Mahcene, Zoubida; Abdellah, Mayou; Zergoune, Mohamed et al.

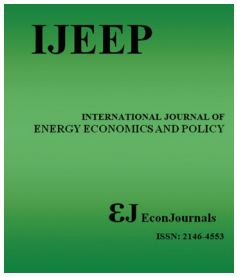
Article

Land degradation and economic development in Algeria

International Journal of Energy Economics and Policy

Provided in Cooperation with:
International Journal of Energy Economics and Policy (IJEEP)

Reference: Mahcene, Zoubida/Abdellah, Mayou et. al. (2019). Land degradation and economic development in Algeria. In: International Journal of Energy Economics and Policy 9 (1), S. 137 - 142. doi:10.32479/ijeep.6947.



International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2019, 9(1), 137-142.

Land Degradation and Economic Development in Algeria

Zoubida Mahcene*, Mayou Abdellah, Mohamed Zergoune, Miloud Lacheheb

Department of Management, Faculty of Management, Economics, and Commercial Sciences, Kasdi Merbah University, Ouargla, Algeria. *Email: zoubidamo@yahoo.fr

Received: 25 July 2018 **Accepted:** 20 October 2018 **DOI:** https://doi.org/10.32479/ijeep.6947

ABSTRACT

This study examines the relationship between land degradation and economic development in Algeria using the autoregressive distributed lag (ARDL) co-integration framework, and examine the existence of environmental Kuznets curve. The results based on the bound testing process endorse a long-run relationship between land degradation and economic development. Data were obtained from the food and agriculture organization and World Bank development Indicators for the period of 1970–2011. Importantly, our results reveal that land degradation insignificantly related to economic development, also, no evidence found for EKC hypothesis. Therefore, there is a dire need for technology improvement which may reduce the pressure on agriculture land demand and halt desertification.

Keywords: Land Degradation, Economic Development, EKC, Autoregressive Distributed Lag
JEL Classifications: Q56, Q01, O11

1. INTRODUCTION

Numerous developing countries have chosen a "grow first, clean up later" method, in which that more concentrate on economic growth promoting regardless potential effects on environment. This approach leads to high rate of deforestation, agriculture land degradation, and biodiversity damage. In certain regions, such as North Africa, deforestation may cause desertification and lead to land degradation.

The relationship between economic growth and deforestation has been widely discussed through EKC hypothesis (Bhattarai and Hammig, 2001; Cropper and Griffiths, 1994; Grossman and Helpman, 1991) and found the existence of Environmental Kuznets curve (EKC) between deforestation and economic growth. Moreover, these studies advocate the positive association between economic development and deforestation.

The theoretical assessment of the EKC for deforestation is afforded by Lopez (1994). The existing of EKC for the relationship between deforestation and GDP per capita, yet, is debatable. The concept EKC refers to the inverted U shape curve for relationship between deforestation and economic growth. In fact, the hypothesis is whether deforestation retains decreasing given that the per capita GDP grows, or at certain level the deforestation commences to decrease as GDP per capita preserve growing.

Many studies assessed the existence of EKC in confirming the relationship between income and deforestation (Cropper and Griffiths, 1994; Bhattarai and Hammig, 2001; Culas, 2007). However, patterns of deforestation are difficult to identify globally due to various influence depending on the countries particularities, and this, confirm that deforestation factors are strongly heterogeneous.

The deforestation and desertification in Algeria has reached a serious level and there is fear of inability to restore it in the medium term, that is only 1.5% of total land area is barely forested (Ali, 2009). In addition, forest fires caused a reduction in total forest area by 779872.11 ha between 1985 and 2006 (Arfa et al.,

2009). Generally talking, targeting to achieve higher growth rate without sufficient attention to forests and arable land leads to overexploitation of forests; Algeria in 1970s and 1980s lacked effective policies that enhance economic growth and forests alike. Furthermore, throughout the increase in population number, people still fighting against difficult living condition, whereas, policies, somehow, still tend to provide basic necessities to individuals. Thus, the forests are vanished from sight (Zaimeche, 1994). In words, land degradation remains a serious problem in Algeria, and yet, no proper mechanism has been applied to appropriately evaluate the different aspects of causes and consequences of deforestation, and then be able to imply right policies to save forests, and also to enlarge forests size in long term (Figure 1).

