

Original Research Article

ECONOMIC EFFICIENCY OF IRRIGATED VEGETABLE PRODUCTION IN BORNO STATE NIGERIA:A STOCHASTIC FRONTIER COST FUNCTION APPROACH

ABSTRACT



This study analysed the economic efficiency of irrigated vegetable producers in Borno State, Nigeria. Multistage sampling technique was used to select the respondents. Structured survey questionnaires were used and administered to 300 respondents to obtain primary data. Both descriptive and inferential statistics were used to analyze the data obtained. Descriptive statistics used were mean, frequency and percentage. The inferential statistics used was stochastic frontier cost function to analyze the level and determinants of economic inefficiency in the studied enterprises. Mean economic efficiency of the irrigated vegetable enterprises were 0.72, 0.86, 0.73, 0.78, and 0.78 for sole onion, sole tomato, sole pepper, onion/tomato and onion/pepper respectively. The maximum likelihood estimates of the cost function indicate sigma square values of 0.248, 0.031, 0.363, 0.228 and 0.122 for sole onion, sole tomato, sole pepper, onion/tomato and onion/pepper respectively and significant at one percent. Variance ratio (gamma) values indicate presence of economic inefficiency in irrigated vegetable production in the study area with coefficients of 0.945, 0.932, 0.945, 0.173 and 0.122 for sole onion, sole tomato, sole pepper, onion/tomato and onion/pepper enterprises respectively. The coefficients of production variables in the stochastic frontier cost function were positive and significant at one percent level. The most significant variables were costs of labour, planting materials, depreciation, seeds/seedling and fuel and maintenance. The economic inefficiency variables also showed negative coefficient and significant at different levels. The study concluded that there was economic inefficiency in irrigated vegetable production in the study area despite high levels of economic efficiencies among the studied farmers. It is recommended that there is need for the concerned agencies to promote both formal and none-formal education. It is recommended that government should provide support in respect to price stability, good market facilities and market information to enhance efficiently of vegetable production in the study area.

Key Words: Economic-Efficiency, Vegetable, Production, Irrigated, Stochastic, Cost-Function

1. INTRODUCTION



Vegetables play very important role in the diet of human. The consumption of vegetable as a cheap source of minerals and vitamins to supplement people's diet cannot be over emphasized. They help in protecting body against diseases. Almost all vegetables are low in fat and calories and many of them are good sources of fibre. The high level of fibre in vegetable keeps the digestive system healthy and prevents constipation. Vegetable production also serves as sources of livelihood for small-scale

35 farmers, create employment opportunities for the populace, generate income and reduce poverty
36 (AVRDC, 2006; Oladoja *et al.*, 2006).

37 Nigeria is one of the vegetable producing nations in Africa. In the past, it was found to be
38 producing below major African producing nations, but currently there is improvement in the
39 production level. As at 2012, production records were put at 643,312 million metric tonnes, which is
40 highest compared to other African vegetable producing nations (CBN, 2013).

41 Borno State is one of the States where vegetable production is highly practised. Production of
42 vegetable is largely carried out during dry season under irrigation condition, although it is also grown
43 under rain fed agriculture. About 10,000 hectares of land is devoted to vegetable cultivation in Borno
44 State BOSADP (2010). The vegetable crops commonly grown in Borno State include onion, tomato,
45 pepper, okra, egg-plant, amaranthus, sorrel, lettuce, cabbage and carrot. Most of these are grown as
46 mixed crops especially onion, tomato and pepper, amaranthus and sorrel, cabbage and lettuce and so
47 on. An average yield of about 15.25 tonnes per hectare, 6.09 tonnes per hectare and 9.65 tonnes per
48 hectare of onion, tomato and pepper respectively were reported to be produced in the State (NFRA,
49 2008; Lawan *et al.*, 2010). Production of vegetables in the State is still at small-scale level, in spite of
50 its economic growth potentials. Studies involving farmers' efficiency and productivity measure could
51 be sound bases for harnessing the growth potentials in vegetables farming. The objectives were to
52 estimate the levels and determinants of economic efficiency of irrigated vegetable production in
53 Borno State Nigeria. This study was concerned with the analysis of economic efficiency among
54 irrigated vegetable producers in Borno State, Nigeria. The study covers the single production season
55 of 2012/2013 season. The enterprises considered under this study were onion, tomato and pepper,
56 which were known to be of high economic value in the study area and can be produced under similar
57 production conditions.

