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Resource-Use Efficiency of Pepper Farmers in Ado-Local Government Area of Ekiti State

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Abstract

The study investigated resource-use efficiency in pepper production in Ado Local Government area Ekiti State, Nigeria. The study specifically examines the socioeconomic characteristics of the farmers, estimates the costs and returns, determines the resource-use efficiency, and identify the main constraints to pepper production in the area. Primary data were used with the aid of a well-designed questionnaire. A two-stage sampling technique was used to randomly select 120 respondents. Descriptive statistics, budgetary technique and multiple regression model were used to analyze the data. The results showed that farmers earned an average net income of ₦100,159 per hectare while the return on investment was estimated to be 1.3. This implies that for every ₦1 invested, the farmer makes N1.30k, confirming the profitable of pepper enterprise in the area. The results of multiple regression revealed that labour, quantity of glove, seed and farm size were the significant factors affecting pepper production in the area. The estimates of resource-use efficiency showed that all the variables in the model were underutilized except variables such as cutlass and quantity of glove which are over utilized. The results further revealed that pest and disease, lack of credit, inadequate storage facilities and inadequate water supply were the main constraints to the optimal productivity and profitability in the area. The study recommends the provision of credit facilities, effective pest and disease management strategies, adequate storage facilities, and efficient use of inputs to enhance the productivity and profitability of pepper farming in the study area. Therefore, the study is vital by identifying the underlying factors that would improve the sustainability and profitability of pepper production.

Keywords:
Pepper; Resource-use Efficiency; Marginal Value Products; Marginal Factor Cost

1. Introduction

The most widely used spice in the world is hot and sweet peppers (*Capsicum spp.*), which account for about 40% of the vegetables consumed by humans (Olutumise, 2022). Small-scale farmers produce the majority of the pepper consumed worldwide, selling their harvests to processors after passing them along to middlemen or traders (Hay, 2009). Virtually all countries of the world produce pepper at different levels. According to Bosland and Votava (2000), pepper production has increased in recent years worldwide and this could be ascribed partly to its high nutritional value. Pepper is a rich source of vitamins A and E and contains more vitamin C to prevent flu-colds than any other vegetable crop. In Nigeria, three major types of pepper are common. The large fruited sweet pepper (tatashe), the medium corrugated fruited hot pepper (rodo) and the small fruited chilli/red pepper (shombo) (Ado, 1990). Pepper plays a significant role in the meals of the average Nigerian because practically all meals cooked at the home level in

that country include some pepper. The northern region of the country produces more pepper, which meets the majority of the needs of the southern regions, where production is still on a limited scale.

The climate and good soils in Nigeria make it easy to grow and produce pepper. Pepper grown in Nigeria is in high demand because of its pungency and good flavor. It can readily be dried, ground and packaged for export. Investing in pepper production is one of the ways of sourcing for foreign exchange (Business Day, 2007). In the past, it was claimed that pepper exportation from Nigeria was a successful industry (Idowu-agida et al., 2010). Pepper is utilized mostly for culinary purposes and seasonings. It also has medicinal uses, internally as a stimulant and carminative and externally as a counter- irritant. This genus was originated from Central and South America and comprises about 30 species, of which, five domesticated that comprise *Capsicum annuum L.* (hot and sweet peppers); *Capsicum frutescens* L. or bird pepper; *Capsicum chinense* Jacq. or aromatic chili pepper; *Capsicum baccatum* L. (aji); and *Capsicum pubescens* (rocoto). The first three species are the most cultivated in both tropical and temperate (Grubben and Tahir, 2004; Olutumise, 2022).

In addition to its commercial significance, pepper is a valuable agricultural crop because of the fruits' nutritional and therapeutic properties, as well as their abundance in natural pigments and anti-oxidant substances (Howard et al., 2000). According to Dipeolu and Akinbode (2008), pepper is one of the world's most consumed and diversified foods. After tomatoes, it ranks as the second-most significant fruit and vegetable in the world, and it is the most widely manufactured spice flavoring and food coloring while supplying vital vitamins and minerals (Bosland and Votava, 2000). Bosland and Votava (2000) noted that pepper output has expanded globally, which may be partially attributed to Grubben and Tahir (2004)'s explanation of pepper's high nutritional value.

