ISSN 2521 – 0408
AEXTJ
AGRICULTURAL EXTENSION JOURNAL

Available Online at www.aextj.com
Agricultural Extension Journal 2018; 2(3):176-183

RESEARCH ARTICLE

Determinants of Food Security Status among Irrigated Vegetable Farmers in Northern Agricultural Zone of Bauchi State, Nigeria

A. A. Bose

Department of Agricultural Economics and Extension, Abubakar Tafawa Balewa University, Bauchi, Nigeria

Received: 05-07-2018; Revised: 30-07-2018; Accepted: 25-08-2018

ABSTRACT

The study examined factors influencing food security status of irrigated vegetable farmers and price trend of vegetables in Northern Agricultural Zone of Bauchi State, Nigeria. Multistage sampling technique was adopted where 360 framers were randomly selected for the study. Data were collected using structured questionnaire and analyzed using descriptive statistics as well as binary logistic model. The result reveals that average quantity produced per hectare of tomato, sweat pepper, and onion was about 227 baskets (6810 kg), 185 bags (7400 kg), and 168 bags (18480 kg), respectively. The net income was N187,245.00 ($520.00), N145,114.00 ($403.00), and N330,761.00 ($919.00) per hectare, for the respective vegetable crops. The result on binary logistic model indicates that the quantity of vegetable produced was found to be positively related with farmers food security status and statistically significant at $P = 0.001$. Monthly income had a positive odds ratio (2.214) and statistically significant at $P = 0.000$. The result also reveals that age was significant ($P = 0.014$) and positively related with a food security status of the farmers with the odds ratio of 0.943. The pseudo R^2 was found to be 0.481, implying that about 48% of variation in the dependent variable is explained by independent factors included in the model. The result on price trend analysis indicates that seasonal variations occur in vegetable prices, for several reasons such as demand and supply factors. Thus, the study recommends that farmers should be provided with adequate information concerning prices, supply, and demand, especially at the local level. Farmers should be encouraged to adopt improved technologies and new farming practices to boost output. In addition, farmers should be encouraged to diversify the source of income to have more funds to purchase other foodstuffs that they could not producing.

Key words: Determinants, farmers, food security, irrigated vegetable, Nigeria, price trend

INTRODUCTION

Food security means provision and access to nutritionally sufficient and culturally accepted food by each member of the household for healthy life obtained through socially acceptable ways. Food insecurity, on the other hand, is the uncertain or limited access to nutritionally adequate and safe food.[1] Food availability is a problem for everyone and, especially, for the developing world. Nigeria still suffers from poverty and food insufficiency.[2] In the recent time, there have been a lot of concerns expressed over the looming danger of food crisis in many nations, including Nigeria. However, food availability is a function of the combination of domestic food stock, commercial food imports, as well as the underlying determinants of each of these factors. The determinants of food security differ at different levels, i.e., from global to regional and national to household and individual level because food security is deemed to be a multidimensional phenomenon encompassing climate change, civil conflicts, natural disasters, and social norms.[1] Irrigation has been identified to be a key part in optimizing agricultural production for self-sufficiency in food production and poverty reduction in most developing countries in the world.[3] The long dry season experienced by farmers in the most parts of Northeast Nigeria form part of the reasons

Address for correspondence:
A. A. Bose,
E-mail: abdullahi.bose@yahoo.com

why farmers seem to be shifting toward irrigation schemes. According to Mani *et al.,*[4] vegetable production is an integral part of the Nigerian agricultural sector. Vegetables are produced in different agro-ecological zones, particularly by small-scale farmers. Thus, its production has been on-going for decades, providing employment and income for the increasing population.[5] Vegetable crops give 5–10 times more yield per unit area than cereals, and they are quick growing and short duration. The short duration nature of vegetables offers scope for raising two or more crops a year and for fitting effectively in different cropping system. In addition, most of the vegetable farmers under current agricultural sector were characterized by smallness of farm size, 0.25–1.00 hectares.[6] Furthermore, there is a need to understand the pattern of price variations, price trends, monthly seasonal indices, and their deviations to establish policies that help stabilize food prices. It is expected that rural populace in various communities may benefit from the outcome of the study toward irrigated vegetable production as a source of income and a means of attaining food security.

