Assessing the Drivers of Deforestation in Nigeria: Evidence From Fully Modified Ordinary Least Squares

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Abstract:- **The study investigates the drivers of deforestation in Nigeria using annual time series data for the period 1990- 2012. The data on all the variables were tested for unit root using KPSS unit root test. The results from KPSS units root test revealed that all the variables are stationary at level. And they are cointegrated as reported by the Engle granger test for cointegration. The result from fully modified ordinary least squares (FMOLS) indicates that wood fuel, economic growth, agricultural land and foreign direct investment have significant positive impacts on deforestation with urbanization been inversely related to deforestation in the long run. Government should give more emphasis on providing alternative means of cooking and lightening apart from fire woods, providing modern means of farming with crops that require small amount of land and lastly emphasis more on public enlightenment campaign on the dangers of deforestation and desertification.**

Keywords:- **Deforestation, Johansen Juselius, KPSS unit root,fully modified ordinary least squares**

I. INTRODUCTION

The immediate or direct drivers of deforestation and forest degradation are the activities of mankind and actions that directly impact forest cover and result in loss of carbon stocks. Agricultural activities are estimated to be the leading driver as it accounts for around 80 percent of deforestation globally [1]. For example, commercial agriculture is the most significant driver of deforestation in Latin America it accounts for around two third of total deforested area. In Africa and sub-tropical Asia, it accounts for around one third of deforestation and is of the same significance to subsistence agriculture. Infrastructure, mining, and expansion of urban cities are important but less well-known drivers [1]. Findings on worldwide patterns of degradation revealed that (commercial) extraction of timber and logging activities account for more than 70 percent of total degradation in Latin America and sub-tropical Asia. In the large parts of Africa, fuel wood collection, charcoal production, and to a smaller amount, livestock grazing in forests are the most imperative drivers of forest degradation [1].

The indirect drivers of deforestation include complex interactions of social, political, economic, technological processes and culture that affect the immediate drivers to cause deforestation or forest degradation. They act as multiple scales: international (commodity prices, markets), national (domestic markets, population growth, governance, national policies,) and local circumstances which include poverty and subsistence [1].

Africa's 635 million hectares of forests account for 21.4 percent of its land area which is equal to 16 percent of the global forested area. In total, some of 23 million hectares of this forest disappeared in the 1980s while another 20 million hectares gave way for other land uses in the 1990s [2]. Estimations revealed that another 4 million hectares of forest were deforested between 2000 and 2005, which is equivalent to one-third of the total deforested area worldwide. The current deforestation rate is estimated at about 0.4 to 0.7 percent per year and is likely to continue at this level (FAO, 2009) as cited in [2].

The direct drivers of deforestation in Africa reflect the global pattern with agricultural expansion as the main driver of deforestation (FAO, 2009) as cited in [2]. Direct conversion of forest area into small-scale permanent agriculture accounts for approximately 60 percent of the total deforestation whereas direct conversion of forest area into large-scale permanent agriculture accounts for another 10 percent (FAO, 2002) as cited in [2]. However, also wood extraction and infrastructure development play a significant role in deforestation across Africa Geist and Lambin (2002) as cited in [2].

In 2010 Nigeria had 9 million hectares of forest area, of which 336,000 hectares were primary forest [3]. The country has one of the maximum rates of deforestation on the globe, having lost approximately 410,100 hectares per year over the period 2005-2010 [4]. The key drivers of deforestation in Nigeria include agriculture, mining and logging activities. Studies conducted in the southern part of the country have indicates

that rapid population growth, agricultural expansion, logging activities and use of fuel wood are important drivers of deforestation [5]. Lots of communities practices traditional methods of farming and are experiencing land use restrictions. Rapid population growth encourages agricultural expansion, thus losing arable land and encouraged clearing of forest. Increasing pump prices of petroleum products, particularly kerosene and cooking gas, have led to both urban and rural households to rely heavily on charcoal and fuel wood as their major sources of energy for cooking and lightening [6]. This has further led to rapid deforestation activities. Whereas logging processes follow a selective system in certain forested areas and in some forest reserves clear felling is common. The cutting down of trees for timber in Nigeria is happening at an uncontrolled rate, with no strict obedience to laws and payment of appropriate fees or levies [7], all leading to growing rates of forest loss and environmental degradation.

