Determinant Factors Affecting Vegetable Productivity in Adamawa State, Nigeria

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***Abstract*: Productivity of agricultural enterprises has remained a major issue in the agricultural sector in Nigeria; this study analyzed the productivity of smallholder vegetable farmers in Adamawa State, Nigeria. A total of 204 respondents were selected through a multi-stage sampling technique. Data were collected through structured questionnaire administered to sampled respondents. The study reveals that mean total factor productivity was estimated to be 2.67kg/₦. The OLS regression analysis revealed that farming experience at p≤0.10, farm size at p≤0.01, labor at p≤0.01, seed at p≤0.05, fertilizer at p≤0.01, agrochemical at p≤0.10, vegetable output at p≤0.01 and market distance at p≤0.05 were the factors affecting the vegetable farmers' productivity in the study area.. High costs of fertilizer, agrochemicals, transportation, labour, and lack of improved variety and the problem of middlemen among others were the identified constraints faced by the vegetable farmers. The research recommended that inputs should be made available in right quantities and at affordable prices to the farmers by the government through the relevant stakeholders in agriculture. Vegetable farmers are encouraged to form a cooperative society or join an existing one in order to access for funds from government, private sector or non-governmental organizations. Timely and adequate extension service delivery should be fostered in the study area. If possible, government should acquire large expanse of lands and lease them out to vegetable farmers at reduced rates and less stringent conditions.**

I. INTRODUCTION

Agriculture has continued to be an embodiment for sustainable development, poverty reduction, attainment of household self-food sufficiency and food security (Olwande *et al*., 2009). Nigeria has reputation as predominantly an agrarian society, as a reasonable percentage of the population engages in agricultural production though at subsistence level. The sector contributed an estimated 38.6% to 40% of Gross Domestic Product (GDP) to the nation's economy in 2013 with about 70% of the population productively engaged in farming (NBS, 2014). It contribution to the Gross Domestic Product has remained stable at between 30 and 42 percent, and employs 65 percent of the labour force in Nigeria. In Nigeria, more than 60 percent of the population is engaged in agricultural production; most of which are engaged in small scale production (Olutawosin and Olaniyan, 2001). The smallholders who are the back bone of the agricultural sector produce about 80 percent of the total food requirement Bamidele *et al.* (2008).

The growing of vegetables is positive, empowering and rewarding; it cuts across different class, race and culture like no other. World production of vegetables grew by 30 percent between 1990 and 2003 reaching 1,274million tons by 2003 (Diop and Steven, 2005). China is currently the world largest producer of vegetables with a share 34percent, followed by latin America and carribbean with 11percent, India with 10percent, while Africa and the European Union both at 9percent respectively (Diop and Steven, 2005). Vegetable production has been inconsistent in Nigeria; for instance, in 2007 about 5924.9 thousand tons were produced, while 3497.7 thousand tons were produced in 2006 (CBN, 2008). Akpan *et al*. (2012) noted that Vegetable production is a form of intensive agriculture; large volumes of produce can be obtained from very small areas of land, so long as the plants are provided with adequate water, nutrients and pest and disease management. In the field (with good management practices) for example onion yields of $5kg/m^2$ and cabbage yields of $4kg/m^2$ (90 days from planting) are achievable. Vegetables are good sources of protein, mineral salts, sugars, vitamins, and essential oils that increase man's resistance to disease (Christian, 2007).

Statement of the Problem

Bamidele *et al.* (2008) noted that low productivity is a characteristic of small-scale crop farms. They also noted that differences in productivity overtime and farming types can result from variety of factors including variation in scale or level of production, farmer's rationality in resources use and management practices at plot levels. These factors appear to be few amongst others; hence there is a need to assess other factors responsible for low productivity among smallholder vegetable farmers. Vegetables such as onions, okra, pepper, spinach and tomatoes are chosen for this study because majority of the vegetable farmers in the state are engaged in producing these crops. Therefore, this study will try to bridge the information gap by assessing the productivity of some smallholder vegetables production in Adamawa State.