The Food and Agriculture Organization (FAO) estimates that the world's production of *Capsicum spp.* will reach 38.5 million tonnes in 2021 from a harvested area of 2.2 million hectares, yielding 17.5 tonnes per hectare on average (Food and Agricultural Organization, 2021; Olutumise, 2022). The yield difference between developed and developing countries, according to recent FAO data, still leaves developing countries with significantly lower yields of capsicum peppers than developed countries, with an average yield of about 10-15 tonnes/ha compared to 25-30 tonnes/ha in developed countries. Nigeria, which accounts for around 5% of global production, is still one of the world's top producers of pepper, according to the Nigerian Export Promotion Council (2022).

Despite Nigeria's position as a major producer of pepper, the country's pepper production is still characterized by low resource-use efficiency, which results in low yields and reduced profitability for farmers. (Odebode et al., 2021). According to Olarewaju, (2018) noted that poor farm management practices, lack of access to quality inputs and credit facilities, and inadequate extension services are among the factors that contribute to low resource-use efficiency in pepper production in Nigeria. In a study on the efficiency of pepper production in Nigeria, Oladele and Adepoju (2019) found that farmers in Nigeria have low levels of resource-use efficiency due to poor access to credit and extension services, inadequate irrigation systems, and poor soil fertility management. Similarly, Ayodele et al. (2018) found that poor access to credit and inadequate irrigation systems were among the factors that contribute to low resource-use efficiency in pepper production in Nigeria. Overall, these studies indicate that low resource-use efficiency is a significant problem for pepper production, and there is a need for research and interventions to address the underlying factors and improve the sustainability and profitability of pepper production in the country. Therefore, the study fills the gaps in knowledge by providing quantitative data on the efficiency levels of different resources used in pepper production. This would help in understanding the specific areas where improvements can be made to enhance the overall efficiency of pepper production. Also, as against the previous studies (Ayodele et al., 2018; Odebode et al., 2021; Olutumise, 2022) that provided general and non-specific strategies for addressing the constraints, the study provides comprehensive and specific constraints targeted at pepper production. Based on this background, the study was carried out to examine the resource-use efficiency in pepper production in Ado Local Government area Ekiti State, Nigeria. The specific objectives were to: (i). describe the socio-economic characteristics of the respondents; (ii). estimate the costs and returns of pepper production in the area; (iii). determine the resource-use efficiency of the farmers in the study area; and (iv). identify main problems encountered by the pepper farmers in the area.

2. Materials and Methods

The research was conducted in the Ado Local Government Area (LGA) in Ekiti State, Nigeria. According to the National Population Commission of Nigeria (NPC, 2006), Ado LGA is located in the middle portion of the state, with a land area of approximately 1,270 square kilometers, and has an estimated population of 239,899 people. Economic activities in Ado LGA are diverse, with agriculture, trade, and education being the major sectors. The area is known for its fertile soil, which supports the cultivation of crops such as yam, cassava, maize, and vegetables (Kareem, Olawale and Amusat, 2014). Due to the high demand and profitability of pepper cultivation, it has become a significant

economic activity in the region in recent years (Adeoye, Ojo and Adesina, 2018). As a result, many farmers have switched from growing conventional crops to peppers. According to Adeoye et al. (2018), small-scale farming dominates pepper production in Ado LGA, with most farmers cultivating less than 1 hectare of land. Scotch Bonnet, Habanero, and Bird's Eye chili peppers, which are well-known in both domestic and foreign markets, are the principal pepper cultivars farmed in the region (Adeoye et al., 2018). However, there are a number of issues that limit the productivity of pepper growing in Ado LGA, including pests and diseases, limited availability to high-quality inputs, and inadequate irrigation infrastructure (Adeoye et al., 2018).

