

Natural Resources Depletion and Economic Growth: Evidence from ASEAN Countries

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Abstract

The economic growth of any country determines how developed a country is. It determines the development of any economy. However, many factors such as less labor, fewer resources, destruction of land, etc., are now devaluating the economic growth and killing it. This question is of much importance as it frustrates the financial analysts and researchers. Therefore, the present study investigates the said problem in ten Association of South-East Asian Nations (ASEAN) countries as the traditional growth has slowed down in these countries, and to see what factors are damaging their economic growth. The data of 25 years is collected from Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. The independent variables are natural resource depletion, mineral depletion, and energy depletion, and their effects are measured on the economic growth of respective countries. The control variables are population growth and per capita income. For analysis, we have conducted cross-sectional-dependence, homogeneity tests for seeing whether the factors are heterogeneous or not. The framework for all countries has been examined using CIPS unit root test. For measuring the directional hypothesis, we have used Konya Granger causality tests. The results indicate that natural resource depletion and mineral

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depletion have been major causes to destroy the economic growth of many countries. This study helps the analysts to focus on how they can have more natural, mineral, and energy resources to gauge the growing need for the betterment of the economy.

Keywords: Natural Resource Depletion, Mineral Depletion, Energy Depletion, Economic Growth, ASEAN.

JEL Codes: N55, O13, O44, O47.

1. Introduction

Economic growth is the increment in the inflation-adjusted market value of services and products produced in an economy over a specified period (one year). It is referred to as the measurement of the total amount of increment in GDP or real GDP (Banerjee, Cicowiez, Vargas, & Horridge, 2016). By Hartley and Medlock III (2017), amongst ASEAN countries, Lao PDR, Cambodia and Myanmar are countries based on agriculture with higher GDP coming through the agriculture sector, whereas, Vietnam, Thailand, Philippines, Malaysia, and Indonesia are at different transformation stages. Overall, ASEAN countries have depicted positive economic development in the previous few decades. As an instance, before the international financial crisis, in the period from 2000 to 2007, there was a growth of six percent in real GDP of ASEAN countries. On average, Vietnam, Thailand, Philippines, and Indonesia are now a part of the countries of middle income, as given in the World Bank database, with Malaysia being at the top of the range (Rees, 2017). The yearly percentage change and projected change in real GDP growth of ASEAN countries are presented in Table 1 (WDI, 2018).

The natural resources of ASEAN countries such as soil, oceans, forests, and water provide livelihoods and economic opportunities to their inhabitants. Most of the countries present within the ASEAN region get served through river systems like Lake Toba and Mekong River Basin. Increased population and economic growth, along with present social inequalities have resulted in an increased pressure over natural resources within ASEAN countries. In addition to this, the ASEAN countries suffer different environmental problems such as the depletion of natural

resources, environmental degradation, land and water, and air pollution (Khan et al., 2019). These forces have to lead to an increment in the generation of waste and the consumption of various resources. Despite more of the natural resources, ASEAN countries still suffer from the challenge to keep a balance between economic development and environmental sustainability.

Table 1
Annual percentage change and projected change in real GDP growth of ASEAN countries

Country	2000-2007	2012	2018	2014-2018
Burunei				
Darussalam	-	1	2.4	2.3
Indonesia	5.1	6.2	6.1	6
Malaysia	5.5	5.6	5.3	5.1
Philippines	4.9	6.8	5.9	5.8
Singapore	6.4	3.1	3.1	3.3
Thailand	5.1	6.5	5.3	4.9
Combodia	9.6	7.2	7.1	6.8
Lao PDR	6.8	7.9	7.5	7.7
Myanmar	-	-	7	6.8
Viet Nam	7.6	5.2	6	5.4
ASEAN-10*	5.5	5.5	5.6	5.4

