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Long Run Analysis of the Carrying Capacity of Agricultural Land for Cereal Production under Population Pressure in Nigeria (1980-2015)

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Abstract— *This study examines the long run response of Agricultural land use indices to population growth in Nigeria. The study made use of 35 year time series data collected from Central Bank of Nigeria (CBN) annual reports, FAOSTAT and World Bank Statistical reports (1980-2015). Collected data were analysed using descriptive and inferential statistical tools. The result shows that agricultural land productivity in terms of cereal (rice, sorghum, millet & maize) yield exhibited a negative and significant response to population growth rate. Agricultural land use intensity showed a positive and significant response to population growth ratein Nigeria. Agricultural value added to GDP demonstrated a negative and significant response to population growth rate. Population growth and cereal yield yearly forecasts were 8.9% and 7.5% respectively.The study provided sufficient empirical evidence on relatively weak capacity of agricultural land to cereal productivity under population pressure and the need for policy on land enhancement technologies in Nigeria.*

Keywords— Long Run, Agricultural Land, Use Indices, Population Growth, Nigeria.

I. INTRODUCTION

The Nigerian Agricultural Sector is characterised by small scale farmers. In Nigeria nearly 80 percent of the total population has been said to be rural inhabitants with agriculture providing employment and source of livelihood for about 75% - 80% of this population (World Bank, 1994). Land tenure issues remain unresolved especially in the face of the continually increasing human population. To feed this population, more food will be needed and this has to come largely from land productivity. The use of land and the resourcestherein is one of the challenges facing mankind today. It has been postulated thatThird World War will be fought overland resources. (Farming Matters, 2010). Furthermore, increasing competition over diminishing non-renewable land resources are on the increase; a situation that has been aggravated by environmental degradation, population growth and climate change.

Therefore, the task of producing adequate quantity and quality of food and fibre requirements of Nigerian population, posses enormous challenge to the agricultural sector of the economy. It has been estimated that nearly 17percent of the Nigerian population is basically food insecure, a portion that translates to about 15.1 million Nigerians (National Production Centre, 1997). The inadequacy in agricultural production may be traced to population growth, land tenure system, urban encroachment,use of crude implements and farmers illiteracy.

Constraints to cultivate marginal lands using inappropriate technologies and low quality input contributes a great extent to environmental degradation, reduced productive capacity of the land and power yield (Magnus, 2008).

Nigeria has the responsibility to supply food for her teaming population and that of other nations that depend on Nigeria's agricultural inputs. Previous public opinion and policy makers based their assumptions and actions on mere intuitions without empirical bases. Such policies and actions are faulty at best, leading to faulty agricultural policy outcomes in Nigeria. The present study is empirical in nature that analyses the contributory relationship connecting land use indices and population growth. The essence is principally to evaluate the carrying capacity of agricultural land to meet aggregate food demand in Nigeria. This is the missing gap on which the spur for the study was based. The present study is an attempt to revisit Rev. Thomas Malthus Theory on population growth and food supply as applied to Nigeria situation.

Land is the most important natural resource that affects every aspect of human's lives; their food, clothing and shelter. No nation, city or rural community can exist without land and it is the single most valuable asset in a country's agriculture. It is the basic resource which supports the production of al agricultural commodities including

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livestock which also depends on land to produce forage and grains they consume (Adegeye and Dittoh, 1985).It is against this background that the research was conducted to address the following questions:

The broad objective of the study was to examine the long run response of Agricultural land use indices to population growth. The specific objectives of the study were to:

i. examine the yearly trends of population growth rate in Nigeria over the period (1980 to 2015).
ii. examine the yearly trends of food production in Nigeria over the period (1980-2015).
iii. examine the relationship between the growth in population and agricultural land use intensity.
iv. evaluate the effect of population growth on Agricultural Value Added to Gross Domestic Product(GDP) in Nigeria (1980-2015).
v. analyse the relationship between population growth rate and the carrying capacity of Agricultural land in terms of poductivity in cereal yield (food supply).
vi. to develop a model for long-run forecast of cereal productivity in Nigeria.

II. METHODOLOGY

The study was carried out in Nigeria. This location was chosen for the study because Nigeria is often referred to as the "Giant of Africa", due to its large population and economy depending With approximately 186 million inhabitants, Nigeria is the most populous country in Africa and the seventh most populous country in the world(FAOSTAT 2016).

The study was based on time series data collected from Central Bank of Nigeria (CBN) annual reports, FAOSTAT and World Bank Statistical data for 35 years (1980-2015). Data obtained includes Agricultural Land Indices and Population growth in Nigeria (1980-2015). The carrying capacity of agricultural land was captured by information on agricultural land indices such as land use intensity, agricultural value added to GDP, productivity of agricultural land with respect to food crops, cereal.

