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ANALYSIS OF FACTORS AFFECTING THE ENVIRONMENTAL QUALITY INDEX IN SUMATRA ISLANDS

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ABSTRACT

The main indicator in assessing the success of economic development is the rate of economic growth. An indicator of the success of a country's economic development is a prosperous society. Therefore, this study aims to determine relationship of economic development focusing on the rate of growth in the agricultural, industrial, mining, and transportation sectors to the Environmental Quality Index (EQI) in the Sumatran Islands. The research method used is panel data regression and the secondary data source is cross sectional data in the form of 10 districts/cities in the Sumatran Islands Province, namely Aceh, North Sumatra, South Sumatra, West Sumatra, Bengkulu, Riau, Riau Islands, Jambi, Lampung, Bangka Belitung, while the time series is 5 years, namely 2015 – 2019. This study uses the variables of the agricultural, industrial, mining and transportation sectors in the Gross Regional Domestic Product (GRDP) and the Environmental Quality of Life Index (EQI). The data was obtained from the Central Statistics Agency (CSA) and the Ministry of Environment and Forestry (EQI). The results of this study indicate that the agricultural sector has a positive and significant effect on the Environmental Quality Index (EQI), while the industrial, mining and transportation sectors have no significant effect on the Environmental Quality Index (EQI). The government as a policy maker is expected to pay more attention to regulations on resource and environmental management. Therefore, all sectors must adhere to the concept of sustainable development and a green economy approach.

KEYWORDS: *Gross Regional Domestic Product Sectors, Environmental Quality Index, Economic Growth*

1 INTRODUCTION

Economic growth is the main indicator in the success of a region's economic development. Economic growth should be carried out to realize people's welfare, improve people's quality of life standards and overcome socio-economic problems (Roby, and Primandhana 2022). Although economic growth is proven to have a positive impact on people's welfare and bring about better changes to the country, economic growth can also present risks that can be detrimental to the environment. Economic development in developing countries often ignores aspects of environmental sustainability, because it only focuses on high economic activity. The inverted U curve of Kuznets shows that especially in developing countries, high economic activity will have a negative impact on

the environment, until it reaches a turning point, where along with economic development, environmental sustainability will improve (Rofiuddin et al., 2019).

It can be said that useful development is development which in its implementation pays attention to the concept of environmental conservation. If the development does not think about it, then the consequences of the development will have a negative impact (Rosana, 2018).

Along with the rapid growth of the industrial world resulting in faster economic growth, so that more and more natural resources are needed in the production process, which in turn will reduce the availability of natural resources on earth (Suparmoko, 2016). All of this started from the view that nature is the only source that is easy to use and promises income and prosperity for the community quickly (Firmansyah & Gunawan, 2007). According to Finocchi (2021) in his journal it is said that in the world's geopolitical puzzle, power has an important role that determines every part to seek global prosperity and security. Not all countries generate sufficient power to influence the world's geopolitical scenario, but the global energy industry influences the geopolitical interests of all countries. In fact, for every 10 percent drop in oil prices, world GDP grows 0.2 percent. Fuels such as petroleum and coal (fossil fuels), making up more than half of all current sources of energy consumption, use geopolitical bargaining strategies. This desire in fact does not think about the various side effects that arise from these efforts, one of which is environmental damage (Firmansyah, 2007). Thus, economic growth has a long-term impact on the environment and results in environmental degradation.

According to Spratt (2019) in his journal he said that in 2050 the world will experience very large natural disasters, such as very dirty air, lack of clean water, forest fires, increasing natural resources, and high temperatures resulting in melting polar ice. In measuring the environmental quality of a region, Indonesia uses the Environmental Quality Index (EQI) which is calculated from three indicators, namely WQI (Water Quality Index), AQI (Air Quality Index), and LCQI (Land Cover Quality Index). In addition, the EQI (Environmental Quality Index) can also be used as information material in the policy-making process related to environmental protection and management (Kemenlkh, 2016).

