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# Analysis of GRDP Per Capita, Population Density and Foreign Investment against the Environmental Quality Index

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**Abstract**
The aim of this research is to analyze the effect of GDP Capita, Population Density and Foreign Direct Investment on the Environmental Quality Index. This type of quantitative research with multiple linear regression model analysis. Using panel data in four provinces of Kalimantan Island in the 2010-2021 period. The results showed that population density has a significant effect on environmental quality. Meanwhile, GDP Per Capita and Foreign Direct Investment partially do not significantly affect environmental quality. The three independent variables simultaneously have a significant effect on the environmental quality index.

**Keywords**: GDP Per Capita, Population Density, Foreign Direct Investment, Environmental Quality Index.

## Introduction

Kalimantan Island is an island with abundant natural resources such as coal, palm oil, natural gas, diamond mining, tropical forests to gold. Kalimantan is also listed as the island with the largest coal producer in Indonesia. Based on data from the Ministry of Energy and Mineral Resources, the number of coal reserves in four provinces on Kalimantan Island is in the top 15 as the highest province as of December 2021, 4 of which are the top 5 largest nationally. Among others, from East Kalimantan of 13,6140 million tons, South Kalimantan of 3,679 million tons, Central Kalimantan of 1,995 million tons, North Kalimanan of 531 thousand tons and 11th from West Kalimantan Province of 43 thousand tons (Ministry of Energy and Mineral Resources Republic of Indonesia, 2021). This makes Kalimantan Island the island with the largest contributor to the country's foreign exchange from the mining sector.

The abundant natural resources of the mining sector can be used to help build the community's economic sector and even the country for economic growth which is expected to compete in the domestic and international markets. Along with the increasing demand for goods and services. Moreover, natural resources as a public good where the rights of the owner are not clearly confirmed. This vagueness causes environmental externalities that result in over consumption and over extraxtion of natural resources and the environment. This encourages ecosystem damage, decreased quality of natural resources and environmental quality.

The community as a direct stakeholder can easily utilize natural resources for daily needs without regulatory consequences. Thus, information on the governance, utilization, and use of natural resources is very necessary for environmentally smart human resources. Therefore, the Ministry of Environment and Forestry makes an Environmental Quality Index Report (EQI), which is published every period with the aim of educating and providing information related to the real conditions of the environment in Indonesia in each province. EQI is also intended for government evaluation materials to take action or sustainable policies.

In 2010, an environmental pollution case, one of which was the largest flood case in South Kalimantan Province in the last 10 years. In those cases there were at least 43 floods that year. In addition, there were 940 forest and land fires in South Kalimantan Province in 2018 (*Geoportal Data Bencana Indonesia,* n.d.). The increase in water pollution cases in the East Kalimantan river is suspected to be due to mining excavation holes of 53 excavated pits with an area of 2,823 hectares, while 53.05 hectares of toxic water in Pit L11N1 were not recovered by Indominco Mandiri (PT IMM). In West Kalimantan, there is excessive exploitation of forests due to the expansion of large industrial investments in the forest and land sector. Of the 14.6 million hectares of provincial area, 98% have been granted investment permits. In addition, in Central Kalimantan Province there was a fire covering an area of 3,000 hectares which was within the PT. Kumai Sentora (PT KS).

Based on the description above, all causes of pollution come from human and economic activities. Economic activity should be based on regulations to avoid environmental externalities that result in environmental degradation. Environmental degradation will also result in natural resources as raw materials being disrupted. If this happens, it will result in a decline in economic growth. The importance of economic growth as one of the benchmarks for a country's achievements.

Per capita income also provides benefits, including as an indicator of state health, a standard for the growth of state prosperity, and guidelines for making economic policies even as a comparison of the level of prosperity between countries. The high and low GRDP per capita certainly affects the value of  where GRDP is per capita. Areas with high incomes can reduce the value of environmental quality index, this is because activities to meet daily needs continue to increase so that pressure continues to occur on natural resources as raw materials for production. Activities from industries that leave residues in production activities also emit waste and pollution, which can also affect the value of environmental quality index in four provinces on the island of Kalimantan.