2.1 Unit root test

Autoregressive integrated moving average (ARIMA) test was used for the problem of non-stationarity or unit root in the data. ARIMA models are best fitted to time series either to better understand the data or to predict future points in the series. They are applied in some cases where data show evidence of non-stationarity, where an initial differencing step (corresponding to the ‘’integrated’’ part of the model) can be applied to reduce the non-stationarity. The regression equation to test for stationarity according to Gujarati (2004), is expressed as given below:

$$\Delta \ln PG = \alpha_0 + \sum_{t-1}^{p} \alpha_1 \Delta \ln AGL_{t-1} + \sum_{t-1}^{p} \alpha_2 \Delta \ln AVGDP_{t-1} + \sum_{t-1}^{p} \alpha_3 \Delta \ln PRDN_{t-1} + \beta_1 \ln AGL_{t-1} + \beta_2 \ln AVGDP_{t-1} + \beta_3 \ln PRDN_{t-1} + U_t \quad \ldots\ldots\ldots\ldots 1$$

The presence of unit root problem or non-stationarity was accessed through hypothesis as follows:

H_0: $\alpha_1 = \alpha_2 = \alpha_3 = 0$ (the time series PG is non-stationary or has a unit root)

H_a: $\alpha_1 < 0$, $\alpha_2 < 0$, $\alpha_3 < 0$ (the time series PG is stationary or has no unit root)

Where:

α_0= constant term, U_t =white noise, α_1- α_3 = coefficients of the first difference variables

β_1- β_3 = coefficients of the explanatory variables, p = lag length, PG = Population growth, AGL = Agric land 1000 (Ha), AVGDP = Agriculture, value added (% of GDP), PRDN = Production (metric tones) Cereals

Augmented Dickey-Fuller (ADF) tests was carried out to test the regression results to show the existence of unit roots as expressed In the hypothesis above.

2.2 Test for co-integration

Johansen maximum likelihood test of co-integration by simple differences is performed to determine the existence of long-run relationship among variables. Gujarati (2004) explained that co-integration test is carried out to determine long-run, or equilibrium relationship between two variables. The Johansen procedure test for co-integration identifies the number of stationary variables among variables. This is to ensure that the regression of the variables will be meaningful and non-spurious. If the Max-Eigen statistics is greater than the 5% critical value, the null hypothesis of no co-integration will be rejected in favour of the alternative hypothesis at that level. Thus, this will show that there is a long-run equilibrium relationship between population growth response and the independent variables, this is shown below:

$$\Delta \ln PG_t = \alpha_0 + \beta_1 \ln AGL_{t-1} + \beta_2 \ln AVGDP_{t-1} + \beta_3 \ln PRDN_{t-1} + U_t \quad \ldots\ldots\ldots\ldots 2$$

2.3 Model specification

The regression model is as specified below

PG=f(T)…………………………………………...…4

CEREALPRDN= f(T)……………….………………5

AGL= f(PG,T)……………………………………….6

AVGDP= f(PG,T)……………………………………7

CEREALPROD = f(PG,T)…………………………..8

The regression model can further be specified linear form as follow

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$PG = b_0 + b_1T_t + U$………………………...………9

$CEREALPROD = b_0 + b_1T + U$……………………10

$AVGDP = b_0 + b_1PG + b_2T + U$………………..…11

$AGL = b_0 + b_1PG + b_2T + U$…………………..…12

$CEREALPROD = b_0 + b_1PG + b_2T + U$………....13

Where:

f= functional form

PG = Population growth

AGL = Agric land 1000 (Ha)

AVGDP = Agriculture, value added (% of GDP)

CEREALPROD = Production (tonnes)

T= Time (years)

b_0 = constant

b_1, b_2, b_3 = coefficients

U = error term

III. RESULTS AND DISCUSSION

Table1 shows the result of the Augmented Dickey Fuller (ADF) test. The result showed that the variables are non-stationary in their levels. The variables only became stationary after first difference. This is confirmed by the ADF-test statistics in Table 1.

Table.1: Result of ADF Unit Root Test

Variables	Level Data	First difference	1% critical level	5% critical level	10% critical level	Level of integration
Population	0.973644	3.334280	-3.661661	-2.960411	2.619160	I(1)
Productivity in cereal	-5.686051	-9.779805	-3.639407	-2.951125	2.614300	I(1)
Agric value added to GDP	-2.408219	-6.134158	-3.646342	-2.954021	-2.615817	I(1)
Agric land use intensity	-1.347526	-5.317980	-3.639407	-2.951225	-2.614300	I(1)

* Significance at 1%

Source: field survey, 2016

Table.2: Result of Johansen Co-integration test (Trace statistic) Series population growth rate, productivity in cereal, agric value added to GDP and agricultural land use intensity.

