Analysis of Crop Production for Sustainable Food Security in Kwara State, Nigeria

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ABSTRACT

This study examines the issue of food security and the trend analysis of agricultural productivity in Kwara State, Nigeria. Agricultural data on maize, sorghum, rice, millet, yam and cassava were collected from Kwara State Agricultural Development Project (KWADP), Ilorin for a period of twenty-two years (1992-2013). Descriptive statistics such as mean, standard deviation and coefficient of variation were used in data analysis. A standardized Anomaly Index was used to analyze fluctuation in crop yields. The semi-average method was used in the trend analysis of crop yield. The result of the descriptive statistics shows that the production of sorghum was heterogeneous. The Standardized Anomaly Index (SAI) revealed that the crop yields fluctuated around the long-term mean. Annual sorghum and rice yields vary positively from 1999 to 2002 while maize and yam vary negatively from 1995 to 2002 and 1997 to 2000 respectively. About 59.1% of the cassava yields fall below the long-term means. The result of the semi-average method shows that all the identified crops exhibit an upward trend. This implies that the production of these crops will keep on increasing and thereby ensuring food security in the country. The study, therefore, suggests that both the State government and private organizations should encourage modern agricultural techniques like the application of fertilizer and pesticides to sustain the increasing pattern of crop productivity in the State.

Keywords: Food Security, Trend, Agricultural Productivity, Kwara State, Nigeria

INTRODUCTION

Agriculture is of great importance to many people in developing countries. According to [1], the livelihood of a major proportion of the population in developing nations is directly or indirectly connected with agriculture. [2], also asserts that about 75% of all world poor people live in rural areas and 86% of them work in the agricultural sector for their livelihood. Agriculture is the economic mainstay of most of the households in Nigeria [3] and one of the important sectors in Nigeria economy. It provides staple food and employment for most of the people in the country. It also contributes to the Gross Domestic Product (GDP) of the nation. According to [4], agriculture has a critical role to play in poverty reduction in Nigeria because over 40% of the GDP comes from the sector and it employs about 60% of the working population. An increase in agricultural productivity brings about growth in the agricultural sector especially in developing countries where agriculture employs a large percentage of the population. An increase in farm output brings about an increase in food supply and income of the farmers which eventually leads to a reduction in poverty level and economic development. Agriculture is therefore a very crucial sector that may reduce poverty in several ways [5].

Food security is an important issue of international concern. This is not unconnected with the current high population growth rate coupled with increasing urbanization, resulting in fewer hands in agricultural food production [6]. Food security is achieved when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preference for an active and healthy life [7]. [8] mentioned that due to lack of proper estimation of food security, the quantity of food availability in a specific period of a particular place for consumption of the population reveals the food security; that is a function of domestic agricultural production or through imports from surplus areas. [9] also defined food security at the national level to mainly refer to availability in the country of sufficient stocks of food to meet domestic demand, either through domestic supply or through imports. Planning Commission (Government of India) also defined food security as a situation where "everyone has access, at all time, to the food needed for an active and healthy life. Currently, food security includes four major components like availability, accessibility, stability, and utilization of food [10]. Food security is directly related to climate variation because any variability in climatic factors can directly affect a country's ability to feed its people [11]. It affects all the components of food security [12]. Food security directly gets affected due to every fluctuation in agricultural productivity. It

is a multidimensional, multi-processing and complex phenomenon in the world.

Agricultural productivity is the measurement of the quantity of agricultural output produced for a given quantity of input [1]. There are different ways and reasons for measuring agricultural productivity. According to [13], yield or land productivity is commonly used to measure the success of new technology and evaluate the amount of land required to meet the future demands of food while labour productivity is used to measure the incomes and wellbeing of people involved in agriculture.

The levels of agricultural productivity in Sub-Saharan Africa are far below that of other areas in the world, and well below that which is needed for food security and poverty reduction [14]. However, the rate of agricultural productivity growth since the early 2000s has been quite encouraging in some African countries [15]. According to [12], the growth of the yield of major food grains throughout the world is about 1% per year. For the developing countries, about 80% increase in food production will need to come from the increase in yields as well as cropping intensity while the remaining 20% will be obtained from the extension of arable land.

Several factors affect agricultural productivity. Some of these factors include climate change, soil fertility and changes in farming techniques. Agricultural production in Nigeria depends mainly on the climate. An increase or decrease in rainfall, temperature and other climatic parameters can affect crop yields. Generally, changes in climatic elements affect crop productivity. Climate is one of the major factors that determine the trend of agricultural productivity of an area. According to [16], it is so fundamental that it affects virtually all aspects of crop production. The type of crop grown, time of planting and harvesting of crops in an area is climate determined. Variations in climatic elements affect crop productivity. According to [17] changes in the occurrence and severity of droughts and floods could pose challenges for farmers and threaten food safety. Furthermore, the soil is also an important factor in agriculture productivity. Soil is a medium through which plant grows. According to [18], the capability of a soil to produce crop yield depends on its fertility. Therefore, variations in the fertility of the soil in an area or over a period of time will cause variations in agricultural productivity.

