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Determinants of food production in Nigeria: Empirical evidence from Katsina state

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Abstract
Food grains production is crucial for greater economic growth because its provide food and income to a vast population. This study investigates the determinants of wet season food grains production in Katsina State using primary data collected through questionnaire in seven local government areas of the State. In all, 500 questionnaires were distributed, but 415 were eventually used in the analysis. The study employs Multiple Linear Regression Analysis Technique to estimate the coefficients of the variables of interest. The findings show that chemical fertilizer usage and rural manpower had significant positive impact on food grains production in Katsina State. This affirms the role of inorganic fertilizer and economically active population in fostering domestic agriculture, farmer's income, food security and employments. Moreover, the results reveal that armed-rural banditry and annual rainfall variability were found to have significant negative impact on food grains production in Katsina State. This implies that armed-bandits attacks on rural communities and changes/declines in the annual rainfall are major obstacle to achieving food security in the State which continues to affects farmer's income as well as food prices. Furthermore, policy makers should endeavour to enhance the production and consumption of chemical fertilizer, tackle insecurity, and lower domestic agricultural sector's sensitivity to rainfall variation in order to improve domestic agricultural activities in Katsina State.

Keywords: food grains, annual rainfall, malnutrition, rural banditry, food security

Introduction

Food production is very important for greater economic growth and overcoming food security problem. Food security refers to a situation whereby general public always have both physical and economic access to enough food to meet their dietary requirements for a productive and healthy life (USAID, 1992) [24]. Agriculture/food production is important to the Nigerian economy contributing a significant percentage to the country's GDP. Similarly, Nigerian economy comprises agriculture as well as human resources. The country has all the potentials to become one of the strongest agricultural economies in Africa particularly in this period of high cost of living. Despite all human and material resources devoted to Nigerian agriculture, the productive efficiency of farmers for most crops still fall below 60 per cent (Moses & Adebayo, 2006) [14].

Katsina State is agrarian and agriculture is its major employer of labour. A huge proportion of land in the State is suitable for cultivation and a variety of crops can be grown. Foods grains such as Maize, Millet and Guinea Corn are predominant agricultural products in the State which provides food and income to a vast population. However, the incessant rural banditry, declines in average annual rainfall, inadequate chemical fertilizer usage as well as the high cost of rural manpower in Katsina State has negatively affected wet season food grains production which continues to affect farmer's income and persistent increases in food prices. Even though Maize, Millets as well as Guinea-Corn are predominantly wet season food grains produces in Katsina State, the number of quintal per hectare harvested annually continues to decline drastically despite Government efforts to tackle production problems.

Thus, this study aimed to provides some additional evidence on the role of different factors in explaining domestic food production in our selected sample. Conclusion, recommendations and policy implications will also be provided from the findings of the study. The rest of this research work is organised as follows. The next section discusses the related literature. Section 3 report the research methodologies used in the present study. Section 4 presents the empirical findings. Finally, section 5 presents the conclusion and policy implications.

Literature review

Theoretical literature

The production function is a tool of analysis used to explain the relationship between input and output. Generally, food production is based on two important theories, i.e. the classical production theory which is the basic production model, and the second one is the neoclassical production theory. The classical production function theory was developed by Adam Smith (1776) [1] and is shown in Equation (1) as follows:

$$Y_t = f(K_t L_t) \quad (1)$$

Where Y represents the output of production, L is a labour, and K is a capital.

$$Y = fK^{\propto} L^{1-\propto} \quad (2)$$

Similarly, the next production theory as shown in Equation (2) is the neoclassical production theory in terms of the resources that will be used in production. This theory was developed by Solow & Swan (1956) [22] and consists of five important categories. First are the raw materials, which are the basic materials that will be used to produce the manufactured product. Next is the machinery that will be used to substitute for human force in producing products. Labour and machinery play parallel roles in production. The fourth category is capital goods, which include the factory, tools, building, and equipment used to produce other products for consumption. The last factor of production is land, which includes all types of natural resources, such as fertilizers, water, air, and soil.

Both Classical and Neoclassical production theories imply that production function is a tool of analysis used to explain the relationship between input and output. Specifically, the Cobb- Douglass production function is used to represent the relationship between input and output. The Cobb-Douglass function was proposed by Wicksell (1855) [25] and tested statically by Charles Cobb and Paul Douglas in 1928. This function has simplified production output, which is determined by the amount of labour involved and the amount of capital invested.

