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Interdependencies of Environmental Quality, Poverty, and Green Growth: A Simultaneous Equation Analysis Across Indonesian Provinces

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Abstract: This study explores the interrelations among environmental quality (EQ), poverty (POV), and green growth (GG) across 34 provinces in Indonesia from 2015 to 2023, employing a simultaneous equation model (SEM) to address the gap in prior research which often overlooked the concurrent analysis of these variables. It was found that POV exerts a significant negative impact on EQ, quantified at a reduction of 0.235 percent. Conversely, GG contributes positively to EQ, enhancing it by 0.197 percent. The findings underscore the necessity for policies that integrate environmental, social, and economic considerations, advocating for inclusive and sustainable development strategies. These strategies are pivotal for fostering economic opportunities that enhance community welfare while ensuring environmental sustainability. The study concludes that a nuanced understanding of the relationships between these endogenous factors is crucial for effective policy formulation, highlighting the need for a balanced approach that harmonizes developmental objectives with environmental stewardship.

Keywords: Environmental quality (EQ); Green growth (GG); Poverty (POV); Simultaneous equation model (SEM); Indonesia

1. Introduction

1.1 Background of Research

EQ is an important component in supporting economic activities because it provides many inputs to produce output (Aung & Fischer, 2020). EQ is an important asset that must be maintained by all economic actors so that its carrying capacity is maintained for future generations (Aimon et al., 2022a). EQ is the unity of space with all objects, forces, conditions, and living creatures, including humans and their behavior, which influences the life and welfare of humans and other living creatures (Dahliah & Nur, 2021). Meanwhile, POV is a multidimensional problem because it is related to the inability to access economic, socio-cultural, and political resources and participate in society (Gasparatos et al., 2017). POV is caused by many things, including the EQ element due to the limited natural resources (NR) that exist in an area.

POV occurs due to a decrease in EQ, or, conversely, EQ is damaged due to the presence of POV in the surrounding area (Dubey & Tiwari, 2018). This cause-and-effect relationship can continue to form an endless cycle where POV will get worse and EQ will get lower (Stephen & Wade, 2018). Previous literature states that POV problems that occur in a country can be overcome by pursuing economic growth (EG) (Özokcu & Özdemir, 2017; Sachs et al., 2019; Zhang et al., 2020). However, this condition will cause EQ to experience further degradation (Nguyen et al., 2020). This step was taken because EG is still the main reference in assessing the success of a country because it believes in the trickle-down effect (TDE) that arises (Rizk & Slimane, 2018). The TDE concept provides concessions to capital owners that will ultimately encourage EG, such as tax cuts, so that they will create more job opportunities, which will have an impact on the poor. Furthermore, EG reflects at least the pull of consumption from the public, growing exports, or booming investment.

These three are the main indicators of preference by the government and entrepreneurs. As an impact, the role

of EG can reduce POV through job creation (Ouyang & Li, 2018). Policies that pursue EG too much will result in a threat, namely a decrease in EQ, which is inseparable from the efforts of developing countries to increase their income and economic performance through the exploitation of NR without planning (Erdiwansyah et al., 2022; He et al., 2019; Nadimi & Tokimatsu, 2018; Zhang et al., 2021). Research results in several developing countries reveal that EQ is closely related to poor economic performance in a country, as indicated by low income and a high POV (Baloch et al., 2020; Cheng et al., 2018; Erlando et al., 2020). Development that occurs in developing countries tends to prioritize EG but ignores social and environmental aspects such as POV and EQ (Ackah & Kizys, 2015; Destek & Sinha, 2020).

1.2 Research Phenomenon

Based on previous studies, there is an empirical phenomenon that needs to be developed to increase EQ and reduce POV simultaneously through the concept of GG because it is economically strong but also environmentally friendly and socially inclusive. GG can be a solution to the exploitative economic system, which has tended to reduce EQ towards a low-carbon, resource-saving economy and mitigate climate change to achieve POV reduction and sustainable EQ sustainability (Dou & Han, 2019; Georgeson et al., 2017; Kurniadi et al., 2021). Apart from that, the GG program, which is implemented through community empowerment and the synergy of various parties, can also help to overcome POV because overcoming POV can be strengthened with the GG concept. Meanwhile, community empowerment will provide stronger support or encouragement for the implementation of GG. Based on this explanation, EQ, POV, and GG are crucial issues that are difficult to separate because they influence each other, so this study becomes a very important topic for achieving sustainable social welfare. Indonesia, as a developing country, also faces EQ, POV, and GG problems where there are phenomena from data that describe the problems that occur.