II. LITERATURE REVIEW

[8] opined that poor living conditions and illiteracy are the causes as well as consequences of environmental degradation. The high level of poverty and illiteracy in Africa directly linked to the current level of environmental pollution and degradation in the continent. The poor and the illiterate are often more interested in issues related to their daily survival than environmental management and this lack of interest and awareness often lead to more reckless environmental behavior which in turn breeds more environmental problems and leads to a vicious cycle of poverty.

[9] studied the current deforestation status of the Nigerian economy and its capacity for depleting the green environment using primary data that consist of questionnaire and interview to test the participation of households in deforestation activities from the six geo political zones of the country. The result from the qualitative analysis revealed that lack of greening the environment, poverty and awareness are among the important variables that affects greening the environment. It is recommended that individuals, communities and government can manage forests in a sustainable way after right policy measures are put in place.

[10] examine the trends and status of deforestation as well as how it can be mitigated in Nigeria and revealed that the existence of pressures on the forest communities in the country are mainly due to urbanization, overpopulation, execution of developmental projects, agricultural expansion, mining, bush burning, fuel wood collection and logging. It is suggested that an attempt should therefore be made to guide human activities that causes forest depletion.

[11] assessed the environmental impact of deforestation in Enugu, Nigeria and found out that constant deforestation in the state is associated with government inability to provide the basic social amenities, constraints impose by the lack of proper awareness and lack of proper environmental protection law to be enforced. The contributing factors to deforestation in Enugu consist of charcoal production, desertification and urbanization. It is recommended that public should be enlightened, monitored and provision of laws with basic amenities that will replaced charcoal and fire woodsas a means of cooking and lightening.

[12] analyzed the pattern and extent of deforestation in Akure forest reserve in Ondo state of Nigeria between 1986 and 2017 using global navigation satellite system (GNSS) receiver to capture the location of the prominent settlements that surrounded the forest reserve alongside landsat OLI_TIRS 2017, landsat ETM+ 2002 and landsat TM 1986with 30m resolution to determine the temporal changing pattern of the forest reserve. The results indicate composition of vegetation that consists of undisturbed forest, secondary regrowth and farmlands.

[13] studied the key determinants of energy demand in Nigeria using time series data spanning 1987-2017 by means of ARDL and VECM approaches. The outcome from the ARDL model revealed that CO_2 emissions and real GDP have significant positive impacts on energy demand with inverse relation from urbanization in both the short run and long run periods. The outcome from VECM indicates that there is short run causality running from CO_2 emission to real GDP, real GDP to energy demand, urbanization to real GDP and access to electricity to real GDP with long run causality in access to electricity and CO_2 emission equations.

III. DATA AND METHODOLOGY

Nigerian time series data on the variables for the periods of 1990-2012 was employed and the choice of the study period was informed due to the availability of the data on all the variables. The data on deforestation (measured as Forest area % of land area), agricultural land (measured as Agricultural land % of land area), urbanization (measured as urban population), foreign direct investment (measured as Foreign direct investment, net inflows % of GDP) and economic growth (measured as GDP constant 2010 US$) were obtained from [14] while data on wood fuel was sourced from [15].The time series data obtained was analyzed using fully modified ordinary least squares (FMOLS). The method was selected based on the number of observations i.e. from 1990-2012 and it is applicable to estimating purely I(0), I(1)or mixture of I(0) and I(1)variables and more importantly FMOLS is more efficient for estimating small sample size data.

3.1 Model Specification

The model was specified based on the earlier studies particularly we adapted and modified the model of Maji (2015)[16]that study the link between trade openness and deforestation for environmental quality in Nigeria. The modified model is given in equation 1. Were DFT_t represent deforestation, URB_t represent urbanization, WF_t represent wood fuels, AL_t agricultural land, GDP_t represent economic growth and FDI_t represent foreign direct investment.

$$DFT_t = F\ (URB_t, WF_t, EG_t, AL_t, FDI_t) \qquad (1)$$

The long run econometric model of our variables with the inclusion of drift parameter and stochastic error term or white noise and where the stochastic error term is expected to be normally distributed with zero mean and constant variance. The econometric form of the model is given in equation 2.

$$DFT_t = \beta_0 + \beta_1 URB_t + \beta_2 WF_t + \beta_3 EG_t + \beta_4 AL_t + \beta_5 FDI_t + \varepsilon_t \quad (2)$$

To reduce the problems serial correlation, heteroscedascity and other regression problems in the time series data, the transformation of equation into natural logarithmic form provide the better result when compared to functional form linear equation [17]. Therefore, we modify and developed logarithmic linear econometrics model and the econometric relationship of our variables is given in equation 3.