Objectives of the study

The study has the following specific objectives:

1. Assess the quantity of vegetable produced per hectare in the study area;
2. Evaluate the profit level of irrigated vegetable production in the area;
3. Examine the factors influencing food security status of irrigated vegetable farmers; and
4. Examine the price trend of vegetable crops in the study area.

Conceptual framework

Logit regression model

Different researchers employed different methods for the analysis of binary data, but many of them adopted logistic regression technique including.[1,7,8] Since the dependent variable food security is qualitative in nature means dichotomous, it can only take two values either the presence of something or absence, so by pursuing the conventional method of binary response, it will either take the value of one or zero. This value of 1 means that farmer is food secure and zero means otherwise because this measure of food security in binary manner yields results which have more policy implications.[9] Logistic regression technique can be used to model the relationship between the dichotomous dependent variable and set of independent variables that are hypothesized to affect the outcome. The logistic regression model characterizing the status of farmer food security is given by Oyebanjo *et al*.,[8] 2013, and Abdullah *et al*.[1]

$$Ln\left[\frac{P_i}{1P_i}\right] = \beta o + \beta 1X1_i + \beta 2X2_i + \beta n_i Xn_i + \mu_i \quad (1)$$

This $[P_i/(1–P_i)]$ is simply the odds ratio in favor of food security (F_i), i.e., the ratio of the probability that the farmer is food secure to the probability that it is not food secure. The subscript "*i*" shows the i^{th} observation in the data. βo is the intercept of the model, while *X*1, *X*2, *X*3 … *Xn* are the explanatory variables. It is important to note that the estimated coefficients do not directly affect the change in corresponding explanatory variables on the probability of the outcome. Rather, the coefficients reflect the effect of individual explanatory variables on its log of odds. The positive coefficient shows that the odds ratio will increase as the explanatory variables increases, and conversely, the odds ratio will decrease as the explanatory variables decreases.

METHODOLOGY

The study was conducted in Misau, Jama'are, and Itas-Gadau Local Government Areas (LGAs) in Northern Agricultural Zone of Bauchi State, Nigeria. It is located between latitudes $9^0$31' and 12^0 30'North and longitudes 8^0 50' and 11^0 East. The study area has two main seasonal climates which comprise wet and dry seasons. April is the hottest month of the year and December is the coldest month, with temperatures averaging 22.4°C. The area received an average of 600–900 mm rainfall per year, which commences lately on April and ends by September. In general, the relief is between 300 and 900 m above the sea level and the vegetation is typically of Northern Guinea Savanna and Sudan Savannah types.[10] It has arable land with rich, fertile soils which is good for the cultivation of a wide variety of food crops, including vegetables. The common vegetable crops grown include tomatoes, onion, cabbage, pepper, okra, fluted pumpkin, amaranths, and garden egg.

Sampling techniques and sample size

Multistage sampling technique was used for this study. The first stage involves a purposive selection of three LGAs which comprise Misau, Jama'are, and Itas-Gadau LGAs in the Zone. The selection of the LGAs was due to the large production of vegetables in the areas. In the second stage, three villages were purposively selected from each LGA. In the final stage, 60 irrigated vegetables farmers were randomly selected in each community comprising of Misau, Jama'are, and Itas communities. In addition, 30 irrigated vegetable farmers were randomly selected in each village which comprises Zindi, DabigiSabon-Gari, Digiza, Melen-Dige, and Gulmo villages. This gives a total sample of 360 farmers for this study. The list of registered vegetable farmers was used as a sampling frame. The sample size was determined using a model adopted by Titus *et al.*[11] and Bose *et al.*[12]: It is specified as follows:

$$n_{irvf} = \frac{N}{1 + N\ (e)^2} \quad (2)$$

Where

n_{irvf} = Sample size of the irrigated vegetable farmers in each village

N = Total number of the registered farmers in each village

e^2 = Error term (0.05^2).