The Philippines and Indonesia are prone to various natural disasters like flooding, storms, and typhoons. As stated by Thang (2016), the main minerals extracted from ASEAN countries are tin, copper, and nickel. Bauxite production is also higher in terms of volume. However, it is lower when referring to the value. Moreover, iron, zinc, lead, gold, and gemstones are the minerals present within ASEAN countries. According to Wood (2017), cooper and aluminium are the primary metals that are being consumed within ASEAN countries, while some other smaller volumes of nickel, tin, lead, and zinc are also used. With Southeast Asia becoming the fastest developing region of the world, the issue of increased energy depletion comes under discussion. The ASEAN countries have a population of around 660 million individuals and its economy is the US \$3 trillion. In addition to this, it has been forecasted by the World Economic Forum that this

region will be the 5th largest world economy by the year 2020. With the rapid development of the region, energy depletion is getting higher as expected (Anh & Huong, 2019; Boer, 2015; Hepburn & Stern, 2019). The energy depletion within ASEAN countries has reached around 60 percent over the previous 15 years and it will have a rise of approximately 2/3 by the year 2040 (Cao, Li, Ma, & Sun, 2015). The prime cause of energy depletion is the higher rates of economic growth. To the best of authors' knowledge, the literature on the influence of natural resources depletion, mineral, and energy depletion on economic growth is scant, particularly, in the context of ASEAN countries. Therefore, this research has been conducted for filling the above-stated gap in the literature. Specifically, this research aims to achieve the following research objectives:

1. To investigate the effect of natural resource depletion on economic growth in ASEAN countries.
2. To determine if the mineral resource depletion is damaging economic growth in ASEAN countries.
3. To examine if the energy depletion is detrimental for economic growth in ASEAN countries.

This research will be useful for the governments of countries under study so they can maintain a respectable rate of economic growth by conserving natural resources, minerals, and energy resources. This section has presented the introduction of the research. Successively, the literature review and hypotheses development are presented in Section two which is followed by research methodology in Section three. Section four presents the results of the analysis and discussion, conclusion, and policy recommendations are given in Section five.

2. Literature Review

2.1 Natural Resources and Economic Growth

Natural resource management (NRM) involves not only the plan of usage of the land, but it also involves the maintenance of ecology, conservation of biodiversity, and air quality, along with the planning of soil and water management. By Day and Hall (2016), contemporary economists of environmental sciences also

incorporate different other problems to ensure the future sustainability of the industries involving forestry, fisheries, tourism, mining, and agriculture. Generally, the availability of natural resources is the function of the supply and demand of resources. The demand side depicts an increasing trend as an outcome of the efforts of the countries to acquire improved standards of living and higher growth rates in the economy. On the other hand, the supply side is more often predictable. The outcome can be the scarcity of various natural resources that causes the risks of approaching some point with no return when referring to environmental degradation. This outcome would not only be the depletion of the ecosystem, but it also augments the chances of exploration for stocks of new resources that would give more damage to the economic growth in ASEAN countries (Lattre-Gasquet & Moreau, 2018; Oyedepo et al., 2018). Therefore, effective and efficient management of natural resources has become very important for the economic growth of countries. Since its inception in the year 1967, the ASEAN countries have been striving to make an acceleration in economic growth, more regional peace, social progress, and stability through increasing cooperation, trust, and interpretation among different states (Georgescu-Roegen, 1979). Over time, the ASEAN countries have widened the given scope and have made expansion in the horizon of practices to get more developed. As part of the given process, with an approach to get better economic growth while promoting green and clean environment through giving protection to the natural resource base of ASEAN countries, ASEAN Socio-Cultural Community (ASCC) was incorporated within ASEAN countries to ensure better economic growth. There were around 11 different factors with 98 action plans for accomplishing the objectives linked with the given features. However, it has been identified in the research of Georgescu-Roegen (1979) that even after the implementation of these action plans, still, natural resource depletion is harming the economic growth of ASEAN countries. The proper use of these natural resources can, however, make a positive impact on economic growth. Thus, the following hypothesis is formulated to test the effect of natural resource depletion on economic growth in ASEAN countries.

