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RESEARCH ARTICLE

FACTORS INFLUENCING ALLOCATIVE EFFICIENCY OF SMALLSCALE TOMATO (*Lycopersicum species*) PRODUCTION IN KADUNA STATE, NIGERIA: IMPLICATIONS FOR FOOD SECURITY AND RESOURCE MANAGEMENT

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ABSTRACT

This study evaluated factors influencing allocative efficiency of smallscale tomato (*Lycopersicum species*) production in Kaduna State, Nigeria: implications for food security and resource management. A multi-stage sampling technique was used to select 120 smallscale tomato farmers. Data of primary sources were collected with the help of a well-structured and a well-designed questionnaire. Data were analyzed using descriptive and inferential statistics. Result indicates that the mean age of smallscale tomato resource farmers were 46 years, the mean household size of the respondents was 7 persons, while the mean resource farm size was 1.17ha. The minimum and the maximum allocative efficiency score of the tomato farmers were 0.30 and 0.93 respectively. The results of profitability analysis indicate that tomato production was profitable with gross margin and net farm income of N550,960 per ha and N497,190 respectively. The gross margin and operating ratios were 0.69 and 0.28 respectively. The resource inputs and socio-economic factors influencing allocative efficiency of tomato production were: age ($P < 0.01$), farm size ($P < 0.01$), household size ($P < 0.01$), gender ($P < 0.05$), marital status ($P < 0.01$), level of education ($P < 0.10$), access to extension services ($P < 0.05$), and membership of cooperative organization ($P < 0.05$). The study recommended that farmers should be provided with the following resource inputs: improved seeds, chemicals, fertilizer input, credit facilities and extension services in order to reduce resource wastages, increase efficiency and productivity.

KEYWORDS

Allocative Efficiency, Smallscale Tomato Production, Resource Management, Food Security, Kaduna State, Nigeria.

1. INTRODUCTION

In recent decades, there has been an improvement in global food production. The percentage of individuals who are underfed has fallen from 33% to 13% even though the world's population has tripled since 1945 (FAO, 2006). Today's average global citizen consumes roughly 25% more calories than they did in 1945, while also eating better and more food. However, due to the fact that 50,000 of the 400,000 newborns every day begin life with a chronic food deficiency (Food and Agriculture Organization (FAO, 2006). According to estimates, the agricultural industry grew on the average was by roughly 7% annually between 1997 and 2008 (World Bank 2009a;UNDP, 2006; World Bank, 2009b). The extension of staple crops into new regions is thought to be the reason for the rate of growth, as agricultural production has been stagnant or falling (Nkonya et al., 2010; World Bank, 2009a; UNDP, 2006; World Bank, 2009b). Traditional farming methods are used in the rural sector to produce agricultural products in a labor-intensive manner. The bulk of Agricultural production in Nigeria takes place in the rural areas and ironically, the level and incidence of poverty and food insecurity is very pronounced in the areas. The bulk of people live in abject poverty in a mostly agrarian economy. A sizable portion of Nigerian farmers are subsistence smallholders who cultivate 1–2 hectares of land using a low-tech, traditional system. Nigeria's social and economic growth depends heavily on agriculture (NPC, 2004). The provision of food for local consumption and agro-allied industries, as well as employment and foreign exchange revenues, are all impacted (Okunneye, 1995). With an estimated contribution of 51% in 1999/2000 and 33.4% in 2008/2009 agriculture is the second-largest contributor to the Gross Domestic Product (GDP) after petroleum (Njoku, 2001;World facts book Nigeria, 2009). However, due to its poor growth in comparison to other economic sectors, Nigerian agriculture has been in decline. For instance, the petroleum industry, which is the sector with the strongest growth,

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experienced an annual growth rate of 8.1% in 2000. In addition, the index measuring per-capita food output dropped from 150 points in 2000/2001, was only 120 points in 2002/2003 (Nkonya et al., 2008).