Method of data collection

Primary and Secondary data were used in this study. The primary data were collected with the aid of structured questionnaires. The information collected are those on vegetable production and food security status of the farmers in the study area. Secondary data were obtained from the Bauchi State Agricultural Development Programme (BSADP). It consists of the average monthly retailed price in naira (N) per kilogram of tomato, sweat pepper, and onion from sampled markets in rural areas of Bauchi State. The secondary data were for 10 years (2008–2017).

Method of data analysis

The data generated will be subjected to a statistical tool of analysis such as descriptive and inferential statistics (logit regression model) and farm budget model. Descriptive statistics such as frequency, mean, percentages, and graphs were used in analyzing objective one and four. Farm budget model was used in analyzing objective two. Logit regression model was used to analyze factors influencing food security status of the vegetable producers (objective three). Logit model was used to analyze the relationship between the food security status and its determinants. The data were analyzed using IBM SPSS 22. Explicitly, this model is specified as follows:

$$F_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \mu_i \quad (3)$$

Where

F_i = 1 if household head is food secure, 0 otherwise

X_1 = Quantity of vegetable produced (kg)

X_2 = Monthly income (₦)

X_3 = Age (years)

X_4 = Sex (male =1 and female = 0)

X_5 = Level of education (years)

X_6 = Farm size (hectares)

X_7 = Farming experience (years)

X_8 = Household size (number of individuals)

X_9 = Membership of cooperative (member =1, 0 = otherwise)

β_o = Vector of parameters

μ_i = Random error.

Farm budgeting model

Farm budget model will be used to evaluate the costs and benefits of vegetable production, where total costs and returns will be estimated. The total cost incurred during the production period is obtained by multiplying the various input resources by their unit market prices, while returns (revenue) refer to the sum of outputs multiplied by their unit price which is also known as the gross income (GI).[13] The model is specified as follows:

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

Where

NFI = Net farm income (₦)

GI = Gross income of vegetable production

TC= Total costs (variable + fixed costs) of vegetable production

$$D = \frac{P - S}{N} \quad (5)$$

Where

D = Depreciation of fixed assets

P = Price of the assets

S = Salvage value
N = Number of years (lifespan of asset)

RESULTS AND DISCUSSION

Quantity of vegetable produced

The result in Table 1 shows the average quantity of irrigated vegetable produced in the area. The result reveals that tomato was produced in a large quantity of about 227 baskets (6810 kg) per hectare with an average market price of ₦1,585.00 per basket. The average quantity of sweat pepper and hot pepper produced was 185 bags (7400 kg) and 145 bags (5800 kg) per hectare with an average market price of N2,550.00 and N3,235.00, respectively. The quantity of onion produced was 168 bags (18480 kg) per hectare with an average price of N4,500.00 per bag. This implies that farmers obtained a substantial output in the area. The market price of the products was favorable as confirmed by the farmers during data collection session.

Table 1: Average quantity of vegetable produced per hectare

Vegetable crops	quantity produced	market price
Tomato[1]	227 baskets	1.585.00
Sweat pepper[2]	185 bags	2.550.00
Hot pepper[3]	145 bags	3,235.00
Onion[4]	168 bags	4,500.00
Okra[5]	245 baskets	1,200.00
Lettuce[6]	155 baskets	1,000.00

Weight: 1=30 kg/basket, 2=40 kg/bag, 3=40 kg/bag, 4=110 kg/bag, 5=20 kg/basket, 6=8 kg/basket. Currency exchange rate (2018)$1.00=₦ 360.0. Source: Field survey,2018

