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COST EFFICIENCY OF *PIPER GUINEENSIS* PRODUCTION IN SELECTED LOCAL GOVERNMENT AREAS OF KOGI STATE, NIGERIA

ZIRA B.D.[a*] ● LAWAL S.[a] ● EZEUZO E. B[b]

[a] Department of Forestry and Wildlife, University of Maiduguri, Maiduguri, Borno State

[b] Department of Social and Environmental Forestry, University of Ibadan, Oyo State

*Corresponding Author's email: zirabamidel@unimaid.edu.ng

ABSTRACT: This study examined the Cost Efficiency of Piper guineensis Production in Selected Local Government Area of Kogi State, Nigeria. Descriptive statistics and stochastic frontier production function were used to analyze the primary data collected with the aid of a structured questionnaire. The Results revealed that the estimates sigma squared (σ^2) and Gamma (ϒ) for the cost function was 0.052 and 0.066 and are both statistically significant at 1% level respectively. Cost of labour, seed, manure, fertilizer and agrochemicals were positively significant at 1% probability level, meaning that these factors are significantly different from zero and thus are important in Piper guineensis production. This implies that a 1% increase in the cost of any of these factors will increase total cost by 0. 209, 0.163, 0.066, 0.084 and 0. 118 respectively. Among the various factors affecting inefficiency, marital status, household size, age and access to credit were significant. The marital status of a Piper guineensis farmer can reduce cost inefficiency therefore increasing the cost efficiency of the farmer. An increase in the household size do not play any significant role in reducing the cost inefficiency of Piper guineensis farmers as most Piper guineensis farmers depend on hired labour for their farm practice. However, older farmers are more efficient in Piper guineensis production than younger farmers are while those who have access to credit are more efficient in Piper guineensis production. The cost efficient level of Piper guineensis farmers ranges from 0.51 to 1.00 indicating that all the sampled Piper guineensis farmers in the study area are cost efficient. The Government should also make sure that Piper guineensis farmers get easy access to credit at the right time.

Key words: Cost Efficiency, credit, Piper guineensiss, Production, Kogi, Nigeria

1. INTRODUCTION

Forest, apart from timber, forest contains many useful goods and services of subsistence and commercial value called Non-Timber Forest Products (NTFPs), which sustain the rural people and rural economies**.** It also play a major role in the economy. In spite of the fluctuations in world prices, Forest contributed about 59 percent of the Gross Domestic Product (GDP) and represent almost 70 percent of total exports. The peasant farmers produced enough food to feed the entire population. The various marketing boards generated much revenue the surplus of which was used by government to develop the basic infrastructural need for long term development. However, in subsequent years during and even after the oil boom the forestry sector recorded a very poor performance in terms or Contribution to GDP and employment. Most peasant farmers no longer produce at full capacity. Focus is no longer channel towards efficiency in Non-timber forest product (NTFP) production. One of the major NTFP attributed to this problem is *Piper guineensis*. For instance, the production

of *P. guineensis* in Nigeria started vigorously in 1939 but no effort has been made to improve the efficiency of *P. guineensis* Production. *P. guineensis* is mostly produce in Kogi state, however production is now centered around Adavi and Okehi Local Government Area of Kogi State (KADP.2004). *P. guineensis* also known as climbing black pepper or Benin pepper is of the family piperaceae. The marketable products include leaf, seed and fruit. These woody leafy vegetables are available at strategic periods in the year, namely the dry season, when the conventional cultivated vegetables are scarce. They therefore contribute significantly to the food security and nutritional well-being of the local people in the region (Zira, 2019).

