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# DETERMINANTS OF ENVIRONMENTAL QUALITY INDEX (EQI) IN INDONESIA IN 2018-2022

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***Abstract*****:** *The environment is a critical issue in sustainable development in Indonesia, with significant variations in environmental quality between regions. This study seeks to examine the influence of the Regional Government Budget, COVID-19 (as a dummy variable), Gross Regional Domestic Product (GRDP), and the Human Development Index (HDI) on the Environmental Quality Index (EQI) in Indonesia. The data for this study were obtained from BPS–Statistics Indonesia and the Ministry of Environment and Forestry, covering the period from 2018 to 2022. The analysis employs multiple linear regression using panel data. Panel model testing indicates that the fixed effects model with cross-sectional lag provides the best fit. The results show that, collectively, all variables have a significant influence on Indonesia's Environmental Quality Index (EQI). Individually, the Regional Government Budget for environmental purposes, the COVID-19 dummy variable, and the Human Development Index (HDI) have a significant positive impact on EQI. In contrast, Gross Regional Domestic Product (GRDP) has a significant negative effect. These findings highlight the need for comprehensive macro-socioeconomic policies to sustain and enhance environmental quality in Indonesia.*

**Keywords :** COVID-19, EQI, GRDP, HDI, Income, Investment

## INTRODUCTION

As a country that is still in the early stages of development and continues to pursue sustainable development, Indonesia faces various environmental problems related to pollution, urbanization, and excessive resource exploitation (Suharti & Sugiarto, 2020). The concept of sustainability is becoming increasingly important as awareness of the environment rises (Rahmadhani, 2025). Their environmental policies are further deteriorated by the existence of a two-tiered system of government, in which responsibility for environmental management is divided between central and regional authorities. The Regional Revenue and Expenditure Budgets set aside to solve environmental problems show the level of commitment regional governments have to confront regional challenges. Access to these funds determines strategic approaches that increase the environmental impact.

The balance of economic activities, measured using Gross Regional Domestic Product, contributes positively and negatively to environmental conditions. Economic development provides an avenue for environmental conservation funding, but it also accelerates pollution and resource overuse (Pujiati et al., 2023). The Human Development Index, which is considered a combination of health, education, and people's standard of living, shows that the population is in relatively good condition. A high human development index places the same responsibility on demand as on quality in the desired environment. In the context of pandemic situation, the COVID-19 coronavirus pandemic has affected every aspect of life (Kuncara & Anugrah, 2023; Suwandi, 2022).The COVID-

19 pandemic has affected the environment and human life in unprecedented ways. Lockdowns and disruptions caused by the pandemic have had both positive and negative impacts on the environment, requiring a deeper examination of their impact on the Environmental Quality Index (Khomariyah et al., 2022).

Economic growth and environmental quality have been researched and analyzed previously. Most studies have shown that during the early phases of development, economic growth often results in environmental degradation. However, as most economies mature, environmental quality tends to improve (Tasri et al., 2022). However, the Kuznets curve is also controversial; despite proposing an inverse U-shaped relationship between economic growth and environmental degradation, Kuznets remains highly debated and criticized. Some studies support the Environmental Kuznets Curve (EKC), while others show no association or even the presence of positive associations, suggesting that economic growth leads to further environmental degradation.

Decentralization and growing public demand for transparency have driven central and local governments to adopt more accountable financial management systems to ensure the efficient, effective, and beneficial use of public funds (Annisa et al., 2022). The changes brought about by fiscal decentralization to a country's governance structure are another emerging area of study regarding its impact on environmental quality. Policies have adopted sustainability with a special focus on development and growth, and policies recognize natural resources as the primary part of the production process, along with environmental quality(Costantini & Monni, 2007). In some cases, decentralization improves environmental outcomes owing to improved regional governance, allowing autonomous and regionalized solutions to persistent regional problems. Nonetheless, other research suggests that decentralization can lead to a 'race to the bottom' phenomenon, where regional governments compete to lower environmental standards to secure investment (Boukhatem & Moussa, 2017).