Profitability analysis

The result in Table 2 reveals that the most prominent variable cost is the labor with constituted about 36.2%, 45.3%, and 46.2% of the total cost for production of tomato, sweat pepper, and onion, respectively. This implies that most of the farmers used hired labor in irrigated vegetable production and this type labor is expensive. This was followed by the cost of transportation with covered about 13.8%, 10.9% and 9.7% of the total cost for the respective vegetables. This may be attributed to the fact that most of the farmers convey their produce to market individually instead to transport their vegetables collectively. Hence, group marketing may help them in reducing transportation fare. This finding is in line with Ala and Bello[14] who reported that labor cost and transportation cost were prominent variable cost in crop production. The result also shows that net income was N187,245.00 ($520.00), N145,114.00 ($403.00), and N330,761.00 ($919.00) for the respective vegetable crops. The Return per Naira Invested was 0.92, 0.65, and 1.03 for tomato, sweat pepper, and onion, respectively. This implies that a farmer acquired a return of ₦0.92,

Table 2: Cost and returns of some vegetable produced (N/kg) in the study area

Variables	Tomato sweat pepper onion		
	Amount (*n*) (%)	TC amount (*n*) %	TC amount (*n*) % TC
Seeds/seedlings	12.700 (6.3)	10.250 (4.6)	13.350 (4.2)
Fertilizer	21.550 (10.6)	23.600 (10.5)	29.800 (9.3)
Pesticides	9.640 (4.8)	13.333 (5.9)	15.500 (4.8)
Herbicides	10.520 (5.2)	10.200 (4.5)	17.600 (5.5)
Labor	73.360 (36.2)	102.133 (45.3)	147.550 (46.2)
Empty bags/baskets	27.000 (13.3)	19.500 (8.7)	36.000 (11.3)
Transportation	28.000 (13.8)	24.650 (10.9)	31.114 (9.7)
Other cost	5.750 (2.8)	6.200 (2.8)	10.700 (3.3)
Total variable cost	188.520	209.866	301.614
Depreciation of farm equipment	14.350 (7.1)	15.420 (6.8)	18.050 (5.6)
Total fixed cost	14.350	15.420	18.050
TC	202.870	225.286	319.664
Gross income (sales of produce)	390.115	370.900	650.425
Net income	187.245	145.114	330.761
RNI	0.92	0.65	1.03

Currency exchange rate (2018)$1.00 = N 360.0 Source: Field survey, 2018. RNI: Return per naira invested, TC: Total costs

₦0.65 and ₦1.03 for tomato, sweat pepper and onion, respectively in every naira invested. Thus, irrigated vegetable production is very profitable and worth undertaking in the area. This finding is in agreement with Ayodele[15] that each rural woman farmer on average earned $1,994.00 (N279,160.00) a year, but with the improved yields, the income has increased to $3,376.00 (N 72,640.00) from the sale of indigenous vegetables.

Factors influencing food security status of the irrigated vegetable farmers

Nine independent variables were included, of which seven variables are found to be significant determinant factors of farmers' food security status in the study area. In line with prior expectation, the quantity of vegetable produce was found to be positively related with farmers food security status and statistically significant at $P = 0.001$. The positive relationship implies that odds ratio in favor of being food secured increases with an increase in the quantity of output and vice versa. Hence, as the quantity of vegetable produced increases by one kilogram, the odds ratio in favor of being food secure increases by a factor of 2.030, assuming that other factors are held constant. This results are in line with Agbola[16] who reported that crop output had a significant influence on food security status of farmers in Nigeria. In the same direction, monthly income had positive odds ratio (2.214) and statistically significant ($P = 0.000$), implying that the odds ratio of being food secure increases by a factor of 2.214. This could be attributed by the fact that farmers' monthly income obtained from sales of vegetables and from non-agricultural sources was used in purchasing other food items, which in turn help them to attain food security.