$$DFT_t = \beta_0 + \beta_1 \ln URB_t + \beta_2 \ln WF_t + \beta_3 \ln EG_t + \beta_4 \ln AL_t + \beta_5 \ln FDI_t + \varepsilon_t \quad (3)$$

Where:β_0 = is the intercept parameterβ_1 – β_5 = are the coefficients of slope parameters ln = Natural logarithmic function, DFT_t = Deforestation, URB_t = Urbanization, WF_t = Wood fuels, EG_t = Economic growth, AL_t = Agricultural land, FDI_t = Foreign Direct Investment, t = Time series (1990-2012) and ε_t = Stochastic Error term.

3.2 Robustness checks

As a test for robustness, the Breakpoint unit root test is employed to serve as robustness check to the result of Kwiatkowski Philips-Schmidt-Shin unit root test result (KPSS) due to the inability of the KPSS to deal with structural breaks, drift and trend in the series alongside Canonical cointegration regression (CCR)to affirm the results of fully modified ordinary least squares (FMOLS) estimates. Canonical cointegration regression (CCR) is popularly known for its power to deal with the problems of simultaneity bias, small sample bias, endogeneity problem and serial correlation in the model. Therefore, this estimator would serve as a validation test for the fully modified ordinary least squares (FMOLS) estimator discussed earlier.

IV. RESULTS AND DISCUSSION

The descriptive statistics which involved the mean, the median, the minimum, the maximum, the standard deviation, the skewness, the kurtosis, the jarque-berra and lastly the probability value were all computed and reported in Table 1. The Jarque-Berra statistics entails that all the variables are normally distributed and that the result of the descriptive statistics are presented in Table 1.

Table 1:Descriptive Statistics

	DFT_t	**URB_t**	**WF_t**	**EG_t**	**AL_t**	**FDI_t**
Mean	13.974	475	58938.94	224	76.234	2.008
Median	13.974	447	59697.55	179	76.858	1.692
Maximum	18.922	756	63216.73	398	80.920	5.790
Minimum	9.027	282	50916.96	144	67.619	0.548
Skewness	3.050	145	3737.775	861	3.553	1.215
Kurtosis	0.000	0.438	-0.783	0.766	-0.862	1.792
Jarque-Bera	1.795 (0.498)	1.977 (0.419)	2.557 (0.281)	2.175 (0.233)	2.907 (0.239)	6.132 (0.000)
Observations	23	23	23	23	23	23

Sources: EViews 9; Note: Values in parentheses are the P-values.

The second Table reported the result of correlation analysis and all the variables are in their natural logarithmic form. The highest approximated correlation value is between urbanization (URB_t) and deforestation (DFT_t) which is -0.997. While the lowest approximated correlation value exists between foreign direct investment (FDT_t) and deforestation (DFT_t)which is -0.188.And all the independent variables ranges from urbanization (URB_t), wood fuel (WF_t), economic growth (EG_t), agricultural land (Al_t) and foreign direct investment (FDT_t) all revealed negative correlation with the dependent variable deforestation (DFT_t).

Table 2: Correlation analysis result

	DFT_t	**URB_t**	**WF_t**	**EG_t**	**AL_t**	**FDI_t**
DFT_t	1.000					
URB_t	-0.997	1.000				
WF_t	-0.918	0.938	1.000			
EG_t	-0.978	0.970	0.832	1.000		
AL_t	-0.754	0.789	0.910	0.648	1.000	
FDI_t	-0.188	0.188	0.089	0.245	0.028	1.000

Sources: Author's computation using EViews 9.

We have conducted Kwiatkowski Philips-Schmidt-Shin unit root test result (KPSS) on all the variables which include deforestation, urbanization, wood fuel, economic growth, agriculture land and foreign direct investment. The null hypothesis of the Kwiatkowski Philips-Schmidt-Shin unit root says that there is stationarity while the alternative hypothesis says that there is no stationarity in the series. Therefore, the null hypothesis of stationarity is accepted for all the series at 1 percent level of significance. Thus all the variables are stationary at level values and therefore they are said to be integrated of order I (0). Base on the Kwiatkowski Philips-Schmidt-Shin unit root result, the best and efficient model for this analysis is ordinary least squares and therefore we applied fully modified ordinary least squares base on its ability to tackle small sample size and serial correlation problems among others.