One of the major vegetables grown in the Nigeria is the tomato (*Lycopersicom esculentum*), which is consumed in a variety of ways (Aditi et al., 2011; Aremu et al., 2016). Nigeria produces 3.58 million tonnes of tomato in 2021 and 3.84 million tonnes of tomato in 2020, the total area and consumption of tomato in 2021 were 844.633 ha and 3,345,000 tonnes respectively (FAO, 2021). Report of shows that a minimum total production of about 1.51 million metric tonnes of tomato per annum, valued at 87.0 billion, grown on a land area of 254,430 hectares in Nigeria, with 0.7 million metric tonnes lost during post-harvest, tomato demands in Nigeria is put at 2.2 million metric tonnes per annum leaving a gap of 1.4 million metric tonnes, the country is now ranked as the world's 14th-largest tomato producer overall and second only to Egypt in Africa (FAO, 2010a, FAO, 2021; FMAFS, 2023). The recorded decline in tomato production from 6 million tonnes to 1.86 million tonnes and then to 1.51 million metric tonnes has led to its scarcity, and this may be as a result of the low return on investment in tomato production due to the high risk involved, the unplanned production process, and distribution network problems The nation still imports tomatoes to suit its needs despite its ranking in the global and regional rankings for tomato production (Edeh, 2017; Okojie, 2017). The value of Nigeria's yearly tomato imports is estimated at US$170 million by (Sunday et al., 2018). This is due to the widespread consumption of tomatoes, which account for roughly 18% of households' daily vegetable consumption (Babalola et al., 2010). The plant contains elements like iron and phosphorus as well as abundant amounts of vitamins A and C. Additionally, it is the richest source of nutrients, dietary fibres, antioxidants like lycopene and beta-carotene, the molecules that protect cells from cancer, as well as minerals like iron and phosphorus. Due to the impact of seasonality, Nigeria's Northern regions are where most tomato cultivation occurs (Aminu et al., 2007). The majority (90%) of producers are smallscale farmers with less than 5 hectares of land (FAOSTAT, 2014; Sahel Research, 2015). In Nigeria, large scale tomato production is mainly under irrigation during the dry season, when temperatures are mild and humidity is moderate. However, pests and diseases that thrive in such warm, humid circumstances typically have an impact on tomato production during the rainy season. As a reported that tomato farmers, like all other farmers, are restricted by poor production practices because of low soil fertility, a lack of improved seeds and technology, an ineffective weed and pest control programme, high post-harvest losses, a lack of infrastructure for processing and marketing, among other factors (Ugonna et al., 2015). The yield of tomatoes per hectare in Nigeria is currently low, estimated at 20 to 40 tonnes per ha/year on average, and 40 to 50 percent of the production is lost due to Nigeria's poor handling, processing, and preservation practices (FAOSTAT, 2014).

Efficiency measures how effectively production firms use variable resources for the purpose of profit maximization given the best production technology available, the level of fixed factors, and product and factors prices. Technical efficiency is measured by the ratio of actual and potential output at given mix of inputs. Technical efficiency measures the ability of a firm to avoid waste by producing as much as output as input usage allows or using as little input as output production allows. Technical efficiency compares the actual to the maximum attainable productivity or actual output to maximum output for a given level of input. Allocative efficiency refers to the ability of a firm to produce at a given level of output using the cost-minimizing input ratios (Ettah and Angba, 2016). Allocative efficiency is the ability of a firm to combine inputs and output in optimal proportions in light of the prevailing prices. Allocative efficiency is measured by the ratio of optimal cost to the costs incurred at the technical efficient level. The costs are optimal when inputs would be used to the point where their marginal products equal their prices or opportunity costs.

1.1 Objectives of The Study

The broad objective is to evaluate the factors influencing allocative efficiency of smallscale tomato (*Lycospersicum species*) production in Kaduna State, Nigeria: Implications for food security and resource management. The specific objectives were to:

(i) determine the socio-economic profiles of smallscale tomato farmers,

(ii) analyze the cost, returns and profitability of smallscale tomato production,

(iii) determine the technical, economic and allocative efficiency scores of smallscale tomato

(iv) farmers,

(v) evaluate the resource inputs and socio-economic factors influencing allocative efficiency of smallscale tomato production, and

(vi) determine the resource constraints facing smallscale tomato farmers in the study area.