The relationship between human progress and environmental degradation is complex. Khan (Khan, 2024) noted that while developed countries have achieved high levels of HDI, these developments are often attributed to extreme environmental destruction. By contrast, the government stock of human capital tends to correlate with the firmness of environmental policies and investment in environmental protection. The unique context of the COVID-19 pandemic allows for an examination of exogenous shocks and their impact on environmental quality. The closure of and restrictions on travel and industrial activities have resulted in several positive environmental changes, including reduced air and water pollution. However, these changes have been overshadowed by a sharp increase in waste production, especially with single-use plastics, and the diversion of funds from environmental protection initiatives to pandemic relief efforts (Trisnowati et al., 2022).

Existing literature describes the various basic elements that affect the quality of the environment; however, there is still a lack of sufficient understanding of certain aspects. A country's development is associated with achieving high levels of HDI, which, in turn, indicates outcomes that lead to severe environmental degradation. One drawback of previous research is the self-imposed isolation of very few indicators and specific geographical boundaries.

The current study aims to fill the gaps in the literature by focusing on the Environmental Quality Index for 34 provinces in Indonesia from 2018 to 2022, with the pandemic as a natural experiment, and using a comprehensive range of explanatory variables, such as regional government budget expenditure on the environment, gross regional domestic product, human development index, and dummy variables for the COVID-19 pandemic.

As mentioned in a previous study (Hajdúova et al., 2014), this allows comparisons in different areas and over a specific period, aiding in the detection of both improvement trends and decreases in environmental quality. It also serves as an index that shows the level of performance of all activities carried out in a spatial area focused on achieving the set objectives. Analyzing the factors affecting Indonesia's Environmental Quality Index is important for several reasons. First, Indonesia is among the top countries in the world in terms of biodiversity, and environmental conditions are critical to the world's efforts to conserve biodiversity. Second, it is a developing country. Therefore, the economic growth path of a country is fundamental to its environment. Third, Indonesia is a decentralized unitary state, meaning that the effectiveness of the country's environmental policies is highly dependent on the ability and willingness of regional governments. Fourth, Indonesia's large population, mostly sedentary, makes air quality an important health issue, particularly with the increase in respiratory diseases (Kusuma et al., 2023). Fifth, the COVID-19 pandemic has emphasized the relationship between human health and the environment, requiring an integrated environmental management approach. Studies that focus on the impact of COVID-19 on environmental quality are still limited because the majority focus solely on the macroeconomic sector (Syamsul et al., 2022). Additionally, many studies have focused on developed countries such as the United

States and the United Kingdom (Sugiarto et al., 2023). This concentration poses an important gap in the study of developing countries, especially Indonesia, which has unique socioeconomic and environmental conditions.

Our neighborhoods support resources and serve as homes for communities. However, human needs and activities have profoundly altered land surfaces, leading to a noticeable decline in environmental quality (Listyaningrum et al., 2022). This study aimed to investigate the determinants of the Environmental Quality Index in 34 provinces of Indonesia from 2018 to 2022. Independent variables include environmental spending from the Regional Revenue and Expenditure Budget, Gross Regional Domestic Product, Human Development Index, and dummy variables for COVID-19 during the pandemic years 2020 and 2021. Analyzing the elements that affect environmental quality is essential for sustainable development and for ensuring that developing populations and future generations are adequately supported (Solheri et al., 2022). There is a strong relationship between sustainable economic growth and improved environmental quality (Wafiq & Suryanto, 2021).