Empirical literature

Agriculture has long been recognised as an important sector to promote in order to sustain economic growth. In this regard, a vast number of studies have examined the determinants of food production particularly in developing countries.

Table 1: The summary of some selected studies for the determinants of food production

Some selected empirical studies													
Determinants of food prodn.	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]
Food import					(+)			(–)					(–)
Capital					(+)	(+)							
Fertilizer					(+)	(–)	(+)	(+)				(+)	
Covid-19 Pandemic			(–)						(–)				
Labour						(+)		(+)					
Banditry		(–)		(–)									
Tractors					(+)								
Land					(+)	(+)		(+)					
Governance					(+)								
Irrigation	(+)				(+)								
Market Access					(+)								
Inflation								(–)					
Agricultural Inputs												(+)	
Climatic Change											(–)		
Rainfall										(+)			
Temperature										(–)			

Note: The symbols in the parenthesis denote the relationship between food production and its determinants. [1] = Manap & Isma‟il (2017), [2] = Umaru (2020), [3] = Poudel *et al*. (2020), [4] = Ladan & Matawalli (2020), [5] = Di-marcantonio *et al*. (2014), [6] = Obasi *et al*. (2013), [7] = Larson & Frisvold (1996), [8] = Arowolo & Ekum (2016), [9] = Rawal *et al*. (2020), [10] = Borrios *et al*. (2008), [11] = Aydinalp & Cresser (2008), [12] = Roberts (2009), and [13] = Gelan (2007).

Based upon the summary of the literature review in Table 1, we find that many studies have examined the determinants of food production, particularly in developing economies. From our readings, fertilizer; land; food import and labour are the most common explanatory variables used in these studies. However, their estimated impacts on food production tend to vary. Some studies (e.g. Di-marcantonio *et al*., 2014; Larson & Frisvold, 1996; Arowolo & Ekum, 2016; Roberts, 2009) [7, 11, 3, 19] found that fertilizer has a significant positive impact on food production. However, Gelan (2007) [8] as well as Arowolo & Ekum (2016) [3] discovers that food import or food aid brought a significant negative impact on food production in their study area. With regard to covid-19 pandemic, previous studies (e.g. Poudel *et al*., 2020; Rawal *et al*., 2020) [17, 18] highlighted that the impact of Covid-19 on food production tends to be negative in India and many countries. Moreover, Umaru (2020) [23] and Ladan & Matawalli (2020) [10] found a negative relationship between armed banditry and food production in Nigeria. In contrast to most studies, those of Obasi *et al*. (2013) [16], Arowolo & Ekum (2016) [3] and Di-marcantonio *et al*. (2014) [7] suggest a positive relationship between the size of the farmland and food production. We have also noticed that previous studies have tend to include more variables in order to capture the impact of land irrigation, temperature, rainfall, inflation, climatic change and agricultural inputs on food production (e.g. Manap & Ismail, 2017; Borrios *et al*., 2008; Aydinalp & Cresser, 2008; Roberts, 2009) [12, 5, 4, 19].

Several interesting conclusions could be drawn from this literature review. First, even though some empirical works have been conducted on food production and economic growth in most of the countries, these earlier studies are generally based upon the secondary data, rather than relying on data obtained by the researcher through questionnaires. Second, our literature survey reveal that past studies were commonly conducted based on large-scale data analysis, that is, at national and regional level. However, conducting research on food production at national or regional level, or using group of countries (Panel Data Analysis) would not be enough to assess the factors that determine the food production in a given country. Third, to the best of our knowledge, this is the first time that a particular research about the determinants of wet season food grains production in Katsina State of Nigeria has been conducted using primary data. Motivated by these shortcomings, the present study would like to address critically the research gaps by examining the extent to which food grains production could be determined and sustained by the number of various factors in our selected sample.

Research methodology
Study Area
This study is conducted in Katsina State, Nigeria. The State occupies an area of about 24,192 square kilometers, with an estimated population of about 5.8 million people (NPC, 2006) [15]. The State located in the North-Western part of the country and lies in between latitudes 110 03ˮ and 130 05ˮ N and longitudes 070 21ˮ and 090 02ˮ East of Greenwich Meridian (NPC, 2006) [15]. Katsina is among ethnic and monolingual State and the people are generally Hausa/Fulani. It has two climate seasons; rainy and dry seasons and has an average annual rainfall of about 400-1300mm (Saleh & Oyinbo, 2017) [20]. The major food crops produced in the State are Millet, Guinea-Corn, Groundnut, Maize, Beans, Rice and Soya-Beans. However, Katsina State is the largest producer of food grains in Nigeria.