H₁: The natural resource depletion significantly affects the economic growth of ASEAN countries.

2.2 Minerals and Economic Growth

The ASEAN countries are endowed with more of the natural resources, involving different energy and mineral resources. The ASEAN countries have a higher reserve share of some of the minerals. Despite having a smaller share in the GDP of the region, there is more significance in the mineral sector within ASEAN countries. Strong economic development within the region and around the globe is increasing the demand for mineral resources in most of the countries and is creating more opportunities and incentives for ASEAN countries for commercializing the mineral reserves. The production of minerals accounted for a lesser share of GDP in ASEAN countries, at almost 0.9% in the year 2015, while exports were around 0.7%. The share of minerals development to GDP was highest in Indonesia (around 2% of total GDP in the year 2015), Myanmar (0.7%), and the Philippines (0.8%) (Ghose, 2016). Minerals development within ASEAN countries was valued in the year 2015 at the US \$5.9 (Hartley & Medlock III, 2017). On the other hand, the trade of ASEAN minerals got valued at US \$10.5 in the year 2016 as claimed by He and Pang (2016). Growing activities of the world economy and development of industries in the previous few decades have increased the requirement for minerals internationally. In current years, enhanced consumption by countries of Asia like India and China has boosted the demand for minerals and costs (Landrigan et al., 2018). Therefore, giving opportunities and incentives to ASEAN member countries to do commercialization of reserves of minerals (Roumasset, Ravago, Jandoc, & Arellano, 2016; Shahbaz, Farhani, & Ozturk, 2015; Shi, Wang, Chen, & Huisingh, 2016; Simpson, 2017). The leaders of ASEAN countries called for integrating action programs that will further increase investment and trade in minerals of the industry to facilitate the industrialization of member countries. It complements the thrust of ASEAN countries in determining the ASEAN Free Trade Area (AFTA) and it continues creating a conducive environment for the participation of the private sector through making processes and rules transparent. The Government

and heads of the State of ASEAN countries in the year 1997 developed the ASEAN Vision 2020 as provided by Jack, Uchechukwu, Azubuikwe, and Akujobi (2016) to increase the intra-ASEAN investment and trade in sectors of minerals and to make a contribution towards technological competent ASEAN. This will in turn increase the economic growth of the country. Following hypothesis is formulated in line with the preceding discussion:

H₂: There is a significant effect of minerals depletion on the economic growth of ASEAN countries.

2.3 Energy Depletion and Economic Growth

For supplementing the developing requirement of energy, the International Energy Agency (IEA) mentioned in the Outlook 2017 of ASEAN countries that the requirement for coal and oil is expected to get augmented in current years. The growing dependency over coal and oil has exerted pressure in energy depletion has become the major concern. The IEA stated that energy depletion could become the major problem for ASEAN countries in the future if it will continue deteriorating itself as an importer of energy than being the producer of energy. The concern for energy depletion is not only about the affordability for customers, but the government too. With the rising requirement for energy, the oil demand is expected to get an upsurge to around 6.6 million barrels from 4.7 million barrels per day as stated by Jack et al. (2016). The ASEAN countries are quite popular for rich fields of oil, however, now a depletion is seen in resources at a faster rate. Aside from Thailand and Brunei, who are the biggest developers of oil, Vietnam, Indonesia and Malaysia are having a tougher time in keeping up with the developing pace of demand of oil in the given area (Sonwani & Maurya, 2018; Tay, Lee, & Yi, 2017). By Juma and Miraji (2018); (Kamble, 2019), these ASEAN countries have got transformed into oil importers rather than being its exporters. It is assumed that imports of crude oil will more even than double by the year 2040. Fulfilling the demand for energy by imports would place more strain on trade balances and expenditure of the governments. With an increase in imports of oil, the ASEAN countries are expected to do the registration of total deficit in the trade of energy of more than US\$300 billion in

the year 2040 (Khan et al., 2019). The burden would make a worse influence on countries that will do employment of oil subsidies like Malaysia, Thailand, and Indonesia. The consumers do not consider this, but the government will realize the burden to import of oil with additional cost required to subsidize it for citizens. That is why, the government of ASEAN countries should reform some policies for ensuring the security of energy and it will help to handle the economic growth of the country. Keeping this relationship in consideration, following hypothesis is formulated: **H₃**: There is a significant impact of energy depletion on the economic growth of ASEAN countries