## RESEARCH METHODS

As a country that is still in the early stages of development and continues to pursue sustainable development, Indonesia faces various environmental problems related to pollution, urbanization, and excessive resource exploitation (Suharti & Sugiarto, 2020). The concept of sustainability is becoming increasingly important as awareness of the environment rises (Rahmadhani, 2025). Their environmental policies are further deteriorated by the existence of a two-tiered system of government, in which responsibility for environmental management is divided between central and regional authorities. The Regional Revenue and Expenditure Budgets set aside to solve environmental problems show the level of commitment regional governments have to confront regional challenges. Access to these funds determines strategic approaches that increase the environmental impact.

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19 pandemic allows for an examination of exogenous shocks and their impact on environmental quality. The closure of and restrictions on travel and industrial activities have resulted in several positive environmental changes, including reduced air and water pollution. However, these changes have been overshadowed by a sharp increase in waste production, especially with single-use plastics, and the diversion of funds from environmental protection initiatives to pandemic relief efforts (Trisnowati et al., 2022).

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The current study aims to fill the gaps in the literature by focusing on the Environmental Quality Index for 34 provinces in Indonesia from 2018 to 2022, with the pandemic as a natural experiment, and using a comprehensive range of explanatory variables, such as regional government budget expenditure on the environment, gross regional domestic product, human development index, and dummy variables for the COVID-19 pandemic.

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## RESEARCH METHODS

This study employs a quantitative research approach to examine the relationships among variables, following the framework proposed (Sugiyono, 2019). Data were obtained from official publications of BPS–Statistics Indonesia (Statistik, 2022) and the Ministry of Environment and Forestry (Kementrian Lingkungan Hidup dan Kehutanan, 2022), covering all provinces in Indonesia from 2018 to 2022. An overview of the study variables is provided in Table 1.

Table 1. Variable Research

| Variables | Unit | Data Scale | Data Training |
|---|---|---|---|
| *Dependent Variables* | | | |
| Environmental Quality Index (EQI) | Points | Ratio | |
| *Independent Variables* | | | |
| Regional Government Budget for Environment | Million Rp | Ratio | Natural logarithms |
| Dummy covid | 1 for 2020 and 2021 | | |

| | | | |
|---|---|---|---|
| | 0 for others | | |
| Gross Regional Domestic Product (GRDP) | Billion Rp. | Ratio | Natural logarithms |
| Human Development Index (HDI) | Points | Ratio | |

Panel data regression analysis is employed in this study, encompassing three modeling approaches: the common (pooled) model, the fixed effects model, and the random effects model (Baltagi, 2005). Model selection tests are conducted to identify the most suitable model for explaining the relationships among the variables. The results of the panel model selection tests are presented in Table 2.

Table 2. Panel Model Selection Test

| Panel Model Test | Null Hypothesis | Alternative Hypotheses |
|---|---|---|
| LM BP Tests | Pooled/common Model is better than Random | Random Model is better than Pooled/ common Model |
| Chow Test | Pooled/common Model is better than a Fixed | Fixed Model is better than Pooled/Common Model |
| Hausman test | A random Model is better than a Fixed | A fixed Model is better than a Random |

Following the selection of the most appropriate model, classical assumption tests are conducted to ensure the model's validity for analyzing the relationships among variables and for predicting the dependent variable based on the known values of the independent variables (Gujarati, 2004). The results of the classical assumption tests are presented in Table 3.

Table 3. Classical Assumption Test

| Assumption Test | Null Hypothesis | Alternative Hypotheses |
|---|---|---|
| Jarque-Bera | Data is normally distributed | Data is not normally distributed |
| Glejser | Homoscedastic variance | Heteroscedastic Variance |
| Breusch-Godfrey | Non-Autocorrelation | Autocorrelation |
| Ramsey RESET Test | Linear Model | Nonlinear Model |

After selecting the optimal model and confirming that it satisfied the classical assumptions, the next step involved evaluating the model's goodness-of-fit (Walpole, 2012). Table 4 presents the results of the goodness-of-fit tests. Once all model testing criteria were fulfilled, the resulting regression equation was interpreted.