In this study the Gross Regional Domestic Product (GRDP) is considered the best measuring tool for the economy in a region. Economic growth is reflected in changes in Gross Domestic Product (GDP) which can be seen through an approach based on current prices and an approach on a constant basis. There are four main sectors that have a major contribution to economic growth in the Sumatra Island, including: the agricultural sector, the industrial sector, the mining sector, and the transportation sector. The four sectors have a trickledown effect and a backswash effect from the economic development process (Febriana, 2019).

2 MATERIALS AND METHODS

Definition of operational variables

Definitions of research variables need to be formulated to prevent errors in data collection. In this study there are two variables, namely:

a. Dependent Variable

The dependent variable in this study is EQI. EQI is an Environmental Quality Index issued by the Ministry of Environment and Forestry of the Republic of Indonesia which is issued once a year. EQI data is obtained directly through the official website www.menlhk.go.id. The data used is the result of the calculation of WQI, AQI and EQI from 2015-2019.

b. Independent variable

The independent variables used include the GRDP of the agricultural sector, the GRDP of the mining sector, the GRDP of the industrial sector, and the GRDP of the transportation sector. The data used is sourced from the Gross Regional Domestic Product of the Provinces in Indonesia by Business Field 2015-2019 by the Central Statistics Agency through www.bps.go.id. The data used is the result of GRDP by field of business on the basis of current prices with units in the form of percent for 2015-2019.

Data Types and Data Sources

The data used in this study is a combination of time series and cross section data called panel data for the last 5 years. The cross-section data is in the form of 10 Regencies/Cities in the Sumatran Islands Province, while the time series is 5 years, namely 2015 – 2019. The research used is quantitative methods and the data source used is secondary data.

Analysis method

This study analyzes the effect of the variable growth rate of the agricultural, industrial, mining and transportation sectors on the Environmental Quality of Life Index. The data is taken from the CSA (Central Statistics Agency) Province in the islands of Sumatra. The analytical tool that will be used in this research is panel data regression with econometric models as follows:

$$EQI_{it} = \beta_0 + \beta_1 logIDS_{it} + \beta_2 logPTN_{it} + \beta_3 logPTB_{it} + \beta_4 logTPT_{it}\ \varepsilon_{it}$$

Where:

$\beta 0$ = Constant

$\beta 1 \ldots \beta 3$ = Independent variable regression coefficient

t = Year t

i = District/City to i

ε = Error term where the values are normally distributed

EQIit = Environmental Quality Index, Air and Water Quality Index (percent)

LogIDSit = Industrial sector GRDP Growth Rate (percent)

LogPTNit = Agriculture sector GRDP Growth Rate (percent)

LogPTBit = Mining sector GRDP Growth Rate (percent)

LogTPTit = Transport sector GRDP Growth Rate (percent)

3 RESULT

The estimation results of Panel Data Regression using the Common Effects Model (CEM), Fixed Effects Model (FEM), and Random Effects Model (REM) approaches can be seen in Table 1

Table 1. Panel Data Regression Results

Variable	Regression coefficient		
	CEM	FEM	REM
C	83,17571	-72,36639	90,37529
logIDS	-2,094430	1,422787	-0,966277
logPTN	-2,305437	-44,11068	-1,796999
logPTB	0,699663	-13,86780	-0,5885597
logTPT	2,617774	-22,90421	1,286407
R^2	0,307048	0,654175	0,093308
Adjusted.	0,244053	0,525726	0,010882
Statistik *F*	4,874123	5,092864	4,218910
Prob. Statistik *F*	0,00242	0,00005	0,353840

Estimated Model Selection Test

Chow test and Hausman test were used to select the best estimated model between CEM, FEM, and REM. If in the Chow test the selected model is FEM and in the Hausman test the selected model is also FEM, the best estimated model is FEM.

Chow test

Chow test is used to determine the estimated model between CEM (PLS) or FEM. H_0 on the Chow test states that the estimated model is the Common Effect Model (CEM), and H_A on the Chow test states that the estimated model is the Fixed Effect Model (FEM) provided that if the probability value of Prob F > 0.10 then H_0 is not rejected with the model conclusion Common Effect Model (CEM) was selected, while if the probability value of Prob.F < 0.10 then H_0 was rejected with the conclusion that the Fixed Effect Model (FEM) selected model.