In addition to GRDP per capita, another factor that can affect the value of environmental quality index is population density. In maintaining the standard of living of the population of an area, the economy must still be carried out in accordance with the needs and demands continuously. Foreign investment is one of the factors other than GRDP per capita and population density which can affect the Environmental Quality Index. According to Kairupan (2014), huge financing is needed to be able to support regional economic growth, and this financing can be helped from domestic and foreign funding sources. According to Sopiana et al, it is assumed that the condition of developed countries is established where investment cannot increase income. This happens because the existing investment already covers all production costs, so that additional savings in the country cannot be used as additional investments (Sopiana et al., 2022). Thus, investment activities are very vital in creating high economic growth in an area.

The influence of FDI is also proven from research Silvia et al., (2021) that foreign direct investment is able to create environmental degradation by 98% and detect the presence of *Pollution-Haven Hypothesis* in ASEAN countries with income. Also, supported by Tang's research (2018) that FDI is able to present CO2 emissions in 41 countries in the world and even 17 countries in Asia by 99% where these results prove that FDI can worsen environmental quality.

## Literature Review

### Environmental Quality Index (EQI)

EQI is a performance indicator of national environmental implementation which is used as news for calculations in the policy making process related to environmental protection and management (Kementerian Lingkungan Hidup dan Kehutanan, 2019). The EQI value is the result of a combination of EQI values from all districts, cities and provinces in Indonesia.

In EQI from 2010 to 2019, there are 3 EQI-forming indicators consisting of the Water Quality Index (WQI); Air Quality Index (AQI); Land Cover Quality Index (LCQI). However, the EQI in the 2020-2024 RPJMN consists of 4 components, namely the Water Quality Index (IKA), Air Quality Index (AQI), Land Quality Index (LQI), and Sea Water Quality Index (SWQI). (Dinas Lingkungan Hidup Provinsi Kalimantan Selatan, 2021)

EQI value in an area is close to 100, the environmental quality in that area is very good, and vice versa if the value is close to 0, the quality of the environment is poor/bad.

### Gross Regional Domestic Product Per Capita

Boediono (1985), economic growth is the process of increasing long-term per capita production. Economists say economic growth is not only measured by GDP and GNP growth, but given intangible weights such as joy, satisfaction with the sense of security and peace experienced by the wider community. (Arsyad, 1999)

According to Sukirno, per capita income is a description of the *income* received by each individual during one period in an area (Sukirno, 2019). Per capita income can be obtained through the quotient of GRDP with the number of residents in the period in line. In short, GRDP Per capita can be used as a measure of economic growth if the growth in question is an increase in the output

of goods and services that must be expressed in real form or formed in a constant price of abundance in a particular region.

**Population Density**

Badan Pusat Statistik (2023), population density is the large population of land area in the administrative area.

Mantra (2007), the population density of the total parable of a human individual with the area of the occupied area/area is then formatted with units of soul/km2.

Hakeem (2017), almost all environmental effects resulting from population density are that residential spaces become narrow, building structures become taller and green *belts* shrink. Air quality will deteriorate as overcrowding increases.

Ehrlich & Holdren (1972), developed a model of the relationship of population density to environmental impacts also described using the IPAT (Impact-Population-Affluence-Technology) model.

**Foreign Direct Investment (FDI)**

Arsyad (1999), the regional economic process is a process in which the city and the community manage natural resources and then form a collaboration between the local government and the private sector to create new jobs and encourage the development of economic activities in the regions. It aims to create community health with the development of regional economic growth.

Dunning (1994), FDI contributions can provide resources that cannot be achieved or can only be achieved at high cost, can direct economic activity towards the production of goods and services that are considered effective by the domestic and international markets, also stimulate the efficiency of distributors and competitors, open new sources or jobs. The formation of additional markets is expected to outperform the existing competitiveness in the domestic and foreign markets.

**Circular Economy**

Strielkowski (2016), in its basic principle, a circular economy based on the concept of *Reduce, Reuse, Recycle* to optimize production levels to utilize environmental resources by reducing natural utilization, environmental pollution, reducing the use of emissions and waste from production (industrial waste, community waste, and household waste) which implies a sustainable concept. This concept is expected to be able to reduce waste by increasing the number of people in the world.