Table 4. Goodness Test Model

| The goodness of Fit Test | Null Hypothesis | Alternative Hypotheses | Reject Ho |
|---|---|---|---|
| Adjusted R square | R square > 0.5 | | |
| Simultaneous Test (Chi-square test) | Model is not fitted (All variables have no effect) | Model is fitted (at least one variable has a significant effect) | Prob. Value < 0.05 |
| Partial Test / T Test | Certain independent variables have no effect | independent variable has a significant effect | Prob. Value < 0.05 |

The regression equation used in this study is as follows:

$$EQI = \beta_0 + \beta_1 lnLGB + \beta_2 ldummycovid + \beta_3 lnGRDP + \beta_4 HDI + \varepsilon_1 \quad (1)$$

The hypotheses of this study were as follows:

H1: The Regional Government Budget for the environment has a significant effect on the positive Environmental Quality Index in Indonesia

H2: Dummy COVID has a significant effect on positive Environmental Quality Index in Indonesia

H3: GRDP has a significant effect on negative Environmental Quality Index in Indonesia

H4: The HDI has a significant effect on the positive Environmental Quality Index in Indonesia.

## RESULTS AND DISCUSSION

The discussion begins with a descriptive analysis to identify the characteristics of each variable during the study period, as shown in Table 5. The average Environmental Quality Index (EQI) is 69.97, ranging from a minimum of 39.06 in DKI Jakarta (2018) to a maximum of 84.22 in West Papua (2022). The average Regional Government Budget allocated for environmental purposes is 229,817.2 million rupiahs, with values ranging from 1,140 million rupiahs in Bengkulu (2021) to 7,462,670 million rupiahs in DKI Jakarta (2019). The mean Gross Regional Domestic Product (GRDP) is 325,806.9 million rupiahs, with the lowest value of 25,034.08 million rupiahs in North Maluku (2018) and the highest of 1,953,489 million rupiahs in DKI Jakarta (2022). The average Human

Development Index (HDI) is 71.15, with Papua recording the lowest (60.06) in 2018 and DKI Jakarta the highest (81.650) in 2022.

Table 5. Descriptive Analysis

| Variable | Minimum | Maximum | Mean | Std. Dev. |
|---|---|---|---|---|
| EQI | 39.06 | 84.22 | 69.97 | 8.080 |
| LGB | 1,140.00 | 7,462,670.00 | 229,817.20 | 906,216.10 |
| GRDP | 25,034.08 | 1,953,489.00 | 325,806.90 | 464,477.90 |
| HDI | 60.06 | 81.65 | 71.15 | 3.94 |

Source: Data Process

To ensure the validity of the regression model, multicollinearity among independent variables must be minimal, as indicated by a Variance Inflation Factor (VIF) value below 10. As shown in Table 6, all independent variables in this study exhibited VIF values below this threshold, indicating the absence of high multicollinearity and confirming their suitability for inclusion in the model.

Table 6. Multicollinearity Test

| Variable | VIF |
|---|---|
| lnRGB | 1.154 |
| COVID | 1.014 |
| lnGRDP | 1.348 |
| HDI | 1.257 |

Source: Data Process

Prior to conducting further analysis using panel data regression, a model selection was performed to determine the most appropriate specification. As outlined in the methodology section and detailed in Table 7, three tests are conducted to compare the panel data models. The fixed-effects model was identified as the most suitable for capturing the relationships among the variables in this study.

Table 7. Panel Model Test

| Test | Test Value | Prob. Value | Conclusion |
|---|---|---|---|
| Chow Test | 4.82 | 0.000 | The fixed Model is better than the Common Model. |
| LM BP Test | 55.08 | 0.000 | The Random Model is better than the Common Model. |
| Hausman Test | 63.35 | 0.000 | The fixed Model is better than the common random Model. |

Source: Data Process

Following the selection of the panel model, classical assumption tests were conducted prior to interpretation. These tests are essential to ensure that the chosen model is appropriate for analyzing the effects and making predictions. The assumptions evaluated included normality, heteroscedasticity, and autocorrelation. The assumption of normality was satisfied, as indicated by a probability value greater than 0.05. However, violations were detected in the tests for heteroscedasticity and autocorrelation, with both yielding probability values below 0.05.