Table 2. Chow. Test Estimation Results

Effects Test		Statistic	d.f.	Prob.
Cross-section F		80,10782	(5,213)	0,001
Cross-section Chi-square		89,98170	5	0,000

Based on Table 2, it can be seen that the results of the Chow Test Analysis of the Effect of Several GRDP Sectors on the Environmental Quality Index in the Sumatra Islands show the prob value. F of 0.0017 < 0.10, so H_0 is rejected, thus it can be concluded that the selected model is the Fixed Effect Model (FEM).

Hausman test

Hausman test is used to determine the estimated model between FEM or REM. H_0 on the Hausman Test states that the estimated model is a Random Effect Model (REM), and H_A on the Hausman Test states that the estimated model is a Fixed Effect Model (FEM) estimated model provided that if the probability value of Prob Chisq > 0.10, then H_0 is not rejected with the conclusion of the selected model is Random Effect Model (REM), whereas if the probability value of Prob Chi-Sq < 0.10 then H_0 is rejected with the conclusion that the model is selected Fixed Effect Model (FEM).

Table 3. Hausman Test Estimation Results

Effects Test	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	70,414300	3	0,0733

Based on Table 3, it can be seen that the results of the Hausman Test Analysis of the Effect of Several GRDP Sectors on the Environmental Quality Index in the Sumatran Islands show that the Chi square Prob value is 0.0733 < 0.10 so that H_0 is rejected. Thus it can be concluded that the model chosen is the Fixed Effect Model (FEM).

Selected Model

Table 4. Fixed Effect Model (FEM) Estimation Results

EQI_{it} = -72,366 -39 + 1,422787$logIDS_{it}$ - 44,11068$logPTN_{it}$ – 13,86780 $logPTB_{it}$ – 22,90421 $logTPT_{it}$			
(0,4766)	$(0,0748)^{***}$	(0,3151)	(0,2205)
R^2 = 0,654175; Adj R^2 = 0,525726; F. Stat = 5,092864; Prob F-Stat = 0,00005			

Note: *Significant at = 0.01; ** Significant at = 0.05; *** Significant at = 0.10; The number in brackets is the probability value of the t statistic.

Coefficient of Determination (R^2)

The magnitude of the coefficient of determination (R2) of the influence of the industrial, agricultural, mining, and transportation sectors on the Environmental Quality Index of 0.654175 means that 65.4175% of the variation of the EQI variable can be explained by the industrial, agricultural, mining, and transportation sectors and the remaining 34, 5825% is influenced by other variables that are not included in the research model.

Simultaneous Significance Test (F Test)

Table 5. Effect Validity Test (t test)

Variable	t-statistic	Prob	Alpha	Conclusion
LogIDS	0,719531	0,4766	< 0,10	No significant effect
LogPTN	1,836668	0,0748	< 0,10	Significant effect on = 0.10
LogPTB	-1,019242	0,3151	< 0,10	No significant effect
LogTPT	-1,247376	0,2205	< 0,10	No significant effect

Based on the validity test of the effect (t test) the agricultural industry variable on the Fixed Effect Model (FEM) has a positive and significant effect on EQI. The PTN variable has a regression coefficient of -44.11068 with a prob value of 0.0748 which is statistically significant at = 10% (0.10).

Effect of IDS variable on EQI

Based on the estimation results on panel data, it can be seen that the coefficient value of the IDS variable has no significant effect on EQI. The industrial development of Sumatra Island is quite important in contributing to national industry and GDP, although its performance still occupies the second position after the performance of the manufacturing industry on Java Island so that the impact on environmental damage is also not significant (Saragih, 2018).

Production activities in the industrial sector produce solid and liquid waste that have an impact on environmental damage such as air pollution due to factory smoke, disposal of solid waste that causes unpleasant air and water pollution as a result of the disposal of residual production in the form of liquid waste. In turn, activities in this sector have an impact on the surrounding community. In other words, social costs are higher than marginal costs – negative externalities (Febriana, 2019).