Piper guineensis production in Nigeria is primarily done by small-scale producers, who do not measure their cost efficiency level of Production. The decision makers in forestry have long recognized the importance of *P. guineensis*. Efficiency in resource allocation has a far-reaching impact on the observed farm output level in *P. guineensis* production. The presence of shortfall in efficiency means that output can be increased without using additional conventional inputs and new technology. Efficiency measurement is useful in determining the magnitude of the gains that could be achieved by adopting improved practices in forestry production with a given technology (Zhu, 2000; Tauer, 2001: Rahman. 2015; Armagan, 2008). The millennium development goal of poverty eradication through food sustainability calls for a serious improvement in the efficiency of small scale farmers in food production.

The relative prices of input used for *P. guineensis* production is very important in any farm practice. Profit is the product of price and quantity and *P. guineensis* farmers can maximize profit by minimizing cost. *P. guineensis* farmers should be able to produce their crop at a possible least cost combination, which is the concept of Isoquant and Isocost. This occurs at a point where the isoquant is tangential to the Isocost. If a farmer produces at this point it is said that the farmer is cost efficient in his farming practice. However, inefficiency may arise where a farmer does not produce at the point of possible least cost combination. This inefficiency arises from so many factors, which are beyond the control of the farmers. Adequate information for optimum productivity should be made available to small scale farmers. If this is not done, the farmer will be producing at a production frontier that amount to waste of resources and low level of productivity. (Ogunniyi, 2008; Rahman 2015).
Nigeria ranked sixth in terms of the percentage of total global area of *P. guineensis* under Cultivation but her contribution to total world output is too low compared to other countries. This can be attributed to the fact that most of these areas under cultivation are cultivated by smallholder and traditional farmers who use rudimentary production techniques, with resultant low yields. In spite of the great potentials of *P. guineensis* farming, the Smallholder farmers are constrained by many problems, for instance, it is a known fact that *P. guineensis* farmers in Nigeria consider farming as a way of life, they do not see it as a business enterprise and therefore lost sight of the cost-minimizing motive. In addition, Inefficiency production on the part of the farmers has variously been implicated as forces militating against *P. guineensis* production. In response to the dwindling performance of *P. guineensis* production in the study area, governments have over sometimes initiated numerous policies and programs aimed at reviving *P. guineensis* production. But, as will be evident from analyses in subsequent research, no significant success has been achieved due to the several persistent constraints inhibiting *P. guineensis* farmers in the study area. From the perspective of sustainable forestry growth and development in Nigeria, the most fundamental constraint is the peasant nature of *P. guineensis* production system, with its low productivity, poor response to technology adoption strategies, and poor returns on investment.

Therefore, in an attempt to increase the level of production most *P. guineensis* farmers in the study area adopted different production techniques without knowing the best practice that can increase the level of output at a minimum cost and through efficient input mixed. However, *P. guineensis* enterprises remain one of the main activities in the study area. This is obvious from the fact that it is from this part of the country that above 62% of *P. guineensis* output are exported. The greater percentage of the local people in the study area also depends on *Piper guineensis* farming for their livelihood. It is therefore important to examine the cost efficiency of *Piper guineensis* production in other to provide profound solution on how *P. guineensis* production can be increased through efficient use of available resources. It is in view of this that this study was designed to evaluate the cost efficiency of small-scale *P. guineensis* farmers in selected local government areas of Kogi state. The specific objectives of the study are to:

i) determine the cost efficiency level of *Piper guineensis* farmers in the study area.
ii) examine the determinant of Cost Inefficiency in *Piper guineensis* Enterprises.

1.1. Theoretical and Conceptual Framework

Farrell (1957) provided the impetus for developing the literature on empirical estimation of technical, allocative and economic efficiency. His work led to a better

understanding of the concept of the efficiency. He proposed that the efficiency of a firm consisted of these components: technical, allocative and economic efficiencies. An economically efficient input-output combination would be on both the frontier function and the expansion path. The stochastic frontier production function model for estimating farm level technical efficiency is specified as:

$$Ci = g(Y_i, Y, P_i; \alpha) + \epsilon_i = 1, 2, \ldots : n \quad \ldots\ldots\ldots\ldots (1)$$

Where
C_i represents total production cost, Y_i represents output produced, P_i represent cost of input, α, represents the parameters of the cost function and ϵ_i, represents the error term that is composed of two elements, that is e =V-U, where V, is the symmetric disturbances assumed to be identically, independently and normally distributed as N $(0, \sigma^2 v)$ given the stochastic structure of the frontier. The second component U_i is a one-sided error term that is independent of V_i and is normally distributed as $(0, \sigma^2 u)$, allowing the actual production to fall below the frontier but without attributing all short falls in output from the frontier as inefficiency.