3. Research Methodology

3.1 Data Collection

In this research study, we have chosen 10 ASEAN countries to measure the effect of natural resource depletion, mineral depletion, and energy depletion on the economic growth of these countries. The data has been collected over 25 years of research from 1993 to 2018. The countries selected for the research purpose are Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. These countries are selected as the economic growth in these developing economies has been slowed down in the past years. The independent variables used for the study are natural resource depletion (NRD), energy depletion (ED), and mineral depletion (MD). The dependent variable to be measured is the economic growth (EG) of all the countries. The control variables are population growth (PG) and per capita income (PCI). Here energy depletion value is the ratio of reserve lifetime and the stock of its energy resources like natural gas, oils, etc., The mineral depletion refers to the ratio between reserves lifetime and the stock of mineral resources like gold, zinc, etc., The natural resource depletion covers the scarcity of non-renewable resources, forest depletion, etc., Whereas, the economic growth is measured as GDP of the respective country.

Hence the functional form is as follows:

$$EG_{it} = f(NRD_{it}, MD_{it}, ED_{it}, PG_{it}, PCI_{it}) \quad (1)$$

The above equation can be modeled as:

$$EG_{it} = \beta_1 NRD_{it} + \beta_2 MD_{it} + \beta_3 ED_{it} + \beta_4 PG_{it} + \beta_5 PCI_{it} + \varepsilon_{it} \quad (2)$$

where EG_{it} is the economic growth, β_1 to β_5 are the coefficients representing the relationship of explanatory variables with dependent variable and ε_{it} is the error term.

3.2 Cross-Sectional Dependence Test

To evaluate whether these depletions of natural resources, mineral, and energy resources affect the economic growth of the countries, we need to see whether these are cross-dependent on each other or not. For which, the null hypothesis states that the variables are independent and identically distributed. Pesaran (2004) has developed a model that we can use for cross-sectional-dependence (CD) analysis. The equation for CD is stated as follows:

$$CD = \sqrt{\frac{2T}{N(N-1)} \sum_{i=1}^{N-1} \sum_{j=i+1}^N \rho} \quad (3)$$

And here ρ indicates the error term for the correlation between the variables. The hypotheses for this test are as follows:

H₀: Cov (u_{it} , u_{ij}) = 0, no cross-sectional dependence

H₁: Cov (u_{it} , u_{ij}) \neq 0, no cross-sectional dependence

Further, the homogeneity slope is tested to see whether the variables measure the same thing or different effects. Hence, the null hypothesis for it is that there is slope homogeneity among the variables. Further, the delta and adjusted delta tests are conducted as proposed by Swamy (1970) to see for the heterogeneity among variables. The model equation for this is as follows:

$$\Delta = \left(\sqrt{N} N^{-1} S - \frac{K}{\sqrt{2k}} \right) \quad (4)$$

Where S is the symbol for the Swamy model. This Δ statistic can be adjusted for further normal distribution and the equation is described as follows:

$$\Delta_{adj} = \sqrt{N} \left(N^{-1} S - \frac{E(zit)}{\sqrt{var(z)}} \right) \quad (5)$$

3.3 CIPS Panel Unit Root Test

The CIPS panel unit root test is conducted to test the stationarity of the variables. The test equation is for CIPS panel unit root test is as follows:

$$CIPS = N - 1 \sum_{i=1}^N i CADF_i \quad (6)$$

Here CADF measures the Augmented Dicky Fuller (Cheung & Lai, 1995). If the test statistic “t” value is larger than the critical value then we reject the null hypothesis and conclude that the variables are stationary.