Table 8. Classical Assumption Test

| Test | Test Value | Prob. Value | Conclusion |
|---|---|---|---|
| Jarque-Bera | 1.899 | 0.386 | Normality |
| Glejser | 7.793 | 0.000 | Heteroscedasticity |
| Breusch-Godfrey | 19.83 | 0.000 | Autocorrelation |
| Ramsey Reset Test | 2.325 | 0.076 | Linearity |

Source: Data Process

To address the violations of heteroscedasticity and autocorrelation, the fixed effects model was adjusted using the White cross-section method with lagged data (Greene, 2020). The final model specification is presented in the hypothesis testing results in Table 9. As shown, the coefficient of determination ($R^2$) is 0.929, indicating that the independent variables collectively explain 92.9% of the variation in the Environmental Quality Index (EQI), with the remaining 7.1% attributed to factors outside the model. The F-test result (p-value = 0.000) is statistically significant at the 5% level, confirming that the independent variables, as a group, have a significant effect on EQI and that the model is appropriate for analysis.

Table 9. Hypothesis Test

| Variable | COEF | beach | t-stat | Prob. | Conclusion |
|---|---|---|---|---|---|
| c | -242.302 | 40.220 | -6.024 | 0.000 | |
| lnRGB | 0.187 | 0.091 | 2.067 | 0.041 | accept hypothesis |
| COVID | 2.764 | 0.252 | 10.956 | 0.000 | accept hypothesis |
| lnGRDP | -10.002 | 4.341 | -2.304 | 0.023 | accept hypothesis |
| HDI | 5.880 | 0.609 | 9.649 | 0.000 | accept hypothesis |
| EQI (-1) | 0.150 | 0.061 | 2.466 | 0.015 | |
| R-squared | 0.949 | | F-statistic | 47.165 | |
| Adjusted R-squared | 0.929 | | Prob(F-statistic) | 0.000 | |

Source: Data Process

The partial test, as indicated by the t-test probability values, demonstrated that all independent variables had a statistically significant effect, with p-values of 0.000, which were below the significance level of 0.05. Based on these results, the following regression equation was derived:.

$$\hat{EQI}=-242.302+0.187\ln LGB+2.764COVID-10.002\ln GRDP+5.880HDI+0.150EQI_{t-1} \quad (2)$$

***Discussion***

The Environmental Quality Index is a complex indicator that describes the level of environmental quality, which is influenced by various socioeconomic components as well as unforeseen events, such as pandemics. This study examines the influence of local government spending on environmental conservation, Gross Regional Domestic Product, Human Development Index, and the COVID-19 pandemic on the value of the Environmental Quality Index.

Spending by the government on the environment comes from the regional budget and positively impacts the quality of the environment, as cited by Ahmad (Ahmad et al., 2023). Expanding investment spending in this area could lead to the formulation and implementation of stronger policies aimed at environmental protection, better waste management, and the adoption of cleaner technologies. Such actions will increase the Environmental Quality Index (Nawaz & Iqbal, 2020). In addition to these environmental factors, the study of Banzhaf et al. (Banzhaf et al., 2014)states that the Human Development Index of health, education, and living standards also positively impacts environmental quality. In particular, educated populations with higher levels of awareness tend to be more environmentally responsible, helping to reduce ecological damage (Tasri et al., 2022b). On the other hand, Gross Regional Domestic Product serves as an indicator of economic well-being. However, without sustainable economic activities and practices, it can harm the Environmental Quality Index.