A well-structured questionnaire was employed to gather the primary data that was used in this investigation. This study used a two-stage sampling technique. The first stage was the purposeful selection of two communities—Amiran and Araromi—that were predominately engaged in the production of peppers, and the second stage featured the random selection of sixty respondents from each community for a total of 120 respondents. The analytical tools that were used include: descriptive statistics, budgetary analysis, and multiple regression analysis. Descriptive statistics such as frequency, percentage, mean was used to describe the socio-economic characteristics and constraints militating against pepper farmers.

Budgetary Technique: This was used in the study to describe the costs and returns of pepper production in the study area. The farm income is the total output multiply by the price per unit cost. Therefore, farm income is the total revenue generated from the production of pepper while net farm income is the difference between the total revenue and total cost. The total cost of production includes both total variable cost and total fixed cost. Total variable cost includes; cost of seed, cost of labour, and cost of agrochemical while total fixed cost includes cost of hoe, cost of sprayer, cost of cutlass and cost of sharpening file.

NFI= TR-TC

Where:

NFI = Net Farm Income (Naira/ha)

TR = Total Revenue (Naira/ha)

TC = Total Cost of Production (Naira/ha)

TC = TVC + TFC

Total Cost (TC) = Total Variable Cost (TVC) + Total Fixed Cost (TFC)

TVC = (seed, fertilizer, labour and agrochemicals)

TFC = (cost of renting land and depreciation of tools)

Return on Investment (ROI) is obtained by dividing the Gross Revenue (TR) with the

Total Cost (TC).

Therefore,

Where:

ROI = Return on Investment

TR = Total revenue

TC = Total Cost

Regression Analysis: The input-output relationship was examined using a multiple regression model, and the implicit form of the model was provided by:

$$Y = f\ (X1\ X2\ X3X4X5X6X7;\ \mu)$$

The regression model was stated explicitly and the model variables were defined as follows

$Y=\beta_{0+}\beta_1X_{1+}\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\ \beta_6X_6+\ \beta_7X_7+\ \mu;$

Y_i=output of pepper (kg)

X_1 = quantity of cutlass (₦)

X_2 = total labour used (man days)

X_3 =quantity of sharpening file (₦)

X_4 = quantity of hoe (₦)

$X_{5=}$ quantity of glove (₦)

$X_{6=}$ seed quantity (₦)

X_7 =farm size(ha)

μ= error term

The model was tested under different functional forms in order to choose the lead equation for the study.

Linear:

$Y= b_0 + b_1X_1 + b_2X_2 + b_3X_3+ b_4X_4+ b_5X_5+ b_6X_6+ b_7X_7+ U_i$

Semi-Log:

$Y= b_0 + b_1\log X_1 + b_2\log X_2 + b_3\log X_3+ b_4\log X_4+ b_5\log X_5 + b_6\log X_6+ b_7\log X_7\ U_i$

Exponentials:

$\text{Log } Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 U_i$

Double log

$\text{Log } Y = b_0 + b_1\log X_1 + b_2\log X_2 + b_3\log X_3 + b_4\log X_4 + b_5\log X_5 + b_6X_{6+} + b_7X_7 + U_i$

The following economic, statistical, and econometric criteria were used to select the lead equation for the regression analysis. After the choice of the lead equation, the MVP for each resource input into pepper production was computed by the following formulae: Marginal physical product (MPP) multiplied by unit Price of pepper:

Depending on the lead equation selected the MPP is computed as follows:

Linear: b_i

Semi log: b_i/x_i

Exponential: $bi*Y_t$

Double log: b_i*Y_t/X_t

Economic theory states that a firm maximizes its profit with respect to input 'X' used if the ratio of its MVP to its Marginal Factor Cost (MFC) is one. A ratio greater than unity shows underutilization of that resource and profit would be increased by increasing the quantity used of that input. A ratio lesser than unity indicates the over-utilization of input; and decreasing the use input will increase the level of profit. Hence,

(1) if $MVPx_i = MFCxi$, farmers are efficient in the use of X

(2) if $MVPx_i > MFCx_i$ resource X is under-utilized

(3) if $MVPx_i < MFCxi$, resource X is over-utilized.

However, scenarios 2 and 3 indicate inefficiency.