2. Methodology

This research study was conducted in Kaduna State, Nigeria. Kaduna State occupies between Longitudes 06^0 15ꞌ and 08^0 50ꞌ East and Latitudes 09^0 02ꞌ and 09^0 02ꞌNorth of the equator. The State has land area totaling 4.5 million hectares. The state vegetation is divided into two (2), the Southern guinea savanna and Northern guinea savanna. There are two (2) seasons in Kaduna State. The seasons are: wet and dry seasons, the dry season is between October to March, and the wet season starts from April to October, in between the wet and dry seasons is the brief harmattan period which span from November to February. The mean or average rainfall is about 1,482mm, the temperature of Kaduna State ranges from 35^0C to 36^0C, which can be as low as 10^0C to 23^0C during the harmattan period. The population of Kaduna as at 2021 was 8.9 million people. They are involved in agricultural activities. Crops grown include: okra, pepper, maize, ginger, sorghum, rice, yam, cassava, millet, and tomatoes. Animal reared include: cattle, goats, sheep, rabbit, and poultry. Multi-stage method of sampling was used. One hundred (120) smallholder tomato farmers were selected. Data obtained from smallholder tomato farmers were of primary sources and were collected using well-designed and also well-structured questionnaire. The questionnaire was administered to smallholder tomato producers using well trained enumerators.

3. Research Design

A descriptive cross-sectional research design was employed in this study with the aim of describing the socio-economic profiles or characteristics of tomato producers, and to evaluate technical, economic, allocative efficiency scores and socio-economic factors influencing allocative efficiency of tomato production.

3.1 Sampling Techniques and Sample Size

A multi-stage sampling technique was adopted for this study. In the first stage, purposive sampling procedure was used to select Kaduna State based of the numerous numbers and concentration of tomato producers in the area. The second stage involved random selection of four (4) local government areas using ballot box method. In the third stage, three (3) villages were selected randomly from each local government area based on the intensity of tomato producers. In the fourth stage, from sampling frame of 171 tomato farmers, proportionate- simple random sampling technique was used to select the desired sample size of 120 tomato farmers. This study employed the formula advanced in the determination or estimation of the sample size. The formula is stated thus by (Yamane, 1967):

$$n = \frac{N}{1+N(e^2)} = 120 \quad (1)$$

Where,

n = Desired Sample Size(Number)

N = Sample Frame (Number)

e =Maximum Acceptable Margin of Error as Determined by the Researcher (5%).

3.2 Methods of Data Collection

The data for this study was collected through the use of a well-designed and well-structured questionnaire. The data collected were cross sectional data from primary source, the data collected from the small-scale tomato producers were socio-economic profiles of the farmers, prices of production inputs, quantity of inputs used and constraints faced by farmers in the course of tomato production in the study area. Data were analyze using the following descriptive and inferential statistics:

Descriptive Statistics: Data collected from field survey on small-scale tomato farmers were summarized through the use of mean, frequency distributions, and percentages. Descriptive statistics was used to summarize the socio-economic profiles of small-scale farmers as stated in specific objective one (i)

Farm Budgetary Technique: Gross margin and net farm income analysis of tomato production was estimated using the following models:

$$GM = TR - TVC \quad (2)$$

$$GM = \sum_{i=1}^{n} P_i Q_i - \sum_{j=1}^{m} P_j X_j \quad (3)$$

$$NFI = TR - TC \quad (4)$$

$$NFI = \sum_{i=1}^{n} P_i Q_i - \left[\sum_{j=1}^{m} P_j X_j + \sum_{k=1}^{k} GK\right] \quad (5)$$

Where

P_i = Price of Tomato ($\frac{₦}{Kg}$),

Q_i = Quantity of Tomato (Kg),

P_j = Price of Variable Inputs ($\frac{₦}{Unit}$),

X_j = Quantity of Variable Inputs (Units),

TR = Total Revenue obtained from Sales from Tomato (₦),

TVC = Total Variable Cost (₦),

GK = Cost of all Fixed Inputs (Naira)

NFI = Net Farm Income (Naira)

The farm budgetary technique was used to analyze the profitability of smallscale tomato production as stated in specific objective two (ii).

Financial Analysis: According to gross margin ratio is defined as (Alabi et al., 2020): $\textbf{Gross Margin Ratio} = \frac{\textbf{Gross Margin}}{\textbf{Total Revenue}}$ (6)

According to operating ratio (OR) is defined as (Olukosi and Erhabor, 2015):

$$Operating\ Ratio = \frac{TVC}{GI} \quad (7)$$

Where,

TVC = Total Variable Cost (Naira),

GI = Gross Income (Naira),

The financial analysis was used to analyze the profitability of tomato production as stated in specific objective two (ii).