However, this paper focuses on the food security and the trend analysis of agricultural productivity with the view of determining whether there is an increase or decrease in productivity of common agricultural crops in terms of yield per hectare of land as it relates to food security. This becomes imperative because of the present drive by the Government at all levels to diversify the nation's economy by engaging the agricultural sector. Therefore, in order to know the kind of measure to put in place, there is a need to ascertain the current level of agricultural productivity in the countries. It is against this background that this paper is being put forward to investigate the trend of agricultural productivity in Kwara State.

MATERIALS AND METHOD

Study Area

The study area is Kwara State. It is located on latitude $7^0 30^1$N and $9^0 40^1$N of the Equator and longitude $2^0 6^1$E and $5^0 2^1$E of the Greenwich meridian. Kwara State shares a boundary with the Republic of Benin and with five states in Nigeria. In the North, it is bounded by Niger State, in the South by Oyo, Osun and Ekiti States, and in the East by Kogi State. Kwara state is referred to as the "gateway" between the Northern and the Southern part of Nigeria. In term of political location, Kwara State is located in the North Central Zone of Nigeria. It comprises sixteen local government areas. Yoruba, Fulani, Bariba and Nupe are the major ethnic groups in the State. According to [19] Kwara State occupies 36,825 square kilometres. In term of population, according to the 2006 population census, the population of Kwara state was 2.37 million [20]. Fig. 1 shows the map of Kwara State.

The climate of Kwara State is characterized by two major seasons. These are wet and dry seasons. The rainy season begins towards the end of April and lasts till October while the dry season begins in November and end in April. The temperature of the state ranges from 33^0C to 35^0C from November to January while from February to April it ranges from 34^0C to 37^0C. The total annual rainfall ranges from 990.3mm to 1318mm. The rainfall exhibits a double maximal pattern. Relative humidity ranges from 75% to 88% from May to October and 35% to 80% during the dry season.

The geology of the area consists of pre-Cambrian basement complex rock. The soil in the area especially in Ilorin the State headquarters supports the growth of cereal crops [16] and vegetables. The dominant vegetation in the State has derived savanna. Grasses in the State includes spear grass, elephant grass and goat weeds while the trees include acacia, shear butter and locust beans trees.

The majority of the people in the State are farmers. The common food crops grown in the State mainly for domestic consumption include Maize, Rice, Sorghum, Millet, Beans, Yam, Cassava, Guinea-corn and Vegetables.

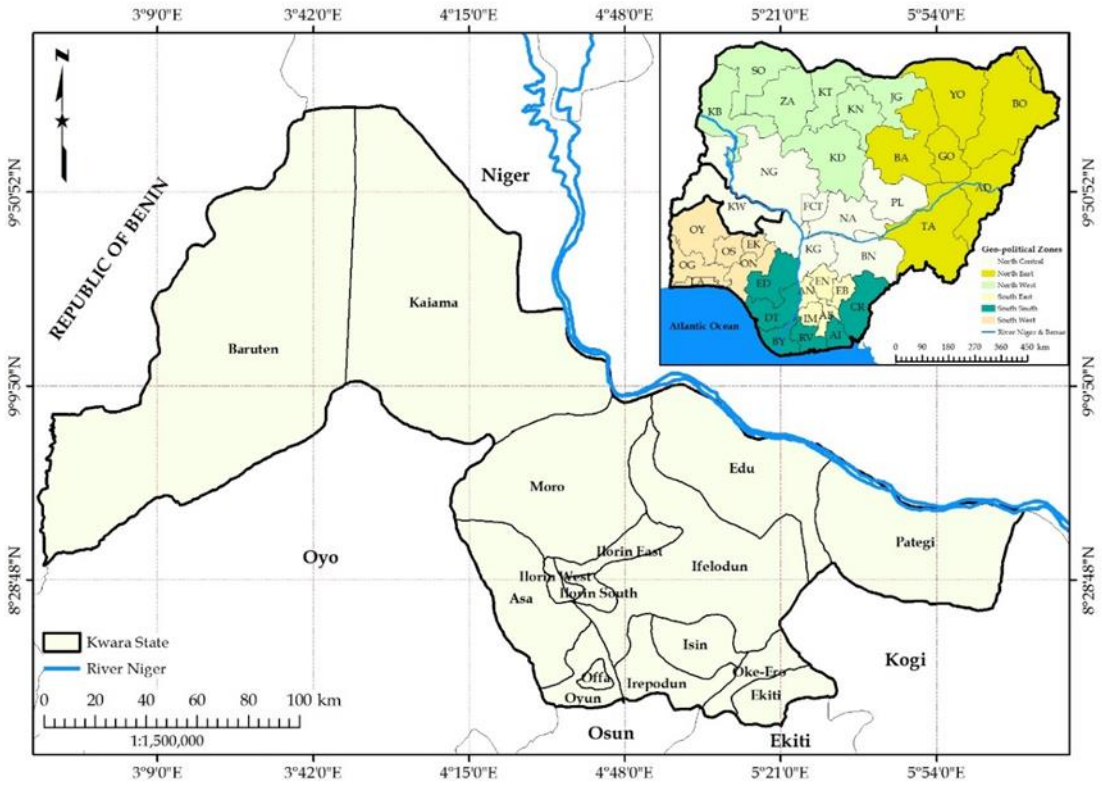

Fig.1: Kwara State Showing the Sixteen Local Government Areas
Source: Generated from map library, 2017 (http://www.maplibrary.org)