Table 2b: Kwiatkowski Philips-Schmidt-Shin unit root test result (KPSS)

	Level Values		First Difference		
Variables	**Constant**	**Constant & Trend**	**Constant**	**Constant & Trend**	**Order of Integration**
$\ln DFT_t$	0.684^{***} (0.739)	0.187^{***}(0.216)	----------	----------	I (0)
$\ln URB_t$	0.686^{***} (0.739)	0.178^{***} (0.216)	----------	----------	I (0)
$\ln WF_t$	0.646^{***}(0.739)	0.166^{***} (0.216)	----------	----------	I (0)
$\ln EG_t$	0.646^{***}(0.739)	0.169^{***}(0.216)	----------	----------	I (0)
$\ln AL_t$	0.552^{***} (0.739)	0.167^{***} (0.216)	----------	----------	I (0)
$\ln FDI_t$	0.141^{***} (0.739)	0.077^{***} (0.216)	----------	----------	I (0)

Sources: Author's computation using EViews 9; Note: Values in parentheses are the Asymptotic critical-values and ***represents statistically significant at 1% level.

To ensure robustness and eliminate spurious result in our analysis, we have equally employed breakpoint unit root test to serve as a robustness check to the result of Kwiatkowski Philips-Schmidt-Shin unit root test. The breakpoint unit root test is employed base on its ability to tackle the problem of structural breaks, trend and drift in the series. The result of the breakpoint unit root test presented in Table 3 revealed that deforestation (DFT_t), urbanization (URB_t), wood fuel (WF_t) and foreign direct investment (FDI_t) are stationary at level values and therefore they are said to be integrated of order I (0). While economic growth (EG_t) and agricultural land(Al_t) are stationary at first difference and they said to be integrated of order I (1). The result of the breakpoint unit root test also supports the application of fully modified ordinary least squares.

Table 2b: Breakpoint unit root test result

	Level value		First difference						
Variables	**Constant**	**Break Point**	**Constant & trend**	**Break point**	**Constant**	**Break point**	**Constant & trend**	**Break point**	**I(d)**
$\ln DFT_t$	-21.354 (1)***	2002	-17.959 (1)***	2005	----------	-----	----------	------	I(0)
$\ln URB_t$	-11.768 (0)***	2000	-4.750 (3)*	2001	-24.370(4)***	2000	-24.370 (4)***	2000	I(0)
$\ln WF_t$	-5.137 (0)***	2010	-2.015 (0)	2010	-5.171 (3)***	2003	-7.557 (3)***	2002	I(0)
$\ln EG_t$	-1.993 (3)	2001	-4.999 (2)*	1998	-4.248 (2)*	2000	-6.750 (3)***	2001	I(1)
$\ln AL_t$	-3.522 (3)	2008	-4.134 (0)	2008	-6.134 (0)***	2009	-7.008 (1)***	2008	I(1)
$\ln FDI_t$	-10.231 (4)***	2004	-7.136 (4)***	2008	----------	------	----------	------	I(0)

Source: Author's computation using Eviews 9; Note: ***,**&*stands for 1, 5& 10% levels of significance and values in brackets are the lag lengths, while I(d) stands for the interpretation of the results.

Optimum lag selection criteria

Table 3 present the result of unrestricted vector autoregressive (VAR) model for optimum lag selection criteria. Using Sequential Modified LR test Statistic, Final Prediction Error (FPE), Akaike Information Criterion (AIC),Schwarz Information Criteria (SC) and Hannan-Quinncriteria (HQ) each test at 5 percent level of significance, revealed that lag 2 should be selected and considered as the optimum lag for the model. Therefore, the maximum lag length for this study is lag 2.

Table 3:Unrestricted VAR optimum lag selection criteria result

Lag	LogL	LR	FPE	AIC	SC	HQ
0	214.0546	NA	1.00e-16	-19.81472	-19.51628	-19.74995
1	495.8194	375.6864	8.01e-27	-43.22089	-41.13185	-42.76752
2	664.0542	128.1789*	8.12e-32*	-55.81468*	-51.93503*	-54.97270*

Sources: Author's computation using EViews 9; Note: * represents the lags selected by different informations criteria's

Table 4 below report the result of Engle Granger test for cointegration and the result indicate that the null hypothesis of no cointegration relationship among the variables was rejected for the period under study (i.e. 1990- 2012), at 1 percent level of significance which is more strong. The T-statistics value of -4.832 is greater than the critical values at 1 percent, 5 percent and 10 percent level of significance. As such, a cointegration relationship exists in this respect. Therefore, strong long run equilibrium relationship exists among our variables.