3.3 Stochastic Production Efficiency Frontier /Cost Efficiency Frontier Model

According to the stochastic production frontier model is stated as follows (Alabi et al., 2022):

$$Y_i = f(X_i, \beta_i)e^{v_i - u_i} \quad (8)$$

The stochastic production frontier model was used to estimate the technical, cost, economic and allocative efficiencies scores as stated in specific objectives three (iii).

3.4 Allocative Efficiency Model

Allocative Efficiency (AE) is computed as follows:

$$\mathrm{AE} = \frac{1}{\mathrm{CE}} \quad (9)$$

$$\mathrm{AE} = \frac{\mathrm{EE}}{\mathrm{TE}} \quad (10)$$

Where,

AE = Allocative Efficiency

TE = Technical Efficiency

EE = Economic Efficiency

CE = Cost Efficiency

Tobit Dichotomous Regression Model: The dichotomous response model is defined as follows:

$$Y_i^* = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \alpha_5 X_5 + \alpha_6 X_6 + \alpha_7 X_7 + \alpha_8 X_8 + U_i \quad (11)$$

$$Y_i = \begin{cases} 1 \ if \ Y_i^* \geq 1 \\ Y_i^* \ if \ 0 < Y_i^* < 1 \\ 0 \ if \ Y_i^* \leq 0 \end{cases}$$

$Y_i^* = Latent\ or\ Unobserved\ Variable$

$Y_i = Efficiency\ Score\ Representing\ Allocative\ Efficiency\ (Number)$

$X_1 = Age\ (Years)$,

$X_2 = Farm\ Size\ (Hectares)$,

$X_3 = Household\ Size\ (Units)$

$X_4 = Gender\ (1, Male; 0, Otherwise)$

$X_5 = Marital\ Status\ (1, Married; 0, Otherwise)$

$X_6 = Level\ of\ Education (0, Non-Formal; 1, Primary; 2, Secondary; 3, Tertiary)$

$X_7 = Access\ to\ Extension\ Services\ (1, Access; 0, Otherwise)$

$X_8 = Membership\ of\ Cooperative\ Organizations\ (1, Member;\ 0, Otherwise)$

$U_i = Error\ Term$,

$\alpha_1 - \alpha_8 = Regression\ Coefficients$

$\alpha_0 = Constant\ Term$,

This was used to achieve specific objective four (iv) which is to evaluate socio-economic factors influencing allocative efficiency of small-scale tomato production in the study area.

Principal Component Analysis: The constraints facing small-scale tomato farmers and militating against tomato production were subjected to principal component analysis. This was used to achieve specific objective five (v).