Hypothesized No. of CE(s)	Eigenvalue	**Trace** Statistic	**0.05** Critical Value	Prob.**
None *	0.813433	99.75424	47.85613	0.0000
At most 1 *	0.505374	42.66943	29.79707	0.0010
At most 2 *	0.318107	18.73499	15.49471	0.0157
At most 3 *	0.154770	5.716992	3.841466	0.0168

Trace test indicates 4 co-integrating equation(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

Source: E-Views Estimation by author 2016

The result in table 2 shows that the trace statistic indicates one co-integrating equation at 5% significance level. Therefore the trace statistics accepted at least one of the alterative hypotheses it can be concluded that a long run relationship exist between the population growth rate, productivity in cereal, agric value added to GDP and agricultural land use intensity.

3.1 Trend of time response of population growth in Nigeria (1980-2015)

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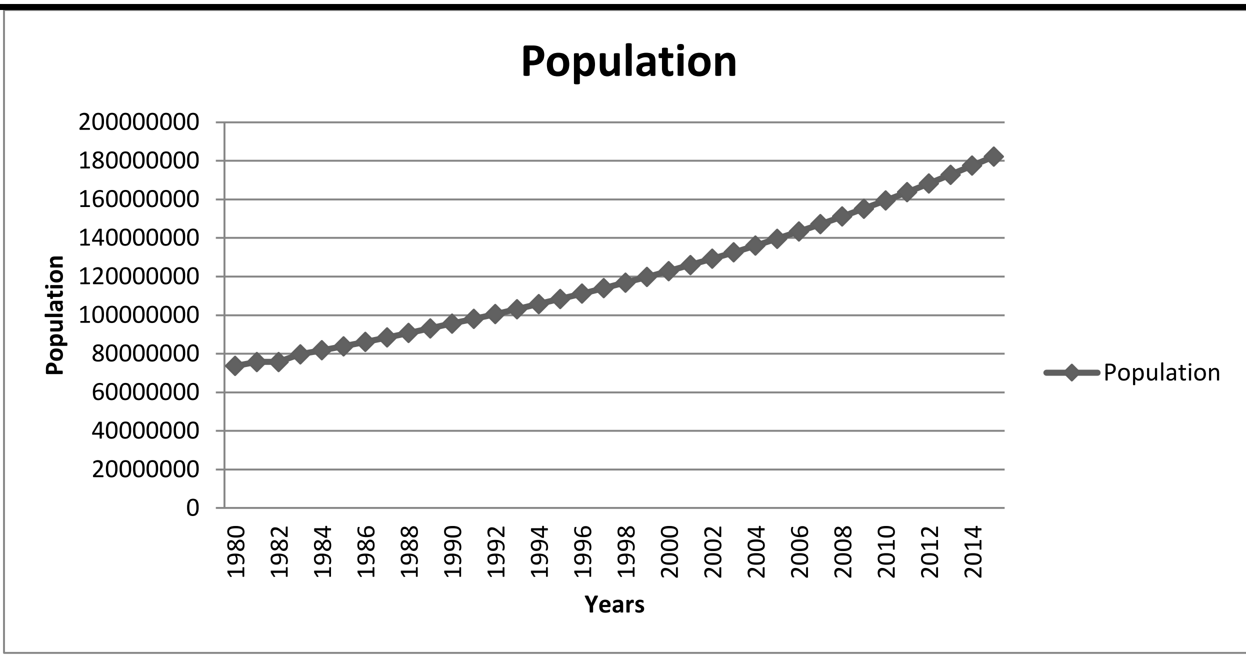

Fig.1: Population growth trend in Nigeria from 1980 to 2015

The figure 1 shows the trend in population growth in Nigeria from 1980 to 2015. The result indicates that there is an increase in the trend of population growth. Population growth steadily rises from 1980 to 2015 (73,698,096 to 182,201,962 persons).

Table 3 presents the result of the time response of population growth in Nigeria (1980-2015). The result reveals that the R^2 of 0.741 (74%) explains that the extent to which time predicts population is 74%. The adjusted R^2 of 0.733 shows that 73% of the variance in population growth was accounted for by the impact of time for the period under review. Table 4.3 showed that there was a positivesignificant relationship betweentime and population growth (0.861) (F(1,34) = 94.340:P<0.01). The null hypothesis is therefore rejected and the alternative holds true. Therefore there is a significant relationship between time and population growth in Nigeria. The Beta weights as seen in Table 4.3 showed that time(B = 0.861: P<0.01) is a positive predictor of population growth and hence contributes to it. The positive value of the Beta coefficient indicates that increase in time will lead to an increase in population.