Research design
This study is a descriptive research in which a survey research design is adopted. In addition, the study is a cross sectional, since data is collected across the 7 LGAs of Katsina State. Moreover, it is quantitative in nature because the variables are measured and analysed using numbers and had predetermine hypothesis, population, procedure, instrument and data analysis techniques.

Population of the study
The target population of this study is the registered farmers of Jibia; Batsari; Safana; Danmusa; Kankara; Faskari and Sabua Local Governments Areas of Katsina State. At the time of conducting this research (2023), the population of the present study is comprise all the 7,035 rural farmers of the aforementioned 7 LGAs as presented in table 2.

Table 2: Population of the Study (Rural Farmers)

S/NO.	Local Governments Areas	Number of Registered Farmers
1.	Batsari	9,55
2.	DanMusa	1,099
3.	Faskari	1,051
4.	Jibiya	730
5.	Kankara	1,160
6.	Sabuwa	1,184
7.	Safana	856
Total =		7,035

Source: All Farmers Association of Nigeria (AFAN), Katsina State Chapter.

Sampling technique and sample size
Multi-stage cluster sampling technique is used in selecting the respondents for the present study. This is one of the probability sampling techniques in which randomisation is use to make sure that every elements of the population has equal chance to be part of the selected sample. First stage was purposive selection of 7 most affected Local Governments by armed-rural banditry in Katsina State. In the second stage, simple random sampling technique is used to select five rural communities in each Local Government, making a total of 35 villages. At the last stage, we randomly select the elements for sampling (i.e. local farmers) across all the 35 rural communities.

Given the total number of population known, Yamaneˮs (1967) [26] formula is used to calculate a sample size which accurately represents the total number of 7,035 rural farmers of the aforementioned 7 LGAs as presented in Table 2. Below is the formula:

$$n = \frac{N}{1 + Ne^2} \qquad (3)$$

Where n is required sample size, N is the population size, e is the Margin of error to be decided by the researcher. We considered confidence level of 95 per cent in this regard. Therefore, 95% confidence interval is equal to the 0.05.

Sample size of rural farmers
For robustness, we also employed Saunders *et al*. (2018) [21] sample selection criterion. According to this criterion, using the 95 per cent level of certainty in a population of 7,000 to 10,000, the sample size of 400 respondents is required. However, the researcher feared that the level of response might not be adequate, an allowance of 100 extra participants is added to get a round figure of 500 respondents. Accordingly, the information about the determinants of wet season food grains production in Katsina State is collected from 500 local farmers in the State. Equally, the total sample of 500 rural farmers was divided into 35 rural settlements, which gave a sub-sample of 14 respondents from each one of 35 villages across all the 7 LGAs. In this regard, about 71 respondents are required in each local government.

Model specification
In an attempt to achieve the goal of the present study, we developed a growth Model based on the Solow & Swan (1956) [22] growth framework. The Model incorporated the Cobb-Douglas production function:

$$Y_t = A_t K_t^{\beta} L_t^{1-\beta} e_t \qquad (4)$$

Where Y_t is the output of production at time *t* which represented by food grains production ($FOODS$), k_t is the physical capital which represented by chemical fertilizer usage ($FETLIZR$), L_t is the labour force represented by local labour hired ($LABOUR$), while A_t refers to the technical and economic efficiencies capturing other factors such as rural banditry ($BANDITS$), and rainfall variability ($RAINFAL$).

Moreover, the Model for A_t can be written as $A_t = \theta_1 BANDITS_t \theta_2 RAINFAL_t$. Based on the production function as presented in Equation (4), we obtain the following Econometric Model:

$$FOODS_t = \beta_0 + \alpha FETLIZR_t + \alpha LABOUR_t + \theta_1 BANDITS_t + \theta_2 RAINFAL_t + \varepsilon_t \quad (5)$$

Additionally, $\theta_1 \theta_2$ and ε_t are the coefficients of the explanatory variables and error term respectively. Moreover, Equation (5) provides the basis for Regression Analysis in the present study.

Choice of the variables

Before specifying the Model to be estimated, it is appropriate to identify and describe the variables that will populate the Model. The variables employed in this study includes, $BANDITS$, $FETLIZR$, $RAINFAL$ and $LABOUR$ as indicators of Rural Banditry, Chemical Fertilizer Usage, Rainfall Variability, and Rural Labour Hired, respectively. These variables were chosen because of their significant impacts on wet season food grains production. Accordingly, $FOODS$ is measure by food grains production in quintal per hectare. The datasets for all the variables are source through structured questionnaire. Table 3 provides a summary and definitions of all the variables used in this study.