4. Results and Discussion

4.1 Socio-Economic Characteristics of Tomato Farmers

This result in Table 1 indicate that 72.5% of tomato farmers were males, while 27.5% were females. This is an indication that tomato farming was a male dominated business in the study area. This may not be unconnected with the limited access of women to productive resources in many cultures and traditions. This is in agreement with the findings of (Haruna et al., 2007). About 38% of tomato farmers were singles, 18% were divorced and 44% were married. In their study of gender differentials in technical efficiency among maize farmers in Essien Udim Local Government Area-Nigeria, observed that marital status was positive and significant in relation to productivity of the male farmers (Simonyan and Omolehin, 2012). Table 1 also revealed that 18% of the resource tomato farmers were within the age range of 31 – 40years, 56% were within the age range of 41- 50 years, 27% were within the age range of 51-60 years while the mean age of resource tomato farmers was 46 years. The role of age of farmers is very critical in agricultural production. In their estimation of technical and allocative efficiency analysis of Nigerian rural farmers, Asongwa *et al*. (2011) observed that age of farmers had a positive effect on technical inefficiency effects. The result further indicates that 86% of the respondents had one form of formal education or the other, while 14% had no formal education. According to Imonikhe (2004), education would significantly enhance farmers‟ ability to make accurate and meaningful management decisions, it could also enhance the knowledge of improved techniques such as how to read and interpret recommended packages. The result in Table 1 also shows that 34% of the respondents had households' range of 1-5 persons, 40% of the farmers had household size range of 6-10 persons, while 26% of the respondents had household size range of 11-15 persons and with the mean household size of 7 persons. The implication of this is that farming households have a good source of family labour for farm business by providing the needed cheap and available manpower all-round the year. In his study of productivity and technical efficiency of smallholder cocoa farmers in Nigeria found that family size was a significant variable which greatly influenced the technical efficiency of farmers (Amos, 2007). The result further indicates that 67.5% of the respondents had extension contacts, while 32.5% of the respondents had no extension contacts. According to higher extensions contact was reported to increase the adoption of improved farm production technologies (Umar et al., 2007). They further observed that the frequency of extension contact is very essential as it guides the farmers from awareness to the adoption stage. About 20% of the respondents had farming experience of 1-5 years, 46.6% had farming experience of 6-10 years, 22.5% had 11-15 years' experience, while10.8 % had 16-20 years farming experience farmers. To observed that the longer a person stays on a particular job, the better the job performance tends to be (Adebayo, 2006). The result also indicates that 77% of the respondents were members of cooperative organizations, while 23% of the respondents were not members of cooperative organizations. The membership of a cooperative organization enables farmers to interact with one another, share their experiences and assist themselves in bulk purchase of inputs. Similarly, found that membership of cooperatives enhances members‟ efficiency by easing access to productive inputs and facilitating extension linkage compared to those who were not members (Gashaw et al., 2013; Folorunso and Bayo, 2020). Also, the result in Table 1 shows that 56% of the respondents had resource farm size range of less than 1 ha, 29% had resource farm size range of 1.1-2.0 ha and 9% of the tomato farmers had resource farm size range of 2.1 – 3.0, while 6% of the respondents had resource farm size range of 3.1 – 4.0 ha. The implication of this result is that all tomato farmers operate small-scale farms. To classification of farms; 0.1 - 5.0 hectares (small-scale); 5.1 - 10 hectares (medium- scale); and 10 hectares and above (large-scale). Since the majority of respondents had farm holdings between 0.1 and 5.0 hectares, it means that these farmers cannot achieve economies of scale production (Based on Olayide, 1980). This is consistent with the findings of whose findings revealed the bulk of the farm households that majority of the respondents operated on farmland sizes between 1–2 ha suggesting the smallholder nature of agriculture (Onuche and Oladipo, 2020).

Table 1: Socio-Economic Profiles of Smallscale Tomato Producers

Variables	Frequency	Percentage	Mean
Gender			
Male	87	72.50	
Female	33	27.50	
Marital Status			
Single	45	37.50	
Divorced	22	18.33	
Married	53	44.17	
Age (Years)			
31 – 40	21	17.5	
41 – 50	67	55.83	
51 – 60	32	26.67	46
Level of Education			
Non-Formal	17	14.17	
Tertiary	14	11.67	
Secondary	56	46.66	
Primary	33	27.50	
Household Size (Units)			
1 – 5	41	34.17	
6 – 10	48	40.00	7.0
11 – 15	31	25.83	
Extension Contact			
Yes	81	67.50	
No	39	32.50	
Farming Experience (Years)			
1 – 5	24	20.00	
6 – 10	56	46.66	9.0
11 – 15	27	22.50	
16 – 20	13	10.84	
Memberships of Cooperative			
Yes	92	76.67	
No	28	23.33	
Farm Size (Hectares)			
Less than 1.0	67	55.83	1.17
1.1 - 2.0	35	29.17	
2.1 – 3.0	11	09.17	
3.1 – 4.0	07	05.83	
Total	**120**	**100.00**	

Source: Field Survey (2022)

