Trends of Staple Crops Yields in Nasarawa State, Nigeria

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Abstract:

The studies focused on getting the crop yield trends of Maize, yam and Rice which are staple crops in Nasarawa State. Crop yields data were collected from the archives of Nasarawa Agricultural Development Programme for the years 1998-2016. The yields were subjected to simple regression analysis in order to determine the trends of the yields. Results show that maize and yam are on the positive trend while rice yield is on the decrease all over the state. Urbanization is seen as one of the factors hampering high yield of rice while more effort should be intensify for both dry and wet farming in the state.

Keywords:

Crop Yields, Regression, Food Shortage

1. Introduction

Climate Change phenomenon which has every prospect of affecting farming practice and food availability all over the world, and with Africa proposed to be most hit. The need to view crops yields trend carefully with the aim of planning for the future and ensuring food security becomes very necessary

Meanwhile, Nigeria is one of the food-deficit countries in sub-Saharan Africa although it is arguably better in terms of production than the others. It has also not suffered any major catastrophe that could precipitate scourges of famine, mass hunger and therefore food crisis. This does not in any way prevent public policy makers from being conscious of avoiding the debilitating impact of food shortages in neighboring countries which has however made food security become a first order priority of the present Nigerian government [1].

Food availability has been a matter of concern to stakeholders and world leaders for a very long time. Inflation-adjusted prices for food have shown a downward trend over the last century as increases in supply have outpaced demand. More recently,

food prices have increased rapidly, and many observers have attributed this in part to weather episodes, such as the prolonged drought in Australia or the heat waves and wildfires in Russia. However, efforts to model the effects of climate on prices or food availability, even for individual countries, must consider effects throughout the world, given that agricultural commodities are traded worldwide and that world market prices are determined by global supply and demand [2]. The study also noted that 32-39% of maize, wheat, rice and soya beans yearly global changes were explained by climate variation. Several Other studies indicated also that yields may no longer be increasing in different regions of the world [3]. Although the need for higher yields is clear, the prospects for achieving them are less. There is increasing evidence of stagnation in crop yield potential as measured under the best possible growing conditions as observed by [4] the study further indicated that average crop yields in major cereal-producing countries have increased [3] projected crop yield in Africa may fall by 10-20% by 2050 due to climate change. [6] Used Erosion productivity impact calculator (EPIC) crop model to project crop yield in Nigeria in the 21st century. The study indicated increase in crop yield across all low land ecological zones as the climate change during the early part of 21st century. However the yield will decrease towards the end of the century.

Prior studies for individual countries and at the global scale also found that recent trends have depressed maize and wheat yields [4]. For example, a recent study of wheat yields in France suggests that climate is an important factor contributing to stagnation of yields since 1990 [3]. Similarly, warming trends in India have a well-understood negative effect on yields and are thought to explain part of the slowdown in recent yield gains [5, 7].

2. Study Area

Nasarawa State is located in the central part of Nigeria otherwise known as the middle belt. The state lies between Latitude 7^0 45^I and 9^0 25^1'N of the Equator and between Longitude 7^0 and 9^0 37'E of the Greenwich meridian as shown in figure 1.0. It has a total landmass of about 27, 137.8 km^2. Nasarawa State has a total of 13 Local Government Areas which are; Akwanga, Awe, Obi, Karu, Nasarawa, Nasarawa Eggon, Keffi, Wamba, Doma, Lafia, Kokona, Toto and Keana. The State Shares boundary with Kaduna State in the North, Plateau State in the East, Benue State in the East and Kogi State and FCT bounded the state in the West [8].

Soil formation in Nasarawa State is a product of the interaction of myriad factors such as rock, climate, organic matter, topography and time. The state is really endowed with rich fertile soils, from the loosed soil materials of alluvial deposit in most of the southern part of the state to the well-structured and developed oxisols and ferrisols in the northern part of the state and the undeveloped soils on hill slopes and entrenched river valleys such as Mada [9].