Age is an important factor in determining household food security status. The result reveals that age was significant ($P = 0.014$) and positively related with food security status of the farmers with odds ratio of 0.943. Thus, the positive coefficient is contrary to expectation and this could be as a result of additional income obtained by adults in the household. This finding is in agreement with Oyebanjo *et al.*[8] who reported that age had a positive relationship and significant influence on food security status of farmers in Ogun State, Nigeria. Furthermore, the result shows that the odds ratio of sex being food secure increases by a factor of 0.958 if the farmer is a male, keeping other variables constant. It is statistically significant at $P < 0.05$. This is in line with the general view that male has better physical endurance and capacity in farm activity unlike female counterpart. This may be because irrigated vegetable production demands higher physical effort and takes more time, whereas females have additional responsibilities inside their home besides farming activities. This finding is in conformity with Teklay *et al.*[17] who observed that odds ratio for sex was positive and significant ($P < 0.05$) influence on the food security status of household.

Education was found positively significant ($P = 0.002$) with odds ratio of 0.993 implying that farmers being food secure increases by a factor of 0.993 if the farmer had acquired formal education. Thus, education had a positive influence on food security status. The more the educated household head is the more food secure the household will be and vice versa. This is because individuals who have access to formal education are less hesitant to adopt improved technologies and farming practices. It also enables them to read instructions on sprayers, fertilizer, herbicide, and pesticide packages, among others for efficient production. This results are in line with Abdullah *et al.*[1] that education had significant (odds ratio = 0.60, $P = 0.005$) influence on food security status of household head.

In addition, farm size had positive and statistical influence on food security of the farmers. The odds ratio was found to be 1.141 and significant at $P = 005$ as shown in Table 3. This implies that, as farmer increases his farm by one unit, food security status increases by a factor of 1.141 other variables kept constant. This findings conform to Agbola[15] who observed that farm size had positive significant influence of food security status of farmers.

In respect of household size, the result reveals a significant ($P = 0.043$) influence with a positive odds ratio of 1.118. The positive relationship implies that the odds ratio in favor of being food secure increases with an increase in household size and vice versa. Thus, family size increases by one more adult, the odds ratio in favor of being food secure increases by a factor of 1.118, assuming that other factors are held constant. A similar result was obtained by Teklay *et al.*[17] that family size had a significant (odds ratio = 2.304, $P = 0.000$) influence on food security status of household. Other explanatory variables that influence food security

Table 3: Binary logistic results on factors influencing food security status of vegetable farmers

Variable	Coefficient	SE	Odds ratio	Wald (Z)	*P* value
Constant	−1.674	1.407	0.188	1.414	0.006
Quantity of vegetable produced (kg) (X1)	1.026	0.103	2.030*	0.102	0.001
Monthly income (N) (X2)	2.130	0.410	2.214***	1.004	0.000
Age (Years) (X3)	1.580	0.040	0.943*	2.140	0.014
Sex (male=1 and female=0) (X4)	0.346	0.117	0.958*	1.003	0.031
Level of education (years) (X5)	0.007	0.037	0.993**	0.033	0.002
Farm size (hectares) (X6)	0.132	0.235	1.141**	0.317	0.005
Farming experience (years) (X7)	0.042	0.047	1.043^{NS}	0.811	0.231
Household size (number of individuals) (X8)	0.112	0.055	1.118*	4.077	0.043
Membership of cooperative (member=1 and 0 = otherwise) (X9)	−0.524	0.731	0.592^{NS}	0.514	0.473
Pseudo R^2=0.481 χ^2=97.38 (8), P<0.001					

***Implies P<0.001, ** implies P< 0.01, * implies P<0.05, NS implies not significant. Source: Field Survey, 2018

status of the farmers are farming experience and membership of cooperative societies, though they are insignificant, implying that increase in the odds ratio of these variables increases the food security of the irrigated vegetable farmers in the study area.

The log-likelihood ratio test robustly rejects the hypothesis that all slope coefficients are simultaneously equal to zero, and thus, the model correctly predicted the observations as shown in Table 3. The overall predictive power of the model reveals that the independent variables had a significant impact in explaining the food security status of the farmers as justifying by the value of pseudo R^2 of 0.481. This implies that about 48% of variation in the dependent variable is explained by independent factors included in the model. Chi-square test was found to be 96.85 with a degree of freedom of 8 and statistically significant at $P = 0.001$.