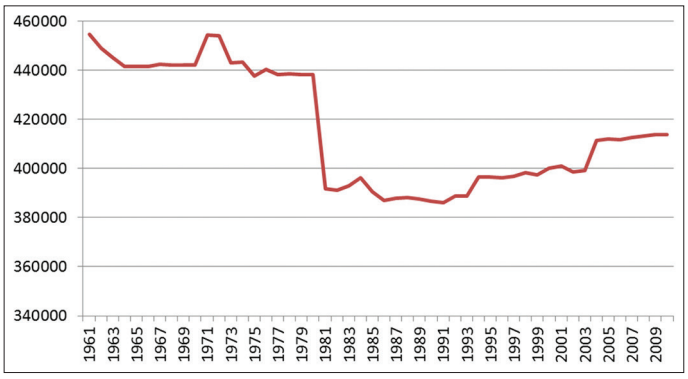
Our paper precisely assesses the relationship between land degradation and economic development in Algeria, applying nonlinear autoregressive distributed lag (ARDL) approach to capture the association between the variables and the existence of EKC. Findings of this study permit finding out at what certain level economic growth leads to increase in deforestation rate. EKC hypothesis allows illustrating at what level would further raise in economic growth leads to decrease deforestation rate. Hence, GDP per capita can be applied to control desertification and land degradation in the country. Also, the results permit to categorize the causes of deforestation in the country as per the impact weight, and hence appropriate policies can applied to halt land degradation and enhance economic growth alike to achieve sustainable economic development in Algeria.

Section 2 presents an overview of related literature review. Section 3 represent methodology and data, while section 4 reveals empirical results, and finally, section 5 concludes the study.

2. LITERATURE REVIEW

The relationship between economic growth and deforestation has been widely discussed through EKC hypothesis. Theory of inverted U-shaped EKC in the association between economic development and land degradation states that at initial level economic growth spurs forest area and deforestation increases (Walker and Nautiyal, 1982; Barbier, 2004; Barbier, 2005; Naidoo, 2004). Eventually, and as people become wealthier, this leads to more conserve environmental quality (Koop and Tole, 2001; Meyer et al., 2003), which will cause reduction in deforestation as the income rises (Bhattarai and Hammig, 2001; Ehrhardt-Martinez et al., 2002; Dinda, 2004).

Figure 1: Trend of agriculture land in Algeria (hectare) (1961–2010).



Source: World Bank, 2014

Yet, several studies found contradictory results. For instance, Shafik (1994) and Koop and Tole (1999) do not find evidence of EKC hypothesis. Bhattarai and Hammig (2001) confirm the existence of inverted U-shape EKC for African and Latin American countries, while Culas (2007) advocate the existence of EKC hypothesis in Latin America only. Thus, existence of EKC may vary across countries and regions; whereas, heterogeneity and country specification characteristics applied (Nguyen-Van and Azomahou, 2007).

Moreover, several studies advocate the existence of inverted U-shape relationship between growth and deforestation (Nguyen-Van and Azomahou, 2003). In this this study Nguyen-Van and Azomahou applied panel data estimation to examine the association between deforestation economic growth and population, in which covers 85 developing countries for the period 1961–1994. The findings using fixed and random effect model show no evidence of existence EKC, despite the negative effect between deforestation and GDP per capita. Also, population pressure appears to be significant in increasing deforestation rate among Latin America and Asian countries.