From the perspective of dummy variables, the COVID-19 pandemic is an interesting example. It has been proven that industrial activities in a region or country usually increase pollution levels. Therefore, the lockdowns and restrictions on industrial activities during the pandemic may improve the Environmental Quality Index during the peak of the pandemic years. Also worth noting is the positive dependency relationship between local government spending and environmental quality. Expenditure by local governments is in line with the doctrine of allocation efficiency in public finance. It is understood that setting aside specific funds for these issues improves the structured management of activities related to the environment.

As directed in a study conducted by Dsouza et al. (Dsouza et al., 2024), government authorities can focus on controlling pollution, saving resources, and encouraging ecological development with the funds they receive for environmental protection. This activity greatly improves the Environmental Quality Index. In addition, the impact of the Human Development Index on environmental quality also highlights the role of human capital in environmental protection. Educated and healthy individuals are more concerned about socio-environmental issues and tend to practice sustainability, which increases the Environmental Quality Index (Costantini & Monni, 2007; Wu et al., 2023).

The enormous negative impact of the Gross Regional Domestic Product on environmental quality is very worrying because it shows the trade-offs of environmental sustainability that arise with economic growth. Economic activities, on the one hand, drive a country's economy and need to be ecologically maintained, but on the other hand, uncontrolled economic development can result in pollution, excessive consumption of resources, and habitat destruction (Esty & Porter, 2005). This result supports the finding that environmental performance is said to be influenced by the level of regulatory sophistication and the economic and social background of the country.

The unprecedented economic disruption caused by the pandemic positively affected the Environmental Quality Index (EQI) during this period. The COVID-19 lockdown led to a reduction in emissions and pollution,

temporarily improving air and water quality. It has been documented that during the COVID-19 pandemic, there has been an improvement in air quality along with a reduction in transboundary haze pollution (Praveena & Aris, 2021). This result supports the hypothesis that temporary industrial activity and travel reductions I can lower atmospheric pollutant concentrations (Singh et al., 2021). Lockdowns indicate an improvement in air quality with 'nowhere to go,' illustrating the impact of economic and travel activities on environmental pollutants, albeit temporary (Schröter et al., 2022). It calls for encouraging deliberate economic growth while avoiding substantial environmental impacts (Ye & Fang, 2025).

## CONCLUSION

Based on panel model testing, the white cross-section with lag in the fixed Model is the best. White cross-section modeling and lag in overcoming autocorrelation and heteroskedastic problems Environmental Quality Index (EQI) models are used. Simultaneously, all variables of the Regional Government Budget for the environment, Gross Regional Domestic Product (GRDP), dummy covid, and Human Development Index (HDI) in Indonesia. Partially, variables of the Regional Government Budget for the environment, dummy COVID, and HDI significantly affect EQI in Indonesia. Increasing the variables of the regional government budget for the environment, dummy COVID-19, and human development index (HDI) will increase Indonesia's EQI level. Meanwhile, GRDP significantly negatively affects EQI in Indonesia.

Based on the findings of this study, comprehensive macro-socioeconomic policies are necessary to ensure the continued improvement of the Environmental Quality Index (EQI) in Indonesia. These policies should include increasing the allocation and efficiency of regional government budgets dedicated to environmental programs, particularly in provinces with low EQI performance. The government could implement fiscal incentives for local governments that prioritize sustainable development, strengthen monitoring and evaluation mechanisms for environmental spending, and integrate environmental targets into broader regional development plans. Additionally, improving human development through education and public awareness campaigns on environmental stewardship, along with expanding green job opportunities, may indirectly enhance EQI. Cross-sectoral coordination between environmental agencies, planning institutions, and economic departments should also be reinforced to ensure that environmental quality is mainstreamed into macroeconomic and social policy frameworks.

Future research could incorporate additional independent variables that may influence EQI, such as unemployment, poverty, and economic stability. In addition, subsequent studies may explore alternative panel data modeling approaches, including random effects models, generalized estimating equations (GEE), or spatial panel models, to improve analytical accuracy and account for spatial and temporal variations.

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