3.4 LM Bootstrap Panel Cointegration Test

A panel cointegration test is used to test whether the variables have cointegration among each other within the group and outside the group mean (Westelund, 2007). If the bootstrap value comes out to be less than its significant value then we reject the null hypothesis and conclude that variables are not cointegrated. The equation used by Westerlund is as follows:

$$LM_N = \frac{1}{NT^2} \sum_{i=1}^N i \sum_{t=1}^T ws \quad (7)$$

Here, s shows the partial and w shows the long-term error variances. When the considered probability values turn out to be smaller as compared to its significance values, then we reject the null hypothesis.

3.5 Panel Causality Test

The final stage of the empirical analysis is the causality tests for the variables. We measured the causality tests from

natural resources depletion, mineral depletion, and energy depletion to economic growth and then from economic growth to natural resources depletion, mineral depletion, and energy depletion. The equation system for Konya causality test is as follows:

$$EG_{1it} = \alpha_{2,1} \sum_n^{i=1} \beta_{1i} NRD_{it} + \alpha_{2,1} \sum_n^{i=1} EG_{1,t-1} + \varepsilon_{it} \tag{8}$$

$$EG_{2it} = \alpha_{2,1} \sum_n^{i=1} \beta_{1i} NRD_{2it} + \alpha_{2,1} \sum_n^{i=1} EG_{2,t-1} + \varepsilon_{it} \tag{9}$$

4. Empirical Results

Table 2 presents the cross-sectional dependence and homogeneity tests. The tests for CD_{BP} , CD_{LM} , and CD show that the null hypothesis is rejected, hence, we conclude that there is a cross-sectional dependency of variables, and delta results show that these are heterogeneous. Further, the delta and adjusted delta results are also significant to indicate the heterogeneity of the items.

Table 2
Cross-Section Dependence and Slope Homogeneity Tests Results

Variable	CD_{BP}	CD_{LM}	CD
NRD	138.32*	73.83*	34.93*
MD	122.87*	26.82*	10.38*
ED	127.17*	75.90*	14.28*
PG	132.18*	87.58*	16.39*
PCI	173.17*	65.93*	18.30*
EG	129.89*	40.49*	15.39*
Results of Homogeneity Slope			
Tests	LM Statistics	t-value	P-Value
Delta	22.47	2.48	.001
Adj Delta	26.38	3.18	.000

Table 3 shows results of unit root tests (CIPS) in which energy depletion (EG), population growth (PG), and economic growth are stationary at a level whereas, natural resources

depletion (NRD), mineral depletion (MD) and per capita income (PCI) are stationary at first difference.

Table 3
CIPS Panel Unit Root Test Results

Variable	At Level	First Difference
NRD	-3.2762	-4.2873**
MD	-1.2737	-7.3767**
ED	-5.2721*	-13.2874***
PG	-8.2387*	-10.2831**
PCI	-1.8784	-9.3773***
EG	-3.3742*	-7.8371**

Table 4 shows the results of the bootstrap analysis which shows the existence of cointegration among variables of interest.

Table 4
LM Bootstrap Panel Cointegration Test Results

Conditions	LM statistics	Bootstrap p-value
Constant	-1.398	0.935
Constant + Trend	2.498	0.964

Table 5 explains the AMG estimation results for every country by measuring the coefficients while focusing on the heterogeneity and cross-dependence of the variables.

