The Effects of Population Growth on Deforestation in Nigeria: 1991 – 2016

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ABSTRACT: This study examines the effects of population growth on deforestation in Nigeria between 1991 and 2016. Anthropogenic factors especially population growth were identified to be the major forces responsible for deforestation in Nigeria. The Augmented Dickey Fuller (ADF) test was used to establish stationarity among the variables and the Johansen cointegration test was used to establish a long run relationship between population growth and deforestation in Nigeria. Population growth was found to have a negative effect on the available forest cover in Nigeria. The study therefore recommends the development of rural areas, enactment of policies aimed at reducing population growth and sensitization to protect the available forest resources in Nigeria.

Forests form an important part of any country due to their ecological and economic roles. Ogundele, *et al.* (2016) mention that Nigeria is naturally endowed with a vast expanse of forest land, with swamp forests in the extreme Southern part of the country, the tropical rainforest in the South – Western part and the wooded savannah in the middle belt. Mfon, *et al.* (2014) mention that Nigerians have always depended on the forest for their survival, economic development as well as their environmental sustenance. Forest resources are often used as sources of fuel which is used for cooking, food as various animals and herbal products are found in forests. Forest resources are also used for housing and furniture as wood gotten for urban development is found in forests. Forests are usually located in rural areas and as such rural dwellers often depend on forest resources for their survival. In agriculture, forests are used to prevent erosion and ensure sustainable land use in Nigeria. Forests through the forestry sector provide a value chain that begins from the raw material to intermediate as well as finished goods with use both domestically and internationally. According to Ojo, *et al.* (2018), about two – thirds of the African population depends on forest resources for income and food and 90% of the population use fuelwood and charcoal as sources of energy. If forests are properly managed and used sustainably, the forest has the capacity to provide a perpetual stream of income and subsistence products, while supporting other economic activities while still engaging about 70% of the overall Nigerian population (Sambe, *et al.* 2018). Forests have gone beyond being a source for timber production and its biodiversity underpins a wide range of goods and services for human well-being. Globally, deforestation has become an environmental menace that threatens to undermine the benefits of forests worldwide. The steady but continuous clearing of forests has become a problem that bothers governments and national planners not only in Nigeria but the world at large. In spite of the importance of forest resources, the natural tropical high forest has continued to diminish rapidly in the African continent (Aliyu, *et al.* 2014). Mfon *et al.* (2014) mention that according to the Food and Agricultural Organization (FAO) in 2004, Nigeria has one of the highest rates of deforestation of primary forests where more than 50% of such forests have been lost in the past. Ganiyu and Mbalisi (2015) further add that the loss of environmental resources is highly pronounced in the countries of Africa especially in the area of forest and forest resources. The global rate of deforestation in the humid tropics was estimated at about 11 million hectares during the late 1970s and 16.8 million hectares in 1990 with forest degradation as a result of harvesting fuelwood and other minor products contributing also the annual rate of deforestation (Ehigiator and Anyata, 2011). According to Mfon *et al*., (2014), deforestation has had a trend beginning from pre – colonial times. Between 1500 and 1900, the rainforest was reduced as a result of the demand for wood by the colonial masters. From 1900 to 1960, the remaining rainforests were reduced to two large blocks with scattered fragments. They also add that from 1960 to 1981, the remaining blocks were

tremendously degraded that by 1991, very few considerable patches of the rainforest were left in some forest reserves and national parks for protection and by 2013 the damage has become tremendous. There are several reasons responsible for deforestation and the loss of forest resources not only in Nigeria but in the world at large. Boahene (1998) mentions agriculture, logging, fuelwood, political and management issues as factors responsible for deforestation in Africa. Bamba, *et al.* (2011) opine that deforestation is usually caused by agricultural practices, timber exploitation and charcoal and firewood consumption and these factors are exacerbated by population growth. According to Anyanwu, *et al.* (2013), large scale deforestation occurs in Anambra state of Nigeria as a result of ignorance of intrinsic value, inadequate environmental laws, poor forest management as well as agricultural practices. They further added poverty as a major cause for deforestation in major African countries. Poverty is a cause of deforestation as many rural dwellers who cannot afford other sources of energy rely on forest resources for energy.