The major soil parent material in the state are derived from cretaceous sandstone, siltstone, shale, limestone and ironstone of the pre-Cambrian to Cambrian. Complex relationship exists between soil types and the forming process; this is because most part of the state has undergone series of climatic and vegetative shifts [9]. The predominant soil unit of Nasarawa State as observed by [9] belongs to the cartegory of oxisols or the tropical ferruginous soil. This soil is derived mainly from basement complex formation of the older sedimentary rocks. Lateric crust occurs in extensive areas on soils on the basement complex while hydromorphic soils are common along

the Benue trough and flood plains of major Rivers. A number of soil types have been identified in most parts of the state to include; ultisols, alfisols, entisols, inceptisols, ertisols and oxisols. The productivity of this soil is high especially for irrigation development. Soil erosion has depleted a lot of soil of their nutrient required for plant. Soil erosion in Nasarawa State is mostly caused by human activities in the form of deforestation, overgrazing, mining and incompatible agricultural methods [9].

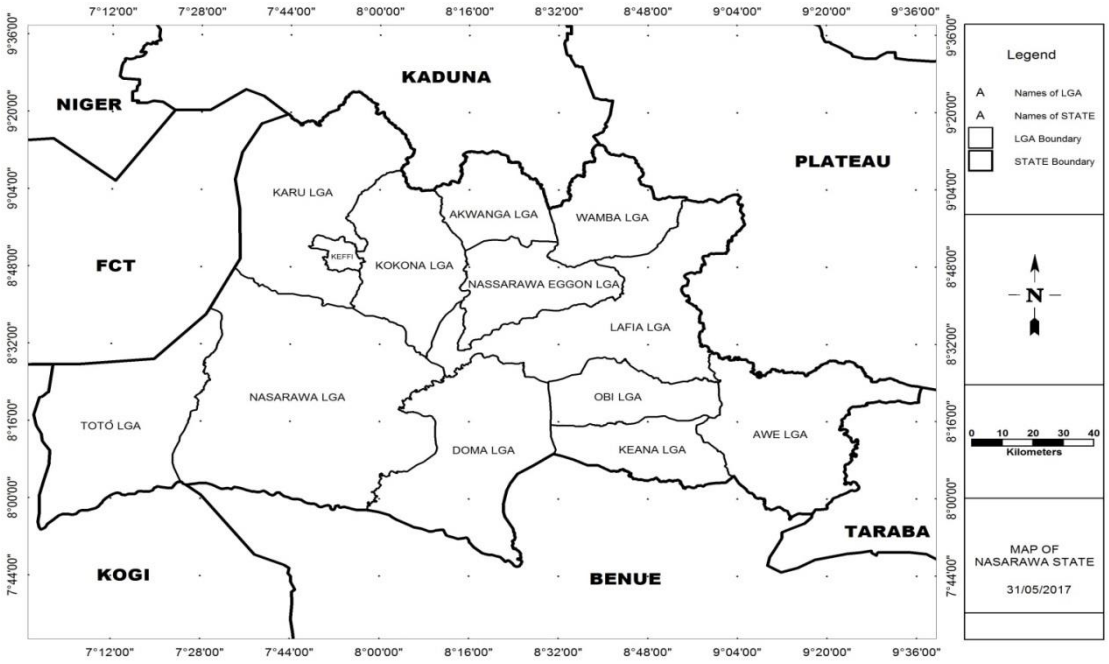

Figure 1. *Map of Nasrawa State, Nigeria.*

The vegetation of Nasarawa State lies within the guinea savanna, which is a derivative of the tropical deciduous forest that existed centuries ago [9]. The characteristics of the vegetation is that of southern guinea, that enjoy a rainy season that last for about 6 to 7 months (April-October) with peak in July. In the rainy season, the grasses and leaves are green and fresh, while in the dry season they die through withering or bush fire [9].

Three distinct vegetation types can be seen in the state according to [9] these are; Southern Guinea savannah, Northern Guinea Savanah and Gallery forest and forest reserve. The southern guinea savannah covers Local Government area like Doma, Awe, Lafia, keana, Toto, Wamba part of Akwanga, Nasarawa Eggon, and Obi L.G.As. This region is home to dense vegetation with trees of between 15m-20m and grasses up to 5 meters tall. The rainy season in this zone last for about 6 to 7 months (April-October) with the mean annual rainfall at about 1100mm and 2000mm.

