficiency of the ith farm
X_1	=	Age of the farmer (in years)
X_2	=	Level of education (in years
X_3	=	Gender of farmer (Male = 1;female = 0)
X_4	=	Farming experience (in years)
X_5	=	Farm size (hectares)
X_6	=	Extension visit (no. of times)
X_7	=	Credit status (Access = 1; no access = 0)
X_8	=	Membership of coop. Societies (Member = 1; non - member = 0)
X_9	=	Household size (no.)
$\in_i$	=	Error terms

The coefficients of unknown parameters are to be estimated by the method of maximum likelihood using the computer program FRONTIER version 4.1 [Coelli, 1994].

RESULTS AND DISCUSSION

The descriptive statistical analysis in table 1 showed that 66.33% of the Fadama farmers practiced mixed vegetable production while 36.67% adopted sole Telfairia cropping system. With percentage representation of 63.33, it implied that majority of the farmers' practiced mixed vegetable production.

The first order explanatory variables depicted that the coefficients for price of fertilizer and wage rate are statistically significant at 1.0% risk level. Given the coefficients, 8.663 and 3.951 for fertilizer and wage rate respectively, the Fadama Telfairia farmers operate in stage one of the classical production function. Consequently, increased procurement of fertilizer and labour demand should be encouraged since the factors are underutilized.

Farm size has a coefficient of 1.212 and that implies that a 1.0% increase in farm size would increase the profit level by 1.212% [Wadud and White, 2000]. Almost all the second order coefficients established strong influence on the farmers' profit level given the fact that their coefficients possessed relatively high t -values except for wage rate/farm size, wage rate/depreciation and farm size/depreciation.

The diagnostic statistics of the translog profit function showed a total variance of 1.423, is statistically significant at 1.0% risk level. This parameter estimates goodness of fit and the correctness of the specified distributional assumption of the composite error term. The estimate of γ (variance ratio) was 0.999 indicating that 99.9% of disturbance in the system is due to inefficiency, one-sided error and therefore 0.10% is due to stochastic disturbance with two-sided error, supported by a high t-value [Fleming *et al*, 2004]. Farmers exhibited varied economic efficiency estimates, ranging from 4 – 99% with a mean of 57% as shown in table 4. The minimum efficiency of 4% showed gross underutilization of resources while the best economically efficient farmer operated almost on the frontier. Furthermore, the percentage of the frontier farmers is 45.33%, which indicates that they are more or less profit maximisers while the non-frontier farmers represented 48.66% of the sampled farmers. There is a yawning gap between the economic efficiency level of best and the worst farmers. To bridge the gap, the average best farmer needs a cost saving of 42.00% ie (1- 0.57/0.99) 100 to attain the frontier while the least of the worst 10 farmers requires a cost saving of 96.00% ie (1 – 0.57/0.99) 100 to become the best efficient farmer in their group. Given the fact that none of the Fadama farmers operated on the frontier (efficiency ratio is less than one), it depicts that more than the profit maximizing level of the input was employed [Onyenweaku and Fabiyi, 1991].

With respect to the efficiency factors in table 3, the coefficients of age and farm size are both statistically significant at 99.0% confidence level and as such agree with a prior expectation that larger farms have higher economic efficiency than smaller ones while increasing age would lead to decrease in efficiency since an ageing farmer would be less energetic to work in the farm [Abaelu, 1998; Akinsami, 1975].

Farming experience has a negative coefficient but statistically significant at 1.0% probability level. The implication is such that Fadama farmers with fewer years of experience achieve higher level of economic efficiency than less experienced farmers whose exposure and receptiveness to new ideas could be responsible for achieving that feat [Ugwu, 1990]. As expected, the coefficients of membership of cooperative and household size are 0.812 and –0.066 respectively. It shows that membership of cooperative has a positive influence on the profit level of the farmer while larger family size brings about decrease in the profit level of the Fadama farmers. Increase in household size may likely engenders consumption oriented farming where much of what is produced is consumed, leaving little or nothing for sale in the market as against popular belief that usefulness of larger household sizes in the farm as work force [Mubarik and Flinn, 1998].