However, because inefficiency is assumed to always increase costs, error components have positive signs. The farm specific Economic Efficiency (EE) is defined as the ratio of minimum observed total production cost(C*) to actual total production cost (C) using the result of equation (2) above. That is:

$$EE = \frac{C*}{C} = \frac{E(ciUi=0,Yi,Pi)}{E(CiUi=YiPi)} = E\,[\exp.(Ui) / \xi] \ldots\ldots (2)$$

EE takes values between; 0 to 1

2. METHODOLOGY

The study was carried out in Kogi State, located between latitude 6 3^0N and 8 3^0'N of equator and longitude 5 51′ E and 8 0^0'E of Greenwich Meridian. Kogi state is located in the Guinea savanna ecological zone of Nigeria (KADP, 2007). The population of the state was 3,314,043 in 2006 (NPC, 2006), it could now be estimated to 4,063,845. A multi- stage random sampling procedure was used for selection of the respondents. At the first stage, two Local Government Areas were randomly selected from twenty-one Local Government Areas in the state and these Local Government Areas were Adavi and Okehi. At the second stage, two villages each were selected randomly from each of the selected Local Government Areas (LGAs). The villages were Osara and Aku and Uboro and Ohu-epee from Adavi and Okehi LGAs respectively. The *Piper guineensis* farmers of the selected villages were enumerated to obtain the sampling frame of each of the villages as par Table 1. At third stage, 10% of the *Piper guineensis* farmers were randomly selected from each of the villages for response giving a sample size of 200. The data was collected using structured questionnaires administered by the researcher and trained assistants.

Table 1: Selected Local Government Areas, sample frame and size

LGA	Village	Frame	Size
Adavi	Aku	400	40
	Osara	460	46
Okehi	Uboro	610	61
	Ohu-epee	530	53
		2000	200

Source: Field Survey, 2021

2.1. Model Specifications

The Cobb-Douglas stochastic frontier cost function, which is the basis for estimating the cost efficiency of the farms is specified as:

$$InC = a_0 + \alpha_1 InW_1 + \alpha_2 InW_2 + \alpha_3 InW_3 + \alpha_4 InW_4 + \alpha_5 InW_5 + \alpha_6 InW_6 + (v_i - U_i) \ldots\ldots\ldots (3)$$

Where:
C = Total input cost of production
α = intercept or constant
α_1-α_6= parameters to be estimated
In = the natural logarithm
W_1 = cost of labour (₦)
W_2 = cost of seed (₦)
W_3 = cost of manure (₦)
W_4 = cost of fertilizers (₦)
W_5 = cost of agrochemicals (₦)
W_6 = cost of farm tools (₦)

The frontier function (production and cost) was estimated through maximum likelihood methods. For this study, the computer programme FRONTIER version 4.1c was used. (Coelli, 1996). However, it should be noted that this computer programme estimates the cost efficiency (CE). Hence, farm-level economic efficiency (EE) was obtained using the relationship:

EE = $\frac{1}{Cost\ Efficiency\ (CE)}$ (Coelli, Rao and Battasse, 1998).