Objectives of the Study

i. Examine the productivity level of vegetable production in the study area;
ii. Determine the factors affecting productivity levels of vegetable production in the study area.

iii. What are the constraints militating against vegetable production in the study area

II. METHODOLOGY

Research Design

The Study Area

This study was carried out in Adamawa State of Nigeria. The State lies between latitude 7^{o} and 11^{o} N of the equator and between longitude 11^{o} and 14^{o}E of the Greenwich meridian. Adamawa State has Total land area of about 36, 917km^2 with an estimated population of 3,737, 223(NPC, 2006). It is bordered by the states of Borno to the northwest, Gombe to the west and Taraba to the southwest while its eastern border forms the national eastern border with Cameroun. The State has twenty-one (21) Local government Areas with Yola as the state capital (Adebayo and Tukur, 1999).

The maximum temperature reaches 42^{0} C especially in March and April, while the minimum Temperature is as low as 28^{0} C between December and January. Relative humidity between January and March ranges from 20-30% and reach the peak of about 80% in August and September (Adebayo, 1997) and the main annual rainfall is less than 1000mm and the major crops grown include rice, guinea corn, cowpea, groundnut, soyabeans and Vegetables (onions and peppers), fishing and livestock production(Jongur, 2006). The topography of Adamawa state is essentially a mountainous land traversed by the big river valleys of Benue, Adamawa and Yedseram. The valleys of Cameroun, Mandara and Adamawa mountains constitute part of this undiluting landscape.

Adamawa State has an agro-based economy with over 50% of the populace actively involved in farming either on full time or part time scale (Mshelia *et al.*,2008) the climate is essentially tropical dry and wet (rainy) seasons. Vegetables produced include tomato, spinach, sorrel, carbage, fluted pumpkin, okra, onion and pepper. Michika, and Madagalli local government area serves as hub for vegetable production and they provide market of fresh vegetables to residents of Mubi region (Mubi,Michika, Madagalli,Maiha) and part of Borno State. Other vegetable markets in the state include Jimeta, Jambutu, Numan, and Lokko. The major crops produced in the state include cash crops like groundnut, cotton, and sugar cane as well as several food crops like that include; rice, maize, millet, cowpea, bambara nuts, cassava, yam, sweet potato. Animals like cattle, sheep, goats, pigs, and poultry are reared for domestic consumption and commercial purposes.

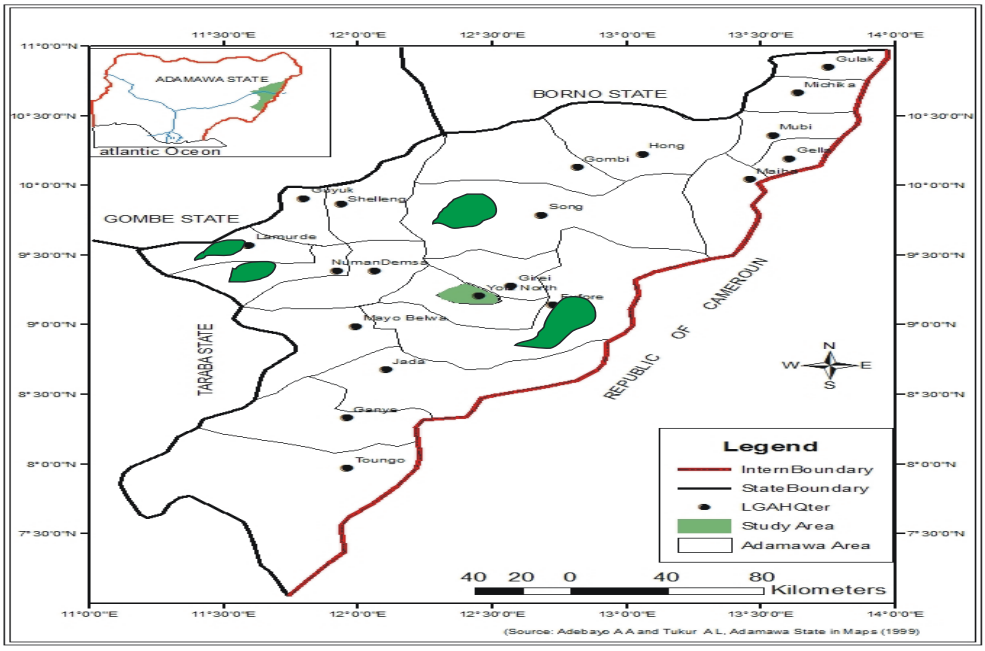

Figure 1: Map of Adamawa State

Figure 1: Map of Adamawa State

Source: Adebayo A.A and Tukur A. L (1999)

