EcoProfit
EcoProfit: Sustainable and Environment Business
EcoProfit 3(1): 1–16
ISSN 3024-9872

Institute for Advanced Science, Social and Sustainable Future
MORALITY BEFORE KNOWLEDGE

Beyond resource abundance: Evaluating the impact of mining and fiscal transfers on regional sustainable development index

Irawan Abae[1,*], Abdul Chalid Ahmad[1], Said Mala[1]
[1] *Development Economics, Economics and Business, Khairun University Ternate, 97869, Indonesia.*
*Correspondence: irawanabae46@gmail.com

Received Date: June 16, 2025 Revised Date: July 1, 2025 Accepted Date: July 31, 2025

ABSTRACT

Background: The mining sector in Indonesia has long been an important pillar of the country's economy. The region Sulawesi, Maluku and Papua is a region rich in resource nature such as minerals and energy, has contributed significantly to the national economy, especially through the export of mining products. However, along with the growth of the mining sector, various challenges have emerged, not only related to economic aspects, but also environmental and social impacts that threaten the sustainability of development. *Natural resource curse theory* : this theory states that countries or regions that depend on natural resources natural resources, such as mining, often experience slow economic growth or negative impacts. socio-environmental imbalance, so that its contribution to sustainable development become limited. **Methods**: Study This use two approach, First that is counting index sustainable development (IPB), and second, using the panel data regression method, covering 10 provinces in the Sulawesi, Maluku and Papua regions. Excluding the three new provinces in the Papua region, namely the Province South Papua, Central Papua, and Mountainous Papua. **Findings:** The results of the IPB calculations for each province in Sulawesi, Maluku and Papua regions using the development dimension. In general, the regions Papua and parts of Sulawesi showed high IPB achievements in 2024. However, there are disparities which is quite striking between provinces. The highest IPB figure is West Papua and the lowest is Maluku Province. **Conclusion**: Fiscal transfers of natural resources (SDA) and population have a significant influence. towards IPB, supported by theories and research that show the importance of resource management nature and population dynamics in sustainable development. As for the GRDP of the mining sector found to have no significant effect. The cause may be due to the impact of *the natural resource curse* and lack of practice mining sustainable. Matter this is what hinder his contribution to IPB. For to support sustainable development, better management of fiscal transfers of natural resources is needed, application of environmentally friendly technology in the mining sector, improving the quality of human resources and infrastructure to manage demographic pressures. **Novelty/Originality of this article:** This research provides novelty in terms of geographical context specifically in the regions of Sulawesi, Maluku, and Papua. Although This area is rich in natural resources, the implementation of sustainable development policies in this area still limited, especially due to infrastructure constraints, human resources, and differences in social conditions And culture.

KEYWORDS: mining sector; sustainable development; fiscal transfer; panel data.

1. Introduction

Since the Earth Summit in Rio de Janeiro in 1992 (Hardjasoemantri & Supriyono, 2019), the concept of sustainable development has become the focus of international discussion.

Cite This Article:
Abae, I. R., Ahmad, A. C., & Mala, S. (2025). Beyond resource abundance: Evaluating the impact of mining and fiscal transfers on regional sustainable development index. *EcoProfit: Sustainable and Environment Business, 3*(1), 1-16. https://doi.org/10.61511/ecoprofit.v3i1.2025.1969

Sustainable development has become increasingly prominent since the emergence of the Sustainable Development Goals (SDGs) agenda as a replacement for the Millennium Development Goals (MDGs) (De Jong & Vijge (2021), which ended in 2015 (Klarin, 2018).

Theoretically, the economic potential of the mining sector should be able to become a catalyst for cross-sector development through optimal fiscal transfers. The theory of fiscal federalism explains that fiscal decentralization, especially in the context of DBH SDA, can strengthen regional fiscal capacity to encourage inclusive and contextual growth (Oates, 1999; Bahl & Linn, 1992). However, in practice, many producing regions are trapped in the resource curse phenomenon, where natural wealth is not accompanied by an increase in welfare or adequate environmental quality (Auty, 2001; World Bank, 2018).

The mining sector in Indonesia has long been an important pillar in the country's economy (IMI, 2018). The Sulawesi, Maluku and Papua (SULAMAPUA) region is an area rich in natural resources such as minerals and energy, and has contributed significantly to the national economy, especially through the export of mining products (Taufikurahman et al., 2023). It is not surprising that in this region the mining sector is the dominant sector (Naryono, 2023); (Yani et al., 2024). However, along with the growth of the mining sector, various challenges have emerged that are not only related to economic aspects, but also environmental and social impacts that threaten the sustainability of development (Mancini & Sala, 2018); (Onifade et al., 2024).

The implementation of sustainable development in Indonesia is very urgent considering the abundant natural resource wealth, including the mining sector which is one of the main pillars of the country's economy (Kurniawan & Managi, 2018); (Arifin et al., 2024). The utilization of abundant natural resources in this sector is often faced with complex problems, such as environmental damage, social inequality, and dependence on raw material exports (Tarigan et al., 2024); (Imran, et al., 2024).

The Sulawesi, Maluku, and Papua (Sulamapua) region is a strategic area of Eastern Indonesia that is rich in natural resources, especially mineral, oil and gas, and marine mining. The mining sector is one of the backbones of the economy in this region, making a significant contribution to the Gross Regional Domestic Product (GRDP) and being a source of state revenue through the Natural Resource Revenue Sharing Fund (DBH) scheme. However, the abundance of resources is not yet fully in line with the achievement of sustainable development indicators, such as the human development index (HDI), environmental quality, and social welfare of local communities (BPS, 2023; Ministry of Finance, 2024).

The main challenge in implementing sustainable development in the mining sector is how to create a balance between economic growth and environmental sustainability, and ensure equitable distribution of benefits for local communities (Kersting, 2021); (Hariram et al., 2023). The application of sustainable development principles in this sector, especially in the SULAMAPUA region, requires a holistic and integrative approach. Not only prioritizing economic aspects but also social and environmental impacts (Bahri et al., 2024); (Bappenas, 2019). Including involving various parties, both local governments, mining companies, local communities, and non-governmental organizations, to create an inclusive, equitable, and environmentally friendly development model (Stacey et al., 2021); (Jamin et al., 2023); (Rohman et al., 2024).