58 2. METHODOLOGY

59 2.1 The Study Area

60 The study was conducted in Borno State, Nigeria. The State lies between latitudes $10^{\circ}02'N$
61 and $13^{\circ}04'N$ and longitudes $11^{\circ}04'E$ and $14^{\circ}04'E$ (Agboola, 1987). The State shares borders with
62 Adamawa State to the south, Yobe State to the west and Gombe State to the southwest. It also shares
63 international borders with Cameroon Republic to the east, Chad Republic to the north-east and
64 Republic of Niger to the north. The State has a land mass of about 69,434 square kilometers (Borno
65 State Diary, 2013). Administratively, it has 27 Local Government Areas (LGAs) with a projected
66 population of about 4.8 million people based on 2.8 percent growth rate (NPC, 2006).

67 The State is divided into three agro-ecological zones; Sahel to the north, Sudan Savannah in
68 the central and southern parts of the State and Guinea Savannah in the southern part. The average



rainfall per annum is 300mm in the north and about 1000mm in the south (Agboola, 1987). The rainy season in the State usually starts in April and ends in October. The temperature ranges from 25°C - 47°C but instantaneous temperature might reach up to 47°C during the hottest months of March-May (BOSADP, 2010). The state is also blessed with lakes and rivers such as Lake Chad, Lake Alau, Lake Tilla, River Ngada, River Yazaram, and River Yare where irrigation farming is carried out especially during dry season.

The major occupation of the inhabitants is farming. Food crops commonly cultivated include millet, sorghum, maize, groundnut, cowpea, rice and wheat. Fruits and vegetables grown include mango, orange, guava, tomatoes, onion, pepper, carrot, amaranths and garden-egg. The State is known for its vegetables production, produced throughout the year, which can be grown both under irrigation and in the rain. Most of the vegetables can be grown as sole or mixed cropping. The vegetable production is carried out during dry and cool seasons under irrigation around November to January.

2.2 Sampling Procedure

Multistage sampling techniques were used to select respondents for this study. The first stage involved selection of three Local Government Areas (LGAs) known for production of vegetables, one from each of the three main agro-ecological zones. The LGAs selected were Hawul in Guinea Savannah, Mobbar in Sahel Savannah and Bama in Sudan Savannah.

The second stage involved random selection of four villages each from the selected LGAs. This was based on the list of major vegetables producing villages obtained from the Borno State Agricultural Development Programme (BOSADP). The third and final stage involved random selection of 300 respondents based on a 25% proportion of vegetable farmers in each of the selected villages. However, 296 questionnaires (98.6%) were retrieved and used for analysis.

2.3 Sources of Data

Primary data and secondary information were used for this study. The relevant primary data were collected through administration of structured questionnaires. Trained enumerators were used to administer the questionnaires. The secondary information was obtained from published materials such as government publications, BOSADP, CBN bulletins, annual statistical data and journals.

2.4 Analytical Techniques

Both descriptive and inferential statistics were used for the analyses of data obtained. Descriptive statistics used include means, frequencies and percentage distributions. The descriptive statistics were also used to examine distribution of levels of economic efficiency irrigated vegetable producers. The inferential statistics used was stochastic frontier cost function to analyze the level determinants of economic efficiency of irrigated vegetables enterprises.

2.4.1 Stochastic Frontier Cost Function

Stochastic frontier cost function was used to estimate the economic efficiencies of irrigated vegetable producers. The farmers' frontier cost function model is explicitly expressed as :

$$\ln C = \alpha_0 + \alpha_1 \ln Q_1 P_1 + \alpha_2 \ln Q_2 P_2 + \alpha_3 \ln Q_3 P_3 + \alpha_4 \ln Q_4 P_4 + \alpha_5 \ln Q_5 P_5 + \alpha_6 \ln Q_6 P_6 + \alpha_7 \ln Q_7 P_7 + \alpha_8 \ln Q_8 P_8 + V + U \quad (1)$$

Where:

C_i = total input cost of i^{th} farm (₦)

Q_i = output quantity of the i^{th} farm (kg)