$MVP = P_X$ Optimum input use

3. Results and Discussion

3.1 Socio-economic Characteristics of the Respondents

The results presented in Table 1 showed that majority (81.7) of the respondent were male while (18.3%) of them were female. This implies that male dominated the enterprise. This result was consistent with the findings of Muinat et al (2015) and Olutumise (2022) whose findings indicated that about 85.0% and 82.0%, respectively of male dominated pepper farming in their study areas. Finding indicates that the mean age of pepper was 41.1 years old. About 70% of the respondents were married, while 30% were single; this implies that married men and women dominated the enterprise. About 15 years' worth of farming experience was the average. This suggests that a typical pepper farmer had prior expertise with the crop. This outcome was in line with the research of Ayodele et al. (2018), who found that the average number of years of farming experience in the Nigerian state of Ekiti was 13 years. Furthermore, the majority of farmers had a household size of 6-10 persons, and the mean household size was 5.8 persons. The result of household size is similar to the findings of Olutumise (2020) that was carried out among yam farmers in Ondo State, Nigeria. Most farmers operated on a small scale, with 1-2 hectares accounting for 95% of the respondents in the study area. The finding is similar to the study of Olubunmi-Ajayi et al. (2023) which was carried out in Ondo State, Nigeria. The educational level of the farmers was low, with about 41.7% having no formal education, 18.3% having only primary school education, 30.8% having secondary school education, and 9.2% having tertiary education.

3.2 Average Cost Structure and Net Farm Income of Pepper Farmers in the Area

The study conducted a budgetary analysis of pepper production in the area showed that the total cost of production was made up of variable and fixed costs. Variable costs, which include expenses on labour, agrochemicals, and seed, accounted for 94.7% of the total cost of which labour accounted for 91.7%. This finding was in agreement with Ayodele et al. (2016) whose findings indicated that labour cost accounted for 91.7% of the total cost of production among pepper farmers in Ekiti state Nigeria. Fixed costs, which were at depreciated values and included items such as cutlass, hoe, file, and glove, accounted for only 5.3% of the total cost. This is likely due to the fact that all fixed costs were depreciated values. The total variable cost of agrochemicals, labour, and seed was ₦257,868, while the total fixed cost of depreciated items was ₦15,294 for the last production season in the study area. The revenue generated from pepper production was ₦373,321, and the net farm income was calculated by subtracting the total cost of production from the total revenue. The average net farm income per hectare for the average pepper farmer was ₦100,159 per hectare, indicating that pepper production in the study area was profitable. The return on investment was estimated to be 1.30, indicating that for every ₦1 invested, the average farmer would make N1.30k, *ceteris paribus*.

Table 1. Socio economical Characteristics of Pepper Farmer

Socio economic variables	Frequency	Percentage	Mean
Gender			
Male	98	81.7	
Female	22	18.3	
Age			
≤25	27	22.5	41.1
26-36	13	10.8	
37-47	36	30.0	
48-58	29	24.2	
≥59	15	12.5	
Marital Status			
Married	84	70.0	
Single	36	30.0	
Experience			
1-10	65	54.2	14.7
11-20	27	22.5	
21-30	16	13.3	
≥30	12	10.0	
House hold size			
1-5	75	62.5	5.8
6-10	29	24.2	
11-15	11	9.2	
≥16	5	4.2	
Farm Size			
1-2	115	95.0	
3-4	5	5.0	
Level of Education			
No formal Education	50	41.7	
Primary school education	22	18.3	
Secondary school education	37	30.8	
Tertiary Education	11	9.2	

Source: Field Survey, 2022

Table 2. Average Cost Structure and Net Farm Income in the Area

Variable cost item	Cost (₦)	Percentage (%)
Total variable cost		
labour	250,530	91.7
Seed	1,399	0.5
Agrochemicals	5,939	2.1
TVC	257,866	
Total fixed cost		
Cutlass	7,304	2.6
Dep hoe	5,412	1.9
file	1,090	0.3
glove	1,488	0.5
TFC	15,294	
TC=TVC=TFC	275,162	
TR=Price*quantity	373,162	
Net farm income (NFI)=TR-TC	100,159	
Return on investment (ROI)=TR/TC	1.3	