4.2 Profitability of Tomato Production

The results in Table 2 indicate that the total cost of tomato production incurred per hectare was ₦302,810. The cost includes variable costs per hectare such as cost of seeds (₦45,000) representing 15% of the total cost of production, fertilizer(₦105,000) representing 35% of the total cost of production, insecticides(₦17,240) representing 6% of the total cost of production, herbicides (₦13,350) representing 4% of the total cost of production and labour costs (₦68,450) (land clearing and preparation, planting, weeding, fertilizer application, chemicals application, harvesting, transportation, and loading and offloading) representing 27% of the total cost of production. Table 2 also indicated that the total revenue (TR) generated per hectare was ₦800,000. The result also indicated that the total variable cost (TVC) was ₦249,040 per hectare representing 82%. Finally, the budgetary analysis per hectare indicated that Tomato farming was profitable as shown by gross margin (₦550,960) per ha and net farm income (₦497,190) per ha. The gross margin and operating ratios were 0.69 and 0.28 respectively, indicating that the 69% of the gross revenue accruing to tomato production constituted the gross margin while 28% of the Gross income was committed to the total variable cost of tomato production. The operating ratio was less than unity and is an indication that their operations were inefficient. This report is similar to the findings of who pointed out that the profits depend on the scale of production (Busari and Okanlawon, 2015; Folorunso et al., 2023). The implication of this on the poverty status of tomato farmers in the study area is that increased and sustained profitability of this enterprise will enable farming households have economic access to basic amenities and thereby aid in poverty alleviation.

4.3 Farm Level Allocative Efficiency Scores of Tomato Farmers

The frequency distribution of the allocative efficiency (AE) estimates of tomato farmers as obtained from the stochastic frontier analysis is presented in Table 3. The result indicates that the minimum and the maximum allocative efficiency score of the farmers were 0.02 and 0.91 respectively, which means that the minimum tomato farmers had 2% allocative efficiency and had a maximum of 91% allocative efficiency. The distribution table further revealed that most (45%) of the tomato farmers in the study area were in the allocative efficiency range of 0.21 – 0.40, followed by farmers with allocative efficiency range of 0.00 – 0.20 were 19.17 %, followed by followed by 14.17% who were within allocative efficiency range of 0.41 – 0.60. The last in the allocative efficiency range is the farmers within the range of 0.81 – 1.00 and were 8.33%. The implication of the result is that for the farmers with the best production practices, Tomato production cost will rise by 9%$[1-(\frac{0.91}{1.00})\times 100]$ from the maximum possible level of 100% due to allocative inefficiencies, while for the tomato farmers with the least practices, the cost will rise by 98%

$[1-(\frac{0.02}{0.91})\times 100]$ from the maximum 100% due to allocative inefficiencies. Also, the result indicated that 45 % of the tomato farmers operated with within the 0.21 – 0.40 allocative efficiency range, which means that majority of the tomato farmers operated far from their production frontier. In the short-run therefore, there is scope for reducing production costs by adopting the techniques and technologies employed by the most efficient tomato farmers.

Table 2: Profitability Analysis of Smallscale Tomato Production per Hectare

Items	Amount (Naira)	% of Total Cost
Total Revenue	**800,000**	
Yield (Kg) = 4000		
Price per Kg	200	
Gross Income	800,000	
Variable Cost		
Seeds	45,000	0.15
Fertilizer Input	105,000	0.35
Insecticides	17,240	0.06
Herbicides	13,350	0.04
Labour Cost:		
(i) Land Clearing and Preparation	21,760	0.07
(ii) Planting	6,980	0.02
(iii) Weeding	11,670	0.04
(iv) Fertilizer Application	9,310	0.03
(v) Chemical Application	3,270	0.01
(vi) Harvesting	6,430	0.02
(vii) Transportation	4,280	0.01
(viii) Loading and Offloading	4,750	0.02
Total Labour Cost	68,450	0.27
Total Variable Cost	**249,040**	**0.82**
Fixed Cost		
Estimated Depreciation Value on Tools (Hoes, Machetes)	24,560	0.08
Rent on Land	29,210	0.10
Total Fixed Cost	**53,770**	**0.18**
Total Cost	**302,810**	**1.00**
Gross Margin	**550,960**	**0.69**
Gross Margin Ratio (GMR)	**0.69**	
Net Farm Income (NFI)	**497,190**	
Operating Ratio (OR)	**0.28**	

Source: Field Survey (2022)

Table 3: Summary Statistics of Technical, Economic and Allocative Efficiency Scores