P_1 = cost per man-day of labour (₦)

P_2 = cost of inorganic fertilizer (₦/ kg)

P_3 = cost of organic fertilizer (₦/kg)

P_4 = cost of planting materials (₦/kg)

P_5 = cost of agrochemicals (₦/lit)

P_6 = depreciations of farm tools(₦)

P_7 = cost of seed/seedling(₦)

P_8 = cost of fuel and maintenance of machines (₦)

α_0 = constant

$\alpha_1 - \alpha_8$ = estimated parameters

V = random variable assumed to be independently and identically distributed as μ (0, σ_v^2) and independent of U_i s; that represent the stochastic effect outside the farmer's control

U = one sided ($U_i \geq 0$) efficiency component that represents economic inefficiency in production which is assumed to be independently and identically distributed as truncation (at zero) of the normal distribution with mean, K_i σ and variance σ_u^2 ($|\mu K_i \sigma, \sigma^2 u|$).

The economic inefficiency model is explicitly expressed as:

$$\mu = \sigma_1 \ln K_1 + \sigma_2 \ln K_2 + \sigma_3 \ln K_3 + \sigma_4 \ln K_4 + \sigma_5 \ln K_5 + \sigma_6 \ln K_6 + \sigma_7 \ln K_7 + \sigma_8 \ln K_8 + w_i \dots \dots \dots (2)$$

Where:

μ = economic inefficiency

K_1 = farming experience (years)

K_2 = formal education (years)

K_3 = extension contact (number of visit)

K_4 = credit availability (Dummy = 1 if available and 0 otherwise)

K_5 = distance to market (km)

136 K_6 = membership in farmers association (Dummy = 1 if member and 0
137 otherwise)

138 K_7 = ownership of irrigation facilities (Dummy = 1 if available and 0
139 otherwise)

140 K_8 = off-farm income (₦)

141 σ_{1-8} = parameters estimated

142 w = random variable defined by the truncation of the normal distribution with zero mean and
143 variance σ_u^2 such that the point of truncation is $K_i \sigma_i$, ie $w_i \geq -K_i \sigma$.
144

145 The coefficient of explanatory variables in the cost function such as wage rate, cost of
146 planting material, cost of agrochemical, cost of farm tools and cost of seedlings are *a priori* expected
147 to be negative. The signs of coefficients of variables in the inefficiency model such as farming
148 experience, distance to market, membership of farmers association, level of formal education,
149 extension contact, credit availability, fuel and maintenance of machines are also *a priori* expected to
150 be positively related to cost efficiency.

151 U_i provides information on the level of economic efficiency of the i^{th} farm. The economic
152 efficiency of individual farmer is expressed in terms of the ratio of the predicted minimum cost (C_i^*)
153 to the observed cost (C_i) as:

$$154 \quad EE = C_i^*/C_i \quad \text{-----} (3)$$

$$155 \quad = \exp (U_i)$$

156 The maximum likelihood estimate (MLE) of the parameters of the model defined by equation (1) and
157 (2) and farmer specific EE defined in (3) were estimated using the computer programme FRONTIER
158 version 4.1 package (Coelli, 1995)

159 In the process, the variance parameters σ_u^2 and σ_v^2 are expressed in terms of parametrization as:

$$160 \quad \sigma^2 = (\sigma_u^2 + \sigma_v^2) \text{-----} (4)$$

$$161 \quad \gamma = (\sigma_u^2 / \sigma^2) - \text{-----} (5)$$

162 where,

163 γ = total variation in output from the frontier which is attributed to economic
164 inefficiency.

165 The value of γ ranges between zero and one. When γ equals zero, variation in cost is due to factors
166 not directly under the control of the farmers. The economic inefficiency ranges between zero and one
167 indicating the extent of producers' deviation above the frontier.

168 3. RESULTS AND DISCUSSION

169 3.1 Level of Economic Efficiency of Vegetable Producers

170 The distribution of economic efficiency level among the respondents for the studied vegetable
 171 enterprises is presented in Table 1. The result revealed that respondents exhibit varied levels of
 172 economic efficiency ranging from 0.44 to 0.98. The mean economic efficiency for the enterprises
 173 were 0.72, 0.86, 0.73, 0.78 and 0.78 for onion, tomato, pepper, onion/tomato and onion/pepper
 174 respectively. The minimum efficiency showed gross under-utilization of resources, while the best
 175 economically efficient respondents operate almost on the frontier. The results indicate that
 176 respondents can still reduce cost by 28, 14, 27, 22 and 22 percent for the studied enterprises
 177 respectively.