Table 3: Summary of the Variables

Variables	Definitions
Dependent Variable $FOODS$	Food Grains Production [i.e. Maize, Millet and Guinea-Corn] in quintal per hectare (q/ha).
Explanatory Variables	
$BANDITS$ $FETLIZR$ $RAINFAL$ $LABOUR$	Rural Banditry *(armed-bandits attacks on rural communities)* Chemical Fertilizer Usage *(100 kilograms per hectare of arable land.)* Rainfall Variability *(changes in Katsina State annual rainfall over a period 2012 to 2022).* Local Labour or Rural Manpower Hired *(size of economically active population).*

Method of data collection

Primary data is collected from a structured questionnaire. The structured questionnaire was with 4 points scale of measurement with options strongly agree (SA), agree (A), Disagree (D), and Strongly disagree (SD). The instrument is developed by the researcher after intensive review of the literature.

Instruments for data collection

One questionnaire is used as instrument for data collection in this study. The questionnaire was divided into two parts, i.e. Part A and Part B. The Part A is used to collect data on demographics information of the respondents, while Part B contained items on the determinants of wet season food grains production in the study area. Lastly, all the items in part B under the questionnaire is rated on a four-point scale of "Strongly Agree" (4), "Agree" (3), "Disagree" (2) and "Strongly Disagree" (1).

Validation of the instrument

The content validation of the instruments is conducted by 5 experts in the field of development economics from Bayero University Kano, Hassan Usman Katsina Polytechnic, Ahmadu Bello University Zaria, Umaru Musa Yar"adua University Katsina as well as Federal College of Education, Katsina. Accordingly, validation of the instruments involves collecting and analysing data to assess the accuracy of an instrument. There are numerous statistical tests and measures to assess the validity of data collection instruments.

Reliability of the instruments

The reliability of the instruments is established using the test-retest method and it has also been determined using Cronbach Alpha Analysis. Similarly, the reliability test is done from the data collected during the pilot survey.

Pilot study

Pilot testing is carried out for this research work to determine the validity and reliability of the study instrument. Three rural communities are selected and the questionnaire which contains the same items as that of the study is distributed to respondents. The instrument validity and reliability coefficient is tested using Multiple Linear Regression Analysis technique.

Method of data analysis

Multiple linear regression analysis is employed to achieve the objectives of this study. This method have been chosen for this study because of its higher performance and simplicity to compute and interpreted. The test statistics is presented as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots \beta_n X_n + \varepsilon_t \quad (6)$$

Where Y is the dependent variable, $X_1 X_2 X_n$ are the independent variables, while $\beta_1 \beta_2 \beta_n$ are the coefficients of the independent variables, and ε is the error term, respectively. Before the estimation of this model, preliminary analysis i.e. correlation analysis is conducted to ascertain the linear relationship between the variables. Additionally, post-estimation tests are conducted to verify the assumptions of regression model and tests for model stability. These include normality test, heteroskedasticity, serial correlation as well as stability tests. Nevertheless, the results finding is presented using Tables and Inferential Statistics. Likewise, the analysis is done with the aid of the Statistical Package for Social Science (SPSS) as well as the Eviews-11 software.

Results and discussion

The empirical results and related discussions/analysis are presented in this section. The analyses commenced with a summary of the bio data of the respondents, correlation and regression analysis. The bio data of the respondents is presented in Table 4.

Table 4: Bio Data of the Respondents

Age Group	Frequency	Percentage	Education	Frequency	Percentage
18 – 33	133	32.05	Informal	89	21.45
34 – 49	171	41.20	Primary	70	16.87
50 – 65	84	20.24	Secondary	111	26.75
66 – 81	27	6.51	Tertiary	145	34.93
Total	**415**	**100**	**Total**	**415**	**100**
Gender	**Frequency**	**Percentage**	**Employment**	**Frequency**	**Percentage**
Male	317	76.39	Farmers	324	78.07
Female	98	23.61	Non-farmers	91	21.93
Total	**415**	**100**	**Total**	**415**	**100**
Marital Status	**Frequency**	**Percentage**	**LGA**	**Frequency**	**Percentage**
Married	388	93.49	Batsari	57	13.73
Single	20	4.82	Dan musa	60	14.46
Divorcee	7	1.69	Faskari	66	15.90
			Jibiya	59	14.22
			Kankara	58	13.98
			Sabuwa	60	14.46
			Safana	55	13.25
Total	**415**	**100**	**Total**	**415**	**100**