	Allocative Efficiency		Economic Efficiency		Technical Efficiency	
Efficiency Score	**Frequency**	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
0.00 – 0.20	23	19.17	21	17.50	10	08.34
0.21 – 0.40	54	45.00	46	38.33	49	40.83
0.41 – 0.60	16	13.33	27	22.50	42	35.00
0.61 – 0.80	17	14.17	12	10.00	07	05.83
0.81 – 1.00	10	08.33	14	11.67	12	10.00
Total	120	100.00	120	100.00	120	100.00
Mean	0.40		0.42		0.44	
Std Deviation	0.2402		0.2463		0.2113	
Minimum	0.02		0.03		0.02	
Maximum	0.91		0.93		0.89	

Source: Field Survey (2022)

4.4 Resource Inputs, Socio-Economic Factors of Farmers and Allocative Efficiency

With the aid of the Tobit regression model, the relationships between allocative efficiency, the resource factors and the socio-economic traits of farmers was evaluated as displayed in Table 4. The pseudo R^2 is 63%, indicating an absolute relationship between the explanatory variables and allocative efficiency in the study area, and 63% of the variation in the variables was explained by the model. The likelihood function is positive (115.79), the Chi-squared value is positive (79.87***) and significant at 1%. Age of the farmer, farm size, household size, gender, marital status, education and access to extension services all significant and would increase the likelihood of household being allocative efficient tomato production.

Age: It was discovered that the age of the farming households had a positive coefficient (0.0130), was significant at the 1% level of probability, and was not what one would have predicted a priori. This suggests that as respondents' ages increase, there is a greater chance that resource wastage will decrease, according to the variable's coefficient. It is common knowledge that farmers tend to have more experience in the agricultural process the older they get. This result is in line with that of who discovered that age was positively correlated with inefficiency in their research of small-scale oat growers in Nigeria (Kolawole and Ojo, 2007).

Farm Size: Small farm size is a barrier to agricultural mechanization because it will be challenging to control weeds using farm equipment like tractors. Farmers' ability to grow their crops depends on a variety of factors, including population pressure, family size, labour productivity, financial situation, and level of experience (Imonikhe, 2004). In line with apriori expectation, the coefficient (0.020*) of farm size was found to be positive as expected and significant at 1% level of probability. Farm size determines the availability of supply to the markets. Therefore, increase in farm size will increase the probability of an increase economic efficiency.

Household Size: It was discovered that the household size coefficient was significant at 1% and positive (0.055) as expected. Significant households require significant amounts of output to feed their members, which means that as household size rises, so does the demand for food. Household size also affects the availability of family labour. The cost of food and other household requirements must go up as families grow, which ultimately leads to an increase in food insecurity. This suggests that agricultural families have a reliable source of family labour for their farming operations. This is a good sign that there will be more family manpower available for farm work and that the size of the farm will consequently need to be increased. Family size was shown to be a significant variable that had a substantial impact on the technical efficiency of farmers in his research of the productivity and technical efficiency of smallholder cocoa farmers in Nigeria by (Amos, 2007).

Gender: The coefficient (0.0372) of gender is significant and positive at 1% level of probability. It means that the likelihood of increasing allocative efficiency increases with the proportion of a certain gender engaged in tomato production. This could be ascribed to the area's traditional system of land ownership, which exclusively permitted male members of the community to inherit and possess and own land. This favours the male farmers than their female counterpart. This might also be a result of the distribution of resources discriminating against women. According to farmland lands are typically owned by husbands or other male family members rather than by the women who work on them (Funminiyi et al., 2020). This supports the claim made that families in rural areas typically make a living by growing both cash and food crops by (Adebayo and Ojogu, 2019).

Marital Status: The coefficient of this variable was found to be positive (0.2466856) and significant at 1% level of probability. This means that marital status is an important variable in the probability of the farmers being able to maximize their profit. A change in marital status of the respondents will increase the probability of the respondents being able to reduce underutilization of resources by the coefficient of the variable.

Educational Level: The coefficient (0.0182) of this variable was found to be positive, significant at the 1% level, and consistent with a priori expectations, which means that as one's educational level rises, the likelihood of underutilizing resources and wastages also rises by 0.0182. Education facilitates farmers' acquisition and application of new technologies (Onyenweaku et al., 2005; Dey et al., 2005; Nwaru, 2004). This suggests that people's ability to produce more to maximize their profits will likely increase the longer they spend in school.