178 The important attributes of the most economically efficient vegetable farmers in the
 179 enterprises were higher level of formal education, membership of farmers' association, have access to
 180 credit to procure inputs especially improved seeds and irrigation facilities. The distribution of level of
 181 economic efficiency in Table 1 indicates that respondents are operating at higher level of economic
 182 efficiency. This may be due to the fact that the inefficiency variables included explained the model in
 183 all the enterprises. A similar result was obtained by Mananga *et al.* (2012), that economic efficiency of
 184 smallholder vegetable producers in Malawi are operating at higher economic efficiency level.

185

186 **Table 1: Distribution of the Levels of Economic Efficiency of Vegetable Enterprises Producers**

Enterprises										
Efficiency Level	Sole onion		Sole Tomato		Sole Pepper		Onion/Tomato		Onion/Pepper	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
0.40 - 0.50	1	1.1	00	00	1	2.3	5	6.8	00	00
0.51 - 0.60	14	15.9	1	2	3	6.8	3	4.1	5	12.5
0.61 - 0.70	28	31.8	5	10	12	27.3	14	18.9	8	20
0.71-0.80	25	28.4	12	24	20	45.5	20	27.0	13	32.5
>0.80	20	22.7	32	64	8	18.2	32	43.2	14	35
Total	88	100	50	100	44	100	74	100	40	100
Mean	0.72		0.86		0.73		0.78		0.78	
Min	0.46		0.60		0.50		0.44		0.58	
Max	0.99		0.99		0.96		0.99		0.99	

187 **Source: Field Survey, 2013.**

188

189

3.2 Determinants of Economic Efficiency

The results of the maximum likelihood estimates of the stochastic frontier cost functions for the considered vegetable enterprises are presented in Table 2. The results revealed that the sigma square estimates for the studied enterprises were 0.248, 0.031, 0.363, 0.228 and 0.122 respectively. This attest to goodness of the fit and correctness of the specific assumption of the composite error terms distribution (Mbanosor and Kalu, 2008). The variance ratio (gamma), revealed that inefficiency effect exist among the vegetable farmers as indicated by 0.945, 0.932, 0.945, 0.173 and 0.266 respectively for the sole onion, sole tomato, sole pepper, onion/tomato and onion/pepper and were all significant at one percent level. The higher percentages of variation in the production cost of vegetables were due to differences in cost inefficiency.

Table 2 also revealed that coefficients of wage rate for all the enterprises were positive and significant at one percent level except for onion/pepper enterprise. This indicates that a unit increase in cost of labour leads to increase in total cost of production by a value equal to the respective coefficients of the enterprises. The implication of this is that as cost of labour increases, total cost of production also increases which may likely affects the profit obtained from the vegetable production activities. The wage rate coefficient is the highest among all the coefficients in the cost function, indicating that labour may have been used most inefficiently

207 **Table 2: Maximum Log-likelihood Estimate of Cobb-Douglas Cost Function for Vegetable Production**