Table 4Engle Granger test for cointegration result

Model	T-stat.	Critical Values	
1990– 2012	-4.832	1%	-3.788
$F(lnDFT_t/lnURB_t,lnWF_t\ lnEG_t,lnAL_t,\ lnFDI_t)$		5%	-3.012
K = 5& n = 23		10%	-2.646

Source: Authors' computation using Eviews 9.

Johansen Juseliustest for cointegration result

The Johansen Juselius test for cointegration was employed to serve as a robustness check to Engle Granger test for cointegration result presented in Table 4 above. The Johansen Juselius test for cointegration has model with Trace statistics and model with Max-Eigen value and all the two models confirm the existence of five strong cointegration equations. Therefore, based on the existence of five strong cointegration equations in each of the models we conclude that there is a cointegration relationship among the variables or that the variables moved together in the long-run. Therefore, the Johansen Juselius test for cointegration corroborates the result of Engle granger test for cointegration.

Table 5: Johansen Juselius test for cointegration

Hypothesized	Eigenvalue	Trace Statistic	0.05	Max-Eigen	0.05
No. of CE(s)			Critical Value	Statistic	Critical Value
$C \leq 0$	0.999	357.914*** (0.000)	95.753	165.047*** (0.000)	40.077
$C \leq 1$	0.985	192.867*** (0.000)	69.818	88.442*** (0.000)	33.876
$C \leq 2$	0.940	104.424*** (0.000)	47.856	59.396*** (0.000)	27.584
$C \leq 3$	0.678	45.028*** (0.000)	29.797	23.853*** (0.000)	21.131
$C \leq 4$	0.537	21.174*** (0.006)	15.494	16.197*** (0.024)	14.264
$C \leq 5$	0.211	4.977** (0.025)	3.841	4.977*** (0.025)	3.841

Sources: Author's computation using EViews 9; Note: Values in parentheses are the P-values and ***&** represents statistically significant at 1 and 5% levels of significant respectively.

The existence of I(0) variables together with long run equilibrium relationship among our variables provides the justification for the estimation of long run model and obtained the long run coefficients. The result of the long run model is presented in Table 6. The coefficient of urbanization (URB_t) indicates significant inverse relation with deforestation. This means that increase in urban population reduce deforestation and help in improving the environmental quality. Precisely when urban population increased by 1 percent deforestation will reduce by 1.041 percent in the long run. The inverse relationship existing between urban population and deforestation therefore revealed an improvement in forest reserve and increase in environmental quality through forest carbon elimination. This result contradicts the findings of [18] for Pakistan.

Moreover, the long run coefficient of wood fuel is significant and positively related to deforestation and the significant level was estimated to be 1 percent as shown by the probability value. This revealed that increase in demand for fire wood will cause an increase in deforestation in Nigeria. Specifically, an increase in demand for wood fuel by 1 percent will increase deforestation by 0.648 percent. Therefore, demand for wood fuel encouraged deforestation activities and reduces environmental safety. This result is in line with the work of [19] for Ethiopia.

Furthermore, the long run coefficient of economic growth is positive and significantly related to deforestation and the significant level is at 1 percent level of significant. This suggests that increase in economic growth is among the major causes of deforestation in Nigeria. Particularly, 1

percent increase in economic growth is associated with 0.111 percent increase in deforestation. Therefore, increase in economic growth encourages land opening and other economic activities which encourage deforestation. This result is in conformity with the findings of [20].

More so, the long run coefficient of agricultural land has significant positive association with deforestation and the significant level is at 1 percent. This entails that increase in agricultural land is also among the major causes of deforestation in Nigeria. Precisely, 1 percent increase in agricultural land is associated with 0.330 percent increase in deforestation. Therefore, increase in agricultural land also encourages land opening which encourage deforestation and this support the findings of [21]and [22] for Ghana.

Similarly, the long run coefficient of foreign direct investment is positive and significant in explaining changes in deforestation and the significant level is at 1 percent as shown by the probability value. This means that increase in foreign direct investment is also among the major drivers of deforestation in Nigeria. When, foreign direct investment increase by 1 percent deforestation will also increase by0.330 percent. Therefore, increase in foreign direct investment also encourages deforestation and reduce environmental safety. This is in line with the finding of [23] and [24] for Nigeria.