Price trend analysis of tomato, sweat pepper, and onion

The results on rural price trend are presented in Figures 1-3 for tomato, sweat pepper, and onion, respectively. The seasons of the year were divided into four seasons as adopted by BSADP[18] and Bose *et al.*,[12] namely early dry (November–January), late dry (February–April), early rainy (May–July), and late rainy seasons (August–October). As shown in Figure 1, in all the seasons, the prices of tomato vary between the seasons of the year throughout the period of the study, where increase and decrease in price were observed. The highest price was recorded in the early rainy season, especially in year 2016. This is not surprising because, in 2016, there were high prices of food commodities in Nigeria due to low supply. The lowest price was observed in 2008

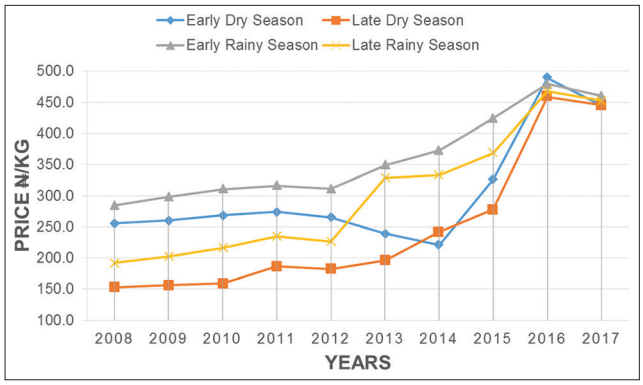

Figure 1: Rural price trend of tomato (N/kg) in Bauchi State

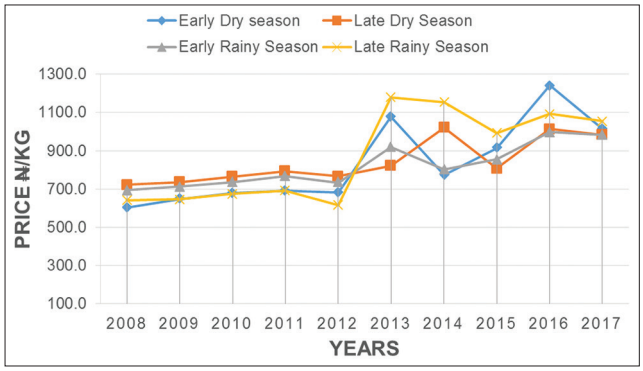

Figure 2: Rural price trend of sweat pepper (N/kg) from 2008 to 2017 in Bauchi State

in all the seasons. Seasonal variations occur in tomato prices, for several reasons such as demand and supply factors. In most of the time, at the early rainy season, the tomato products were scarce because at that time irrigated tomato was very scarce in the market and that of the rainy season was yet to be available. Thus, low supply was observed which in turn leads to high prices. This finding is in line with Mani *et al.*[4] who reported that high price variation of fresh tomato in the market is common, especially between harvest and lean periods. Similarly, the result is in agreement with

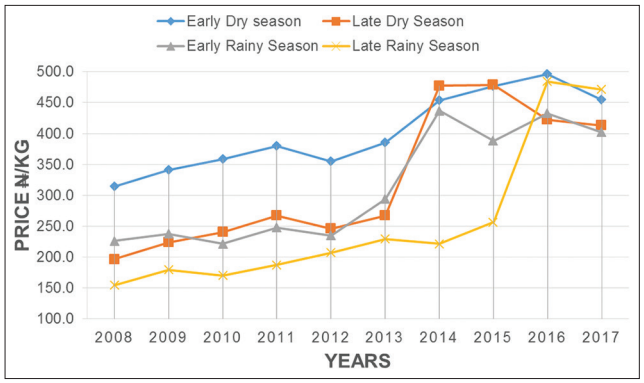

Figure 3: Rural price trend of onion (N/kg**)** from 2008 to 2017 in Bauchi State

the findings of Akpan *et al.*[19] who ascertain that marketing of fresh tomato and pineapple in Akwa Ibom State is generally not promising in terms of better prices at the rural levels. However, a general rising pattern of prices was observed throughout the seasons.