More recent studies have investigated this issue from different angles. Al-Mulali et al. (2015) explore the effect of financial development on CO_2 emission in 129 countries classified by the income level using urbanisation, GDP growth, trade openness, petroleum consumption and financial development variables. The rest of the determinants, especially petroleum consumption, are determined to be the major source of environmental damage in most of the income group countries. Apergis and Ozturk (2015) focused on how both income and policies in these countries affect the income - emissions relationship using the EKC hypothesis for 14 Asian countries. Results reveal that the EKC hypothesis is confirmed for the 14 Asian countries. However, Al-Mulali et al. (2015) investigate the existence of the EKC hypothesis in Vietnam during the period 1981–2011 but found no evidence on the existence of EKC hypothesis in Vietnam.

Oyebanji et al. (2017) examine the long-run equilibrium between green growth and some environmental variables like deforestation, energy depletion and carbon dioxide) emissions in Nigeria from 1980 to 2015. The results confirmed a positive long-run relationship exists between green growth variable and deforestation. Similarly, Gill et al. (2017) advocate that EKC growth strategy is resource intensive and has huge environmental cost that this planet may not be able to absorb in future. Meanwhile, Diputra and Baek (2018) explored growth-environment nexus in Indonesia and found little evidence that urbanization causes significant environmental degradation.

Since Algeria influenced by land degradation which is caused through deforestation and desertification, we estimate the association between deforestation, desertification and economic development.

3. DATA AND METHODOLOGY

This study used annual data from 1970 to 2011. Angelsen (1999) highlighted main factors that cause land degradation; the main factors that lead to deforestation and land degradation are: Population, income level, trade liberalization, and round wood production. In line with related literature, the following variables have been applied to examine the relationship between land degradation desertification and economic growth along with validation test of EKC hypothesis: Arable land, rural population, economic development, round wood production, and total forest product export. As a measure of deforestation and desertification, agriculture land has been applied to capture degradation of land in Algeria.

The data is on yearly basis which covers the period from 1970 to 2011, total of 42 observations. Data is basically sufficient to test for long-run relationship. Data are mostly collected from Food and Agriculture Organization website database, Agriculture Area, Arable Land, Rural Population, Round Wood production, and total forest product export (1000 US$); While, GDP (constant 2005 US$) is taken from World Development Indicators (WDI), World Bank.

Our general equation model to capture income level effect and EKC existence is as follows:

$$AGREA=f(ARLND, RPOP, GDP, GDPS, RWD, EXP) \quad (1)$$

The above function demonstrations that (AGREA) land degradation rate is the function of, (ARLND) is arable land area; (RPOP) is rural population; (GDP) is GDP (constant 2005 US$); (GDPS) is GDP square (constant 2005 US$); (RWD) is round wood production, and (EXP) is total forest product export (1000 US$).

From the above given equation, the nonlinear relationship among the variables becomes:

$$LAGREA_t=\beta_0+\beta_1 LARLND_t+\beta_2 LRPOP_t+\beta_3 LGDP_t+\beta_4 LGDPS_t+\beta_5 LRWD_t+\beta_6 LEXP_t+\varepsilon_t \quad (2)$$

Although, numerous studies have been conducted in evaluating the effect of economic growth on deforestation, but few studies have investigated this relationship in term of land degradation in desert area. Thus, the above model attempts to estimate the effect of linearity and nonlinearity relationship between economic development and land degradation. The ARDL procedure can distinguish between dependent and explanatory variables. In this case, the error correction representations of the ARDL specification model for Eq. (2) are given by:

$$\begin{aligned}\Delta \mathrm{Ln}AGREA_t &= \beta_0 + {}^{2}{}_{1}\mathrm{Ln}AGREA_{t-1} + \beta_2 \mathrm{Ln}ARLND_{t-1} \\ &+\beta_3 \mathrm{Ln}RPOP_{t-1} + \beta_4 \mathrm{Ln}GDP_{t-1} + \beta_5 \mathrm{Ln}GDPS_{t-1} + \beta_6 \mathrm{Ln}RWD_{t-1} \\ &+\beta_7 \mathrm{Ln}EXP_{t-1} + \sum_{i=1}^{n} a_1 \Delta \mathrm{Ln}AGREA_{t-1} + \sum_{i=0}^{n} b_1 \Delta \mathrm{Ln}ARLND_{t-1} \\ &+\sum_{i=0}^{n} d_1 \Delta \mathrm{Ln}RPOP_{t-1} + \sum_{i=0}^{n} e_1 \Delta \mathrm{Ln}GDP_{t-1} + \sum_{i=0}^{n} e_1 \Delta \mathrm{Ln}GDPS_{t-1} \\ &+\sum_{i=0}^{n} e_1 \Delta \mathrm{Ln}RWD + \sum_{i=0}^{n} e_1 \Delta \mathrm{Ln}EXP_{t-1 t-1} \varepsilon_t \end{aligned} \quad (3)$$

Where Δ represents the first difference operator, β_0 is the drift component, ε_t is the usual white noise residuals, Eq. (3) is a standard VAR model in which a linear combination of lagged-level variables are added as proxy for lagged error terms which measures the departure of the dependent variable from the independent variables in Eq. (2).

4. EMPIRICAL RESULTS

Unit root test is employed to test the integration order for each variable; agriculture area, arable land, rural population, GDP, GDP square, round wood production, and forest exported product. Augmented Dickey-Fuller (ADF) test is conducted to verify the order of integration of each variable. Table 1 obviously reveals that the variables are a combination of I(0) and I(1) variables. Thus, the autoregressive distributes lag approach (ARDL) popularized by Pesaran et al. (2001) is most suitable for this study. Before the long-run and short-run estimations are conducted, a bound test is necessary to ascertain the existence of a cointegration between the variables. Table 2 represents the computed F-value, likelihood ratio and Lagrange multiplier for testing the existence of long run relationship agriculture area and its determinants. The calculated F-statistics is compared with the critical bounds provided by Narayan (2005). The calculated F-statistic of the model is 6.9356 which is significant at 1%. Therefore, it can be concluded that long run cointegration relationship among agriculture area and it determinants exist.

Since long run cointegration exists among variables, we can proceed to estimate the long run coefficient between the variables using ARDL approach. The Table 3 displays the results of long run coefficient for the selected model.

The estimated long run model shows that GDP has positive but statistically insignificant related to deforestation and desertification

Table 1: Unit root test ADF

Variable	Level		1st difference	
	Constant	Constant and trend	Constant	Constant and trend
LAGREA	−2.935001 (−1.695264)	−3.523623 (−1.217492)	−2.936942*** (−6.353675)	−3.526609*** (−6.745328)
LARLND	−2.935001 (−2.417120)	−3.523623 (−2.326350)	2.936942*** (−6.522536)	−3.526609*** (−6.719971)
LEXP	−2.935001 (−0.981349)	−3.523623 (−1.430384)	−2.936942*** (−6.736483)	−3.529758*** (−6.346480)
LGDP	−2.936942*** (−3.967280)	−3.552973 (−2.586255)	−2.936942 (−8.794306)	−3.526609 (−9.868494)
LGDPS	−2.936942*** (−3.746502)	−3.552973 (−2.621009)	−2.936942 (−8.731013)	−3.526609 (−9.691602)
LRPOP	−2.943427* (−2.857684)	−3.529758 (−1.748009)	−2.943427 (−1.732116)	−3.536601 (0.038704)
LRWD	−2.935001** (−2.950003)	−3.523623 (−0.004412)	−2.936942*** (−5.548340)	−3.526609*** (−6.065697)

*.**.*** denote significance at 10%, 5% and 1% levels respectively. Values in parentheses represent t-value. ADF: Augmented Dickey-Fuller

in Algeria. The presence of the relationship between deforestation and income depends on the used variables (Barbier, 2004; Ehrhardt-Martinez et al., 2002). Furthermore, results endorse the inexistence of EKC. Large diversity in environmental and social characteristics which exists across countries may explain the presence or absence of EKC (Koop and Tole, 1999). Algeria torture by the natural land degradation and desertification which the income has no effect on it.