Procedure

Agricultural productivity is the measurement of the ratio of agricultural output to inputs. There are two major ways of measuring agricultural productivity. These are Partial Measures of Productivity (PMP) and Total Factor Productivity (TFP). While PMP compares the agricultural output to input (for example yield per hectare of land), TFP compares an index of agricultural inputs to an index of outputs. According to [21], the most commonly used term for representing agricultural productivity is the average yield per hectare of land. Therefore, for this study, agricultural data on maize, sorghum, rice, millet, yam and cassava yields were collected from Kwara State Agricultural Development Project (KWADP), Ilorin for a period of twenty-two years (1992-2013). Mean, standard deviation and coefficient of variation were used in the descriptive characteristics of crop yields. The semi-average method was used in the trend analysis of crop yield. This method was adopted because it is more objective than fitting a line by eye to the plotted series [22] and the set of agricultural data is even (22years). In addition, Standardized Anomaly Index (SAI) was used to examine the changes in the values of crop yields over the period of 1992 -2013. The SAI of each climatic parameter was calculated for the individual station. The Standardized Anomaly Index was calculated using the following equation:

$$SAI = \frac{X_i - \overline{X}}{S.D}$$

Where:

X_i = annual total of crop yield

$\overline{X}$ = mean value of crop yield for the period of study

SD= standard deviation from the mean value of crop yield for the period of study.

RESULTS AND DISCUSSION

The pattern of Crop Productivity in Kwara State (1992-2013)

Table 1 shows the results of the descriptive analysis of crops production in Kwara State (1992-2013). From the table, cassava has the highest mean per yield (13.38) followed by yam (12.25) while maize has the lowest mean per yield (1.33). This implies that from 1992 to 2013 cassava has the highest yield value. This suggests that the production of cassava is relatively high in the state compare with other identified crops. The highest standard deviation which shows the measure of the dispersion of the crop value from its mean was also recorded in cassava (2.78). The implication is that values of cassava production within the years under review were relatively more spread apart from the mean than the values of other crops. The

coefficient of variation which measures the relative variability between crop yields revealed that sorghum was heterogeneous. This is because the value of the coefficient of variation was greater than 33%. This implies that the production of sorghum from 1991 to 2013 differs significantly. These deviations could be as a result of climatic or other non-climatic factors like edaphic factors.

Table 1: Descriptive Analysis of Crop Productivity (1992-2013)

Crop	Mean (Yield)	Standard Deviation	Co-efficient of Variation
Maize	1.33	0.19	14.29
Sorghum	1.52	0.55	36.18
Rice	2.34	0.69	29.49
Millet	1.48	0.40	27.02
Yam	12.25	1.00	8.16
Cassava	13.38	2.78	20.78

Source: Authors Computation, 2017

Fluctuations in Crop Yields

Fig. 2 (a-f) shows the fluctuations of crop yields in Kwara State for a period of 22 years (1992-2013). The annual crop yields fluctuated around the long-term mean. The figure revealed that annual sorghum and rice yields fall below the long–term mean in the years 1992 to 1998. Millet and cassava fall below the long–term mean from 1992 to 1999 and 1992 to 2005 respectively. On the other hand, sorghum and rice fall above the long-term mean between the years 1999 to 2002 while millet and cassava fall above the long-term mean between the years 1998 to 2001 and 2006 to 2013 respectively. However, maize and yam fall below the long-term mean between the years 1995 to 2002 and 1997 to 2000 respectively. The years with maize and yam yield above the long-term mean were 2007 to 2013 and 2008 to 2013 respectively. This implies that the annual sorghum and rice yields in 1999 to 2002 vary positively while maize and yam from 1995 to 2002 and 1997 to 2000 respectively varies negatively. 59.1% of cassava yields fall below the long-term mean.