Hariz (2018) states that the emergence of a concept known as green industry which refers to environmentally friendly industrial areas with the aim of achieving as many environmental, economic and social benefits as possible with long-term and sustainable goals. This concept in industrial areas is to maintain the balance of the ecosystem. The project for the transformation of industrial estates into green industrial areas is still ongoing in Indonesia. A gradual emission and waste reduction program is being implemented by industry to support climate change mitigation by directing large industrial sectors such as cement, steel, pulp and paper, and other industries to use more efficient machinery, use alternative fuels, and increase production efficiency stated in the National Long-Term Development Plan 2005-2025 and a proposal from the Ministry of Environment and Forestry.

The influence of PTN variables on EQI

Based on the estimation results on the panel data, it can be seen that the coefficient value of the PTN variable has a positive and significant influence on EQI with a linear-logarithmic model, which means that every GRDP in the agricultural sector increases by 1 percent, the EQI will increase by 0.44110 percent.

According to Oktavia (2016) in its concept the agricultural sector puts forward an integrated organic farming system to integrated pest control. The development is carried out by prioritizing commodities that have comparative advantages with biophysical and socio-economic aspects. Based on the results of the 8th Council meeting of the International Tropical Timber Organization (ITTO) In Indonesia, the practice of Eco labeling was carried out in early 2000, but only focused on the forestry sector (because this sector has the highest export value).

Effect of PTB variable on EQI

Based on the estimation results on panel data, it can be seen that the coefficient value of the PTB variable has no significant effect on EQI. Environmental damage on the island

of Sumatra continues to occur. The main cause starts from coal mining activities. From the analysis of the Sumatran network, the impacts most felt by these activities, namely air pollution, river pollution, sea pollution, soil pollution to the problem of the loss of people's livelihoods (Esa, 2022).

Mining activities also convert a lot of forest land into mining land. Deforestation in Indonesia still occurs due to mining activities, with 4 million hectares of forest area being converted to the mining sector (greenpeace, 2022).

Effect of TPT variable on EQI

Based on the estimation results on panel data, it can be seen that the coefficient value of the TPT variable has no significant effect on EQI. Kuripan Village, Kalianda Regency, South Lampung is a village very close to the construction of the Trans Sumatra Toll Road (JTTS). With the development of infrastructure in the form of the opening of the Trans Sumatra Lampung Toll road, it is very possible that the level of mobility of transportation activities will increase. The transportation sector is a sector that can help smooth the distribution of goods resulting from production activities carried out by the agricultural and industrial sectors. In the long term, heavy traffic flow will result in a decrease in air quality (Febriana, 2019).

In research (Mediana, 2021) transportation has a negative effect due to the increase in the number of motorized vehicles on the highway and the use of very high amounts of fossil fuels resulting in air pollution from motorized vehicles, including carbon monoxide (CO), nitrogen oxides (NOx emissions). , sulfur dioxide (SO2), black sulfur (Pb), and dioxide (CO2) are getting higher.

4 CONCLUSION

The influence of GRDP in the agricultural sector has a significant positive effect to EQI, while the GRDP in the industrial, mining, and transportation sectors has no significant effect. Negative externalities of environmental quality, such as disease and death, can be caused by air pollution which can cause odors, material damage, visual disturbances and can cause acid rain which damages the environment. However, positive externalities have the form of a pattern of sustainable development reform for the environment and the economy.

5 SUGGESTIONS

With the authority and responsibility given by the central government to local governments, for the creation of sustainable development and the protection of nature conservation, the government as a policy maker is expected to pay more attention to regulations relating to resource management and the environment. Therefore, all sectors must adhere to the concept of sustainable development and a green economy approach.

6 RESEARCH LIMITATIONS

This study has limitations that can be taken into consideration for future researchers in order to get better research results. The lack of theoretical exploration that can enrich

the research and the results of the study are the limitations of this research. In addition, this study uses three independent variables that affect EQI. There are still several other factors that can explain and have an influence on the EQI variable either directly or indirectly. Research with dynamic models also needs to be done to determine the impact of economic growth on environmental damage in the short and long term.

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