Similar phenomena also occur in Sub-Saharan Africa, countries such as the Democratic Republic of Congo and Zambia face similar dilemmas in managing the mining sector, dependence on raw material exports, ecosystem damage, and social conflicts in mining areas (Hilson & Maconachie, 2020). Likewise in South America, countries such as Peru and Bolivia face challenges in implementing sustainable development principles in the mining sector, especially related to indigenous peoples' rights and environmental degradation (Bebbington et al., 2018; Haslam & Tanimoune, 2016). However, several countries have begun to implement benefit-sharing mechanisms and strengthening local content as a form of solution that has been relatively successfully adopted. Here is a model to clarify sustainable development:

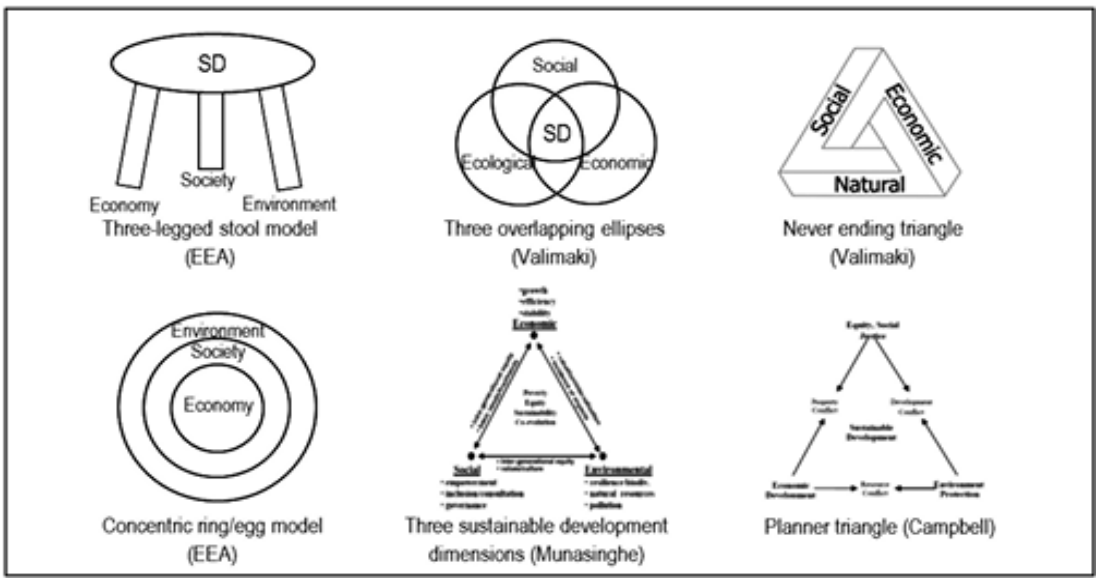

Fig. 1. Sustainable development model (economic, social, and environmental)

The first model is the Three-legged Stool Model Showing that economic, social, and environmental diversity must be balanced so that the "stool" (sustainability) does not collapse. The second model explains the size of the three overlapping circles (Venn diagram) Showing the middle area where the economy, social, and environment intersect is where sustainable development "SD" is located. Then the third model is the Nested Circles Model The economic sphere is within society, and everything is in the environment, showing a hierarchy of dependencies. And the fourth model is the Planner's Triangle Model Regarding the conflict and balance between social justice, economic development, and environmental protection, from Campbell and colleagues

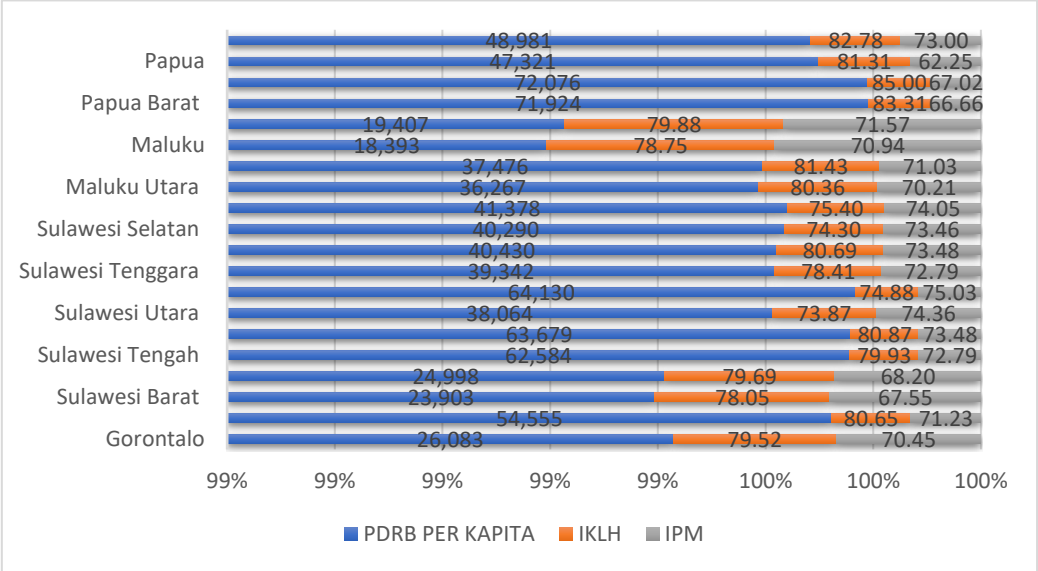

Fig. 2 Three indicators of sustainable development in 10 provinces of Eastern Indonesia

Sustainable development in Indonesia includes three main pillars: the Economic pillar represented by GRDP per capita, the Social Pillar represented by the Human Development Index (HDI), and the Environmental Pillar represented by the Environmental Quality Index (IKLH). In the context of the eastern region of Indonesia, especially the Sulawesi, Maluku, and Papua regions, the three pillars can be evaluated simultaneously through the indicators of Gross Regional Domestic Product (GRDP) per capita, Human Development Index (HDI),

and Environmental Quality Index (IKLH). Data for 2023–2024 shows interesting dynamics in these three dimensions in each province.

From an economic perspective, GRDP per capita shows disparities between regions. The province with the highest achievement in 2024 was West Papua (IDR 72,076 million), followed by Central Sulawesi (IDR 63,679 million), while Maluku (IDR 19,407 million) and West Sulawesi (IDR 24,998 million) recorded the lowest values. This shows that despite fairly even economic growth, structural disparities still exist, especially between provinces rich in natural resources and those that still rely on the traditional primary sector. Significant increases in the provinces of Gorontalo and North Sulawesi indicate fairly successful economic development interventions.

In the social dimension, the HDI, which reflects the quality of life of the community, shows a positive trend, although with varying achievements. North Sulawesi and South Sulawesi recorded the highest HDI in 2024, at 75.03 and 74.05 respectively, reflecting success in the aspects of education, health, and people's purchasing power. Meanwhile, Papua experienced a very significant increase in the HDI, from 62.25 in 2023 to 73.00 in 2024. This increase indicates significant progress in human development in a previously lagging region. However, West Papua, despite having a high GRDP, still recorded a relatively low HDI (67.02), indicating that the distribution of economic development results towards improving people's welfare is not yet optimal.