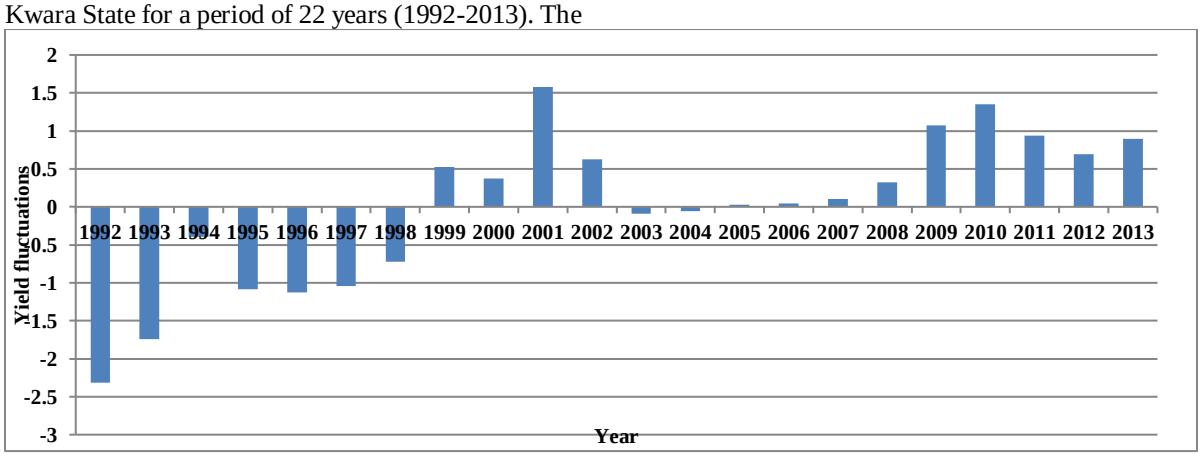

Fig. 2a: Annual Maize Yield Fluctuations for Kwara State

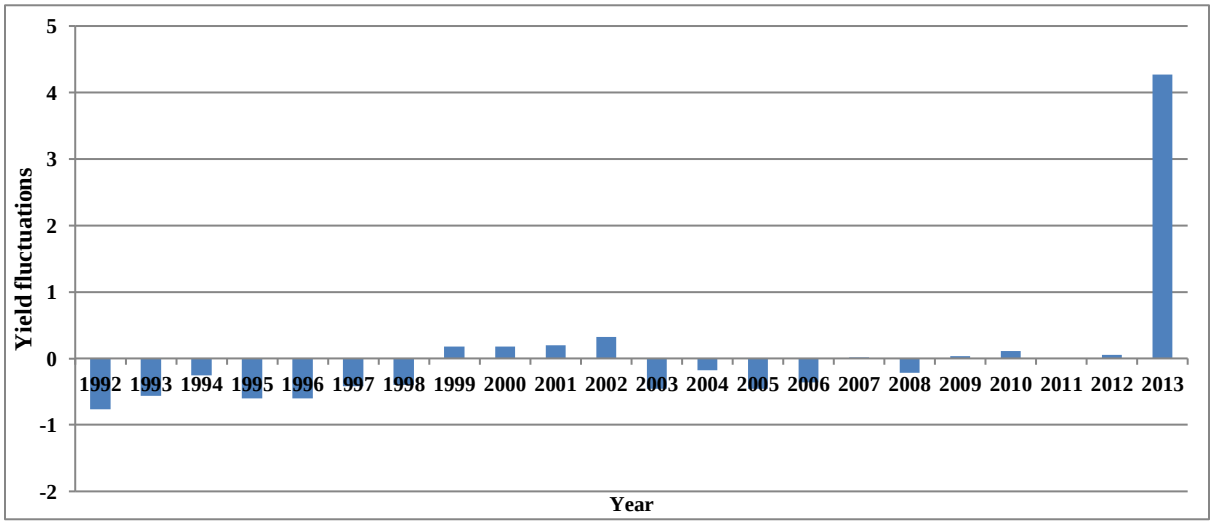

Fig. 2b: Annual Sorghum Yield Fluctuations for Kwara State

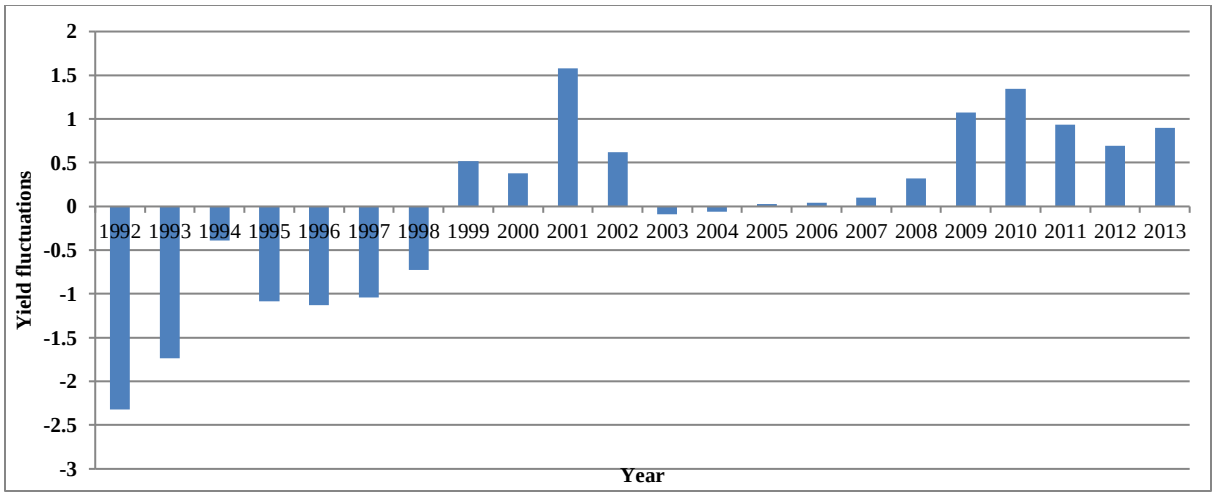

Fig. 2c: Annual Rice Yield Fluctuations for Kwara State

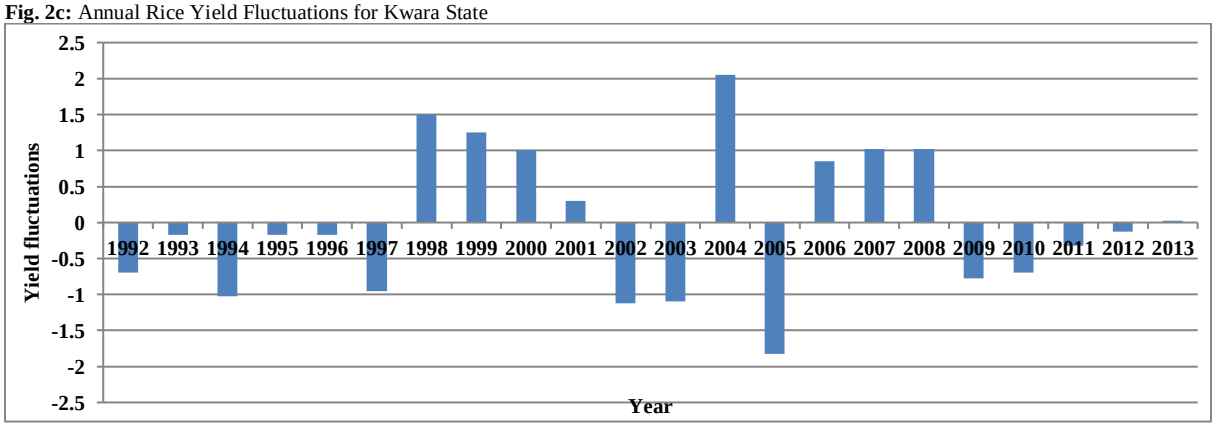

Fig. 2d: Annual Millet Yield Fluctuations for Kwara State

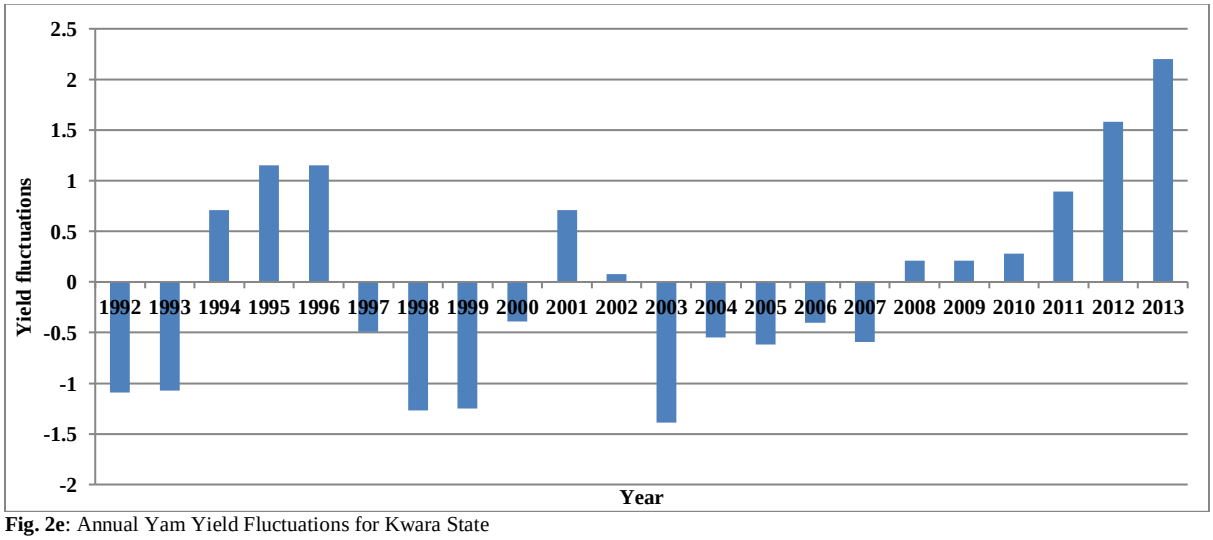

Fig. 2e: Annual Yam Yield Fluctuations for Kwara State

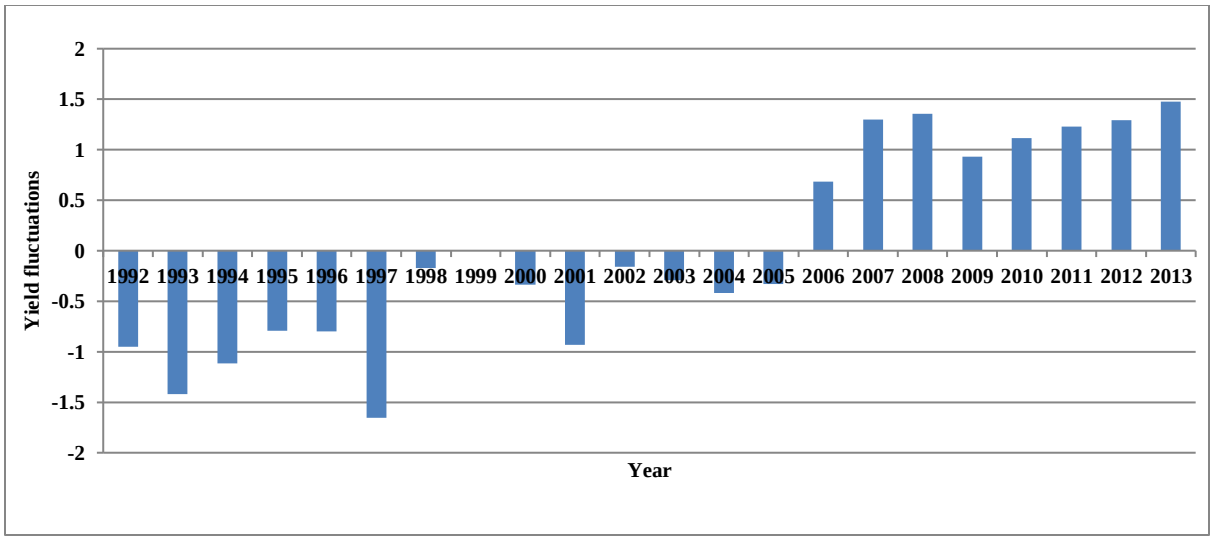

Fig. 2f: Annual Cassava Yield Fluctuations for Kwara State

The trend of Crop Yields

The results of the trend analysis using the semi-average method were computed in Table 2. Semi-average method was