**Environmental Degradation**

Degradation can be caused by environmental pollution such as modern urbanization, industrialization, excessive population growth, deforestation (Tyagi et al., 2014). In fact, environmentalgradation is also pressed by the state in order to increase economic growth and development, and the needs of the people to meet basic needs (Reswita et al., 2021)

The role of the government in managing and maintaining the quality of the environment, where the environmental sector is one of the priority sectors of the state. In Law Number 32 of

2009, it is hoped that an integrated effort to preserve the function of the environment and prevent losses from happening to related parties.

**Previous Researchers**

Dimnwobi et al. (2021), GDP per capita and population density can increase environmental degradation. Case studies in African Countries

Pham et al. (2020), foreign direct investment, economic growth and population size are positively correlated with carbon emissions. Case studies in European Countries

Hashmi & Alam (2019), Population and GDP as the two main driving forces for increasing carbon emissions in OECD countries. Increased per capita environmental tax revenues reduce carbon emissions for OECD countries (29 of the 35 OECD countries 1999–2014 except Chile, Estonia, Iceland, Latvia, Luxembourg, and Portugal. Because data is not available)

Xiangmei et al. (2021), Water consumption in more than 50% of regions shows a downward trend in terms of regional GRDP growth. In population, water consumption has also decreased in more than 50% of the region. Regional GDP and population in 31 regions (provinces, cities and autonomous regions) in China.

Mosikari & Eita (2020), Results provide evidence of the existence of the truth of the Kuznets hypothesis. Urban populations negatively impact CO2 emissions in 29 selected countries in Africa.

Mansoor & Sultana (2018), Per capita income lowers CO2 emissions which implies that the country's economic growth helps reduce high mass CO2 emissions in a country. Pakistan case study (time series: 1972-2016)

Hao et al. (2018), Support the U-shaped Curve of GDP per capita and EQI. This low value means that the EQI built continues to decline as the economy develops, and China's development is still in the early stages of EKC. That is, being in the main stages of the EKC shows the current environmental impact of the economic development of the entire country cannot be ignored.

Liu & Lin (2019), Empirical results show that environmental pollution in each province has a clear spatial correlation, and there is an inverse N relationship between environmental pollution and economic development. In addition, the second proportion of industries has a significant positive relationship with environmental pollution, and increased R&D investment can significantly improve environmental quality, while there is no significant correlation between FDI and environmental pollution.

Aslam et al. (2021), Support the existence of the EKC hypothesis in the case of China. The long-term vector coefficient indicates that GDP per capita and the square of GDP per capita. Industrialization, population density, and trade openness positively affect CO2 emissions at the level of 5%.

Jiang et al. (2018), GRDP per capita has a positive direct effect but indirect effect is not significant, FDI has a negative direct influence, KP has a negative effect on the Water Quality Index.

## Research Method

Using a quantitative approach with a secondary type of data research. The purpose of this study is to analyze the influence of cause and effect between the variables of GRDP Per Capita, Population Density and Foreign Investment on the Environmental Quality Index. Panel data from West Kalimantan Province, East Kalimantan Province, South Kalimantan Province, and Central Kalimantan Province in the period 2010 to 2021.

## Data Analysis Techniques

Data analysis techniques use multiple linear regression. Then it is formulated in the equation of the regression function as follows:

$$\boldsymbol{Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + e}$$

where:
Y = EQI (Pertase), X1 = GRDP per capita (thousand rupiah), X2 = Population Density (Soul/km$^2$), X3 = Foreign Investment (Million Dollars), $\alpha$ = Constant, $\beta$ 1,2,3 = Coefficient of Free Variables, e = Error (Interference Variable)

## Results and Analysis

Based on the estimation results, it can be seen that the Chow test shows that rejecting $H_0$ then the selected model is a fixed effect model. While the results of the Hausman test show that the rejection of $H_0$ is rejected, the selected model is a fixed effect model in this test. So, it can be concluded that the best model that is able to describe data well is the fixed effect model.