Population and Sampling Technique

The population for this study consisted of smallholder vegetable farmers in Adamawa State, Nigeria. A multi-stage sampling technique was used to select a total sample size of 204 respondents, as presented in Table 1. The first stage involved purposive sampling technique of the study area into two zones that is (southern and central agricultural zones) where vegetable farming mainly takes place in the state. The second stage also involved purposive sampling of five (5) Local government areas (Fufore, Yola north, Lamurde, Song and Numan) where vegetable farming is predominant. The third stage involved random selection of twelve (12) communities from the selected LGAs. Fourthly, sample frame was developed for each community using a proportional allocation of 10% across board and a total sample size 204 respondents were selected for the study and only 200 questionnaires were returned and analyzed. The aggregate vegetables (onion, okra, tomato, spinach and pepper) were considered for the analysis.

Sample Size Selection Plan

Zones	Local Govt.	Communities	Sampling Frame	Sample Size
South	Lamurde	Kabawa	172	17
		Zekun	146	15
South	Numan	Bare	171	17
		Wodi Lure	155	16
Central	Yola North	Jambutu	190	19
		Rhumde	162	16
		Gwadabawa	150	15
Central	Song	Lokko	198	20
		Dumne	169	17
Central	Fufore	Pariya	172	17
		Malabu	178	18
		Dasin	169	17
Total				**204**

Source: Adapted from ADADP, 2014

Method of Data Collection

The data for this study was obtained through primary and secondary sources. The primary data was obtained through structured questionnaire administered through personal interview process to the vegetable farmers in the study area. The questionnaire was designed in a manner as to provide answers that are in line with the objectives of the study.

Techniques of Data Analysis

Data collected from the study was subjected to achieve objective (i) using total factor productivity to capture the productivity of selected aggregate vegetable in the study area, objective ii was achieved using ordinary least square Multiple Regression while Objective iii.

Total factor productivity

To determine vegetable farmer's productivity (TFP) in the study area, Key and Mcbride (2003) approach to the determination of total factor productivity was adopted. This was used to compute the productivity level for each of the respondents. This is given as:

$$TFP = \frac{Y}{TVC} = \frac{Yi}{\Sigma PxiXi} \quad \ldots\ldots (1)$$

$$TFP = \frac{TVC}{Y}, \text{ then}$$

$$TFP = \frac{Y}{TVC} = \frac{1}{AVC} \quad \ldots\ldots (2)$$

$$AVC = \frac{TVC}{Y} = \frac{Yi}{\Sigma i = PxiXi} \quad \ldots\ldots$$

Multiple regression analysis was employed to determine factors influencing productivity levels of aggregate vegetable in the study area. The implicit model for vegetable households in the study area is model as: -

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9 X_{10} X_{11}, X_{12}, X_{13} X_{14} X_{15}) \quad \ldots\ldots (8)$$

Where,

Y = Productivity (TFP) of vegetable farmer

X_1 = Age (years)

X_2 = Educational levels of farmers (yrs)

X_3 = Farming experience (yrs)

X_4 = Farm size (ha)

X_5 = Household size

X_6 = Extension contacts

X_7 = Cost of Labour (mandays),

X_8 = Cost of Seed (Kg)

X_9 = Cost of Fertilizer (Kg),

X_{10} = Agrochemicals/insecticides (litre)

X_{11} = Access to Credit (1 if Yes, 0 if No)

X_{12} = Quantity of Vegetable crop produced (kg)

X_{13}= Quantity of fertilizer used (kg)

X_{14} = Distance to Market

X_{15} = Price of Vegetable Crop (₦)

U = Error term.

Four functional forms using ordinary least square (OLS) technique will be tried and the functional form which best explains the input-output relationship will be selected. The selection will be based on the value of the coefficient of determination (R-square), number of significant variables and conformation to the *apriori* expectations.