CONCLUSION

Due to paucity of resources and fast consolidated basic idea of "no waste" on which economists have built up a variety of theories, efficiency studies have become very relevant in the new world order. The study that employed stochastic profit function approach has shown that Fadama Telfairia farmers in Imo state, Nigeria are not operating at full economic efficiency level. This could be attributed to larger family sizes, which impose pressure on farmers' output and thus, leaving little or nothing for the market. Among the policy variables identified to have huge influence on efficiency in Fadama Telfairia production are age, farming experience and farm size, which were highly significant. Household size reduced efficiency and as such there is a need to introduce birth control policies as well as encourage the current family planning programme in Nigeria. Review of Land Use Act of 1990 is necessary to ease difficulties associated with land acquisition.

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TABLES

Table 1: Distribution of Fadama Farmers by Production Systems

Production Systems	**Frequency**	**Percentage (%)**
Sole	44	36.67
Mixed	76	63.33
Total	120	100

Source: Field Survey, 2005

Table 2: Translog parameter Estimates For Economic Efficiency

Production Factor	Parameter	Coefficient	Standard Error	t-value
Constant term	β_0	-16.360	0.934	-17.518***
Price of seeds	β_1	0.250	0.484	0.516
Price of Fertilizer	β_2	8.663	0.242	35.819*
Wage Rate	β_3	3.951	0.491	8.046***
Farm size	β_5	1.212	0.460	2.633***
Depreciation	β_5	-0.533	0.568	-0.938
Price of seeds^2	β_{11}	-0.253	0.020	-12.884***
Price of Fertilizer^2	β_{22}	-1.122	0.055	-2.041**
Wage Rate^2	β_{33}	-0.120	0.112	-1.778*
Farm size^2	β_{44}	1.736	0.161	10.761***
Depreciation^2	β_{55}	0.109	0.016	6.807***
P. of seeds x Fertilizer	β_{12}	0.198	0.019	11.737***
P. of seeds x Wage rate	β_{13}	0.206	0.061	3.381***
P. of seeds x Farm size	β_{14}	-1.524	0.078	-19.436***
P. of seed x Depreciation	β_{15}	0.108	0.016	6.940***
P. of Fertilizer x W/ rate	β_{23}	-1.148	0.073	-15.660***
P. of fertilizer x F/ size	β_{24}	0.688	0.198	3.485***
P. of fertilizer x Dep.	β_{25}	-0.040	0.017	-2.373**
Wage Rate x Farm size	β_{34}	-0.002	0.113	-0.022
Wage Rate x Dep.	β_{35}	-0.044	0.093	-0.468
Farm size x Dep.	β_{45}	0.002	0.043	0.054
Diagnostic Statistics				
Log – Likelihood function		69.093		
Total Variance (σ^2)		1.423	0.098	14.578***
Variance Ratio (γ)		0.999	0.0003	31516.515***
LR Test		74.873		

Source: Computed from Survey data, 2005
***, **, * are significant levels at 1.0%, 5.0% and 10.0% respectively

Table 3: Determinants of Economic Efficiency in Fadama Telfairia Production

Variable	Parameter	Coefficient	Standard Error	t-value
Intercept	σ_0	1.483	0.898	1.651*
Age	σ_1	0.028	0.004	6.424***
Education	σ_2	0.004	0.014	0.320
Gender	σ_3	-0.0005	0.002	-0.231
Farming Exp.	σ_4	-0.955	0.227	-4.202***
Farm size	σ_5	0.0006	0.0002	3.090***
Extension Visit	σ_6	-0.002	0.009	-0.209
Credit Access	σ_7	-0.015	0.031	-0.483
M/ship of Coop.	σ_8	0.812	0.271	2.991***
Household size	σ_9	-0.066	0.023	-2.834***

Source: Computed from Survey data, 2005
***, **, * are significant levels at 1.0%, 5.0% and 10.0% respectively

Table 4: Distribution of Economic Efficiency for Fadama Telfairia

Economic Efficiency Range	Frequency	Percentage (%)
0.00 – 0.20	12	10.00
0.21 – 0.40	28	23.33
0.41 – 0.60	29	24.17
0.61 – 0.80	19	15.83
0.81 – 1.00	32	26.67
Total	120	100
Maximum Economic Efficiency =	0.99	
Minimum Economic Efficiency =	0.04	
Mean Economic Efficiency =	0.57	
Mean of Worst 10 =	0.09	
Mean of Best 10 =	0.99	

Source: Computed from Field Survey, 2005