Otum, *et al.* (2017) state that most of the activities that can lead to deforestation are human initiated and are for economic purposes. They also add that forest exploitations are done on two levels: firstly, by local people for the survival and livelihood and secondly, a more commercial level which involves commercial logging, land conversion for agricultural purposes etc. Weslem and Alexandre (2013) state that economic development puts pressure on forests and their ecosystems in developing countries where these tropical forests are located. According to Ogunwale (2015), the unwise use of the natural environment due to ignorance, poverty, greed and overpopulation amongst others have led to deforestation and degradation of the environment. Ogundele, *et al.* (2016), also add urbanization, industrialization, infrastructural development, tourism, bush burning, mining, logging and fuelwood collection, corruption and political cause as some causative factors responsible for deforestation in Nigeria. Urbanization creates increasing concern about the effects of expanding town and cities as its one strike effect is on the natural resources such as forest lands (Ibrahim, *et al.* 2013). The need for expansion of cities and towns results in the clearing of forest areas to meet several development needs. The expansion of some roadways has also resulted in the loss of several forest resources. Rural dwellers depend heavily on forest resources for survival and livelihood especially with fuel wood being used as the major source of energy leading a great reduction and clearing of this resource. Also, logging usually for commercial purposes has resulted

in a great reduction in forest resources leading to deforestation. A lot of this logging is done illegally and due to corruption in several institutions, a lot of this logging goes unchecked leading to deforestation. Furthermore, due to inadequate supervision of many forest areas, illegal logging goes unhindered and uncontrolled resulting in deforestation. Sambe, *et al.* (2018) further mentioned that large expanse of forest estates has been encroached upon by the government for other forms of land use including the impounding of river Niger at Kanji.

Sedjo (2005) mentioned that macroeconomic policies oriented toward economic stabilization and structural adjustment in the development (including trade liberalization) may have negative effects on forest and forests sustainability. Rapid population growth and the resultant anthropogenic activities have exerted great pressures not only on the natural environment but the man – made environment as well (Mmom and Mbee, 2013). The population of Nigeria as well as that of the entire world has been on a steady increase putting pressure on the available natural resources. According to Kosamu, *et al.* (2016), the earth will have nine billion inhabitants in 2050, who are more likely to live on a depleted natural resource base as mentioned by the United Nations (UN). Oramah (2006) mentioned that the world's population according to the September 2005 estimate is 6.4 billion. This high increase in population implies tremendous pressure on the available natural resources including forests especially since natural resources are limited. Hussaini (2014) mention that population explosion has sped up the process of deforestation. From all the identified factors affecting deforestation, human activities have been primarily responsible for the loss of forest resources in Nigeria and these human activities will continue to escalate with population growth. Deforestation poses several challenges and problems in any economy. Ibrahim, *et al.* (2015) state that deforestation has drastic effects on soil properties as it leads to a decrease in its organic content. Anyanwu, *et al.* (2013) mention that deforestation has caused several problems including erosion, loss of soil fertility, loss of several forest products, extinction of species, climate change as well as the displacement of indigenous people. Ogundele, *et al.* (2016) further mention that deforestation results in economic losses with several social consequences. Sambe, *et al.* (2018) also add that deforestation threatens the livelihood and cultural identity of forest – dependent people by reducing the amount of forest products. The economic losses caused by deforestation could in the loss of potential revenue for the government, increase in unemployment as many people who depend on forest resources for raw materials to be used in production

such as carpenters and saw mill industries. Deforestation may also result in an increase in the prices of timber and non – timber products due to the scarcity of forest resources. This may even lead to a reliance on imports leading to balance of payment problems and exchange rate difficulties.\