In Figure 2, the results reveal that the price of sweat pepper had a similar trend with that of tomato where price fluctuated in all the seasons. The highest prices were recorded in an early rainy season. This was not surprising because at that period there was a high demand of vegetables for household consumption, especially during festivities. In early dry and late rainy seasons also, exorbitant prices were recorded in 2013 and 2016, respectively. This also may be attributed to high demand of the product at those periods. In general, prices move closely range with some kind of interwoven movement in increasing and decreasing within the seasons of the years (between the harvest and the lean periods). Hence, price fluctuates throughout the seasons.

In Figure 3, the highest price of onion was recorded in early dry season in 2016 and lowest price was recorded in late rainy season 2008. Moreover, exorbitant price was recorded in late dry season in 2014 and 2015. In addition to this, high price of onion was observed in late rainy season in 2016. It can be noted that the prices were increasing and decreasing within all the seasons over the years. The seasonal pattern was as the result of storage needed to bridge a discontinuous flow of supply with a continuous demand for the commodity over an annual cycle. Thus, seasonal price variation is common in all the vegetable crops under review in the study area. It could be noted that there are price swings in production and marketing periods of fresh vegetables and that changes in price in the market were influenced by time variable.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of this study, it can be concluded that farmers obtained a substantial output of about 227 baskets (6810 kg) of tomato, 185 bags (7400 kg) of sweat pepper, and 168 bags (18480 kg) of onion per hectare. The net incomes were N187,245.00 ($520.00), N145,114.00 ($403.00), and N330,761.00 ($919.00) per hectare for tomato, sweat pepper, and onion, respectively. This indicates that vegetable production is very profitable and worth undertaking in the area. Seasonal price variation is common in all the vegetable crops under the study in the area. The pseudo R^2 recorded was 0.481, implying that about 48% of variation in the dependent variable was explained by independent factors that influence the food security status of the farmers. The significant independent variables influencing food security status of the vegetable farmers were quantity of vegetable produced, monthly income, age, sex, education, and household size in the study area. To minimize the problem of price fluctuations at all levels of vegetable marketing, the study recommends that farmers should be provided with adequate information concerning prices, supply, and demand, especially at the local level. This will enable farmers to assess alternative opportunities of marketing their crops and thereby minimize the problem of low prices caused by seasonal glut in the area. The study further recommends that since the quantity of vegetable produced has high influence on food security, farmers should be encouraged to adopt improved technologies and new farming practices to boast output. Similarly, monthly income has significant influence on food security; therefore, farmers should be encouraged to diversify source of income to purchase other foodstuffs that they could not producing in their farms.

ACKNOWLEDGMENT

The author would like to express the profound gratitude to Tertiary Education Trust Fund (TETFund) for sponsoring this research work under Institution Based Research (IBR). In addition, the author would like to appreciate the Management of Abubakar Tafawa Balewa University, Bauchi, Nigeria, for giving me the opportunity to conduct this research project.