adopted because according to Ayoade, (2008) it is more objective than fitting a line by eye to the plotted series. From the table crop productivity in Kwara State from 1992–2013 exhibits an upward trend. This implies that the productivity of maize, sorghum, rice, millet, yam, and cassava will likely keep on increasing. In other words, increased productivity of the identified crops in Kwara State has been identified. This suggests that variability in climate may have little impact on crop productivity in Kwara State. Adeniyi, (2013) also reported that climate has a weak impact on crop productivity in Ilorin. In addition, the result suggests that the modern pattern of agricultural practices was adopted throughout the years under review. These include the application of fertilizer and insecticides to improve soil fertility and reduce the effects of pest on crop productivity. Fig.s 3a-f show the graphical trend line of the crop yields in Kwara State.

Table 2: Trends in Crop Productivity in Kwara State (1992-2013)

Crop	First Part Average	Second Part Average	Trend
Maize	1.19	1.46	Upward Trend
Sorghum	1.38	1.66	Upward Trend
Rice	2.01	2.67	Upward Trend
Millet	1.47	1.48	Upward Trend
Yam	12.09	12.41	Upward Trend
Cassava	11.27	15.49	Upward Trend

Source: Authors Computation, 2017

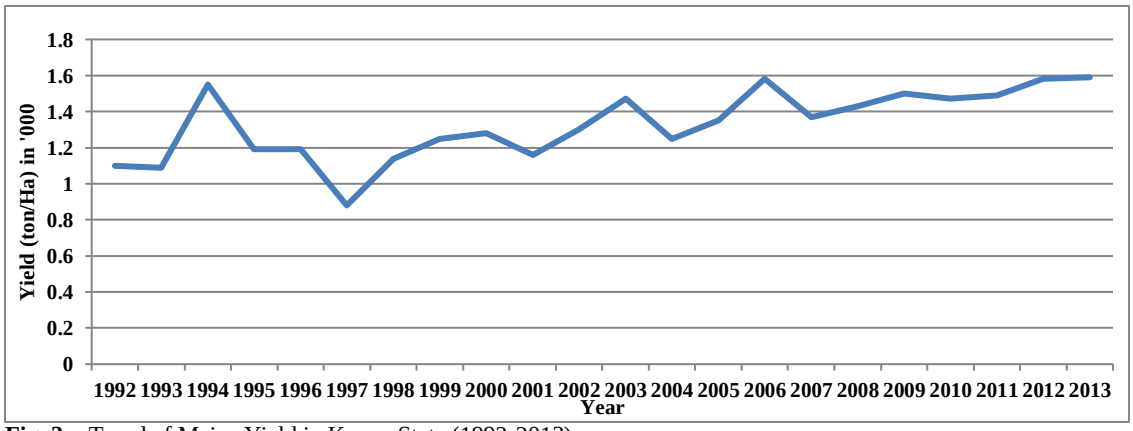

Fig. 3a: Trend of Maize Yield in Kwara State (1992-2013)

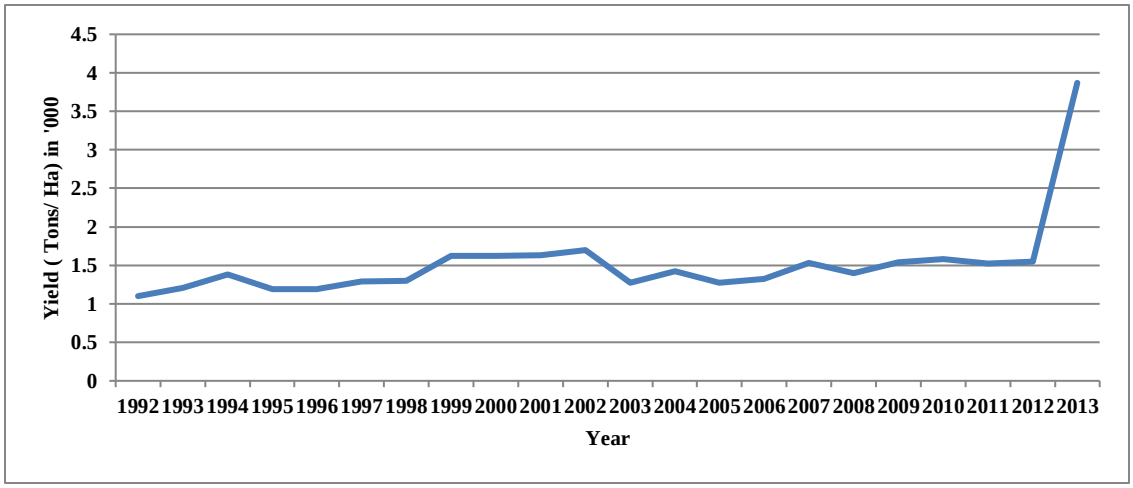

Fig.3b: Trend of Sorghum Yield in Kwara State (1992-2013)