Enterprises											
		Sole Onion		Sole Tomato		Sole Pepper		Onion/Tomato		Onion/Pepper	
Variables	Parameters	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constants	β_0	2.954	7.180***	5.539	7.989***	4.115	5.532***	4.501	3.994***	9.538	6.484***
LnWage rate of Labour (X_1)	β_1	9.936	14.335***	0.341	12.095***	0.154	2.630***	1.464	6.811***	0.128	1.898 ^{NS}
Ln Cost of Inorg. Fert. (X_2)	β_2	0.005	1.96*	0.100	9.560***	0.176	8.253***	0.195	7.908***	0.252	6.906***
LnCost of Og Fert. (X_3)	β_3	0.040	9.597***	0.033	2.168**	0.816	6.835***	0.424	12.569***	0.385	13.780***
Ln Cost of Planting Material (X_4)	β_4	0.030	5.707***	0.077	3.325***	1.503	5.976***	0.306	6.075***	0.119	12.641***
Ln Cost of agrochemical (X_5)	β_5	0.727	19.744***	0.202	14.171***	1.917	5.418***	0.588	14.634***	0.094	2.193**
Ln Cost Depreciation (X_6)	β_6	0.051	2.933***	0.327	17.338***	0.641	11.754***	0.515	12.696***	0.579	8.774***
Ln Cost price of Seed/seedling (X_7)	β_7	0.074	13.384***	0.007	0.257 ^{NS}	0.147	2.928***	0.128	2.371**	0.730	9.535***
Ln Cost of Fuel & maintenance (X_8)	β_8	9.929	14.346***	0.075	3.534***	1.762	4.314***	3.190	15.105***	0.766	14.434***
Inefficiency											
Ln Farming exp. (Z_1)	α_1	-0.035	-1.981*	-0.480	-8.910***	-4.634	-3.320***	-0.679	-6.082***	-0.608	-5.040***
Ln Level of formal Edu. (Z_2)	α_2	-0.010	-1.998**	-0.103	-3.064***	-0.615	-8.073***	-0.478	-7.377***	-0.373	-3.778***
Ln Ext. Contact (Z_3)	α_3	-0.118	-5.509***	-0.201	-3.258***	-0.739	-3.107***	-0.403	-2.828***	-0.602	-2.157**
Ln Credit Avail. (Z_4)	α_4	-0.018	-0.254 ^{NS}	-0.928	-8.699***	-0.304	-2.561***	-1.241	-4.713***	-1.801	-6.329***
Ln Dist. to Mkt. (Z_5)	α_5	-0.365	-5.477***	-0.193	-2.131**	-0.864	-4.831***	-0.264	-1.836 ^{NS}	-3.144	-17.666***
Ln Memship of Farmers' Ass. (Z_6)	α_6	-0.221	-3.460***	-0.174	-1.824 ^{NS}	-0.314	-1.054 ^{NS}	-3.454	-12.948***	-0.880	-2.708***
Ln Owned Irrg.Facility (Z_7)	α_7	-0.026	-0.358 ^{NS}	-0.515	-2.557***	-0.672	-1.350 ^{NS}	-3.404	-6.415***	-1.013	-8.990***
Ln Off- farm Income (Z_8)	α_8	-0.002	-0.345 ^{NS}	-0.006	-0.380 ^{NS}	-0.029	-0.440 ^{NS}	-0.091	-4.837***	-0.647	-5.294***
Sigma Square	δ^2	0.248	7.448***	0.031	4.635***	0.363	6.292***	0.228	-6.478***	0.122	4.428***
Gamma	Γ	0.945	2.795***	0.932	13.867***	0.945	52.724***	0.173	-8.107***	0.266	10.546***
Log likelihood ratio		-5.679		-15.802		-9.718		50.213		-14.690	

208 **Source: Computed from Field Survey Data 2013.**

209 *** Significant at 1%, ** Significant at 5%, NS Not significant

210

211 The coefficient of cost of inorganic fertilizer in was positive and significant at one percent level. The
212 values of coefficients for the studied enterprises were 0.005, 0.100, 0.176, 0.195 and 0.252
213 respectively. This means that as the cost of inorganic fertilizer increases the total cost of production in
214 vegetable production in the study area also increases. This is in line with the findings of Gambo
215 (2008) that vegetable production requires high doses of inorganic fertilizer which increases the cost of
216 production.

217 Table 2 also indicated that coefficients of cost of organic fertilizer for the studied enterprises
218 were positive and significant at one percent level except for tomato enterprise which was significant at
219 five percent level. The coefficients were 0.040, 0.033, 0.186, 0.424 and 0.385 for the studied
220 enterprises respectively. This indicates that increase in unit cost of this variable leads to increase in
221 total cost of production equal to the value of the respective coefficients of the studied enterprises. The
222 implication is that this variable contributes to total cost of production positively.

223 The cost of planting materials also had positive coefficients and significant at one percent
224 level for all the enterprises except onion/pepper enterprise which was significant at five percent level.
225 The coefficients as presented in Table 2 were 0.030, 0.077, 1.503, 0.366 and 0.119 for the studied
226 enterprises. This means that there is a positive contribution of this variable to total cost of production
227 equivalent to the respective coefficients in the different enterprises. The results imply that planting
228 material is an important factor contributing positively to the cost of production.