Onoja, *et al.* (2008) state that deforestation affects the carbon cycle as the clearing of forests releases more carbon dioxide into the atmosphere which increases global warming as the volume of green house gases, desertification which also poses problems like food insecurity and unemployment, loss of biodiversity, increase in natural disaster thus causing social dislocations and human suffering. Deforestation on a micro scale results fires, soil erosion, watershed deterioration and microclimate change while on a global scale, deforestation may cause negative global consequences on timber supply, hydrologic unbalance, biodiversity, global cycles of substantial elements and massive carbon emissions (Indarto and Mutaqin, 2016). Deforestation also makes sustainable development almost impossible to achieve especially in developing countries like Nigeria. According to Gupta (2012), sustainable development ultimately aims at improving human well being, particularly through alleviating poverty, increasing gender equity, and improving health, and other aspects of human resources, along with safeguard to the natural environment. Deforestation of drylands destroys the trees and vegetation that bind the soil and because of the prevailing climatic conditions in drylands, the possibility of regeneration of denuded vegetation is low this leads to desertification (Olagunju, 2015). A lot has to be done to reduce the rates of deforestation in developing countries especially Nigeria. Onoja, *et al.* (2008) advocates several policies to reverse deforestation which include community participation, research development, encouragement to the forestry departments to control and sanction loggers and that the government should enact more friendly energy policies. Community education comprising environmental literacy education, civic adult education and vocational adult education is also necessary for forest conservation and preservation in Nigeria (Ganiyu and Mbalisi, 2015). One of the major causes of deforestation in Nigeria is the use of fuelwood. By making alternative sources of energy more accessible and affordable, there would be a reduced demand for fuelwood thus preserving forest resources.

Ogundele, *et al.* (2016) suggests the promotion of sustainable forest management, increased areas for forest plantation and area permanently reserved for timber production, the need for enforcement of policies, legislature regulatory measures and massive research in forestry education and creation of awareness as mitigating efforts against deforestation. Illegal felling of trees also has to be discouraged with the enforcement of stringent measures and improved security in forest areas. The objective of this study is to determine the effects of population growth on the rate of deforestation in Nigeria.

MATERIALS AND METHODS

Data Sources: The data used in this study were obtained from the World Development Indicators and the United Nations (UN) database. Secondary data was used covering the period from 1991 to 2016.

Methodology: Several factors have been identified to cause deforestation in Nigeria and they include population growth, urbanization, illegal felling of trees, infrastructural development, economic development, agricultural practices, charcoal and fuelwood consumption among others. In order to empirically determine the relationship existing between population growth and deforestation, forest cover (LNFOR) will be a function of population (LNPOP), economic growth (ECO), trade (TRA) and fuelwood consumption (LNFFC). This can be expressed as:

$$LNFOR = f (LNPOP, ECO, TRA, LNFFC)$$

This can further be mathematically expressed as

$$LNFOR = \beta_0 + \beta_1 LNPOP + \beta_2 ECO + \beta_3 TRA + \beta_4 LNFFC + \mu$$

Where β_0 is the intercept, β_1, β_2, β_3 and β_4 are the respective coefficients and μ is the error term.

The Augmented Dickey Fuller (ADF) test will be used to test for the presence of unit roots while the Johansen cointegration technique will be used to establish a long run relationship among the variables. The E – Views 10 statistical software will be employed for the econometric analysis of the data.

RESULTS AND DISCUSSION

Time series data was used in this study and unit root tests are required in order to check for stationarity. The Augmented Dickey Fuller (ADF) test will be used in this study and the variables can be stationary either at levels I(0) or first difference I(1). From Table 1, it can be observed that all the variables are stationary after first difference. Therefore, in order to establish a long run relationship among the variables, the Johansen cointegration test will be conducted.

Table 1. Unit Root Tests

Variable	ADF Value at Levels	ADF Value at First Difference	McKinnon Critical Value at 5%	Order of Integration
LNFOR	-	-15.36480	-2.991878	I(1)
LNPOP	-	-4.345708	-3.004861	I(1)
ECO	-3.166908	-8.179132	-2.986225	I(1)
TRA	-2.746943	-4.742978	-2.991878	I(1)
LNFFC	2.199569	-3.897048	-3.277364	I(1)

Source: Author's Computation from E – Views 10

Table 2. Unrestricted Cointegration Rank Test and Maximum Eigen Value

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.999800	304.7657	69.81889	0.0001
At most 1 *	0.846297	91.82061	47.85613	0.0000
At most 2 *	0.720106	45.00234	29.79707	0.0004
At most 3	0.343830	13.16876	15.49471	0.1088
At most 4	0.100049	2.635383	3.841466	0.1045

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.999800	212.9451	33.87687	0.0001
At most 1 *	0.846297	46.81828	27.58434	0.0001
At most 2 *	0.720106	31.83357	21.13162	0.0011
At most 3	0.343830	10.53338	14.26460	0.1792
At most 4	0.100049	2.635383	3.841466	0.1045

Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Source: Author's Computation from E – Views 10

From Table 2, the estimated number of cointegrating equations is 3. This is done by comparing the Trace statistic or Max-Eigen statistic value with the 5% critical value. When these values are greater than the 5% critical value, it implies a rejection of the hypothesis of no cointegrating equations. It can thus be concluded that a long run relationship exists among the variables under study implying that even though deviations from the equilibrium may occur in the short run, there will be a convergence in the long run. Table 3 shows that LNPOP, ECO and TRA have negative effects on LNFOR meeting the a priori expectation while LNFFC did not meet the a priori expectation. The t – statistic value for all the variables were statistically significant as the values were greater than 2. Table 4 reveals that the previous period's deviation from the long run equilibrium is corrected in the current period at a speed of adjustment of 0.6909%.

Table 3. Normalized Cointegration Coefficients (Standard Error Estimates)

LNFOR	LNPOP	ECO	TRA	LNFFC
1.000000	0.446331	8.44E-05	6.11E-05	-0.046790
	(0.00316)	(2.0E-05)	(1.1E-05)	(0.00315)
	[141.277]	[4.28393]	[5.72803]	[-14.8581]

Source: Author's Computation from E-Views 10: Note: Standard error and T-statistics are stated in parenthesis as () and [] respectively.

Table 4. Vector Error Correction Model

Error Correction:	D(LNFOR)	D(LNPOP)	D(ECO)	D(TRA)	D(LNFFC)
CointEq1	-0.006909	-0.011050	-74.70287	25.58008	-0.333448
	(5.8E-05)	(0.00080)	(62.9161)	(169.760)	(0.32182)
	[-118.263]	[-13.7465]	[-1.18734]	[0.15068]	[-1.03613]

Source: Author's Computation from E – Views 10

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It can be observed from Table 3 that population growth has a negative effect on the available forest cover thus deforestation. This goes with a priori expectation and was statistically significant. This result was confirmed in the works of Nath and Mwchahary (2012) and Mfon, *et al.* (2014) who have identified population growth and its resultant effect on deforestation in Nigeria. This is because as population grows, it increases the pressure on the available forest resources for sustenance and survival. Also population growth also increases the demand for housing and construction which results in a general forest decline in Nigeria. Furthermore, as population grows in urban areas, without adequate planning and management, enormous pressure is put on the environment and the forest as well. Economic growth also has a negative relationship with forest size in Nigeria meeting the a priori expectation. This can be because economic growth usually results in infrastructural and urban development which can result in a general forest decline. Indarto and Mutaqin (2016) add economic growth to be among the causes of deforestation because it can also result in the expansion of urban areas especially in Nigeria resulting in the need for raw materials needed for construction. Table 3 further shows that trade has a negative effect on forest size leading to deforestation meeting the a priori expectation. Weslem and Alexandre (2013) verifies this as they mention that external influences, trade policies and the international market for timber commodities are drivers of deforestation. Therefore, the demand for timber and non – timber forest products for exports can result in deforestation. Also, this increase in trade coupled with the prevalent illegal felling of trees causes a general forest decline resulting in deforestation. However, fuelwood consumption did not meet the a priori expectation having a positive sign despite having a significant t – statistic value.

Conclusion: Deforestation has become a serious problem facing the Nigerian environment requiring immediate attention from the government and the entire country at large. Among other factors, population growth has been identified as one of the major causes of deforestation in Nigeria. Therefore, the population growth has to be reduced in order to reduce the pressure on the available forest resources. The government has to take into account the religious, socio – economic and cultural factors affecting population in Nigeria so that policies targeted at population can have a better effect. Also, there needs to be a sensitization on the need for family planning especially in rural areas. The Nigerian government should also enact policies discouraging illegal felling of trees and sanctioning those who have been found to be guilty. Also, better security measures are needed in many forest areas so as to discourage illegal fellers. The government also needs to develop the rural areas so that their standard of living can improve. This will increase their access to other sources of energy thus reducing the pressure on forest resources. Also, there should be an increased community participation in addressing issues of deforestation in rural areas so that the rural community can be involved in protecting the forests within their communities. Furthermore, conservation education needs to be undertaken so that the entire populace can be involved in protection and conservation of forest resources.

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