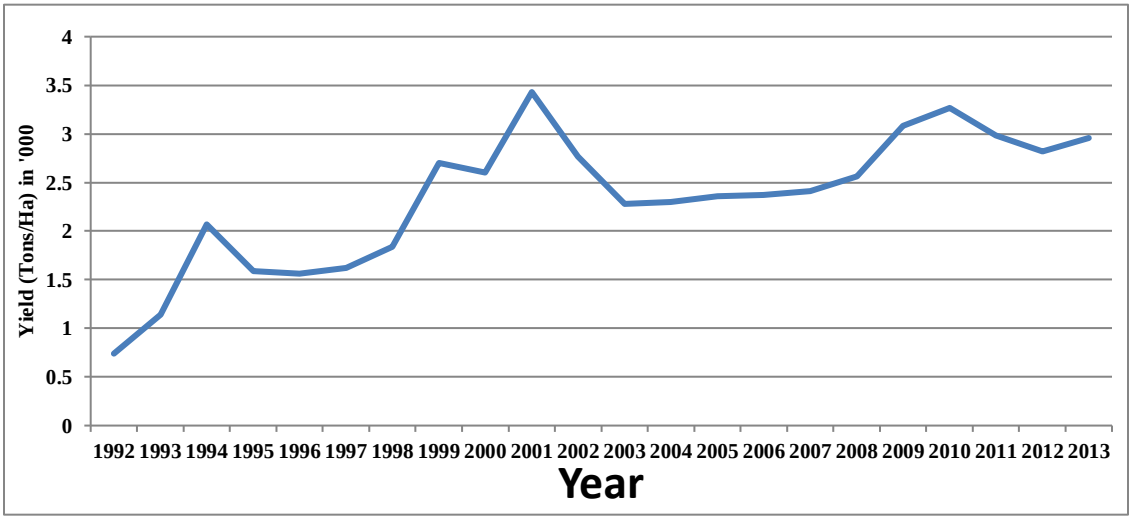

Fig. 3c: Trend of Rice Yield in Kwara State (1992-2013)

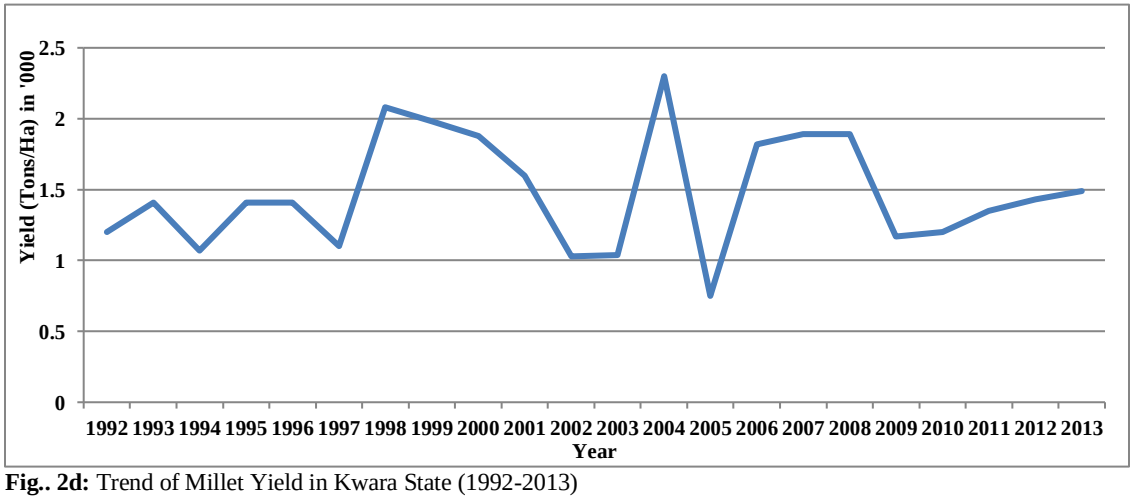

Fig.. 2d: Trend of Millet Yield in Kwara State (1992-2013)