The model specifications for the different functional forms are as follows:

Linear form:

$Y = bo + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + + b_{12}X_{12} + b_{13}X_{13} + b_{14}X_{14} + b_{15}X_{15} + \mu$……. *(9)*

Semi-log form:

$Y = bo + b_1 log_{g1} + b_2 log_{g2} + b_3 log_{g3} + b_4 log_{gg4} + b_5 log X_5 + b_6 log X_6 + b_7 log_{og7} + b_8 log_{og8} + b_9 log_{og9} + b_{10} log_{g10} + b_{11} log X_{gX}\ b_{12} log X_{12} + b_{13} log X_{13} + b_{14} log X_{X4} + b_{15} log X_{15} + \mu$ …………. *(10)*

Double log form:

$log Y = bo + b_1 log_{g1} + b_2 log_{g2} + b_3 log_{g3} + b_4 log_{gg4} + b_5 log X_5 + b_6 log X_6 + b_7 log_{og7} + b_8 log_{og8} + b_9 log_{og9} + b_{10} log X_{10} + b_{11} log X_{11} + b_{12} log X_{12} + b_{13} log X_{13} + b_{14} log X_{14} + b_{15} log X_{15} + \mu$………. (11)

Exponential form:

$log Y$ = bo + b1X1 + b2X2 + b3X3 + b4X4 + b5X5 + b6X6 + b7X7 + b8X8 + b9X9 +b10X10 +b11X11 + b_{12}X12 + b13X13 +b14X14 +b15X15 +μ…… (12)

Where $b_1 – b_{11}$ are the coefficients of the corresponding variables and these variables are as defined earlier, bo is the constant of the regression model and U is the error term.

Factor Analysis:

This was used to explain the relationship among several problems by identifying the constraints militating against vegetable production in the study area. Steps involved in factor analysis include;

i. Identifying the variables by labeling them; showing variables);
ii. Standardizing of each variable by dividing each by standard deviation

$$S = \frac{\sqrt{\sum(x-x)2}}{N}; \ldots\ldots\ldots (18)$$

iii. Determination of the loadings by calculating the x of correlation matrix in the table;
iv. Approximation of loadings to obtain new components or factors and
v. Interpretation of the rotated matrix.

Result interpretation was based on Kaiser's (1958) rule of thumb which states that variables with correlation coefficients of 0.40 or more have high loadings and as such are qualified to be used in classifying or naming a factor.

III. RESULTS AND DISCUSSION

Productivity level of the vegetable farmers in the study area

Effort was made to ascertain the level of vegetable productivity in the study area particularly taking into consideration the value of output and the various inputs employed in other to compute the productivity level for each of the respondents. Production inputs such as labour, seed, fertilizer and agrochemical were considered as they are very important factors that have great influence on the productivity of smallholder farmers as argued by Durba (2017).

The result of the analysis of aggregate vegetable productivity in the area is presented in Table 2. It showed that 42.50% of vegetable farmers had productivity level that ranged from 1.00 and 2.00 kg/₦ while 29.50% had productivity level that ranged from 2.01 and 3.00 kg/₦. Also, 12.00% and 11.50% of the farmers had between 3.01 and 4.00 kg/₦and 4.01 and 5.00 kg/₦ productivity levels respectively. Only a meager 4.5% had productivity level above 5.00 kg/₦. It is noteworthy that all the vegetable farmers in the study area had productivity level above 1.00 with the minimum of 1.05 and maximum of 9.66 recorded respectively. Furthermore, the average productivity level estimated among the vegetable farmers in the area was 2.67. This result shows the farmers were very productive in the vegetable production enterprise in the study area. This figure is similar to that reported by Mbam and Edeh (2011) for rice farmers in Anambra State.

Table 2. Productivity level of the vegetable production in the study area

Total factor productivity	Frequency	Percentage
1.00 – 2.00	85	42.50
2.01 – 3.00	59	29.50
3.01 – 4.00	24	12.00
4.01 – 5.00	23	11.50
Above 5.00	9	4.50
Total	200	100.00
Mean value	2.67	
Minimum value	1.05	
Maximum value	9.66	

Sources: Field survey, 2017

Factors Affecting Productivity Levels of Vegetable Production in the Study Area

The ordinary least squares (OLS) regression estimates of the factors affecting the productivity of the aggregate vegetable farmers in the study area are presented in Table 3. The double-log functional form was chosen as the lead equation based on the F-value, R-squared value and the number of significant variables. The result revealed that the F-value of 48.44 was statistically significant at 1% level of probability. This implies that the whole model was significant, that is, there was a significant relationship between the dependent variable and the independent variables included in the model. It also shows that the coefficient of multiple determination (R-squared) was 0.7720. This implies that 77.20% variation in the productivity of the vegetable farmers was explained by the explanatory variables ($X_1 - X_{13}$) included in the model, while the remaining 22.80% not explained is as a result of variables not included in the model as well as factors beyond the farmers' control.