REFERENCES

1. Abdullah DZ, Tariq S, Sajjad A, Waqar A, Izhar U, Aasir I. Factors affecting household food security in rural northern hinterland of Pakistan. J Saudi Soc Agric Sci 2017;301-10. Available from: http://www.ac.els-cdn.com/S1658077X16301709. [Last accessed on 2018 Apr 10].
2. Food and Agriculture Organization. Food Insecurity Indicators. Food and Agriculture Organization; 2014. Available from: http://www.fao.org/economic/ess/ess-fs/fsdata. [Last accessed on 2018 Jun 17].
3. Hassan A, Ahmad ME, Adewumi MO, Falola A. Irrigation and income poverty reduction: An assessment study of river basin development authority's irrigation scheme in dadinkowa, Gombe State, Nigeria. Dutse J Agric Food Secur 2017;4:56-64.
4. Mani JR, Hudu MI, Ali A. Price Variation of Tomatoes and Ginger in Giwa Market, Kaduna State, Nigeria; 2018. Available from: https://www.dx.doi.org/10.4314/jae.v22i1.9. [Last accessed on 2018 Aug 05].
5. Busari AO, Idris-Adeniyi KM, Oyekale JO. Economic analysis of vegetable production by rural women in iwo zone of Osun State, Nigeria. Green J Agric Sci 2012;3:6-11.
6. Echeme II, Nwachukwu CC. An investigation on the impact of Fadama II project implementation in Imo State. Am J Sci Ind Res 2010;1:532-8.
7. Arene CJ, Anyaeji C. Determinants of food security among households in Nsukka metropolis of Enugu state, Nigeria. Pak J Soc Sci 2010;30:9-16.
8. Oyebanjo O, Ambali OI, Akerele EO. Determinants of food security status and incidence of food insecurity among rural farming households in Ijebu division of OgunState, Nigeria. J Agric Sci Environ 2013;2:351-7. Available from: http://www.journal.unaab.edu.ng/index.php/JAgSE/article/view/1214/1110. [Last accessed on Mar 25].
9. Coleman-Jensen A, Nord M, Andrews M, Carlson S. Statistical Supplement to Household Food Security in the United States in 2010: AP-057. USDA, Economic Research Service; 2011. Available from: http://www.ers.usda.gov/publications/ap-administrative-publication/ap-057.aspx. [Last accessed on 2018 Jul 22].
10. Bauchi State Information. Bauchi State of Nigeria. Nigeria Galleria; 2016. Available from: http://www.Nigeria galleria. com/Nigeria/States_Nigeria/Bauchi_State.html. [Last accessed on 2018 Jul 20].
11. Titus OG, Olise MC, Eze GA. Research Methods in Business Management Sciences. Nigeria: Iyke Ventures Production Enugu; 2008. p. 258.
12. Bose AA, Mohammed I, Haruna U. Price Trends and determinants of market supply in cross-border cattle trade between Nigeria and Niger republic. Dutse J Agric Food Secur 2016;3:13-24.
13. Olukosi JO, Erhabor PO. Introduction to Farm management Economics, Principles and Application. Nigeria: Agitab Publishers Zaria; 2005. p. 114.
14. Ala L, Bello FA. Reducing the incidence household food insecurity via crop production among farmers in Patigi local government area, Kwara state. Niger J Farm Manag 2011;12:23-9.
15. Ayodele V, Makaleka MB, Chaminuka P, Nchabeleng LM. Potential Role of Indigenous Vegetable Production in Household Food Security: A Case Study in Limpopo Province of South Africa; 2011. http://www.actahort. org/members/showpdf? Book nrarn r=911_52. [Last accessed on 2018 Aug 17].
16. Agbola PO. Factors influencing food insecurity among small scale farmers in Nigeria. Afr J Agric Res 2014;9:1-7. Available from: http://www.academicjournals.org/AJAR. [Last accessed on 2018 Aug 20].
17. Teklay N, Aynalem S, Nega AR. Determinants and coping strategies of household food insecurity evidence from agro pastoralists of Afar Region (Zone Two) Addis Ababa. J Poverty Invest Dev 2015;12:1-11.
18. BSADP. Report for the Monthly Technology Review Meeting for the Month of November, 2012. Bauchi State, Nigeria: Bauchi State Agricultural Development Programme; 2012.
19. Akpan SB, Patrick IV, Edet GE, John DE. Analysis of price transmission of fresh tomato and pineapple in the rural and urban markets of AkwaIbom sate, Nigeria. Am J Agric For 2014;2:66-78.