Round wood production has statistically insignificant relationship with agriculture area reduction. This reflects the unusual and accidental forest fires that occur especially in summer session. Forests in Algeria, currently fragile, desires additional protection since deforestation is continuously gaining in extent because of frequent forest fires (Arfa et al., 2009).

Forest exported product has a negative, but, statistically insignificant in explaining agriculture area variation. Algerian economy heavily depends on hydrocarbon sector, such as gas and oil with 98% of total export. Agriculture and forest product trading is still sharing a minor percentage in trade.

We proceed to compute short run model along with error correction Reorientations ECT. Error correction term, ecm_{t-1} measures the speed of adjustment, when explained variable adjust to change in the independent variables before converging to the equilibrium level. The experimental findings are based on the re-parameterization of the estimated ARDL (1, 0, 0, 0, 0, 0, 0) model. From the results error-correction model must be significant and attached with a negative sign. The negative ecm_{t-1} means that the variables have converged in the long run. In this model the probability of ecm_{t-1} is 0.001 (Table 4).

Since ect_{t-1} is negative and statistically significance, we can conclude that the short run cointegration relationship exists for this model. The coefficient is 0.59669 which suggests that convergence to equilibrium level of agriculture area in one year is corrected by about 5.966% in the following year.

A battery of diagnostic tests was also applied to the empirical model to gauge the adequacy of the specification of the model (Table 5). The diagnostic test explores the Heteroscedasticity, normality, functional form and serial correlation associated with the model. The diagnostic tests presented in Table 5, confirm that there is no evidence of m problem with the model. Furthermore, DW-statistic is >R2 we conclude that there is not autocorrelation.

The stability test for the model applies the cumulative sum of the squares of recursive residuals (CUSUM-squared) and the cumulative sum of recursive residuals (CUSUM) proposed by Brown et al. (1975), which are presented in Figures 2 and 3., These results again confirm the robustness of our results achieved in the diagnostic tests. Obviously, the CUSUM and CUSUM-squared statistics stay within the critical bounds indicating significant relationship between agriculture area and the other variables.

Table 2: The bound test

Model	F-statistic	Lag	Significance level 1.0%	Critical bound F-statistic	
				I (0)	I (1)
Fy (LAGREA, LARLND, LRPOP, LGDP, LGDPSLRWD, LEXP)	6.9356	2			
Likelihood Ratio Statistic	56.3067		1.0%	3.656	5.331
Lagrange Multiplier Statistic	29.7945		1.0%		

Table 3: Long-run relationship

Model: (LAGREA, LARLND, LRPOP, LGDP, LGDPSLRWD, LEXP) (1, 0, 0, 0, 0, 0, 0)						
LARLND	LRPOP	LGDP	LGDPS	LRWD	LEXP	INTERCEPT
0.57077	−1.1840	5.0048	−0.22836	0.12457	−0.0049162	−21.0081
(1.6698)	(−2.8108)[a]	(0.66874)	(−0.65954)	(0.64612)	(−0.69881)	(−0.53432)

Figures in parentheses ( ) indicate the standard errors. While, superscript denotes statistical significance at 5% level

Table 4: Error correction representation for the selected ARDL model

Model: DLAGREA, DLARLND, DLRPOP, DLGDP, DLGDPS, DLRWD, DLEXP						
$\Delta AGREA = -12.5353 + 0.34057 dlarlnd_{t-1} - 0.70645 dlrpop_{t-1} + 2.9863 dlgdp_{t-1} - 0.13626 dlgdps_{t-1} + 0.074329 dlrwd_{t-1} - 0.0029335 dlexp_{t-1}$						
(−0.52141)	(1.6168)	(−2.1635)[b]	(0.64629)	(−0.63781)	(0.63167)	(−0.69915)
−0.59669ecm (−1)						
(−3.7158)						

Standard errors in parentheses, Δ means the first difference, and the superscript "a" denotes statistical significance at 5% levels