The estimated coefficients of farming experience, farm size, labour, seed, fertilizer and market distance were 0.0359, 0.0471, 0.1476, 0.1952, 0.3147 and 0.0304 and significant at 10%, 1%, 1%, 5%, 1%, 1% and 5% level of probability respectively. This implies that for 1% increase inthese variables holding other variables constant will lead to increase in the vegetable farmers' productivity by 3.59%, 4.71%, 14.76%, 19.52%, 31.47% and 3.04% for farming experience, farm size, labour, seed, fertilizer, vegetable output and market distance respectively. Conversely, the estimated coefficient of agrochemical was -0.1258 and significant at 10% level of probability indicating that 1% increase in the use of agrochemical holding other variables constant will lead to decrease in the vegetable farmers' productivity by 12.58%. This might be that the vegetable farmers are over using herbicide in the study area.

Summarily, farming experience, farm size, labour, seed, fertilizer, agrochemical, vegetable output and market distance were the significant factors affecting the vegetables farmers' productivity in the study area. This finding is similar to that of Mohammed (2017) who reported that farming experience, farm size, and fertilizer, were the significant factors affecting food crop farmers' productivity in north east Nigeria. It also corroborates the findings of Fakayode *et al*. (2007), Obasi *et al*. (2013), and Adesiyan (2015) who all reported that years of farming experience, farm size, fertilizer use, planting materials and labour are the main determinant of agricultural productivity.

Table 3: Estimates of Factors Affecting Productivity Levels of Vegetable Farmers in the Study Area

Variable	Linear		Double-log		Semi-log		Exponential	
	Coefficient	**t-value**	**Coefficient**	**t-value**	**Coefficient**	**t-value**	**Coefficient**	**t-value**
Age (years)	-0.0026	-0.68	-0.0181	-0.22	-0.0372	-0.26	-0.0013	-0.38
Education (years)	-0.0075	-1.14	-0.0041	-0.33	0.0017	0.08	-0.0072	-1.24
Farming experience (years)	0.0057	1.74*	0.0359	1.72*	-0.0511	-1.04	0.0051	1.76*
Farm size (ha)	0.0084	3.25***	0.0471	3.63***	0.0666	2.52**	0.0089	2.30**
Household size (no)	-0.0040	-0.49	0.0065	0.20	0.0195	0.36	-0.0044	-0.61
Extension contact (no)	0.0180	0.25	0.0129	1.25	-0.0117	-0.67	0.0131	0.21
Labour (man-day)	0.0006	0.97	0.1476	5.10***	0.1283	2.61***	0.0006	1.14
Seed (kg)	0.0104	1.44	0.1952	2.18**	0.0938	1.62	0.0112	1.74*
Fertilizer (kg)	0.0007	5.76***	0.3147	4.67***	0.3878	3.39***	0.0007	6.00***
Agrochemical (litre)	0.0206	3.89***	-0.1258	-1.68*	0.0225	0.17	0.0119	2.51**
Credit (₦)	1.04E-06	0.96	0.0009	0.22	0.0002	0.03	7.17E-07	0.74
Vegetable output (kg)	0.0001	9.20***	0.9217	19.61***	0.8644	10.82***	0.0001	10.61***
Market distance (km)	0.0025	2.50**	0.0304	2.46**	0.0465	2.21**	0.0022	2.49**
Constant	0.8302	5.26***	-4.9757	-10.31***	-3.5415	-4.32***	-0.2834	-2.01**
R-Squared	0.5987		0.7720		0.5193		0.5636	
Adjusted R-Squared	0.5706		0.7560		0.4857		0.5331	
F-Value	21.34***		48.44***		15.45***		18.48***	

*** = $p \leq 0.01$; ** = $p \leq 0.05$ and * = $p \leq 0.10$

Sources: Field survey, 2017

Analysis of Vegetable Production Constraints in the Study Area

Factor analysis using the varimax rotated factors with Kaiser Normalization was used to analyze the perception of the vegetable farmers in the study area on the production constraints they faced with. Results are presented in Table 4 which shows the outcome of factor loadings from factor analysis after varimax rotation of farmers' responses to questions posed to them in an attempt to understand their perception in constraints associated with vegetable production. It indicated that the significant constraints that affect vegetable production in the study area were high cost of fertilizer and agrochemicals, high cost of transportation, high cost of labor, poor storage facilities, poor infrastructure, problem of middlemen and land tenure system. These constraints were listed according to the proportion of variance associated with them and were classified under three major factors. These are economic, infrastructural and institutional factors and are discussed as follows:

Table 4 shows that there were three (3) main constraints of vegetable farmers in Adamawa State (factor 1 (economic factors), factor 2 (infrastructural factors), factor 3 (institutional factors)**:** Factor one is comprised of high cost of fertilizer and agrochemicals (0.5238), high cost of transportation (0.6060) and cost of labor (0.5817). High cost of farm inputs was a major constraint faced by the farmers which pose a barrier to farmers' timely access to adequate resources required for improved vegetable productivity. High cost of transportation can hinder the smooth movement of farm produce to the market. The implication of this is that, farmers are not able to sell their produce in good time. This may lead to farmers suffering post-harvest losses which will reduce their farm income. Mbam and Nwibo (2013) reported that rural farmers should be pleased and motivated to save and invest so as to maintain the already established standard of living.

Factor 2 (infrastructural factors): This was dominated by problem of poor storage facilities (0.5984) and poor infrastructure (0.4532). The implication of these is that, farmers are not able to smoothly transport their farm produce from the field and also not able to preserve it for a long time. This could cause the farmers to suffer post-harvest losses which will reduce their farm income. Access to market and availability of market are bound to reduce marketing costs on matters such as transport and other transaction costs and offer favourable price for tomatoes (Wachira, 2012; Anyiro and Oriaku, 2011).

Factor 3 (institutional factors): This was dominated by problem of middlemen (0.6143) and land tenure system (0.4355). The problem of middlemen could limit the profit maximization objective of the vegetable farmers through middlemen exploitation, delay in getting produce to target consumers and high levies among others. The problem of land tenure system could also greatly affect the productivity of the vegetable farmers particularly when the farmers do not have adequate access to fertile arable land. Agbochenu (2016) in his study on the analysis of marketing efficiency of cereals and vegetables among marketers in Benue State of Zone C observed that inadequate storage facilities and inadequate marketing channels creates surpluses at harvest period which must be sold at low prices.

Table 4. Analysis of Vegetable Production Constraints in the Study Area

Production Constraints	Factor 1 (economic factors)	Factor 2 (infrastructural factor)	Factor 3 (institutional factors)
High cost of fertilizer and Agrochemicals	0.5238*	0.0048	0.1098
High cost of transportation	0.6060*	0.2582	0.0868
High cost of labor	0.5817*	0.0601	0.0624
Lack of improved variety	0.228	0.0707	0.1887
Problem of Middlemen	0.189	0.2202	0.6143*
Poor Storage Facilities	0.1071	0.5984*	0.1567
Poor marketing System	0.3001	0.5852	0.4129
Problem of Insect and diseases	0.0524	-0.0193	0.2491
Lack of access to credit	0.1246	0.2245	-0.2679
Land tenure system	0.3759	0.2566	0.4355*
Lack of Extension agent visit	-0.3272	0.2755	0.3512
Poor infrastructure (road, water, etc)	-0.0029	0.4532*	-0.0352

Note: Factor loading of **0.40** was used at 10% overlapping variance.

Rotation method: Varimax with Kaiser Normalisation

Variables with factor loadings of less than **0.40** were not used.

Variables that load in more than one factor were also ignored.

IV. CONCLUSION AND RECOMMENDATIONS

Based on the findings of this study, it was concluded that the vegetable farmers were relatively productive and vegetable production is a profitable farm enterprise in the area. Farming experience, farm size, labour, seed, fertilizer, agrochemical, vegetable output and market distance were the significant factors affecting the vegetables farmers' productivity in the study area.

The following recommendations were made based on the outcome of this study; policy that should encourage farm mechanization in vegetable production is strongly advocated in the state as it will reduce the effect of high labour cost and raise the output of the sub-sector to meet up with future demand in the state. Timely and adequate extension service delivery should be fostered in the study area. The findings therefore call for farm level policies aimed at intensifying extension services among vegetable farmers and If possible, government should acquire large expanse of lands and lease them out to vegetable farmers at reduced rates and less stringent conditions. This would go a long way to reduce the problem of land tenure system and ensure access to land.

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