The data in Table 4 shows that a reasonable number (171) of the respondents are within the age group 34 to 49 years; this represents 41.20 per cent. This is followed by the age groups 18 to 33, with 133 respondents as well as 50 to 65 with 84 respondents, representing 32.05 per cent and 20.24 per cent respectively. The results in Table 4 indicates that majority of the respondents are in the active working age and thus are engaged in one economic activity or another. Moreover, the employment status reveals that majority of the respondents (78.07 per cent) are farmers, while the remaining 21.93 per cent are engaged in various economic activities.

Furthermore, Table 4 reveals the educational qualification of respondents where 145 (34.93 per cent) as well as 111 (26.75 per cent) have attained tertiary and secondary education respectively, while 70 (16.87 per cent) and 89 (21.45 per cent) have primary and informal education respectively. Similarly, on gender, majority of the respondents were males, accounting for 317 (76.39 per cent), where females accounting for only 98 (23.61 per cent). This has shown the dominance of men in economic and social activities in Katsina State. Additionally, a vast majority of the respondents (388) are married, which represents 93.49 per cent. Likewise, the data in Table 4 reveals that the respondents are fairly distributed across the LGAs under study. Faskari LGA accounts for 15.90 per cent, while Sabuwa and Dan Musa account for 14.46 per cent each. Equally, Safana, Batsari, Kankara and Jibiya accounts for 13.25 per cent, 13.73 per cent, 13.98 per cent and 14.22 per cent respectively. Generally, the bio data of the respondents has implied that the tendency of bias in the outcome of the study is reduced to the barest minimum because they represent various socio-economic groups. In an attempt to shed more light on the type of relationship that prevailed between the variables in the study, pair-wise correlation analysis is conducted and the results is presented in Table 5.

Table 5: Correlation Matrix

Variables	FOODS	BANDITS	FETLIZR	RAINFAL	LABOUR
FOODS	1.000				
BANDITS	-0.637*** (0.009)	1.000			
FETLIZR	0.681*** (0.001)	0.173 (0.343)	1.000		
RAINFAL	-0.742*** (0.000)	0.235 (0.434)	0.521* (0.060)	1.000	
LABOUR	0.574** (0.030)	0.146 (0.424)	0.560*** (0.001)	0.742*** (0.000)	1.000

Note: The asterisk ***,** and * denote the statistical significant at the 1 per cent, 5 per cent and 10 per cent levels respectively. P-values are in parenthesis ( ).

Table 5 reveals that the negative and significant linear relationships exists between the food grains production and rural banditry, which implies that armed rural banditry has a larger impact on food production, and this affect economic growth as well. Interestingly, the linear association between foods grains production and explanatory variables (i.e. chemical fertilizer usage, rural manpower, rainfall variability) is significant and positive. However, the correlation between rural banditry and other explanatory variables is insignificant at all levels. Moreover, there is significant and positive relationship between chemical fertilizer usage and rainfall variability. Furthermore, in an attempt to achieve the goal of the present study, the results of the multiple linear regression analysis technique is presented in Table 6, where food grains production ($FOODS$) is used as dependent variable. On the other hand, the explanatory variables are chemical fertilizer usage ($FETLIZR$), and rural manpower ($LABOUR$), rural banditry ($BANDITS$), and rainfall variability ($RAINFAL$).

Table 6: Result of Regression Analysis

Dependent Variable:				
Independent Variables	Coefficient	**Std. Error**	**t-Statistic**	**Prob.**
$BANDITS$	-2.221***	27.643	-0.080	0.0002
$FETLIZR$	0.111**	0.245	0.453	0.0115
$RAINFAL$	-0.002*	0.010	-0.212	0.0603
$LABOUR$	0.169*	0.119	1.424	0.0811
Joint Significance and Diagnostic Tests				
R-squared	0.869			
Adjusted R-squared	0.918			
F-statistic	8.935			0.0000
Durbin-Watson stat	1.607			

Note: The asterisk ***,** and * denote the statistical significant at the 1 per cent, 5 per cent and 10 per cent levels respectively.