The implication of the result in Table 3 is that a 1% increase in time will increase in population less proportionate by 0.861%. This result is an indication that increase in time in Nigeria exerts positive pressure on population. This finding coroborates the earlier findings of Hummel *et al*., (2009), who stated that human population has a positive correlation with time.

PGR = 1604543.192 + 83087.070Tim + ei………………………………..14

(9.088) (9.713) ***

The time response of population model is shown in equation 14. The time response growth model indicates that a unit change in year corresponds with a 1% change in population growth rate. Solving the equation where Tim = 1year, population growth rate = 1604543.192 + 83087.070(1) = 1604544.192. Since the coefficient is significant at (p < 0.01), it shows that the 1,604,544 yearly increase in population growth rate is significant and hence population growth is established within the period under review.

Table.3: Time response of population growth in Nigeria (1980-2015)

Model summary						
Model	**R**	**R^2**	**Adjusted R^2**	**SEE**		**Durbin-Watson**
Linear	0.861	0.741	0.733	511115.143		2.783
ANOVA						
Linear	**SS**	**Df**	**MS**	**F**	**P**	

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Regression	2.465E+13	1	2.465E+13	94.340	0.000
Residual	8.621E+12	33	2.612E+11		
Total	3.327E+13	34			
Variables in the equation					
Linear	**Unstandardized coefficient**		**Standardized coefficient**		
	B	**Std Error**	**Beta**	**t-Ratio**	**P**
(constant)	1604543.192	176558.829		9.088	0.000
Time	83087.070***	8554.303	0.861	9.713	0.000

Dependent variable: population growth
Independent variable: time
***significant at 1%

3.2 Trend of time response of food productionin Nigeria (1980-2015)

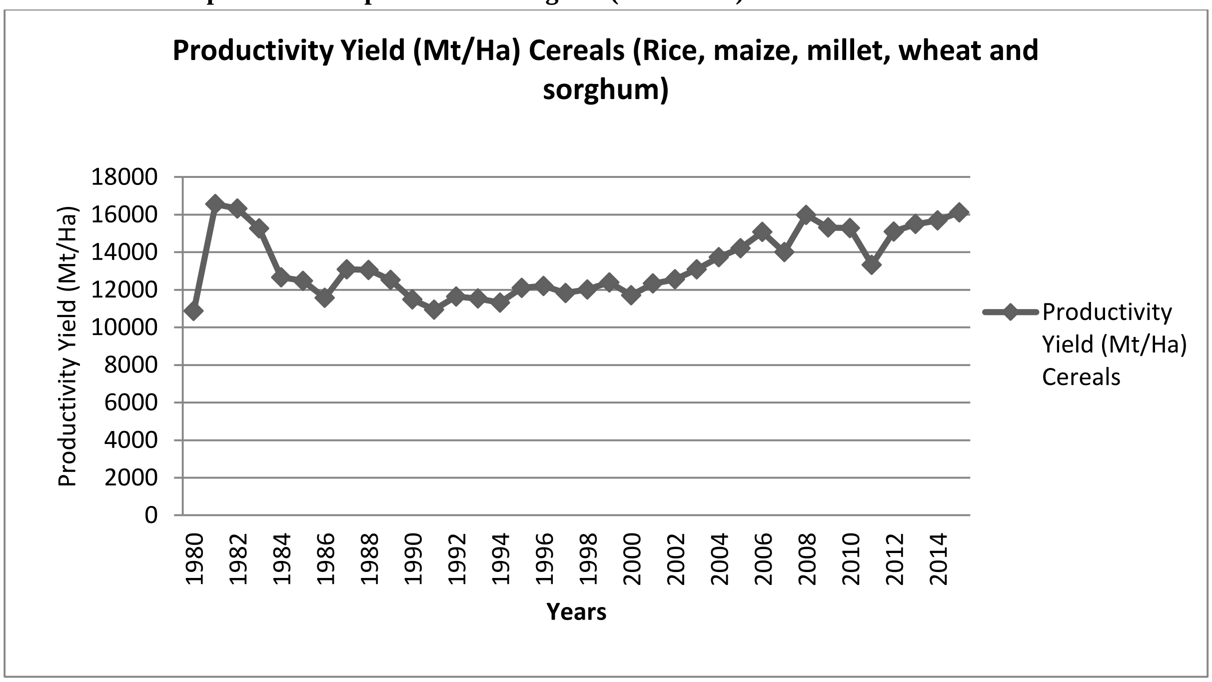

Fig.2: Productivity yield in cereal trend in Nigeria from 1980 to 2015

The Productivity yield in cereal rises steadily from 1980 and sharply dropped in the year 1983 and thereafter, recorded an undulating flow that shows a rise and fall between 1986 and 2000. Then experience a drop in the year 2007 and immediately rise in 2008 and a fall reoccurred in the year 2012. It revealed that productivity yield in cereal continued to rise after the year 2013.