229 The coefficients of costs of agrochemicals, depreciation, seed/seedling and fuel and
230 maintenance were found to be positive and significant as presented in Table 2. The results indicate
231 that cost of production of vegetable increase with values equal to the coefficient of these variables.
232 The cost of fuel and maintenance is the second most inefficiently utilize variable in vegetable
233 production as indicated by the coefficient in the cost function. Okoye and Onyenweaku (2006) found
234 that maintenance costs contribute significantly to the total cost of production for irrigated vegetables.

235 The inefficiency component of the cost function is also presented in Table 2. As *a priori*
236 expected, the coefficients of the inefficiency variables were negative and significant. The negative
237 signs on the coefficients indicate that a unit increase in the inefficiency variable leads to decrease in
238 economic inefficiency in vegetable production. The coefficients of years of farming experience for
239 the studied enterprises were negative and significant at one percent level except onion enterprise
240 which was significant at five percent level. The coefficients were -0.035, -0.480, -4.634, -0.679 and -
241 0.608 for studied enterprises respectively. This means that increase in years of vegetable farming
242 experience leads to a decrease in economic inefficiency. This may be due to the fact that, with more
243 years of vegetable production experience comes greater understanding of cultural practices and other

management practices that would help reduce products losses as the vegetable grows up to the point of harvest. This may influence the economic efficiency of the vegetable farmers significantly.

Coefficients of level of formal education were negative and significant. The coefficients were -0.010, -0.103, -0.615, -0.478 and -0.373 and significant at one percent level. This indicates that as educational level of farmers increase, the economic inefficiency in vegetable production reduces. The implication is that higher level of education, especially agricultural related education by farmers leads to higher economic efficiency. This is in agreement with the findings of Wan *et al.* (1999) who reported a negative relationship between economic inefficiency and level of formal education.

The estimated coefficients of extension contact were also negative (-0.118, -0.201, -0.739, -0.403 and -0.602) and significant at one percent levels with onion/pepper enterprise being significant at five percent. This means that extension contact affects economic inefficiencies by the values equal to the magnitudes of the respective coefficients. The implication is that providing appropriate extension services to vegetable farmers have the influence of reducing inefficiency in their production activities. A similar result was reported by Khan and Saeed (2011) who maintained that extension visits had negative implication on economic inefficiency in tomato production.

The coefficients of access to credit were negative as expected with values of -0.081, -0.928, -0.304, -1.241 and -1.801 for the studied enterprises. All the coefficients were significant at one percent except for onion. This means that increasing access to credit will lead to a decrease in economic inefficiency in vegetable production in the study area. The implication is that with credit availability, farmers can purchase all required inputs for efficient production, hence reducing of economic inefficiency.

The coefficients of proximity to market indicate negative values and significant at one percent levels for all the studied vegetable enterprises except for onion/tomato enterprise. The coefficients were -0.365, -0.193, -0.304, -1.241 and -1.801 for the studied enterprises respectively. The result implies that a unit increase in proximity to market leads to reduction in economic inefficiency equal to the respective coefficient of the enterprises.

Membership of farmers' associations plays important roles in determining economic inefficiency (Mbanasor and Kalu, 2012). Table 2 revealed that membership of farmers' association had negative coefficient for all the studied enterprises and significant at one percent, except for tomato and pepper enterprises were not significant. The coefficient of the significant variables were -0.221, -3.454 and -0.880 for onion, onion/tomato and onion/pepper respectively. The result indicates that intensity of participation in farmers association by one percent leads to decrease in economic inefficiency by equal amount of the respective coefficients of the enterprises. Hence production of

vegetable in the study area can be economically efficient if farmers get more involved in cooperative activities that are beneficial to their production activities.

Coefficient of ownership of irrigation facilities and off-farm income were negative as indicated in Table 2. This means that these variables contribute negatively to economic inefficiency by an equal amount of the respective coefficients of the enterprises. The implication of this is that people who own facilities such as water pumps are more efficient as such facilities have the tendency of reducing inefficiencies through proper scheduling of irrigation and timeliness of required operations. Off-farm income can also be used in purchasing additional equipment, paying for labour for smooth operations on the farm leading to economic efficiency.