Access to Extension Services: The coefficients of Extension contact (0.101) is positive, consistent with the apriori expectation and significant at 5% level of probability. This means having extension agents introducing innovation and training was not enough to significantly cause a farmer to attain higher levels of allocative efficiency if he cannot afford the technology or put the training to use. This is supported that the presence of extension services can increase greatly the awareness and adoption level of innovations by (Fuminiyei et al., 2020). This also agrees with who stated that inadequate extension workers and services relations were key barriers to the adoption across all of the research villages, ranking high in the literature and seen as a barrier to Climate Smart Agricultural Practices adoption during the farmers' interview (Salisu, 2022).

Table 4: Maximum Likelihood Results of the Tobit Dichotomous Regression Model

Variables	Parameters	Coefficient	Standard Error	t-Value
Constant	α_0	0.7544***	0.0560	13.48
Age	α_1	0.0130***	0.0042	3.11
Farm Size	α_2	0.020***	0.006	3.26
Household Size	α_3	0.055***	0.017	3.280
Gender	α_4	0.0372**	0.0154	2.421
Marital Status	α_5	0.1981***	0.0677	2.923
Level of Education	α_6	0.0182*	0.0087	2.094
Access to Extension Services	α_7	0.101**	0.04	2.74
Member of Cooperative Organization	α_8	0.071**	0.031	2.74
Sigma	0.1283			
LR Chi^2	79.87***			
Pseudo R^2	-0.6343			
Log Likelihood	115.79			

Source: Data Analysis (2022) *Significant at ($P < 0.10$)., **Significant at ($P < 0.05$), ***Significant at ($P < 0.01$).

Table 5: Principal Component Model of Constraints Encountered by Tomato Producers

Constraints	**Eigen-Value**	**Difference**	**Proportion**	**Cumulative**
Lack of Credit Facilities	2.7904	0.1796	0.1145	0.1145
Inadequate Extension Services	2.6108	0.6302	0.1179	0.2324
Bad Road Infrastructures	1.9806	0.0800	0.1305	0.3629
High Labour Cost	1.9006	0.0716	0.1429	0.5058
High Cost of Farm Input	1.8290	0.0629	0.1538	0.6596
Bartlett Test of Sphericity				
Chi Square	793.01***			
KMO	0.7107			
Rho	1.00000			

Source: Field Survey (2022)

4.5 Principal Component Analysis of Resource and Infrastructures Constraints Facing Smallholder Tomato Farmers.

Table 5 shows the results of the resource constraints faced by smallscale tomato farmers, PCA is a statistical technique that transform interrelated data with many variables into few numbers of uncorrelated variables. From the result the number of principal components retained using the Kaiser Meyer criterion are five based on the Eigen value greater than 1. By demonstrating the viability of employing the data set for principal component analysis, the Kaiser-Meyer-Olkin measures of sampling adequacy (KMO) of 0.7107 and Bartlett test of sphericity of 793.01 were significant at 1% level of probability. According to the perception of small-scale tomato farmers as the challenges faced in tomato production in the country, lack of credit facilities had an Eigen value of 2.7904 and ranked first, inadequate extension services had an Eigen value of 2.6108 and ranked second, bad road infrastructure had an Eigen value of 1.9806 and is ranked third, high labour costs had an Eigen value of 1.9006 and was ranked fourth, and high input costs had an Eigen value of 1.8290 and was ranked fifth.

5. Conclusion and Recommendations

Based on these findings, it is concluded that tomato production was profitable going the both profitability and financial indices. Similarly, the wide variations in the efficiencies were indicative of the inefficiencies of tomato farmers. Age of farmers, farm size, household size, gender, marital status, education status and access to extension services were the resource and socio-economic determinants of allocative efficiency. Lack of credit facilities, inadequate extension services, bad road infrastructures, high cost of labour and high cost of farm inputs based on the perceptions of smallscale tomato farmers were the challenges faced in tomato production. It is therefore recommended that; (i) Farmers should be trained through extension services in order to reduce resource wastages for optimum profitability, (ii) Farmers should take advantage of family labour to compliment hired labour in order to increase farm size cultivated, (iii) Efforts should be put in place by the three tiers of government in addressing and eliminating the constraints to production identified by the farmers.

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