The inefficiency model used in the measurement of technical efficiency was also incorporated in this model. This inefficiency factor was estimated as:

$Ui = a_0 + a_i Z_1 + a_2 Z_2 + a_3 Z_3 + a_4 Z_4 + a_5 Z_5 + a_6 Z_6 + a_7 Z_7 + a_8 Z_. + e\ i$……(4)

Where:

Z_1 = farm size (ha)

Z_2 = marital status
Z_3 = Household size (numbers)
Z_4 = Age (years)
Z_5 = Number of years spent in formal education
Z_6 = access to credit (₦)
Z_7 = Number of extension contact
Z_8 = Farming experience (years)
e_i = Error term.
a_0 = intercept or constant

3. RESULTS AND DISCUSSION

3.1. Production function

The stochastic frontier production functions are presented in Table 1. On the average, a typical *Piper guineensis* farmer in the study area is 42.00 years old, with an averagely low extension education and an average household size of 7.00 members. Most of the respondent has many years of farming experience and mostly attained secondary education. The respondents had access to credit only once maximally with an average output of 13,885.53kg of *Piper guineensis*, cultivated 3.09 ha of land, uses about 5,233.75>kg of seed and an average of 864.00kg and 16.96litres of fertilizer and agrochemicals respectively. On the average, the depreciation on capital input was estimated to be (₦6, 853.45). The average cost of labour (₦358, 566.18) was the highest followed by costs of seed (₦227, 202.38), fertilizer (₦151, 768.03), implement (₦33,904.67), agrochemicals (₦20,666.46) and manure (₦19,926.38) respectively. The average of the total cost amount to be ₦815,458.65, this result is in line with the work of Kationg (2007) which shows that *Piper guineensis* farmers incurred high cost of production in the study area.

3.2. Cost Efficiency and Determinant of Cost Inefficiency in *Piper guineensis* Enterprises

The results of the maximum likelihood estimation of stochastic frontier cost function for the respondents are presented in table 2. The sigma square estimate was 0.052. This is significant at 1% probability level also showing a goodness of fit and the correctness of the specified assumptions of the composite error term distribution. A gamma value of 0.066 was estimated which was also significant at 1% level. All the cost factors; cost of labour, seed, manure, fertilizer and agrochemicals were positively significant at 1% probability level, meaning that these factor are significantly different from zero and thus are important in *P. guineensis* production.

This also implies that a 1% increase in the cost of any of these factors will increase total cost by 0.209, 0.163, 0.066, 0.084 and 0.118 respectively. The cost of implement was negatively significant at 10% level, among the inefficiency variables, marital status and household size were negatively and positively significant at 1% level of probability respectively while age and access to credit were negatively and positively significant at 10% probability level respectively. The marital status of *Piper guineensis* farmers can reduce cost inefficiency therefore increasing the cost efficiency of the farmers. An increase in the household size do not play any significant role in reducing the cost efficiency of *Piper guineensis* farmers as most *Piper guineensis* farmers depend on hired labour for their farm practice. However, older farmers are more efficient in *Piper guineensis* production than younger farmers while those who have access to credit are more efficient in *Piper guineensis* production.

Table 1: Summary statistics of the variables in the production function, cost function and the determinant of technical efficiency

Variables	Minimum	Maximum	Range	Mean
Cost Function				
Total Cost	36050.00	7172420.00	7136370.00	815458.65
Cost of Labour(₦)	1000.00	6335020.00	6334020.00	358566.18
Cost of Seed(₦)	1206.00	2522000.00	2520794.00	227202.38
Cost of Fertilizer (₦)	10000.00	7212000.00	7202000.00	151768.03
Cost of Manure(₦)	1000.00	385000.00	384000.00	19926.38
Cost of Agrochemicals (₦)	1900	477000.00	475100.00	20666.46
Cost of Implement(₦)	1000.00	275000.00	274000.00	33904.67
Inefficiency Variable				
Farm size	0.500	10.00	9.50	3.09
Marital Status	1.00	6.00	5.00	1.31
House Hold Size	1.00	23.00	22.0	7.00
Age	22.00	86.0	64.0	42.00
Level of Education	1.00	17.00	17.00	10.00
Access to Credit	0.00	1.00	1.00	0.03
Extension Education	0.00	17.00	17.00	0.33
Years of Farming Experience	6.00	68.00	62.00	27.30