The population of Nasarawa State according to the 2006 census report was 1,863,275 and has a population density of 130. The state has witnessed the influx of people in three forms; to Lafia the administrative headquarters of the state, to Keffi the Educational hub of the State and to Karu the commercial center of the state and the gateway to FCT. Nasarawa State is a cosmopolitan state, with diverse people from different backgrounds co-habiting peacefully. The main indigenes are: Koro (Migili), Eggon and Kambari, Gbagyi, Mada, Gwandarawa, Afo, Hausa, Nidre,etc

Agriculture is the main economic activity in Nasarawa State. Nasarawa State Agricultural Development Program [10] observes that farming in the state is

subsistence and generally rain fed cultivation of annual crops. Although there are many rivers in the state, the population engaged in irrigation farming is insignificant. Crops grown include grains such as rice, wheat, Soybeans, beans, maize and millet and tuber crops such as yam and cassava.

The bulk of crop production in Nasarawa State is undertaken by small scale farmers most of whose labour force, management and capital originate from the households [11]. Agriculture employs the larger percentage of the working population in the LGAs, but agricultural landholdings are generally small. The average number of farm plots per household ranges between 3 and 30 plots and between 0.4 and 4.0 ha [12]. There are three agricultural zones in the state according to [10].

3. Methodology

Crop yield data of Rice, Maize and Yam were collected from Nasarawa Agricultural Programme (NADP) for the period of 1998-2016. The yield is recorded in metric tons/hecter and it is the summation of all crop yields across the thirteen Local Government Area of the State, which was collected, recorded and stored by NADP.

Time series trend analysis model as shown in figure 2 and equation 1, was used to determine the trend line. The trend line will show the basic long term underlying pattern of crop yield series. The line will be generated by running a simple regression analysis, taking time as the independent variable for explaining the fluctuations in crop yield for the period under study. The equation is expressed as:

Figure 2. *Straight-line trend.*

The straight-line trend is represented by the equation (1): $Y_t = b_0 + (b_1 \times t)$

where Y_t are the trend values, a is the Y intercept or the value of Y when X = 0, b represents the slope of line or the amount by which Y variable will change if X is increased or decreased by one unit, and X variable is the time period.

4. Result and Discussion

The distribution of yields of the selected crops for this study across Nasarawa state is shown in table 1.

Table 1. *Crop yields in Nasarawa State.*

S/N	YEAR	YAM YIELD (MT)	RICE YIELD(MT)	MAIZE YIELD(MT)
1	1997	14.65	2.81	2.7
2	1998	13.5	2.03	2.23
3	1999	14.42	2.29	1.86
4	2000	13.3	2.35	2.03
5	2001	16.9	2.53	2.22
6	2002	14.52	2.15	1.83
7	2003	15.8	2.16	1.75
8	2004	16.23	2.5	1.75
9	2005	19.6	2.3	1.83
10	2006	21.69	2.38	3.59
11	2007	10.31	2.2	1.84
12	2008	20.21	2.21	2.04
13	2009	21.56	1.78	2.1
14	2010	21.69	2.74	2.15
15	2011	19.8	2.46	2.48
16	2012	20.46	2.03	2.57
17	2013	19.5	2.03	1.87
18	2014	19.43	1.97	2.36
19	2015	18.9	1.3	1.9

Source: (NADP, 2015)

The value is the aggregate of totals from the thirteen Local Government Area of Nasarawa State.

Figure 3-5 shows the trends of selected crop yields in Nasarawa State.