Table 4 presents the result of the time response of food productionin Nigeria (1980-2015). The result shows that the R^2 of 0.481 (48%) signifies that the extent to which time predicts cereal production output is 48%. The adjusted R^2 of 0.33 shows that 33% of the variance in percentage change in cereal production was accounted for by the impact of time for the period under review. Table 4 showed that there was a positivesignificant relationship betweentime and cereal production output (0.011) ($F(1,33) = 3.757$:$P<0.05$). The null hypothesis is therefore rejected and the alternative holds true. Therefore there is a significant relationship between time and cereal production output in Nigeria. The Beta weights as seen in Table 4 showed that time(B = 0.011: P<0.05) is a positive predictor of cereal production and hence contributes to it. The positive value of the Beta coefficient indicates that increase in time will lead to an increase in cereal production.

The implication of the result in Table 4 is that a 1% increase in time will increase in cereal production by 0.48 This result is an indication that increase in time in Nigeria exerts positivegrowth on cereal production output.

CEREAL PROD = 12.493 + 0.140Tim + ei……………………………….15

(0.265) (0.061)**

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The time response of cereal production model is shown in equation 15. The time response model indicates that a unit change in year corresponds with a 1% cereal production. Solving the equation where Tim = 1year, productivity yield in cereal = 12.493 + 0.140(1) = 13.493Mt/Ha. Since the coefficient is significant at ($p < 0.05$), it shows that the 13.493Mt/Ha yearly increase in cereal production is significant and hence percentage change in cereal production is established within the period under review.

3.3 Long run forecast of time on food production

Solving the equation where Tim = 10years, productivity yield in cereal = 12.493 + 0.140(10) = 22.493Mt/Ha. Since the coefficient is significant at ($p < 0.05$), it shows that the 22.493Mt/Ha in cereal production is significant and hence cereal production is established within the period under review.

Table.4: Time Response of Food Production (Cereal Yield (Mt/Ha)) In Nigeria (1980-2015)

Model summary						
Model	**R**	**R^2**	**Adjusted R^2**	**SEE**		**Durbin-Watson**
Linear	0.617	0.481	0.333	136.22623		1.650
ANOVA						
Linear	**SS**	**Df**	**MS**	**F**	**P**	
Regression	69720.250	1	69720.250	3.757	0.0065	
Residual	61240.367	33	18557.587			
Total	130960.617	34				
Variables in the equation						
Linear	**Unstandardized coefficient**		**Standardized coefficient**			
	B	**Std Error**	**Beta**	**t-Ratio**	**P**	
(constant)	12.493	47.058		0.265	0.000	
Time	0.140**	2.280	0.011	0.061	0.036	

Dependent variable: productivity yield in cereal (Mt/Ha)
Independent variable: time
**significant at 5%

Trend of time response of Agricultural land use intensity in Nigeria (1980-2015)