**Table 1. Multiple Linear Regression Results**

| **Models** | ***Common Effect Model*** | | | ***Fixed Effect Model*** | | | ***Random Effect Model*** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Variables** | ***Coefficient*** | **t-Stat** | ***p-Value*** | ***Coefficient*** | **t-Stat** | ***p-Value*** | ***Coefficient*** | **t-Stat** | ***p-Value*** |
| **C** | 4,236 | 16,989 | 0,000* | 3,564 | 6,978 | 0,000* | 4,236 | 21,079 | 0,000* |
| **LogGDPPC** | 0,016 | 0,759 | 0,451 | -0,044 | -1,569 | 0,124 | 0,016 | 0,942 | 0,351 |
| **LogPD** | -0,07 | -2,96 | 0,004* | 0,335 | 2,994 | 0,004* | -0,07 | -3672 | 0,000* |
| **LogFDI** | 0,01 | 0,443 | 0,6596 | -0,008 | -0,38 | 0,705 | 0,01 | 0,55 | 0,585 |
| ***R-Squared*** | 0,225674 | | | 0,531318 | | | 0,225674 | | |
| ***Adj R-Squared*** | 0,17288 | | | 0,46273 | | | 0,17288 | | |
| **F-Stat** | 4,274549 | | | 7,746547 | | | 4,274549 | | |
| **Prob. (F-Stat)** | 0,00985 | | | 0,000013 | | | 0,00985 | | |
| **Chow Test** | Cross-section F = 0,000*<br>Cross-section Chi-square F = 0,000* | | | | | | | | |
| **Hausman Test** | | | | Cross-section random *p-Value* < 0,0 | | | | | |

* Significant at a rate of 1%

Based on the results of the regression above, the following equation is obtained based on the values contained in the table:

$$logEQI_{it} = 3.564 - 0.044logGDPPC_{it} + 0.335logPD_{it} - 0.008logFDI_{it} + e_{it}$$

Based on the equation above, it can be explained as follows:
The value of the determinant coefficient (R2) is 0.531318. These results presented the ability of free variables to be able to explain changes in fixed variables in 4 provinces on the island of Kalimantan by 53%. When viewed from the coefficient value of 3.564867, it means that simultaneously free variables can positively affect fixed variablels.

The value of the logGDPPC variable coefficient is -0.044609 and the probability is 0.1242 which means that the GRDP per capita affects the quality of the environment negatively and is not significantly below 1%. Thus, if the GRDP per capita increases by 1 rupiah, then the quality of the environment in the four provinces of Kalimantan Island decreases by 0.04%, provided that other variables remain.

The logPD coefficient value is 0.335703 and the probability is 0.0047 which means that Population Density affects the quality of the environment positively and is significantly below 1%. Thus, if the population density increases by 1 person, then the quality of the environment in the four provinces of Kalimantan Island has increased by 0.33%, provided that other variables are fixed.

The logFDI variable has a coefficient of -0.008026 and a probability of 0.7058. This means that if foreign investment increases by 1 US$, then the quality of the environment in the four provinces of Kalimantan Island will decrease by 0.008%, provided that other variabel remain.

## Conclusion

Per capita GRDP has no effect on EQI and has a negative relationship in the Four Provinces on Kalimantan Island in 2010-2021. This is due to differences in economic conditions between provinces. Also the utilization of natural resources that are not recorded. Population density affects EQI and has a positive relationship. When the number of socialized population increases, the awareness of overcoming and protecting the environment is higher, then activities to meet needs also increase and the value of EQI also increases. PMA has no significant effect on EQI and has a negative relationship. This is because the phenomenon of investment conditions between provinces is not the same, transportation aconomdation factors and maintenance costs require large costs.

This research proves that GRDP per capita and Foreign Investment have a negative influence on EQI in four provinces on the island of Kalimantan, this indicates a condition that needs to be worried. However, an important note for the government/swatsta and related stakeholders, not only active in increasing regional income/economy, but also policy decision making must pay attention to the condition of natural resources as an important aspect of production raw materials.

Awareness of improving the quality of the environment and the literacy of environmentally friendly technology/transportation is one of the proofs that the community helps realize

government regulations. However, it would be better if the equalization of supporting factors such as asphalt roads is not only in the capital, charging stations for electric transport and others.

The scope of the place used is only in the four provinces of Kalimantan Island due to limited information in North Kalimantan Province, it is feared that it is not able to describe the real situation. Based on the simultaneous results of the three free variables only 53% affect the EQI on the island of Kalimantan. This means that there are still many factors beyond the variables studied that are better able to describe the influence of EQI.

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