Source: Field Survey, 2022

3.3 Production Function Estimation

Under this subsection, we present the results of the OLS regression estimation of production function. Two different functional forms were fitted to the data and these were linear, exponential, semi-log and double log on the basis of the criteria of choice of the lead equation (economic, statistical and econometric criteria), semi log and double log were omitted variable. the linear model was chosen as lead equation because it has the highest R^2 of 0.364 and this implies that 36.4% of the total variation in the level of pepper output is accounted for by all the explanatory variables in the regression model. Secondly, the estimated coefficient of labour and land were positive and significant at 1-10 percent alpha levels, except for glove which is negative.

The coefficient of farm land input is positive and significant indicating that cultivation of larger hectares of land leads to increase in pepper output. This was in line with Nweke et al. (2017) who found that land size significantly influenced the yield and productivity of pepper crops in Nigeria. The study reported that pepper farms with larger land sizes tended to have higher yields than farms with smaller land sizes. Similarly, the estimated coefficient of labour is positive and significant at 1% alpha level, indicating that increased use of labour will increase pepper output. This supports Olutumise and Oparinde (2022) who also found positive relationship with crop output. Glove is not only negative but also significant, and this suggests that as glove increases, pepper production will drop.

Table 3. OLS Regression Estimation of Production function for Pepper production.

	Variable letter code	Linear	Exponential
Constant	coefficient	85.577	4.432
	P-value	0.000	0.000
Cutlass	X1	-7.480	-0.22
		0.260	0.693
Labour	X2	2.204	.012
		***0.000	0.006*
Quantity of file	X3	1.701	.006
		0.468	0.767
Quantity of hoe	X4	9.389	.039
		0.132	0.450
Quantity of glove	X5	-8.533	-.074
		0.001***	0.000***
Quantity of seed	X6	.409	-.152
		0.905	0.010**
Farm size	X7	14.791	.008
		0.000***	0.033**
	R square	36.4	31.2
	Ad R^2	32.4	26.8
	F- ratio	9.0	7.1

Source: Computed from Field survey 2022., Figure in first line= estimated coefficient, Figures in parenthesis = t value, Figure in third line=p value, ***< 0.01-1%, ** 0.01-0.05= 5%, *0.051-0.099=10%

3.4 Analysis of Resource Use Efficiency

This section presents the results of the resource use efficiency analysis carried out in this study. The first result column of Table 4 shows the Marginal Physical Product (MPP) of various resource inputs in the production of pepper, while column 2 shows the unit price of pepper to be ₦3,439.2 The Marginal Value Product (MVP) is shown in the third column while the Marginal Factor Cost (MFC) is presented in column 4. We compute the efficiency index in column 5 as ratio of MVP to MFC. The results show the resource use efficiency index for labour, glove and farm size are 6.8, -106.7, and 7.2 respectively. This implies that labour and farm size are currently being under-utilized on pepper farms. This study conforms to the findings of Adesope et al. (2016) that labour and farm size were under-utilized in pepper production in Nigeria; and these limited the productivity and profitability of pepper farms. The efficiency index for glove is lesser than one, implying that glove is being over utilized. If more gloves are being used on the farms, profits from pepper production will probably decline. On the other hand, land is currently overused, suggesting that utilizing less land for pepper production is likely to boost profitability given the amount of availability

or use of other resources. Olutumise and Oparinde (2022) reported that farm size is a significant factor in addressing the technical efficiency of food crop farmers.