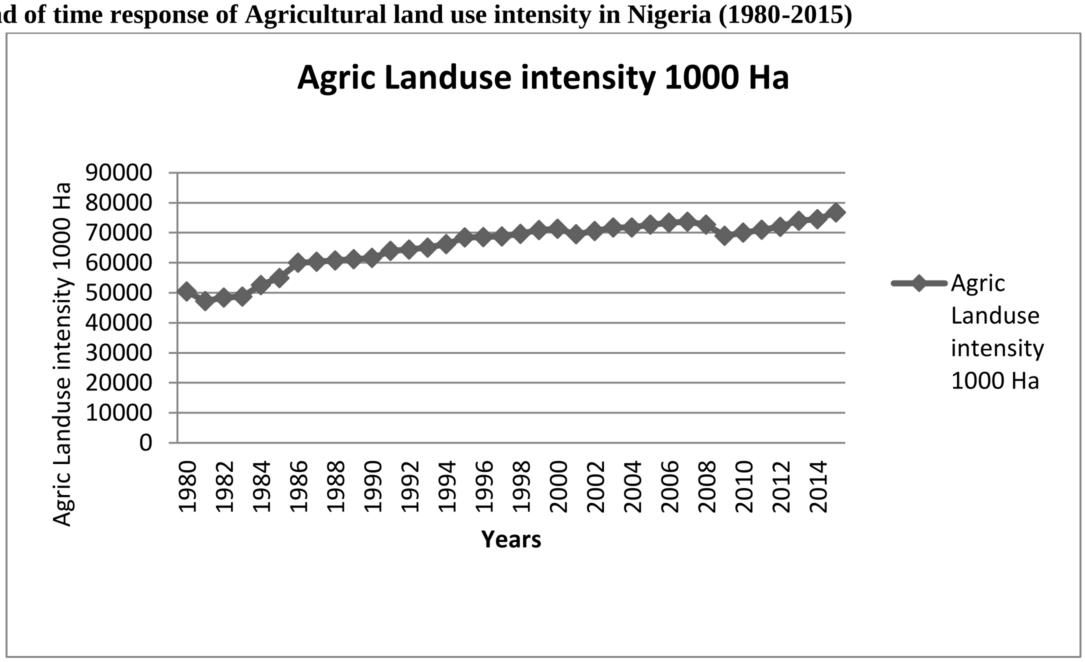

Fig.3: Agricultural land use intensity

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The Agricultural land use intensity falls in 1981 and steadily rises from 1982 to 2000. A fall was observed in 2001 but thereafter it continued to rise again from 2002 and fell again in 2009. From 2010 a steady but gentle increase in Agricultural land use intensity was experienced till 2014.

Table 5 presents the result on the relationship between population growth rate, time and Agricultural Land Use Intensity. The result indicates that the R^2 of 0.314 (31%) shows the extent to which population growth and time predict agricultural land use intensity in Nigeria is 31%. The adjusted R^2 of 0.235 shows that 24% of the variance in land use intensity was accounted for by the impact of population growth and time for the period under review. Table 4 showed that there was a positive significant relationship between population growth and time on land use intensity (0.147) ($F(2,32)$ 3.814:$P<0.1$) and (0.037) ($F(2,32)$ 3.814:$P<0.05$). The null hypothesis is therefore rejected and the alternative holds true. Therefore there is a significant relationship between population growth and land use intensity in Nigeria. The Beta weights as seen in Table 5 showed that population growth rate ($B = 0.147$: $P<0.1$) is a positive predictor of land use intensity and hence contributes to it. Also time ($B = 0.037$: $P<0.05$) is a positive predictor of land use intensity and hence contributes to it. The positive value of the Beta coefficient indicates that increase in population growth rate and time will lead to an increase in land use intensity.

The implication of the result in Table 5 is that a 1% increase in population growth and time will increase land use intensity more proportionate by 0.31%. This result is an indication that increase in the total number of people and time in Nigeria exerts positive pressure on land use intensity. This finding coroborates the earlier finding of Soumya, (2010) who revealed that increase in population is associated with increased land utilization for agricultural purposes.

AGLUI = 1497.086 + 0.0145 Pop + 5.802 Tim + ei……………………………….16

(1.643) (0.856) * (0.107)**

The time response of percentage change in Land use intensity model is shown in equation 16. The time response model indicates that a unit change population growth rate and in year corresponds with a 1% change in Land use intensity. Solving the equation where Pop =1 and Tim = 1year, Land use intensity = 1497.086 + 0.0145(1) + 5.802(1) = 1502.9Ha. Since the coefficients are significant at ($p < 0.1$) and ($p <0.05$), it shows that the 1502.9Ha yearly increase in Land use intensity is significant and hence percentage change in Land use intensity is established within the period under review.

Model summary						
Model	**R**	**R^2**	**Adjusted R^2**	**SEE**		**Durbin-Watson**
Linear	0.473	0.314	0.235	125.2587		1.445
ANOVA						
Linear	**SS**	**Df**	**MS**	**F**	**P**	
Regression	19.187	2	9.594	3.814	0.068	
Residual	82.98	32	2.515			
Total	102.167	34				
Variables in the equation						
Linear	**Unstandardized coefficient**		**Standardized coefficient**			
	B	**Std Error**	**Beta**	**t-Ratio**	**P**	
(constant)	1497.086	911.014		1.643	0.000	
Population growth	0.0145*	0.000458	0.147	0.856	0.075	
Time	5.802**	53.972	0.037	0.107	0.015	

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3.5 Trend of time response of Agricultural value added to GDP in Nigeria (1980-2015)