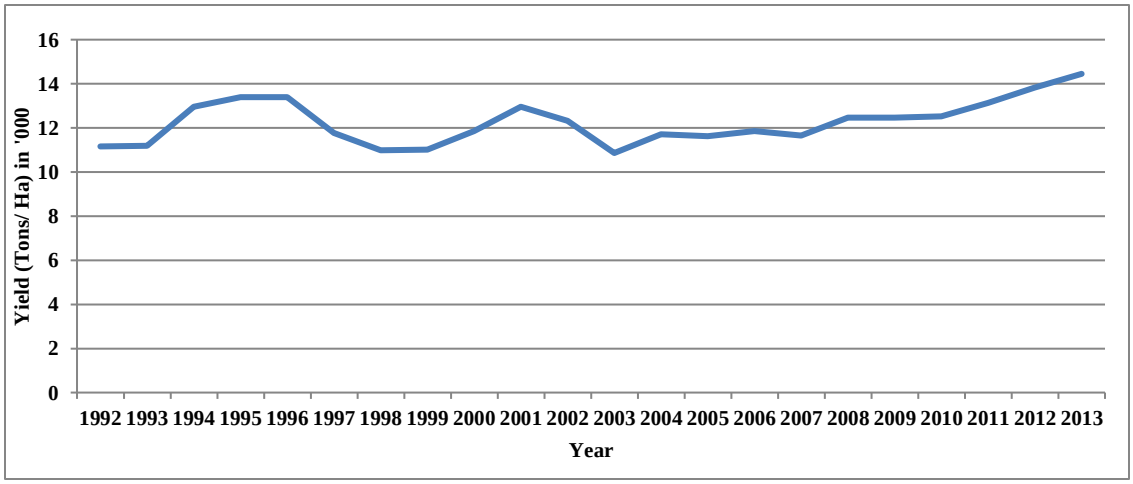

Fig.3e: Trend of Yam Yield in Kwara State (1992-2013)

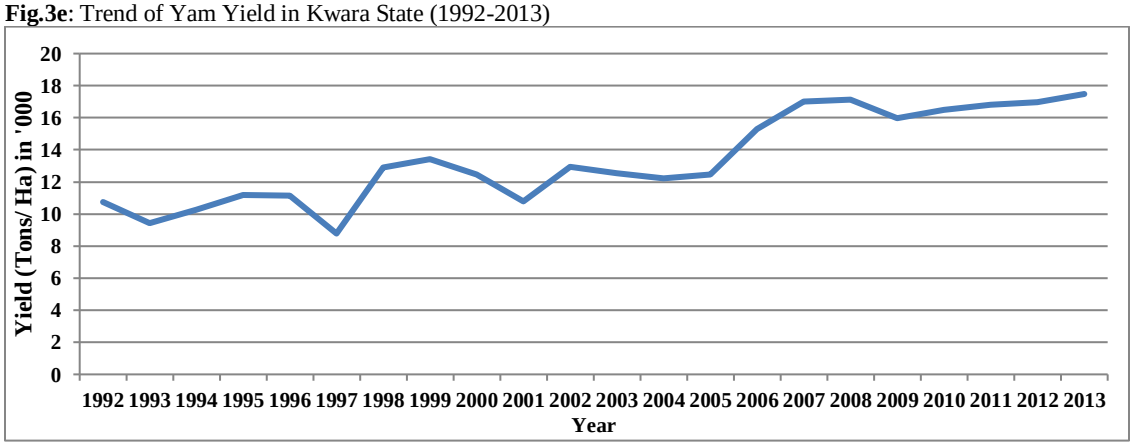

Fig. 3f: Trend of Cassava Yield in Kwara State (1992-2013)

CONCLUSION AND RECOMMENDATIONS

Aside from climatic variations, low yields occur because of technical constraints that prevent local food producers from increasing productivity or for economic reasons arising from market conditions. For example, farmers may not have access to the technical knowledge and skills required to increase production, the finances required to invest in higher production (e.g., irrigation, fertilizer, machinery, crop-protection products, and soil-conservation measures), or the crop varieties that maximize yields. After harvest, they may not be able to store the products or have access to the infrastructure to transport the produce to consumer markets. Farmers may also choose not to invest in improving agricultural productivity because the returns do not compare well with other uses of capital and labour. Trend analysis of agricultural productivity in Kwara State revealed that annual yield productivity of maize, sorghum, rice, millet, yam and cassava fluctuated around the long-term mean. In other words, the crop yields show both below and above the long term mean pattern. However, crop yields exhibit an increasing trend. The increasing trend could be as a result of the use of modern agricultural practices and input like the use of fertilizer and insecticides. However, an increase in food production is only half the battle. Solutions are also needed to address farmers' access to credit, surplus storage, and market distribution. Access to credit remains a big challenge for rural farmers as financial institutions are usually reluctant to finance smallholders' farmers due to the lack of collateral and the high risk related to agricultural production. Kwara State can significantly reduce the risks of food insecurity and improve its economy. Given that the state's economy is primarily based on the rural sector, which employs 86% of the labour force (National Population Census, 2006), productivity-led growth in the agricultural sector is the key to new employment opportunities, higher incomes, and a brighter future.

Therefore, the study recommends that both the state government and private organizations should encourage modern agricultural practices to sustain the increasing trend of crop yields in the State.

ETHICAL ISSUES

The authors have observed all ethical issues including double publication and/or submission, plagiarism, references, data fabrication and/falsification.

CONFLICT OF INTEREST

We confirm that this article is the original work of the authors and have no conflict of interest to declare.

AUTHORS' CONTRIBUTIONS

All authors participated fully in all stages of the research.

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