The result in Table 6 highlights that all the estimated coefficients were statistically significant at the conventional levels. These findings indicate that armed-bandits attacks on rural community had a significant negative impact on food grains production in Katsina State. In fact, a 1 per cent increase in armed-rural banditry will decrease Katsina State‟s food grains production by approximately 2.221 per cent. This finding is consistent with that of many previous studies who found a negative association between armed-rural banditry and food grains production (see Dennis *et al*., 2022; Ladan & Matawalli, 2020; Umaru, 2020; Audu & Adamu, 2021; Ladan & Badaru, 2021) [6, 10, 23, 2, 9]. The significant negative impact of armed-rural banditry on food grains production in Katsina State indicates that insecurity is a major obstacle to achieving food security in the State which continues to affects farmer‟s income and caused persistent increase in food prices.

Similarly, the results reported in Table 6 demonstrates that the quantity of chemical fertilizer consumed per hectare of arable land had a significant positive impact on food grains output, as one per cent increase in chemical fertilizer usage improved food grain production by approximately 0.111 per cent in Katsina State. This result affirms the role of inorganic fertilizer in fostering domestic agricultural activities in the study area. While the positive impact of chemical fertilizer usage on food grains production contradicted the findings of Obasi *et al*. (2013) [16], it is nevertheless consistent with that of many previous studies which found a positive association between inorganic fertilizer usage and food grain production (e.g. Larson & Frisvold, 1996; Barrios *et al*., 2008; Roberts, 2009; Di-marcantonior *et al*., 2014) [11, 19].

Apart from armed-rural banditry and chemical fertilizer consumption, the annual rainfall changes over a given period also plays an important role in wet season food grains production. Based on the results in Table 6, it is apparent that the changes in the annual rainfall overtime reduce agricultural output in our selected sample. This is signified by the fact that a one per cent increase in annual rainfall variability decreased agricultural output by approximately 0.002 per cent, implying that Katsina State agricultural sector is sensitive to rainfall variations. This is consistent with Molua (2002) [13], and Aydinalp & Cresser (2008) [4], who averred that wet season food production is extremely reliant on rainfall, and any changes in annual rainfall have acted to reduce agricultural output.

Additionally, the results in Table 6 show that there is significant positive relationship between the size of economically active population and food production. Specifically, a one per cent increase in rural manpower leads to 0.169 per cent increases in the food grains output in our selected sample. This means that availability of active labour force improved agricultural activities, farmer‟s income, food security and youth employments. This finding is consistent with that of Barrios *et al* (2008), Obasi *et al* (2013) [16], and Di-marcantonio *et al* (2014) [7] who found a positive relationship between rural labour and food production.

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Conclusion and Policy Implications

This study has achieved its objectives of investigating the determinants of wet season food grains production in Katsina State. The findings of the study show that there is a strong positive impact of inorganic fertilizer usage and rural manpower on food grains production, meaning that chemical fertilizer and economically active population are important growth catalysts for the domestic agricultural activities in the study area. The results also reveal that armed-rural banditry and annual rainfall variability were found to have significant negative impact on food grains production in Katsina State. This suggests that armed-bandits attacks on rural community and changes/declines in the annual rainfall are major obstacle to achieving food security in our selected sample which continues to affects farmer's income as well as food prices.

Since it has been conclusively established that inorganic fertilizer usage is vital for food grains production in Katsina State, policymakers should do everything possible to increase the domestic production and consumption of the fertilizer to boost agricultural activities in the State. In addition, government and stakeholders should provide more fertilizers to farmers so as to encourage and improve the utilization of fertilizer particularly in rural areas. Given that rural manpower plays a crucial role in overall agricultural activities, initiatives to strengthen active farm workers should be prioritised. These include incentives for agricultural related manpower, increasing the amount and quality of trained technical and professional manpower in agriculture. Additionally, governments should promote policies to increase the number of agricultural based institutions in order to stimulate and sustain economic growth.

Since the study also unequivocally demonstrated that armed-rural banditry have significant negative impact on food grains production in Katsina State, policymakers should endeavour to provide more sophisticated weapons to all the security agencies to successfully overcome the rural banditry. This would include the creation of a vigilante groups and supply them with more operational materials and logistics, to carry out their duty successfully. Given that the finding of the present study reveals that annual rainfall variability were found to have significant negative impact on food grains production in Katsina State, policymakers should also take a specific steps that are probably to lower Katsina State agricultural sector‟s sensitivity to rainfall variations. This may involves the adoption of agricultural techniques that optimise the use of water through increased and improved irrigation systems and crop grazing area development.

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