Figure 3 shows the trend in rice yield in the study area in the period under study. The linear regression shows a negative trend of Y= -0.00309x +2.5312. This shows that the yield in rice is declining over the years. The result concur with the findings of (13) which stated that in the 1990s, while rice output increased, the yield of rice declined.This may not be unconnected to the inter-annual rainfall variability because, rice is more drought prone than other crops grown in the area. [14] in his study of rainfall and water requirement of rice during growth period found out that water requirement of rice and the amount of rainfall indicated that the rainfall was insufficient in the final stage (September) of the rice growing period in the experimental year in the TU micro-catchment area. This period is very sensitive because important phenological events like flowering, spikelets formation, grain filling and ripening occur during this period. If these events are affected due to water shortage, rice production declines significantly.

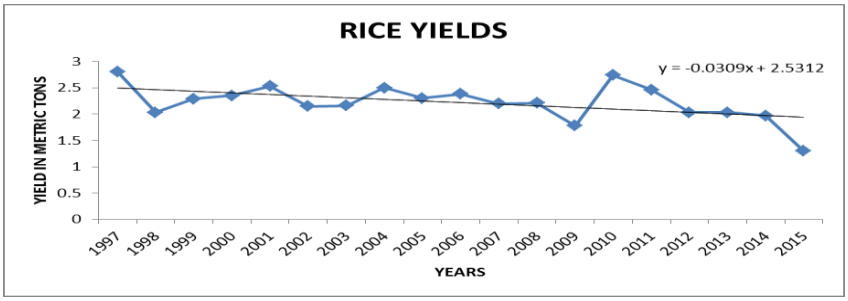

Figure 3. *Trends of rice in metric tons from 1997-2015.*

Rice cultivation is usually done in swampy areas close to river and with population explosion and urbanization more swampy areas that are supposed to be used for rice farming will be taking up for other activities, which will lead to inadequate land for rice cultivation and the possible cause of decline in rice yield in Nasarawa state. This is supported by the findings of [15] which noted that Rice is cultivated in virtually all the agro-ecological zones in Nigeria. Despite this, the area cultivated to rice still appears small; in 2000, out of about 25 million hectares of land cultivated to various food crops, only about 6.37% was cultivated to rice. High dependence on imported rice also lead to decline in rice yield as farmers will have no value to their product which will be competing with better and well-polished foreign rice, this will lead to lack of zeal in rice farming.

4.1. Trend in Maize Yield in Nasarawa State Between 1997-2015

Figure 4 shows a positive trend of maize yields over Nasarawa State. The trend of Y= 0.0024x+2.1391 implies that the yield of Maize is increasing in the study area from 1997-2015. This may be because of the suitability of almost all the agricultural zones in the state to maize production and the relatively short length of growing season for maize which might not be affected by the variability of rainfall. From time of planting to harvest it is about 90-120 days. This allows it to survive in area with irregular water supplies.

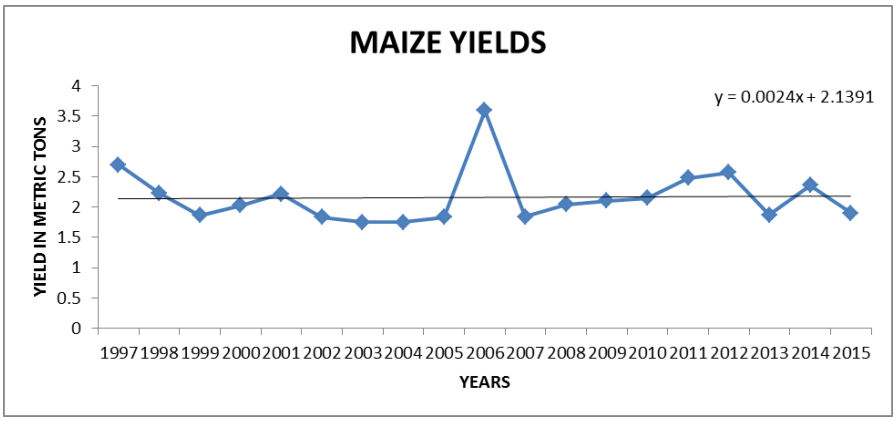

Figure 4. *Trends of Maize yields in metric tons from 1997-2015.*

This agrees with [13] which stated that Maize is high-yielding, easy to process, readily digested and costs less than other cereals, and it is also a versatile crop, allowing it to grow across a range of agro ecological zones The crop cycle is relatively shorter thus making it the first crop to harvest for food during the hunger period in Nigeria. Large arable and available land in almost all zones plus the relatively short cycle of growth is an additional motivation to more people to cultivate maize hence lead to high yield.