Source: Field Survey, 2021

Table 2: Maximum likelihood estimates of parameters for the measurements of cost efficiency of *Piper guineensis* farmers

Variables	Parameters	Coefficient	t-ratio
Intercept	a_0	4.362	9.877***
Cost of Labour (₦)	a_1	0.209	11.812***
Cost of Seeds (₦)	a_2	0.163	7.126***
Cost of Manure (₦)	a_3	0.066	3.474***
Cost of fertilizer (₦)	a_4	0.084	2.912***
Cost of Agrochemicals (₦)	a_5	0.118	3.335***
Cost of Implement (₦)	a_6	0.208	-1.604*
Diagnostic Statistics			
Sigma Squared	S^2	0.052	3.677***
Gamma	ϒ	0.066	5.621***
Log-Likelihood		122.970	
LR test		19.899	
Inefficiency Variables			
Constant		1.360	-1.604
Farm Size (ha)		0.115	1.211
Marital Status		0.316	-3.652***
Household Size		0.049	5.929***
Age(Years)		0.052	-1.685*
Level of Education		0.052	1.524
Access to Credit		0.523	- 1.951*
Extension Contact		0.1 117	0.087
Farming Experience		0.049	1.587

Source: Survey analysis/computer printout of Frontier 4.1 ***, **, *Implies significant at the 1%, 5% and 10% probability levels respectively.

3.3. Frequency Distribution of Cost Efficiency

The frequency distribution of cost efficiency of the *Piper guineensis* farmers in the study area is presented in Table 3. The cost efficiency level ranges from 0.51 to 1.00 indicating that all the *Piper guineensis* farmers in the study area are cost efficient. A greater proportion (67.5%) of the respondents falls within the cost efficiency range of 0.81-90. The most cost efficient of *Piper guineensis* farmer is operating very close to the frontier with maximum cost efficiency of 0.965. The mean cost efficiency of 0.801 was observed. These results indicate that an average *Piper guineensis* farmer in the study area will enjoy a cost saving of 16.994 % if he or she attain the level of the most cost efficient farmer among the respondents. The most cost inefficient farmer in the study area will have a cost efficiency gain of 47.047 % in *Piper guineensis* production if he or she is to attain the efficiency level of the most efficient farmers in the study area.

Table 3: Cost efficiency indices among *Piper guineensis* farmers in the study area

Efficiency Level	Frequency	Percentage
0.51-0.60	2	1.0
0.61 - 0.70	2	1.0
0.71- 0.80	30	15.0
0.81-0.90	135	67.5
0.90-1.00	31	15.5
Total	200	100.0
Minimum Efficiency	0.511	
Maximum Efficiency	0.965	
Mean Efficiency	0.801	

Source: Computed from frontier 4.I MLE/Survey data, 2021

4. CONCLUSION AND RECOMMENDATIONS

Based on the findings from this study, the following conclusions are made;

1. The study indicated that *Piper guineensis* farmers in the study area are highly cost efficient but are not fully efficient as a result of some certain inefficiency factors.
2. Individual levels of efficiency range between, 0.51 to 1.00, which means the cost efficiency of 80.1%. On the average, *Piper guineensis* farmers will enjoy a cost saving of 16.994% if he or she is to attain the level of the most cost efficient of *Piper guineensis* farmer in the study area.
3. Important factors indirectly related to cost efficiency are marital status, household size, age and access to credit. Marital status reduces cost inefficiency and increase in household size reduces cost efficiency. However, older farmers and those who have access to credit are more cost efficient in *Piper guineensis* production.
4. Based on the findings the government should make provision for a reliable source and access to credit facilities for *Piper guineensis* farmers in the study area.
5. To improve the food security status of the farmers, Nigerian government should use some incentives that will boost farmer's adoption to modern practice in *Piper guineensis* enterprises.

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