Conclusion and Recommendation

The study concluded that economic inefficiency was present in irrigated vegetable production in the study area. The study also concluded that production variables for the studied vegetable enterprises were significant in contributing to the production of vegetables under irrigation. Costs of inorganic fertilizer, organic fertilizer, planting material, agrochemical, depreciation, seed/seedling and fuel/maintenance were contributing immensely to cost of production vegetable. The economic inefficiencies variables such as experience, level of formal education access to credit and distance to market were contributing positively to economic efficiency. Based on the findings of the study it is recommended that there is need for concerned agencies to promote both formal and non-formal education as the way forward to increase efficiency in vegetable production; vegetable farmers should be mobilized and encouraged to strengthen the activities of farmers' clubs and associations. This could help the vegetable farmers to acquire professional advice, inputs and credit facilities and use them efficiently giving rise to efficiencies in vegetable production, Government should provide financial and material supports to farmers to improve the efficiency of vegetable production by making loans available and accessible to vegetable farmers in the study area.

REFERENCE

- Asian Vegetable Research Development Center (2006). Improving Vegetable Productivity. *Sate journal/ejournal, icrisat.Org* 4(1):1-2.
- Borno State Government (BSG) (2013). Government Diary, Ministry of Home Affairs, Information and Culture, Maiduguri.
- Borno State Agricultural Development Programme (BOSADP) (2010). Package of Crop Recommendations for Borno State.
- Borno State Agricultural Development Programme (BOSADP) (2013), Borno State Agricultural Development Programme Annual Report. Central Bank of Nigeria (CBN) (2013). Statistical Bulletin 2 (2): 1-156.

- 311 Gambo, B.A. (2008). Effect of Nitrogen, Potassium, Cow Dung and Weed Interference on the
312 Growth and Yield of Onion (*Allium cepa* L.) in Semi-Arid Environment. Unpublished
313 Ph.D Thesis, Department of Crop Science, Usmanu Danfodio University, Sokoto.152p.
- 314 Hussaini, I. and Abayomi, O.O. (2010). Technical and Scale Efficiency in Vegetable Crops
315 Production Under Fadama in north Central Nigeria. *Journal of Agricultural*
316 *Resources*.48(3):409-418
- 317 Khan, H. and Saeed, I. (2011). Measurement of Technical, Allocative and Economic Efficiency of
318 Tomato Farms in Northern Pakistan. Proceedings of International Conference on
319 Management, Economic and Social Science, December, Bangkok. Pp. 459-468.
- 320 Lawan, M., Sastawa, B.M. and Kabir, B.G. (2010). Spraying Regime of Cypermethrin for the
321 control of tomato Fruithworm, *Helicoverpa armigera* , during Dry Season Tomato
322 Production in Maiduguri, Sudan Savanna of Nigeria. *Journal of Arid Agriculture*, 19:
323 36-40
- 324 Mbanasor, J.A. and Kalu, K.C.(2012). Economic Efficiency of Commercial Vegetable
325 Production System in Akwa Ibom State, Nigeria: A Translog Stochastic Frontier
326 Cost function Approach. *Journal of Tropical and Subtropical Agro-ecosystem*, 2(8):
327 313 - 318.
- 328 National Agricultural Extension Research Liason Services (NAERLS) (2009). Pepper Production
329 under Irrigation. Extension Bulletin No 206, Agric. Engineering Series, No. 7.
- 330 National Food Reserve Agency (NFRA) (2008). Annual Report of National Food Reserve
331 Agency, Abuja, Nigeria.
- 332 National Population Commission (NPC) (2006), National Population Census in Nigeria,
333 Gazette. Abuja Nigeria.
- 334 Okoye, B.C., Onyenweaku, C.E. and Sumugha, G.N.A. (2007). Allocative Efficiency of Small-Holder
335 Cocoyam Farmers in Anambra State, Nigeria. *Agricultural Journal*, 4(38): 70-80.
- 336 Oladoja, M.A., Akinbile, L.A. and Adisa, B.O.(2006). Assessment of the Environment-Related
337 Problem and Prospect of Vegetable Production in Peri-Urban Lagos State, Nigeria.
338 *Journal of Food, Agriculture and Environment*, 4 (380): 271-275.