[16] Maize is a favorite raw material for animal feeds, many of the developed countries; more maize is used in animal feed production than for human consumption. This is another factor that is boosting the yield since a readily available market is there.

The presence of extension workers from N.A.D.P and the introduction of high yielding maize seed to farmers is a panacea for high maize yield in Nasarawa state. According to [17] Impacts of hybrid maize cultivation in Nigerian agriculture have been summarized as follows: 1) Productivity potential of maize varieties has been

improved. Several populations have been improved that now perform equally well with or better than the initial hybrids. 2) Total area under maize production has increased.

4.2. Trend in Yam Yield in Nasarawa State Between 1997-2015

Figure 5 indicates a positive trend line for yam yield in Nasarawa State. A linear regression of y=0.391x +13.58 means the yield of yam over the study area and period is increasing. The increase might be as a result of deliberate efforts by government to export yam from the state which makes it a good source of foreign income. In view of the crash in global oil prices and the present administration's efforts to diversify the economy, agriculture has been put in the front burner. The latest data from [18] shows that export earnings from agricultural goods are hefty. With the flagging off of yam exports by the Federal Government on agriculture export earnings will rise significantly.

[19] Noted that yields of yams are far from consistent, especially in Ghana and Nigeria partly due to the unattractiveness of farming and low prices of yams in the market. However, the majority of the rural population still engaged in farming activities because there are no other job opportunities for them apart from yam cultivation in these regions

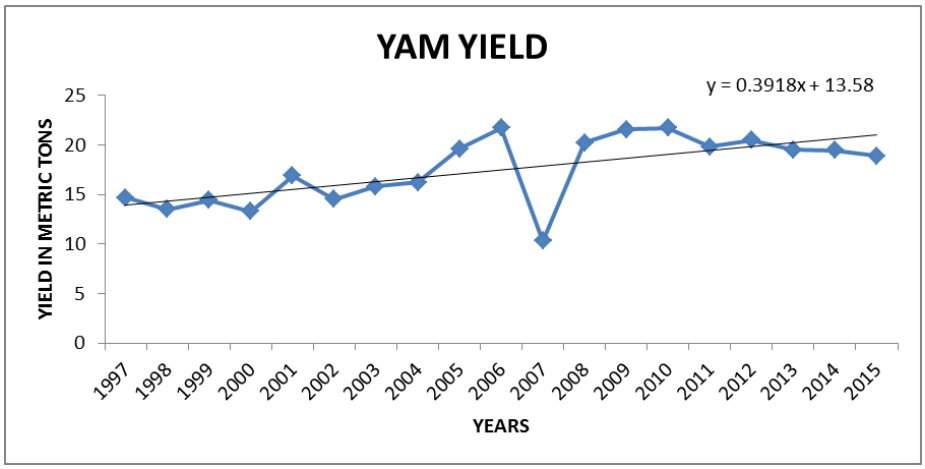

Figure 5. *Trends of Yam yields in metric tons from 1997-2015.*

The entire agriculture zone in the state support yam cultivation, this implies that there are more land for yam farming and hence the reason for the high yield across the state. Yam grows in areas of annual rainfall around 1200mm, the mean annual precipitation across Nasarawa state is above 1000mm this shows that yam farming is boosted with abundant rainfall, hence the increased in yield.

5. Conclusions

The studies found out that both maize and yam are increasing over time in Nasarawa State while rice is declining. Thus, there is a need to focus more on rice farming both dry and wet season in order to bridge the deficit gap. Urbanization is also found to be a factor militating against a bountiful yield of rice. Efforts should be made to reduce the takeover of fertile land that is suitable for rice cultivation by physical structures. Maize and yam farming should be giving more adequate attention seeing that they both are consistently having a high yield. This may help to fight hunger and poverty in the state.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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