Meanwhile, from the environmental side, IKLH provides a relatively more stable picture but indicates its own challenges. West Papua and Papua provinces recorded the highest IKLH, at 85.00 and 82.78 respectively in 2024. The high quality of the environment in these two regions is likely influenced by the dominance of natural ecosystems and low levels of exploitation compared to other regions. In contrast, provinces with high economic and social achievements such as North Sulawesi and South Sulawesi actually recorded lower IKLH (74.88 and 75.40 respectively). This phenomenon indicates a potential conflict between economic growth and environmental preservation, which can be a challenge in implementing the principles of sustainable development.

Overall, the three main indicators of sustainable development show that not all provinces in eastern Indonesia have been able to achieve balance between pillars. Several provinces show excellence in one or two pillars, but still face major challenges in other pillars. Therefore, a more integrative development policy is needed, which not only focuses on economic growth, but also pays attention to social aspects and environmental sustainability simultaneously. The integration of these three pillars is key to driving the transformation of eastern Indonesia towards inclusive and sustainable development.

Previous studies have shown that inefficient management of natural resource revenues, weak institutional capacity, and minimal integration between extractive sector policies and social development have caused economic benefits from mining to be unevenly distributed (Ardiansyah et al., 2020). This is particularly relevant in the Sulamapua region, which despite recording a surge in mining investment in the past decade, still faces serious challenges in poverty alleviation, regional disparities, and environmental damage (KLHK, 2023; Bappenas, 2022).

Meanwhile, several empirical studies examining sustainable development focus on Indonesia in general (Wijaya et al., 2024); (Yorisca, 2020); (Qur'an, 2018); (Fauzi & Oktavianus, 2014), and Asia (Li et al., 2024). This study tries to offer novelty in terms of geographical aspects specifically in the SULAMAPUA region. The reason is because although this region is rich in natural resources, the implementation of sustainable development policies is still limited. The causes include the dominant role of the mining sector amidst the limited quality of human resources, differences in population and differences in the allocation of fiscal transfer funds for natural resources. A number of these obstacles are the focus of this study to analyze how they impact sustainable development in SULAMAPUA.

Within the framework of sustainable development, it is important to comprehensively evaluate how the contribution of the mining sector and the natural resource fiscal transfer scheme actually play a role in supporting the three pillars of sustainable development: economic, social, and environmental. Understanding these dynamics is crucial to designing

fiscal policies that are not only efficient, but also spatially and ecologically just. Therefore, this study seeks to analyze the influence of the mining sector and natural resource fiscal transfers on sustainable development in the Sulamapua area, in order to provide evidence-based recommendations for the formulation of more adaptive and transformative fiscal and development policies.

1.1 Problem formulation, objectives and benefits of research

The main problems that are the focus of this research are: (1) how are the dynamics of sustainable development in the Sulawesi, Maluku and Papua regions during the last eight years?; (2) does the fiscal transfer of natural resources affect sustainable development in the Sulawesi, Maluku and Papua regions?; (3) does the mining sector affect sustainable development in the Sulawesi, Maluku and Papua regions?; (4) does the population affect sustainable development in the Sulawesi, Maluku and Papua regions? The purpose of this research is to analyze the effects of the dynamics of the mining sector, fiscal transfer of natural resources and population on sustainable development in the Sulawesi, Maluku and Papua regions.

This article is expected to provide the following benefits: (1) can enrich scientific studies on the role of the mining sector in sustainable development in the regions of Sulawesi, Maluku and Papua; (2) can provide practical insights for local governments, policy makers and other stakeholders related to sustainable management of the mining sector accompanied by strengthening fiscal transfer policies for natural resources in Sulawesi, Maluku and Papua; (3) Can contribute to the development of science in the field of natural resource economics.

2. Methods

This study uses two approaches, namely: first, the sustainable development index (IPB) calculation formula developed by (Fauzi & Oktavianus, 2014) and (Hickel, 2020). This formula uses two IPB calculation indicators, namely from the side of the preparation indicators (Real PDRB, HDI and IKLH) and from the side of the development dimensions (economic, social, and environmental). This study uses a calculation scenario that is more directed at the development dimensions (economic, social and environmental). PDRB and IKLH each represent the economic and environmental dimensions, while HDI represents two dimensions at once, namely social and economic. In order for the weight between dimensions to be the same, each indicator is given a different weight, 1/6 for Real PDRB, 3/6 for HDI and 2/6 for IKLH:

$$IPB = \frac{PDRB+(3xIPM)+(2\text{xIKLH})}{6} x100 \quad \text{(eq. 1)}$$

The GRDP used in this formula is the GRDP at constant prices for 10 provinces in SULAMAPUA, the IPM is the Human Development Index in the same province, and the IKLH is the Environmental Quality Index, also in the same province. Next, for the second approach, namely using the panel data regression method, covering the same 10 provinces as cross-section units. The 10 provinces in question include: South Sulawesi, West Sulawesi, Central Sulawesi, Southeast Sulawesi, Gorontalo, North Sulawesi, Maluku, North Maluku, Papua and West Papua. Three new provinces in Papua (Central Papua, South Papua, Papua Pegunungan) are not included in the analysis because: 1) data are not consistently available for all indicators across the 2017–2024 period; 2) these three provinces were the result of expansion at the end of 2022, so they do not have adequate historical data series; 3) inclusion of provinces with partial data may result in biased or unstable regression estimates.

Although this may reduce the overall coverage of Papua, this decision is necessary to maintain the validity of the model and the consistency of the panel data. The potential bias

due to this exclusion is considered minimal because the proportion of GRDP and population in the three provinces were previously still covered by their parent provinces (Papua and West Papua) until 2021. The data sources for the research variables are: 1) Central Statistics Agency/*Badan Pusat Statistik* (BPS): for GRDP data, population, and HDI; 2) Ministry of Finance DJPK: for SDA fiscal transfer data; 3) Ministry of Environment KLHK: for IKLH data. The empirical model of this study is in the form of a panel data regression model developed from previous studies (Sulistiawati, 2021); (Putra Fanolo Hia et al., 2024). This model was then modified and adjusted to the research objectives. This model is then specified as follows:

$$IPB\ i,t\ =\ \alpha\ +\ \beta\ 1\ FISSDA\ i,t-1\ +\ \beta\ 2\ SECTAMB\ i,t\ +\ \beta\ 3\ JPK\ i,t\ +\ \varepsilon\ i,t \quad \text{(eq. 2)}$$

notation i = 1, 2, 3, ..., 1 0 is a *cross-section unit* for 10 provinces in the SULAMAPUA region; t = 1, 2, 3, ..., 8 is the unit of observation year period; IPB_{it} is the Sustainable Development Index variable for province i in year t; $FISSDA_{it}$ is the fiscal transfer variable of natural resources (SDA) in province i in year t; $SEKTAMB_{it}$ is the *constant price GRDP variable for* the mining sector of province i in year t; JPK_{it} is the population of province i in year t; α is a constant; $\beta 1, \beta 2, \beta 3$ are the regression coefficients; ε_{it} is *an error term*.