Table 5: Diagnostic tests

Test statistics	LM version	P-value	F version	P-value
Serial correlation	=0.65520	(0.418)	F (1, 30)=0.51261	(0.480)
Serial correlation	=0.23801	(0.626)	F (1, 300)=0.18421	(0.671)
Normality	=134.3118	(0.000)		
Heteroscedasticity	=1.3811	(0.240)	F (1, 37)=1.3584	(0.251)
R^2	=0.88364	DW-statistic	1.8574	0.251

Figure 2: Plot of CUSUM

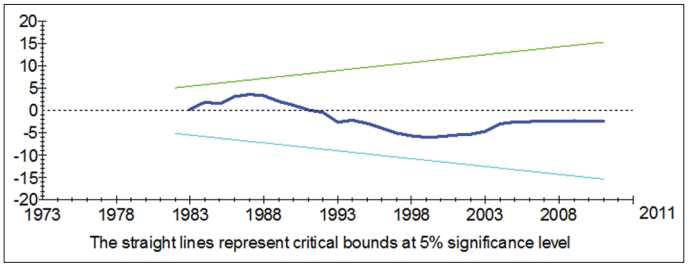
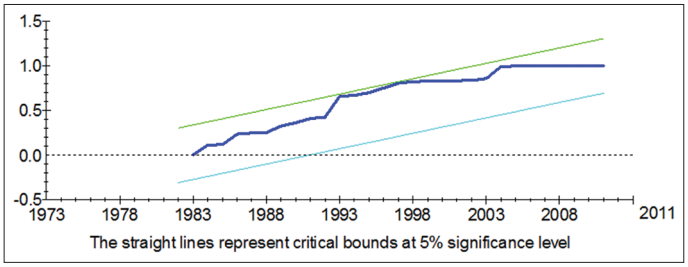


Figure 3: Plot of CUSUM-squared



Finally, we found the parameters remained stable over the entire study period using CUSUM and CUSUM square tests, because both of the recursive lines fall within the bound.

5. CONCLUSION

This study investigated the nonlinear relationship between economic development on land degradation in Algeria. Estimated results, using ARDL model to cointegration approach, revel the negative, but, insignificant, relationship between economic and deforestation rate. Furthermore, results confirm the inexistence of EKC between land degradation and economic growth in Algeria. However, rural population appears to have positive and significant association to deforestation. Long run results show that change by 1% in GDP decreases deforestation by 2.98%. While 1% increase in rural population leads to increase in deforestation by 1.18%. However, round wood production and forest exported production statistically insignificant in explaining changes in land degradation rate in the Algeria.

Furthermore, by applying a bulky number of diagnostic test and the CUSUM and CUSUMSQ tests to the model, we found the parameters remained stable over the entire study period and the diagnostic tests confirm that there is no evidence of diagnostic problem with the model. Thus we conclude that economic growth does not affect deforestation and desertification in the Algeria.

From the policy perspective, there is a dire need to implement improved technology in order to achieve sustainable forest management and reduce pressure on agriculture land. Moreover, reforestation is critically required to save forest area and halt desertification. Hence, appropriate policies are required to be implemented in order to increase and save existing forest area from desertification and deforestation. Equally important, providing substitute jobs for people in rural area may reduce the deforestation and desertification in the country.

REFERENCES

Al-Mulali, U., Saboori, B., Ozturk, I. (2015), Investigating the environmental Kuznets curve hypothesis in Vietnam. Energy Policy, 76, 123-131.

Al-Mulali, U., Tang, C.F., Ozturk, I. (2015), Does financial development reduce environmental degradation? Evidence from a panel study of 129 countries. Environmental Science and Pollution Research, 22(19), 14891-14900.

Ali, G. (2009), Desertification in Algeria: Policies and measures for the protection of natural resources. In: Facing Global Environmental Change. Berlin, Heidelberg, New York: Springer. p. 159-173.

Angelsen, A., Kaimowitz, D. (1999), Rethinking the causes of deforestation: Lessons from economic models. The World Bank Research Observer, 14(1), 73-98.