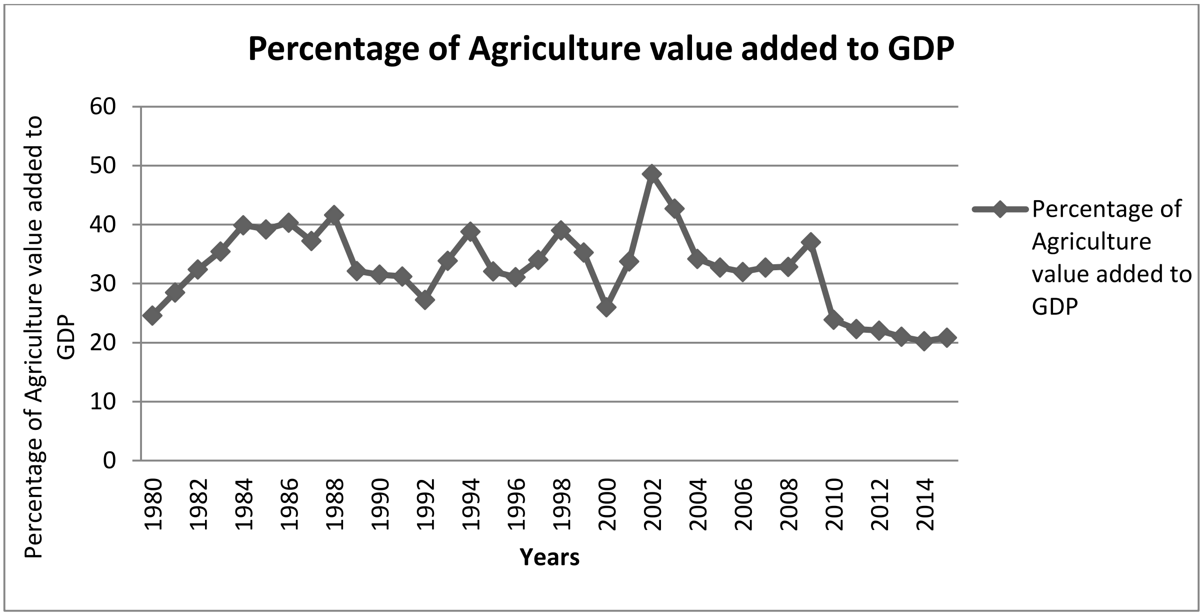

Fig.4: Agricultural value added to GDP

The agricultural value added to GDP rises steadily from 1980 and slightly dropped in the year 1985 and thereafter, recorded an undulating flow that shows a rise and fall between 1986 and 1998. Then experience a drop in the year 2000 and immediately rose to a peak 2002 and a fall reoccurred in the year 2010. The result further showed that between 2010 and 2014 a steady fall of agricultural value added to GDP was experienced.

Table.6 presents the result on the relationship between population growth rate, timeandagricultural value added to GDP. The result shows that the R^2 of 0.280 (28%) indicates the extent to which population growth rate and time predict agricultural value added to GDP is 28%. The adjusted R^2 of 0.089 shows that 8% of the variance in agricultural value added to GDP was accounted for by the impact of population growth rate and time for the period under review. Table 6 showed that there was a negative and significant relationship betweenpopulation growth rate and agricultural value added to GDP (-0.166) ($F(2,32) = 0.559$:$P<0.1$). The null hypothesis is therefore rejected and the alternative holds true. Therefore there is a significant relationship between population growth rate and agricultural value added to GDP in Nigeria. The Beta weights as seen in Table 6 showed that population growth rate (B = -0.166: P<0.1) and time (B = -0.154: P<0.1) are negative predictors of agricultural value added to GDP and hence contributes to it. The negative value of the Beta coefficient indicates that increase in population growth rate and time will lead to a decrease in agricultural value added to GDP.

The implication of the result in Table 6 is that a 1% increase in population growth will decrease agricultural value added to GDP less proportionate by 0.28%. This result is an indication that increase in the total number of people in Nigeria exerts negative pressure on agricultural value added to GDP. This finding coroborates the earlier findings of Gollin, (2010) and Diao*et al.*, (2010) who stated that the agricultural sector accounts for a large share of the workforce. This therefore accounts for roughly 25% of the value added in the economy growth in agricultural productivity and causes significant aggregate effects and will therefore also influence the general economic growth within a country.

AGDP = 2.756 -0.00000009235Pop – 0.083 Tim + ei……………………………….17

(0.888) (-0.967)* (-0.452)

The time response of percentage change in agricultural value added to GDP model is shown in equation 17. The time response model indicates that a unit change in population growth rate and year corresponds with a 1% change in agricultural value added to GDP. Solving the equation where Pop = 1 and Tim = 1year, agricultural value added to GDP = 2.756 -0.00000009235(1) – 0.083(1) = 2.67%. Since the coefficient is significant at (p < 0.1), it shows that the 267% yearly increase in agricultural value added to GDP is significant and hence percentage change in agricultural value added to GDP is established within the period under review.

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Table.6: Impact of Population Growth and Time on Agric Value Added to GDP

Model summary						
Model	**R**	**R^2**	**Adjusted R^2**	**SEE**		**Durbin-Watson**
Linear	0.466	0.280	0.089	5.506		2.092
ANOVA						
Linear	**SS**	**Df**	**MS**	**F**	**P**	
Regression	34.712	2	17.356	0.559	0.058	
Residual	993.912	32	31.060			
Total	1028.623	34				
Variables in the equation						
Linear	**Unstandardized coefficient**		**Standardized coefficient**			
	B	**Std Error**	**Beta**	**t-Ratio**	**P**	
(constant)	2.756	3.102		0.888	0.000	
Population growth	-9.235E-7*	0.000	-0.166	-0.967	0.069	
Time	-0.083	0.183	-0.154	-0.452	0.654	