Methods that can be used to estimate panel data regression models, namely the Common Effect, Fixed Effect and Random Effect approaches. (Sumarjo & Mangantar, 2022); (Madany et al., 2022). To determine which model to use from the three approaches, it is necessary to test the panel data model through the Chow Test, Hausman Test and Lagrange Multiplier Test (LM Test). In addition, the Classical Assumption test is also carried out through the Multicollinearity, Heteroscedasticity and Autocorrelation tests. The results of the panel data model estimation are then subjected to statistical testing through the Simultaneous Significance Test (F Statistic Test), Partial Test (t Statistic Test), and Coefficient of Determination (R2).

3. Results and Discussion

3.1 Results of calculation of sustainable development index

IPB's calculation results show the highest achievement in West Papua (75.11) and the lowest in Maluku (22.28). Although several provinces, especially in Papua and Sulawesi, recorded significant progress in 2024, disparities between provinces remain high, reflecting structural challenges in realizing inclusive and equitable sustainable development in the SULAMAPUA region.

Table 1. IPB values of development dimensions between provinces in Sulamapua

No	Province	2017	2018	2019	2020	2021	2022	2023	2024
1	Gorontalo	23.92	25.33	27.02	27.05	27.40	28.06	28.94	57.45
2	West Sulawesi	24.79	25.78	26.97	25.35	25.67	25.89	26.70	27.85
3	Central Sulawesi	35.76	41.77	44.67	47.69	52.40	59.35	65.46	66.59
4	North Sulawesi	35.24	36.32	38.16	36.24	37.43	39.06	40.74	66.85
5	Southeast Sulawesi	34.63	35.86	37.92	38.37	39.30	40.73	42.17	43.34
6	South Sulawesi	36.16	37.94	40.18	38.97	40.29	41.85	42.98	44.11
7	North Maluku	21.88	23.03	24.40	24.70	27.99	33.35	39.15	40.40
8	Maluku	18.37	19.06	19.93	19.25	19.67	20.34	21.23	22.28
9	West Papua	65.09	67.43	67.41	57.30	56.24	56.52	74.90	75.11
10	Papua	48.32	50.87	43.11	34.94	39.27	42.01	50.21	51.95

3.1.1 Sustainable development trends in Sulawesi region

During the period 2017–2024, provinces in Sulawesi Island showed a positive, although varied, increase in the Sustainable Development Index (SDI). Central Sulawesi and North

Sulawesi recorded significant spikes, from 35.76 to 66.59 and from 35.24 to 66.85, respectively. This indicates accelerated development driven by strategic investment and strengthening regional policies. South Sulawesi and Southeast Sulawesi experienced more moderate but consistent SDI growth, reflecting the stability of institutional development and public services. Meanwhile, West Sulawesi experienced a slow increase from 24.79 to 27.85, indicating relative stagnation. In contrast, Gorontalo recorded a sharp spike from 28.94 (2023) to 57.45 (2024), possibly triggered by policy reforms, accelerated infrastructure development, or revisions to development indicator measurements.

3.1.2 Sustainable development trends in Maluku region

Maluku region shows a slow trend of increasing IPB. North Maluku recorded a stable growth from 21.88 (2017) to 40.40 (2024), reflecting gradual improvements in infrastructure and public services. In contrast, Maluku Province experienced a minimal increase from 18.37 to 22.28, indicating persistent structural challenges, such as low connectivity and uneven distribution of development.

3.1.3 Sustainable development trends in Papua anad West Papua regions

The Papua region shows complex development dynamics. West Papua Province maintained a high IPB throughout the period, from 65.09 to 75.11, indicating relatively sustainable development success, although it needs to be evaluated more deeply in terms of equitable distribution of development benefits. Then Papua Province experienced a decline in IPB from 50.87 (2018) to 34.94 (2020), but again showed an increasing trend to reach 51.95 in 2024. This fluctuation could be caused by external disturbances such as socio-political conditions, as well as geographical and logistical challenges in implementing development.

3.2. Panel data regression analysis

Panel data regression testing in this study uses Eviews software. Based on the results of the Chow Test in Table 3.2, the cross-section probability value F is less than 0.05, which is 0.0000 <0.05, so it can be concluded that H0 is rejected and Ha is accepted.

Table 2. Chow test results and hausman test results

Type Test					
Test Chow			Hausman test		
Cross section F			Random cross section		
F-Statistic	Prob.	Model Selected	F-Statistic	Prob.	Model el Selected
15.616975	0.0000 *	FEM	8.685907	0.0338 *	FEM

The results of the Chow Test are that the fixed effect model (FEM) is better when compared to the common effect model (CEM). Then the Hausman Test Results show that the random cross-section probability value is greater than 0.05, which is 0.0338 <0.05. It can be concluded that FEM is better when compared to REM. Therefore, FEM is chosen.

3.3 Results of the classical assumption test

Classical assumption testing is a mandatory procedure in classical linear regression analysis. Through this test, researchers can verify whether their model is suitable for drawing conclusions and formulating policies. If violations are found, corrective measures such as data transformation, robust standard errors, or the use of alternative models (such as logistic regression, GLS, or panel data regression) can be considered. The selected panel data model is the Fixed effect model (FEM), therefore the classical assumptions are

immediately carried out. The classical assumption tests used are Multicollinearity and Heteroscedasticity.

3.3.1 Multicollinearity test results

The correlation coefficient of FISSDA and SEKTAMB variables is -0.197614 <0.85, the correlation coefficient of FISSDA and JPK is -0.033564 <0.85 and the correlation coefficient of SEKTAMB and JPK is -0.182756 <0.85. So it can be concluded that it is free from multicollinearity.

Table 3. Multicollinearity test results

	FISSDA	SECTAMB	JPK
FISSDA	1,000,000	-0.197614	-0.033564
SECTAMB	-0.197614	1,000,000	-0.182756
JPK	-0.033564	-0.182756	1,000,000

From the residual graph, it can be seen that it does not cross the limits (500 and -500). This means that the residual variance can be said to be not affected by heteroscedasticity or free from heteroscedasticity symptoms.