R-square value of 0.998means that approximately 99 percent variation in the dependent variable can be jointly explained by the independent variables and only 1percent variation in the dependent variable is explained by the error term. The Jarque-Bera value of 0.211is statistically insignificant as given by the P-value of more than 0.05 which means that we accept the null hypothesis that says the errors in the model are normally distributed and we reject the alternative hypothesis that says the errors are not normally distributed.

Table 5: Fully modified ordinary least squares results (FMOLS)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$lnURB_t$	-1.041***	0.061	-17.004	0.000
$lnWF_t$	0.648***	0.132	4.893	0.000
$lnEG_t$	0.111***	0.032	3.426	0.003
$lnAL_t$	0.330***	0.060	5.467	0.000
$lnFDI_t$	0.005**	0.002	2.414	0.028
Constant	9.507***	1.130	8.412	0.000
R-squared	0.998			
Adjusted R-squared	0.998			
Jarque-Bera	0.211			0.899

Sources: Author's computation using EViews 9;Note: Values in parentheses are the P-values and ***, ** & * represents statistically significant at 1, 5 & 10% levels respectively.

The result of canonical cointegration regression is presented in Table 5. The long run coefficient of urbanization is found to be inversely and significantly related to deforestation in Nigeria, indicating that increase in urban population causes reduction in deforestation for the period under study and therefore urbanization has not taking place at the cost of the deforestation. But wood fuel, economic growth, agricultural land and foreign direct investment all have positive and significant impact on deforestation in the long run in Nigeria. Meaning that percent increase in any of these variables have direct impacts on deforestation activities in the long run for the period under study. This finding is in line with the result of fully modified ordinary least squares (FMOLS).

Table 5:Canonical cointegration regression result (CCR)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$lnURB_t$	-1.078***	0.069	-15.438	0.000
$lnWF_t$	0.724***	0.151	4.792	0.000
$lnEG_t$	0.127***	0.035	3.638	0.002
$lnAL_t$	0.330***	0.062	5.310	0.000
$lnFDI_t$	0.006**	0.002	2.363	0.031
Constant	8.909***	1.248	7.138	0.000
R-squared	0.998			
Adjusted R-squared	0.998			
Jarque-Bera	0.433			0.805

Sources: Author's computation using EViews 9; Note: Values in parentheses are the P-values and ***, ** & * represents statistically significant at 1&5% respectively.

V. SUMMARY, CONCLUSION AND RECOMMENDATIONS

The study investigates the causes of deforestation in Nigeria using a time series data for the period of 23 years (1990-2012) on important variables in the study. The data sourced was analyzed using the Kwiatkowski Philips-Schmidt-Shin unit root test, Engle granger test for cointegration and fully modified ordinary least squares. The result from the Kwiatkowski Philips-Schmidt-Shin unit root test revealed that all the variables are stationary at level and they are cointegrated as shown by the Engle Granger test. Whereas the result from fully modified ordinary least squares indicates that with exception of urbanization all the other independent variables are positive and significantly related to deforestation in Nigeria. The results were robust checked using Breakpoint unit root test, Johansen Juselius test for cointegration and canonical cointegration regression. The result from breakpoint unit root test revealed that there is a mixture of order of integration of the variables, therefore did not corroborate the findings of Kwiatkowski Philips-Schmidt-Shin unit root test. Johansen Juselius test for cointegration indicates five strong cointegration equations in both the two models and therefore it is in line with the Engle Granger test for cointegration result. Canonical cointgeration regression result is also in consistent with the result of fully modified ordinary least squares.

The long run coefficient of urbanization is found to be inversely and significantly related to deforestation in Nigeria, indicating that increase in urban population causes reduction in deforestation for the period under study and therefore urbanization has not taking place at the cost of the deforestation. But wood fuel, economic growth, agricultural land and foreign direct investment all have positive and significant impact on deforestation in the long run in Nigeria. And this indicates that increase in any of these variables have direct effects on deforestation.

In view of the result summarize above, this study makes the following recommendations for consideration by policy makers. Government should make dual purpose kerosene available and at affordable price per litre together with a downward review of liquefied natural gas for cooking in order to reduce over reliance on fire wood and charcoal for cooking by the households in the country. The use of modern farming system and particularly crops that does not require large amounts of land should be practice by the farmers and by doing so will help in reducing deforestation and encourage reforestation in country. Again, government should employ the use of workable measures on activities of foreign firms that are involves in mining of natural resources since these activities involves cutting down of trees and consequently lead to desertification. Moreover, all economic activities that involves cutting down of trees should be review by the government and public enlightenment campaign on the dangers of deforestation should be highly encouraged.

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