Dependent variable: agric value added to GDP
Independent variable: time, population growth
*significant at 10%

Table 7 presents the result on the relationship between population growth rate and time with carrying capacity of Agricultural Land in terms of productivity in cereal yield. The result reveals that the R^2 of 0.265 (27%) shows the extent to which population growth rate predicts productivity in cereal is 27%. The adjusted R^2 of 0.124 shows that 12% of the variance in productivity of cereals was accounted for by the impact of population growth rate and time for the period under review. Table 7 showed that there was a negative and positive significant relationship betweenpopulation growth rate and time with productivity in cereal (-0.000) ($F(2,32) = 1.470$:$P<0.05$) and (0.043) ($F(2,32) = 1.470$:$P<0.05$). The null hypothesis is therefore rejected and the alternative holds true. Therefore there is a significant relationship between population growth and productivity of cereals in Nigeria. The Beta weights as seen in Table 7 showed that population growth rate (B = -0.000: $P<0.05$) and time (B = 0.043: $P<0.05$) are negative and positive predictors of productivity in cereals and hence contribute to it.

The negative value of the Beta coefficient indicates that increase in population growth rate will lead to a decrease in productivity in cereal yield.The implication of the result in Table 7 is that a 1% increase in population growth will reduce the productivity in cereal yield less proportionate by 0.27%. This result is an indication that increase in the total number of people in Nigeria exerts negative pressure on available agricultural land for cereals production in two ways such as reduced farm size per farmer, reduction in fallow period and continous cultivation. These have the tendency to reduce the fertility and productivity of agricultural land over time. Hence the carrying capacity of agricultural land decrease with increasing population. This is in consonance with that ofOduwole (2011) who reported that in a developed country like USA, population growth could be favourable but in a developing country like Nigeria it may be dangerous because in a developed country, increase in population adds to the labour force which in turn leads to increase in aggregate food crop supply and further boost economic growth while in a developing country which is characterised by unemployment, high forest exploitation, increase in population could widen the gap in aggregate of food supply.

CEREAL = 15.205 – 0.000000006342Pop + 0.560 Tim + ei……………………………….18
(0.198) (-0.003) ** (0.123)**

The time response of productivity in cereal model is shown in equation 18. The time response model indicates that a unit change in population growth and year corresponds with a 1% change in productivity in cereal. Solving the equation where Pop = 1 and Tim = 1year, productivity in cereal = 15.205 – 0.000000006342(1) + 0.560(1) = 15.76Mt/Ha.

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Table.7: Impact of Population Growth and Time on Agric Land Productivity in Cereal Yield

Model summary						
Model	**R**	**R^2**	**Adjusted R^2**	**SEE**		**Durbin-Watson**
Linear	0.356	0.265	0.124	136.23397		1.650
ANOVA						
Linear	**SS**	**Df**	**MS**	**F**	**P**	
Regression	5625.134	2	2812.567	1.470	0.028	
Residual	61242.954	32	1913.842			
Total	66868.088	34				
Variables in the equation						
Linear	**Unstandardized coefficient**		**Standardized coefficient**			
	B	**Std Error**	**Beta**	**t-Ratio**	**P**	
(constant)	15.205	76.761		0.198	0.044	
Population growth	-6.342E-8*	0.000	0.000	-0.003	0.038	
Time	0.560**	4.547	0.043	0.123	0.017	

Dependent variable: productivity yield in cereal (Mt/Ha)
Independent variable: time, population growth
**significant at 5%, *significant at 10%

IV. CONCLUSION AND RECOMMENDATIONS

Agricultural land use indices responded to population growthon different scale. The result revealed that Agricultural land productivity in terms of cereal yield had a negative and significant effect on population growth rate and a positive significant effect on time in Nigeria. Agricultural land use intensity had a positive and significant effect on population growth rate and time in Nigeria for the period, indicating that population growth exerts pressure on land use intensity. Agricultural value added to GDP decreased with population growth over time. Therefore population growth will lead to land degradation due to continuous cropping without rules governing its access, when production is mainly subsistence and when the soil is fragile and rainfall light.

Based on the findings, the following recommendations were made to improve the Long run response of Agricultural land use indices to population growth in Nigeria.

1. Government should formulate policy on land use enhancement.
2. Agricultural intensification through provision of modern input should also be adopted so as to reduce population growth on marginal agricultural land.
3. The interaction between carrying capacity of agricultural land use and population dynamics which is complex in nature demands corresponding regulatory measures that can guarantee a roburst linkages in the long run.
4. Government should be able to allocate resources equally to all areas of agricultural sectors to improve in yield to avoid food shortage and the patterns of commercial agricultural expansion should be looked into.

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