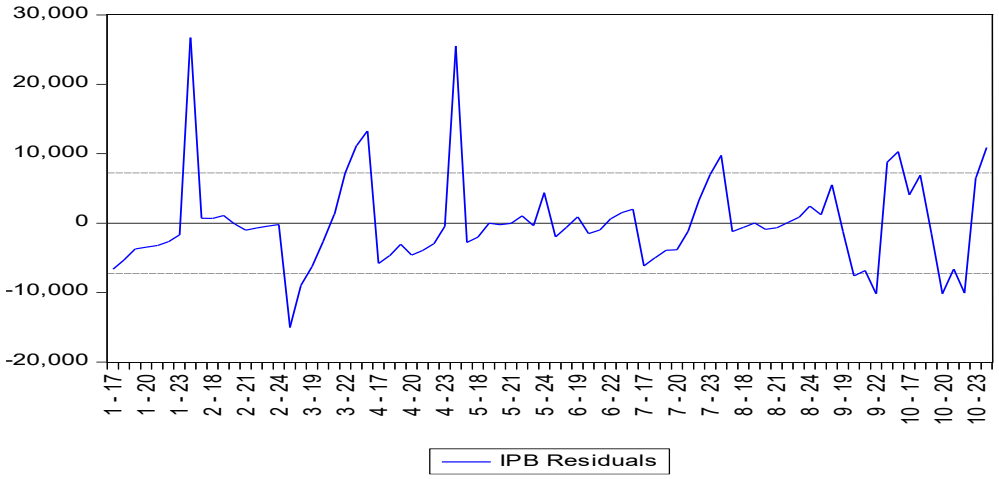

Fig. 3. Heteroscedasticity test results

3.4 Panel data regression equation

The panel data regression equation formed using the fixed effect model approach is as follows. The estimation results show a constant value of 1.6232, indicating that without changes in the independent variables, IPB still increases by 1.62 points. The FISSDA coefficient of 0.9487 indicates that a 1% increase in natural resource fiscal transfers has the potential to increase IPB by 0.95%, ceteris paribus. The mining sector's GRDP has a coefficient of 0.0157, indicating a positive but relatively small contribution to IPB. Meanwhile, population has a positive effect with a coefficient of 0.0069, reflecting the influence of demographic growth on sustainable development, although its impact is limited.

$$IPB = 1.6232 + 0.9487 * FISSDA + 0.0157 * SEKTAMB + 0.0069 * JPK$$

3.5 Hypothesis test results

3.5.1. t-test results

The t-test is needed to test the influence of each independent variable used in this study on the dependent variable partially. The t-test results show that fiscal transfers of natural

resources (FISSDA) have a significant effect on IPB with a p-value of 0.0145 <0.05 and a positive relationship direction. This is in line with the hypothesis that fiscal transfers of natural resources have an effect on sustainable development in the Sulawesi, Maluku and Papua Regions. This means that an increase in FISSDA is followed by an increase in sustainable development.

Table 4. t-test results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	16232.59	28076.09	0.578164	0.5651
FISSDA	0.948760	0.658831	1.440066	0.0145
SECTAMB	0.015763	0.033121	0.475918	0.6357
JPK	0.006972	0.009693	0.719268	0.0445

The results of the t-test show that the mining sector (SEKTAMB) does not have a significant effect on IPB with a t-value of 0.4759 < t-table 1.9908 and a p-value of 0.6357> 0.05. This is not in line with the hypothesis that states whether there is a relationship between the mining sector and sustainable development in the regions of Sulawesi, Maluku and Papua. The results of the t-test show that the number of residents (JPK) has a significant effect on IPB with a p-value of 0.0445 < 0.05, although the t-count value is 0.7192 < t-table 1.9908. This is in line with the hypothesis stating that there is a relationship between the number of residents and sustainable development in the regions of Sulawesi, Maluku and Papua. These findings reflect the complex demographic effects. According to Malthusian theory, population growth can put pressure on resources and public services if it is not balanced by improvements in the quality of human resources and infrastructure (Sulistiawati, 2021); (Todaro & Smith, 2015). The dual effects of population are also recognized: creating potential markets and labor, but at the same time risking slowing down sustainable development if the adaptive capacity of the region is limited (Brida et al., 2024); (World Bank, 2020). The Voices of the Poor report emphasizes that inequality of access due to demographic pressures can worsen socio-economic and environmental outcomes (Kapriadi, 2022).

3.5.2. F test results

Based on the estimation results with the fixed effect model approach, the F-count value of 20.2369> F-table 2.7249 with a p-value of 0.0000 <0.05, indicating that the model is simultaneously significant. This means that the FISSDA, SEKTAMB, and JPK variables have an effect on IPB. The adjusted R^2 value of 0.7450 indicates that 74.50% of the variation in IPB can be explained by the three independent variables, while the remaining 25.50% is explained by other factors outside the model.

Table 5. F test results

Weighted Statistics			
R-squared	0.783761	Mean dependent variable	38859.69
Adjusted R-squared	0.745032	SD dependent var	14341.99
SE of regression	7241.894	Akaike information criterion	20.76082
Sum squared residual	3.51E+09	Black criterion	21.14790
Log likelihood	-817.4328	Hannan-Quinn critter.	20.91601
F-statistic	20.23691	Durbin-Watson stat	0.860557
Prob(F-statistic)	0.000000		

3.6 Cross-section results of cr-effect model fixed effect model (FEM) in the SULAMAPUA region

Table 6 shows the results of the model estimation that analyzes the dynamics of the mining sector, fiscal transfer of natural resources and sustainable development in the Sulawesi, Maluku and Papua (Sulamapua) regions. This estimation uses the cross-section

effect (CR-Effect) value. The CR-Effect coefficient in the nine districts/cities all have negative values for the village fund transfer model, both partially and totally (Table 6).

Table 6. Cross-section random effect

No	Province	Mark
1	Gorontalo	-5706.459
2	West Sulawesi	-2648.446
3	Central Sulawesi	10430.51
4	North Sulawesi	2619.347
5	Southeast Sulawesi	-1221.015
6	South Sulawesi	-2088.699
7	North Maluku	-8917.757
8	Maluku	-16188.91
9	West Papua	21490.94
10	Papua	2230.483

The results of the Cross-section Random Effect estimation in Table 3.6 show that the coefficient values vary between provinces in the Sulamapua region. Negative coefficients are found in most provinces such as Gorontalo (-5,706), West Sulawesi (-2,648), Southeast Sulawesi (-1,221), South Sulawesi (-2,088), North Maluku (-8,917), and Maluku (-16,188). Conversely, positive coefficients are found in Central Sulawesi (10,430), North Sulawesi (2,619), West Papua (21,490), and Papua (2,230).

The negative CR-Effect value indicates that in these provinces, there is a decrease in development disparity as an effect of fiscal intervention and economic sector dynamics, including village fund transfers. This means that the model shows that the existence of transfer funds and natural resource management has begun to provide a redistributive effect in these regions.

On the other hand, the fairly high positive CR-Effect values in West Papua and Central Sulawesi reflect the existence of inequality that is still strong, or even tends to increase. This could be caused by the dominance of the mining sector which is exploitative but not inclusive, as well as the less than optimal role of fiscal in reducing social and spatial inequality. The novelty of this finding is that not all natural resource producing regions receive equal impacts of sustainable development. In fact, in some regions, such as West Papua, the effects of economic growth in the mining sector can actually widen the gap, if not balanced with fair fiscal governance and equal distribution of benefits.