Apergis, N., Ozturk, I. (2015), Testing environmental Kuznets curve hypothesis in Asian countries. Ecological Indicators, 52, 16-22.

Arfa, A.M.T., Benderradji, M.E.H., Alatou, D. (2009), Analyse des bilans des incendies de forêt et leur impact économique en algérie entre 1985 et 2006. New Medit, 8, 52-57.

Barbier, E.B. (2004), Agricultural expansion, resource booms and growth in Latin America: Implications for long-run economic development. World Development, 32(1), 137-157.

Barbier, E.B. (2005), Frontier expansion and economic development. Contemporary Economic Policy, 23(2), 286-303.

Bhattarai, M., Hammig, M. (2001), Institutions and the environmental Kuznets curve for deforestation: A crosscountry analysis for Latin America, Africa and Asia. World Development, 29(6), 995-1010.

Cropper, M., Griffiths, C. (1994), The interaction of population growth and environmental quality. The American Economic Review, 84, 250-254.

Culas, R.J. (2007), Deforestation and the environmental Kuznets curve: An institutional perspective. Ecological Economics, 61(2), 429-437.

Dinda, S. (2004), Environmental Kuznets curve hypothesis: A survey. Ecological Economics, 49(4), 431-455.

Diputra, E.M., Baek, J. (2018), Is growth good or bad for the environment in Indonesia? International Journal of Energy Economics and Policy, 8(1), 1-4.

Ehrhardt-Martinez, K., Crenshaw, E.M., Jenkins, J.C. (2002), Deforestation and the environmental Kuznets curve: A cross-national investigation of intervening mechanisms. Social Science Quarterly, 83(1), 226-243.

Gill, A.R., Viswanathan, K.K., Hassan, S. (2017), Is environmental Kuznets curve (EKC) still relevant? International Journal of Energy Economics and Policy, 7(1), 156-165.

Grossman, G.M., Helpman, E. (1991), Trade, knowledge spillovers, and growth. European Economic Review, 35(2-3), 517-526.

Koop, G., Tole, L. (1999), Is there an environmental Kuznets curve for deforestation? Journal of Development Economics, 58(1), 231-244.

Koop, G., Tole, L. (2001), Deforestation, distribution and development. Global Environmental Change, 11(3), 193-202.

Lopez, R. (1994), The environment as a factor of production: The effects of economic growth and trade liberalization. Journal of Environmental Economics and Management, 27(2), 163-184.

Meyer, A.L., Van Kooten, G.C., Wang, S. (2003), Institutional, social and economic roots of deforestation: A cross-country comparison. International Forestry Review, 5(1), 29-37.

Naidoo, R. (2004), Economic growth and liquidation of natural capital: The case of forest clearance. Land Economics, 80(2), 194-208.

Narayan, P.K. (2005), The saving and investment nexus for China: Evidence from cointegration tests. Applied Economics, 37(17), 1979-1990.

Nguyen-Van, P., Azomahou, T. (2007), Nonlinearities and heterogeneity in environmental quality: An empirical analysis of deforestation.

Journal of Development Economics, 84(1), 291-309.
Oyebanji, I.J., Adeniyi, B., Khobai, H., Le Roux, P. (2017), Green growth and environmental sustainability in Nigeria. International Journal of Energy Economics and Policy, 7(4), 216-223.
Pesaran, M.H., Shin, Y., Smith, R.J. (2001), Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16(3), 289-326.
Shafik, N. (1994), Economic development and environmental quality: An econometric analysis. Oxford Economic Papers, 46, 757-773.
Nguyen-Van, P., Azomahou, T.T. (2003), Déforestation, croissance économique et population. Revue Économique, 54(4), 835-855.
Walker, E.W., Nautiyal, J. (1982), Some possibilities in the economic development of Liberia through the forestry sector. Forest Ecology and Management, 4(2), 179-189.
Zaimeche, S. (1994), Change, the state and deforestation: The Algerian example. Geographical Journal, 160(1), 50-56.