Table 5
AMG Estimation Results

Countries	NRD	MD	ED	PG	PCI
Brunei	0.223**	0.377**	0.168*	0.032	0.274**
Cambodia	0.127*	0.288*	0.040	0.027	0.233**
Indonesia	0.036	0.372**	0.229**	0.136*	0.233*
Laos	1.381***	0.281**	0.198**	.0214**	0.254*
Malaysia	0.471***	0.283**	0.294**	0.065	0.149*
Myanmar	0.213**	0.026	0.224***	0.243**	0.285**
Philippines	0.043	0.131*	0.341***	0.313*	0.253*
Singapore	0.387***	0.131**	0.122**	0.217**	0.254**
Thailand	0.321**	0.411***	0.015	0.203**	0.164*
Vietnam	0.659**	0.183*	0.037	0.229**	0.043
Penal	0.239**	0.212**	0.351***	0.311***	0.193**

Accordingly, natural resource depletion is damaging the economic growth of all the countries under study except Indonesia

and the Philippines. Likewise, mineral depletion also damages the economic growth of all the selected countries except Myanmar. Also, energy depletion is detrimental to economic growth for all the selected counties except Cambodia, Thailand, and Vietnam. Additionally, the Konya panel causality test is conducted to examine the direction of causality among all the variables under study. Table 6 briefly presents the results of the panel causality test.

It can be observed from Table 6 that there exists bidirectional causality among all the selected variables with the economic growth except energy depletion which means all the study variables are integrated such that a change in any of the study variables will harm the economic growth of the selected countries.

Table 6
Kónya Panel Causality Test Results

Alternative Hypothesis:	F-Statistic	Prob.
NRD causes EG	0.76630	0.4683
EG cause NRD	0.37410	0.6892
MD causes EG	2.09102	0.1307
EG causes MD	6.88280	0.0018
ED causes EG	4.50880	0.0142
EG causes ED	0.09406	0.9103
MD causes NRD	0.68184	0.5088
NRD causes MD	1.77580	0.1764
ED causes NRD	1.60960	0.2068
NRD causes ED	0.13619	0.8729
ED causes MD	0.26234	0.7700
MD causes ED	0.45156	0.6384

5. Discussion of Results

The primary objective of this research study is to analyze the importance of energy, minerals as well as natural resources to enhancing the economic growth of a country. It is well known that natural resources, minerals, and energy play an important role in enhancing the growth of the economy (Katz & Pietrobelli, 2018). It can be observed from the analysis that natural resources have a significant positive role in enhancing economic growth which means a depletion in natural resources impedes economic growth.

A recent previous study illustrates that resources are important for the development of any country (Abdulahi, Shu, & Khan, 2019).

For example, to generate energy, one needs fossil fuels; and for industrial development, mineral resources are required (Zallé, 2019). Likewise, the results also indicate that mineral resources also contribute to enhancing economic growth. The more a country has mineral resources, the more growth it will evidence (Aimer, 2018). In the past, some economist says natural resource curse is a solid fact but some refuse it (Lin, 2018). The abundance of natural resources such as coal, mining, minerals, gold, silver, crude oil, and others increase the GDP of an economy. Similarly, depletion of energy resources negatively affects the economic growth of a country.

6. Conclusion

This study concludes the determinants of economic development in ASEAN countries. Several factors hinder growth like labor, resources, destruction of land, and many more. The objective of the study to examine the detrimental factors which damage the economic growth in 10 selected ASEAN nations. For this purpose, this study covered the data of 25 years of Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. The dependent variable is economic growth and independent indicators are natural resources depletion, mineral depletion, and energy depletion with the supporting variables are population growth and per capita income. They used cross-section dependency tests, second-generation unit root CIPS unit root tests, and applied the Konya Granger causality tests. Results concluded that natural resource and mineral depletion significantly destroyed the economic growth of many countries.

7. Policy Recommendations and Future Research

The results have revealed that all-natural resources, minerals, and energy depletion significantly impact the economic growth of ASEAN countries. The findings illustrate that an abundance of natural resources heavily contributes to the economic growth of all the ASEAN countries. Therefore, the respective governments increase their focus in conserving and

enhancing their natural resources, minerals, and energy resources since it will help in attaining the macroeconomic targets.

Like all other studies, this research has some limitations that can be covered by future studies. Therefore, it is recommended that future research should focus on the effect of such natural resources on various other development indicators. Also, other novel techniques may be considered by future studies to investigate the subject matter.

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