3.7 Dynamics of sustainable development in Sulawesi, Maluku and Papua Regions

The development of the Sustainable Development Index (SDI) in the Sulawesi, Maluku, and Papua regions during the 2017–2024 period showed quite varied dynamics, indicating disparities in performance between provinces in integrating the three pillars of sustainable development: economic, social, and environmental. In general, Central Sulawesi, North Sulawesi, and West Papua experienced a significant increase in SDI, while Maluku and West Sulawesi showed a relatively stagnant trend.

One of the prominent findings is the jump in the IPB of Gorontalo Province from 28.94 in 2023 to 57.45 in 2024. This drastic increase indicates the possibility of fiscal policy reform, acceleration of basic infrastructure development, or optimization of fiscal transfers in supporting sustainable programs. On the other hand, provinces such as Maluku, although showing slow growth (from 18.37 in 2017 to 22.28 in 2024), are still classified as lagging behind in composite terms, reflecting the weak synergy between economic growth and improving the quality of life and environmental protection.

This finding strengthens the argument in the development literature that the success of sustainable development is not solely determined by the magnitude of economic growth, but by the effectiveness of institutions and governance of regional development. The theory of sustainable development put forward by Sachs (2015) emphasizes that ideal development must create a balance between economic productivity, social equity, and

ecological sustainability. In this context, the increase in IPB in provinces such as Central Sulawesi and West Papua can be linked to the fiscal role of natural resources and the expansion of infrastructure development that supports these pillars. However, disparities between regions remain a major challenge. In line with Damanik's research, there are indications that fiscal inequality and institutional weaknesses cause uneven achievement of sustainable development, especially in island and underdeveloped regions such as Maluku and Papua. The study by Ardiansyah et al. (2020) also highlights that although fiscal transfers of natural resources have increased, their effectiveness is highly dependent on regional planning capacity and policy integration between sectors.

The novelty of this finding lies in the longitudinal observation that not all regions with high economic growth are able to create inclusive sustainable development. With IPB data up to 2024, it can be concluded that the success of sustainable transformation requires a synergy of fair fiscal policies, ecological resource management, and strengthening institutional capacity at the local level. Future development strategies must be evidence-based (*evidence-based planning*) and sensitive to local contexts, especially in the face of demographic pressures, climate change, and intensive resource exploitation. Thus, the dynamics of sustainable development in the SULAMAPUA region reflect not only geographical and resource diversity, but also the quality of governance and adaptability of regional policies. This study reinforces the urgency of a more holistic, spatially equitable, and long-term sustainability-oriented development approach.

3.8 The impact of fiscal transfer of natural resources on sustainable development in the Sulawesi, Maluku and Papua Regions

The t-test results show that Fiscal Transfer of Natural Resources (FISSDA) has a positive and significant effect on the Sustainable Development Index (IPB). This finding is consistent with the theory of natural resource economics and sustainable development (WCED, 1987; (Rose, 2024), which emphasizes that revenue from natural resources can strengthen the education, health, and infrastructure sectors. Empirical support is also shown by the studies of Cui et al., (2022), (Xu, 2023), and (Olivia, 2020) which found a positive correlation between the management of natural resource funds and improving the quality of regional development. Theoretically, this finding strengthens the principle of fiscal decentralization, where fiscal decentralization allows local governments to utilize natural resource transfer funds to address local needs more effectively (Oates, 1999). However, the novelty of this finding lies in the empirical validation that it is not only the amount of funds that matters, but also the direction of their use that determines their impact on sustainability.

In contrast to previous pessimistic views that associated natural resources with the "resource curse", this study shows that with good fiscal governance, FISSDA actually becomes a driver of sustainable development acceleration. The fact that IPB increases as FISSDA increases strengthens the argument that fiscal distribution reform can be a corrective strategy to improve inter-regional inequality, especially in resource-rich but socially disadvantaged areas. Thus, this finding encourages a more progressive policy: encouraging sustainable fiscalization, namely the integration of natural resource fiscal transfers with the SDGs agenda at the local level, so that every rupiah from natural resources truly flows to welfare and sustainability.

3.9 The influence of the mining sector on sustainable development in the Sulawesi, Maluku and Papua regions

The t-test results show that the mining sector variable (SEKTAMB) has no significant effect on the Sustainable Development Index (IPB). This finding rejects the initial hypothesis stating that there is a positive relationship between the contribution of the mining sector to sustainable development in the Sulawesi, Maluku, and Papua (Sulamapua) regions. Critically, this finding reflects a disconnect between mining economic activities and cross-

sector development achievements at the regional level. Although the mining sector often contributes greatly to GRDP, its contribution to improving social quality and environmental preservation seems limited or even non-existent. This strengthens the criticism in the resource economics literature, where mining wealth is not always directly proportional to the welfare of local communities, a phenomenon known as the resource curse (Auty, 2001).

This finding also provides empirical evidence that the high growth of the mining sector in the Sulamapua region has not been integrated with a comprehensive sustainable development system. Revenue from mining tends not to be distributed fairly, and has not been fully invested in sectors that support long-term welfare, such as education, health, and environmental protection. This is in line with the findings of (Humphreys et al., 2007); (Barri et al., 2021); (Taufikurahman et al., 2023), which states that mining expansion in eastern Indonesia often emphasizes exploitation rather than community-based development. The novelty of this finding lies in the assertion that the size of the extractive sector does not automatically improve the quality of development if it is not accompanied by sustainable and equitable governance. Thus, sustainability in mining-rich areas such as Sulamapua requires a transformative approach that links mining with fiscal reform, strengthening local capacity, and integrating the environmental agenda.

3.10 The Influence of population on sustainable development in the Sulawesi, Maluku and Papua Regions

The t-test results show that population (JPK) has a significant effect on the Sustainable Development Index (IPB), indicating that demographic factors have a real role in determining the direction of development in the Sulamapua region. This finding reflects the complex demographic effects. According to the Malthusian view, population growth without an increase in the quality of human resources and infrastructure can put pressure on public resources and services (Todaro & Smith, 2015; Sulistiawati, 2021). However, modern development theory also emphasizes the potential of population as an economic force if managed properly (Brida et al., 2024).

The development of post-Malthusian theory recognizes the dual effect of population : a large population is not only a burden, but also a potential productive force and domestic market. The study by Brida et al. (2024) and the Voices of the Poor Report (Kapriadi, 2022) show that demographic pressures in low-access areas can exacerbate inequality and environmental degradation. Thus, the novelty of these findings is that population is not just a demographic burden or bonus, but an active factor that requires specific policy interventions so that its contribution to development is truly sustainable.