Table 4. Ratios of the marginal value product (MVP) to marginal factor cost (MFC)

Input	MPP	Price of pepper (Py)	MVP= MPP*Py	MFC	MVP/MFC (Efficiency index)	Interpretation
Cutlass	-7.480	3,439.2	-25725.2	1,374	-18.7	Over utilizing
Labour	2.204	3,439.2	7579.9	1,100	6.8	Under utilizing
File	1.701	3,439.2	5,850.0	170	34.4	Underutilizing
Hoe	9.389	3,439.2	32,290.6	1,646	19.6	Under utilizing
Glove	-8.533	3,439.2	-29,346.6	275	-106.7	Over utilizing
Seed	.409	3,439.2	1,406.6	664	2.1	Under utilizing
Farm size	14.791	3,439.2	50869.2	7000	7.2	Underutilizing

Source: Computed from Field survey, 2022

3.5 Constraints Militating Against Production of Pepper

Table 5 showed challenges of pepper farmers in the study area. Pest and disease are the most significant constraint faced by pepper farmers, with 99.2% of farmers reporting it as a problem. To support this claim, several studies have reported that pests and diseases are the primary challenges faced by pepper farmers, including a study by Akande et al. (2020) in Nigeria and another study by Sharma et al. (2018) in India. The amount of credit and unpredictable climatic conditions are the second and third most common constraints, with 93.3% and 92.5% of farmers reporting them as issues respectively. Farmers also cite inadequate water supply and storage facilities as major obstacles, with 92.5% and 87.5% of farmers citing these issues, respectively. 56.6%, 43.3%, and 20% of farmers, respectively, cited access to extension agents, government subsidies, and pepper related cooperative membership as challenges. Overall, these constraints can significantly impact the productivity, yield, and quality of pepper crops, which can affect the income and livelihoods of pepper farmers as also reported by Olutumise (2022).

Table 5. Distribution of Respondent's Constraints in Pepper Production.

s/no	Constraints	Frequency	Percentage	Rank
1	Pest and disease	119	99.2	1st
	Amount of credit	112	93.3	2nd
2	Unpredicted climatic condition	111	92.5	3rd
3	Inadequate water	111	92.5	3rd
4	Storage	105	87.5	5th
5	Extension agent	68	56.6	6th
6	Subsidy from government	52	43.3	7th
7	Pepper related cooperative membership	24	20.0	8th

Source: Computed from Field survey, 2022

4. Conclusion and Recommendation

Based on the findings of the study, it can be concluded that pepper production is a profitable enterprise for income generation, poverty alleviation, and job creation in Ado Local Government Area, Ekiti State, Nigeria. The study revealed that the average net farm income per hectare for pepper farmers in the study area was N100,159, indicating that the investment in pepper production is a viable business. However, the study also identified several constraints that hindered the optimal productivity and profitability of pepper farming in the area, including pest and disease, lack of credit, inadequate storage facilities, inadequate water supply, lack of cooperative membership, and extension agent visits. Moreover, the study showed that labor and farm size were currently being under-utilized on pepper farms, while gloves were over-utilized. This implies that increasing the use of labor and farm size could lead to increased profitability, while reducing the use of gloves could also improve profitability.

Therefore, based on the conclusion drawn from the study, here are some policy recommendations that could be considered:

Providing credit facilities: The lack of credit was identified as a major constraint for pepper farmers. Therefore, providing credit facilities through government-backed schemes or partnerships with financial institutions could be

beneficial for farmers. This will enable them to purchase essential inputs such as fertilizers, pesticides, and other farm tools, and improve their production yield.

Pest and disease management: Since pest and disease management was identified as a major constraint, there is a need to develop effective strategies and interventions for their management. This could include the provision of improved pest-resistant seed varieties, training on pest and disease control measures, and the establishment of extension services.

Provision of storage facilities: Lack of storage facilities was identified as a major constraint for pepper farmers. Therefore, the provision of adequate storage facilities, either through the establishment of community-based storage facilities or through partnerships with private sector players, will help farmers to reduce post-harvest losses, increase their profits, and enhance food security in the region.

Encouraging efficient use of inputs: The study found that labor and farm size were currently being under-utilized while gloves were over-utilized on pepper farms. Therefore, there is a need to encourage efficient use of inputs by providing training and education to farmers on how to optimize the use of available resources, such as labor and farm size, to improve profitability. This could be done through extension services or farmer field schools.

By implementing these policy recommendations, it is hoped that the productivity, profitability, and overall livelihoods of pepper farmers in the study area will improve, ultimately leading to poverty alleviation and improved food security.

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