4. Conclusions

The results of this study confirm that fiscal transfers of natural resources (FISSDA) and population are two variables that have a significant effect on the Sustainable Development Index (SDI) in the regions of Sulawesi, Maluku, and Papua. This finding provides a strong signal that fair and efficient fiscal governance, as well as adaptive demographic management, play a key role in driving a development agenda that not only pursues economic growth, but also ensures social equity and environmental preservation. On the other hand, the insignificance of the mining sector to the SDI reflects the existence of structural dysfunction in the utilization of natural resources, which leads to symptoms of the resource curse. This shows that the economic contribution of the extractive sector has not been fully converted into inclusive and sustainable development benefits.

Within the EcoProfit framework, which emphasizes the harmonization of economic benefits and ecological sustainability, this study makes it clear that such synergy will not be achieved without fundamental reforms. A more progressive and inclusive fiscal policy approach is needed, capable of channeling natural resource funds effectively to productive and social sectors. On the other hand, the adoption of environmentally friendly technologies in the mining sector is an absolute requirement to reduce negative impacts on the

environment. In addition, investment in human resource development and the provision of basic infrastructure are important strategies to manage population pressure sustainably and maximize demographic potential as development capital. Thus, sustainable development in resource-rich areas such as Sulamapua requires an integrative approach th bridges economic, social, and environmental interests. These findings provide an important contribution to the development of sustainable fiscal policies based on spatial and ecological justice, as well as a foothold to avoid the trap of unproductive and unsustainable natural resource exploitation.

Acknowledgement
The authors would like to express sincere gratitude to the reviewers for valuable insights and constructive feedback, which have significantly contributed to the improvement of this manuscript.

Author Contribution
I.B., A.C.A., and S.M., contributed to the literature search, interpretation, writing, and proofreading of the manuscript. All authors have read and agreed to the published version of the manuscript.

Funding
This research received no external funding.

Ethical Review Board Statement
Not available.

Informed Consent Statement
Not available.

Data Availability Statement
Not available.

Conflicts of Interest
The authors declare no conflict of interest.

References
Arifin, R., Mashhar, A., Sumardiana, B., Ramada, DP, Kamal, U., & Fikri, S. (2024). Indonesian sustainable development policy: How the government ensures the environment for future generations. *IOP Conference Series: Earth and Environmental Science, 1355*(1). https://doi.org/10.1088/1755-1315/1355/1/012005

Auty, R. M. (2001). *Resource Abundance and Economic Development*. Oxford University Press.

BPS. (2023). *Indonesian Statistics 2023*. Badan Pusat Statistik.

Bahri Abd. Rasyid, S., Misran, & Saputra, H. A. (2024). A portrait of green economy governance in sustainable development in Eastern Indonesia. *Jurnal Bina Praja, 16*(3), 557–572. https://doi.org/10.21787/jbp.16.2024.557-572

Bappenas. (2019). *Low Carbon Development: A Paradigm Shift Towards A Green Economy in Indonesia.* Badan Perencanaan Pembangunan Nasional Republik Indonesia (Bappenas), 162.

Bappenas. (2022). National Medium-Term Development Plan. Badan Perencanaan Pembangunan Nasional Republik Indonesia (Bappenas).

Barri, A. R. R., Zakaria, S., & Bidullah, T. (2021). The Influence of the Mining and Quarrying Sector on the Gross Regional Domestic Product of Banggai Regency. *Productive Scientific Journal, 9*(1), 20–26. https://ojs-untikaluwuk.ac.id/index.php/jip

Brida, J. G., Alvarez, E., Cayssials, G., & Mednik, M. (2024). How does population growth affect economic growth and vice versa? *An empirical analysis. Review of Economics and Political Science, 9*(3), 265–297. https://doi.org/10.1108/REPS-11-2022-0093

Cui, Y., Wang, G., Irfan, M., Wu, D., & Cao, J. (2022). The effect of green finance and unemployment rate on carbon emissions in China. *Frontiers in Environmental Science, 10(*July), 1–16. https://doi.org/10.3389/fenvs.2022.887341

de Jong, E., & Vijge, M. J. (2021). From Millennium to Sustainable Development Goals: Evolving discourses and their reflection in policy coherence for development. *Earth System Governance, 7*, 100087. https://doi.org/10.1016/j.esg.2020.100087

Fauzi, A., & Oktavianus, A. (2014). Measuring Sustainable Development in Indonesia - Akhmad Fauzi. In *Measuring Sustainable Development in Indonesia* (Vol. 30).

Hardjasoemantri, K., & Supriyono, H. (2019). History of the Development of Environmental Law. In *Module 1 History of the Development of Environmental Law* (p. 17).

Hariram, N. P., Mekha, K. B., Suganthan, V., & Sudhakar, K. (2023). Sustainalism: An Integrated Socio-Economic-Environmental Model to Address Sustainable Development and Sustainability. *Sustainability (Switzerland), 15*(13). https://doi.org/10.3390/su151310682

Hickel, J. (2020). The sustainable development index: Measuring the ecological efficiency of human development in the anthropocene. *Ecological Economics*, *167*(March 2019), 106331. https://doi.org/10.1016/j.ecolecon.2019.05.011

Humphreys, M., Sachs, J. D., & Stiglitz, J. E. (2007). *Escaping The Natural Resource Curse.* Columbia University Press.

Imran, M., Alam, M. S., Jijian, Z., Ozturk, I., Wahab, S., & Doğan, M. (2024). From resource curse to green growth: Exploring the role of energy utilization and natural resource abundance in economic development. *Natural Resources Forum, 49*(2), 2025–2047. https://doi.org/10.1111/1477-8947.12461

Indonesian Mining Institute (IMI). (2018). *Report on Indonesia Mining Sector Diagnostic* (November Issue). World Bank.

Jamin, M., Jaelani, A. K, Mulyanto, Kusumaningtyas, R, O, & Ly, D. Q. (2023). The Impact of Indonesia's Mining Industry Regulation on the Protection of Indigenous Peoples. *Hasanuddin Law Review, 9*(1), 88–105. https://doi.org/10.20956/halrev.v9i1.4033

Kapriadi, A. Y. (2022). Indonesian Presidency G20 Collective Ideas towards sustainable recovery and growth. In *Addition of Sodium Benzoate and Potassium Sorbate (Anti-inversion) and Stirring Speed as an Effort to Inhibit Inversion Reactions in Sugarcane Juice.*

Kersting, N. (2021). Participatory democracy and sustainability: Deliberative democratic innovation and its acceptance by citizens and German local councilors. *Sustainability (Switzerland), 13*(13). https://doi.org/10.3390/su13137214

Klarin, T. (2018). The Concept of Sustainable Development: From its Beginning to the Contemporary Issues. *Zagreb International Review of Economics and Business, 21*(1), 67–94. https://doi.org/10.2478/zireb-2018-0005

Kurniawan, R., & Managi, S. (2018). Economic Growth and Sustainable Development in Indonesia: An Assessment. *Bulletin of Indonesian Economic Studies, 54*(3), 339–361. https://doi.org/10.1080/00074918.2018.1450962

Li, X., Ma, L., Ruman, A. M., Iqbal, N., & Strielkowski, W. (2024). Impact of natural resource mining on sustainable economic development: The role of education and green innovation in China. *Geoscience Frontiers, 15*(3), 101703. https://doi.org/10.1016/j.gsf.2023.101703

Madany, N., Ruliana, & Rais, Z. (2022). Panel Data Regression and Its Application in Financial Performance on Profit Growth of Idx Lq45 Companies of Indonesia Stock Exchange. *VARIANSI: Journal of Statistics and Its Application on Teaching and Research, 4*(2), 79–94. https://doi.org/10.35580/variansiunm28

Mancini, L., & Sala, S. (2018). Social impact assessment in the mining sector: Review and comparison of indicators frameworks. *Resources Policy, 57*(January), 98–111. https://doi.org/10.1016/j.resourpol.2018.02.002

Naryono, E. (2023). *Nickel Mine Exploitation In Indonesia, Between A Blessing And A Disaster Of Environmental Damage*. Center for Open Science, 1–22.

Olivia, D. (2020). Allocation of Natural Resource Revenue Sharing Funds in the Framework of Decentralization. *KADARKUM: Journal of Community Service, 1*(2), 85. https://doi.org/10.26623/kdrkm.v1i2.2886

Onifade, M., Zvarivadza, T., Adebisi, J.A., Said, KO, Dayo-Olupona, O., Lawal, A.I., & Khandelwal, M. (2024). Advancing toward sustainability: The emergence of green mining technologies and practices. *Green and Smart Mining Engineering, 1*(2), 157–174. https://doi.org/10.1016/j.gsme.2024.05.005

Putra Fanolo Hia, S., Damanik, D., & Nainggolan, P. (2024). The Influence of the Agricultural Sector, Mining Sector, and Manufacturing Sector in North Sumatra Province. *Journal of Equity, 6*(1), 16–28. https://doi.org/10.36985/rbazcb03

Qur'an, AA (2018). Natural Resources in Sustainable Development from an Islamic Perspective. *El-Jizya: Journal of Islamic Economics, 5*(1), 1–24. https://doi.org/10.24090/ej.v5i1.1621

Rohman, A., Hartiwiningsih, & Rustamaji, M. (2024). Illegal mining in Indonesia: need for robust legislation and enforcement. *Cogent Social Sciences, 10*(1). https://doi.org/10.1080/23311886.2024.2358158

Rose, A. (2024). *Exploring the 4 Pillars of Sustainable Development: A Complete Guide*. Lythhouse.

Stacey, N., Gibson, E., Loneragan, N. R, Warren, C., Wiryawan, B., Adhuri, D. S, Steenbergen, D. J, & Fitriana, R. (2021). Developing sustainable small-scale fisheries livelihoods in Indonesia: Trends, enabling and constraining factors, and future opportunities. *Marine Policy*, 132, 104654. https://doi.org/10.1016/j.marpol.2021.104654

Sulistiawati, R. (2021). Demographic Transition and Economic Growth in West Kalimantan. *Proceedings of the SATIESP National Seminar*, 164–180. https://feb.untan.ac.id/satiesp-2021/

Sumarjo, C. M., & Mangantar, M. (2022). The Effect of Geopolitical Risk, Profitability and Leverage on Stock Returns of Mining Companies in the Oil and Gas Subsector Listed on the Indonesia Stock Exchange. EMBA Journal: Journal of Economic, Management, *Business and Accounting Research, 10*(3), 1027. https://doi.org/10.35794/emba.v10i3.43665

Tarigan, N. M. R, Islam, U., & Utara, S. (2024). Analysis of Natural Resource Management in Langkat Regency: Impact on the Local Economy. *Regress: Journal of Economics & Management*, 3(3), 180–186. https://jurnal.medanresourcecenter.org/index.php/REG/article/view/1523

Ministry of Finance. (2024). Report on Realization of Transfers to Regions.

KLHK. (2023). Indonesian Environmental Quality Index.

Oates, W.E. (1999). An Essay on Fiscal Federalism. *Journal of Economic Literature, 37*(3), 1120–1149. https://www.jstor.org/stable/2564874

Taufikurahman, M. R., Firdaus, A. H., Ahmad, T., Febriani, D. A, & Permana, A. S. (2023). *The Impact of Mining Sector Investment on National and Regional Economic Performance*. INDEF Policy Brief.

Wijaya, B. S., Rozi, F. F. P., Sukma, S. R., & Nadirah, K. (2024). Environmental Degradation and Sustainable Development: The Effectiveness of Unep and ASEAN Cooperation in Addressing Environmental Problems in Southeast Asia. *Indonesian Journal of International Relations, 8*(2), 375–391. https://doi.org/10.32787/ijir.v8i2.530

World Bank. (2020). *Indonesia Public Expenditure Review: Spending for Better Results*. Worldbank. 1–393. www.worldbank.org/id

World Bank. (2018). Indonesia Systematic Country Diagnostic. World Bank.

Xu, X. (2023). Identifying the Impact of Industrial Agglomeration on China's Carbon Emissions Based on the Spatial Econometric Analysis. *Journal of Environmental and Public Health*, 1–17. https://doi.org/10.1155/2023/4354068

Yani, A. A, Muhammad, A. Y, Zainal, Z., Arief, M., & Zuada, L. H (2024). *Local Political Dynamics of Natural Resource Exploration: A Case Study of Nickel Mining in Sulawesi Island (Issue Wcgss)*. Atlantis Press SARL. https://doi.org/10.2991/978-2-38476-236-1_21

Yorisca, Y. (2020). Sustainable Legal Development: Efforts to Achieve Sustainable National Development. *Indonesian Journal of Legislation, 17*(1), 98. https://doi.org/10.54629/jli.v17i1.507

Biographies of Authors

Irawan Abae, Development Economics, Economics and Business, Universitas Khairun Ternate, 97869, Indonesia.

- Email: irawanabae46@gmail.com
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: N/A

Abdul Chalid Ahmad, Development Economics, Economics and Business, Universitas Khairun Ternate, 97869, Indonesia.

- Email: chalid@unkhair.ac.id
- ORCID: https://orcid.org/0000-0002-9471-5909
- WoS ID : KCK-8117-2024
- Scopus Author ID : 58913718500
  Homepage: https://www.webofscience.com/wos/author/record/KCK-8117-2024

Said Mala, Development Economics, Economics and Business, Universitas Khairun Ternate, 97869, Indonesia.

- Email: saidmala@unkhair.ac.id
- ORCID: 0009-0003-2722-0812
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: N/A