The factual phenomenon that has occurred in EQ in Indonesia since 2015–2018 has decreased over the last three years (Baldini et al., 2018). Then, the environmental quality index (EQI) score in 2021 was 68.03, or a decrease of 0.11 points from 2020. The decrease in EQI was driven by a decrease in the air quality index (AQI), land cover index (LCI), and water quality index (WQI) scores. It was recorded that the AQI score in 2021 was 77.23, or a decrease of 0.02 points compared to 2020. Meanwhile, the WQI score in 2021 was 71.03, or a decrease of 12.09 points compared to 2020 (Harsono & Yuanjaya, 2020). In contrast, there was an increase in EQI in 2022 by 0.97 points compared to 2021 due to increases in AQI and WQI (Aye & Edoja, 2017). Furthermore, the factual phenomenon that occurs is that POV in Indonesia tends to fluctuate, but there was a relatively high increase in 2016–2018, while in 2019–2022, there was a decrease (Erhabor & Don, 2016). This fluctuation in EQI and POV is likely caused by the low contribution of GG, which has tended to decline over the last six years (Aimon et al., 2022b; Allen, 2020).

On the other hand, the empirical phenomenon regarding this study, if traced from previous literature, shows that there are several main gaps in previous research, including Aimon et al. (2023) conducted a literature review on the topic of modeling ecological relationships and POV from 4335 publications for the period 1981–2017, which found that ecological degradation and POV are interrelated and must be addressed simultaneously. In addition, Saputri & Pratama (2021) investigated financial inclusion, EG, and POV in eastern Indonesia during the 2010–2016 period by using bivariate vector autoregression, which found a strong relationship between these three variables. Based on the explanations from these various studies, the novelty of this research is to expand the findings of previous research, where previous research only examined the relationship between EG and POV; environment and POV; financial inclusion, EG, and POV.

1.3 Novelty of Research

Based on the focus of research conducted by previous researchers, it turns out that there has been no research that discusses development and environmental studies regarding EQI, POV, and GG in a system simultaneously. This condition is important so that the causes and driving factors for EQI, POV, and GG can be identified more comprehensively and policy directions can be determined to address these problems more specifically. Based on this explanation, there is a gap between factual and empirical phenomena, so it is necessary to carry out further studies in this research. Resolving social problems related to EQ in each province of Indonesia will have an impact on the realization of sustainable development in Indonesia because regional development is an integral part of national development. Based on the various motivations that have been explained, this research will examine the nexus of EQI, POV, and GG by focusing on panel data for 34 provinces in Indonesia from 2015 to 2023.

2. Materials and Method

2.1 Data Types and Sources

This research uses secondary data sourced from various agencies, including the Indonesian Central Statistics

Agency and the Indonesian Ministry of the Environment. More specifically, this research analyzes panel data, where the time series is 2015–2023 and the cross-section is 34 provinces in Indonesia. This is based on consideration of the description of the research phenomenon spread across all provinces in Indonesia and also the time span of changes in these variables each year. Then, this research is classified as quantitative research because the research target is broad, using an analytical emphasis on numerical data, the aim of which is to provide a description, explanation, and validation of the phenomenon being studied. Furthermore, to provide readers with a better understanding of the data, this research presents descriptive statistics (Table 1) for all variables, consisting of EQ, POV, GG, population (POP), education (ED), industrialization (IND), labor participation (LP), investment (INV), and regional financial performance (RFP).

Table 1. Descriptive statistics results

Variable	Unit	Average	Standard Deviation
EQ	Index	69.040	7.720
POV	Total	26594	1160
GG	Percent	2.825	0.260
POP	Percent	1.276	0.088
ED	Index	71.160	3.850
IND	Percent	33.240	4.960
LP	Percent	67.650	0.261
INV	Billions of Rupiah	996	394
RFP	Index	46.640	6.830

Table 1 summarizes some important information related to descriptive statistical results for the period 2015–2023 in 34 provinces in Indonesia. First, the EQ condition is 33.24 points every year for all provinces in Indonesia, and the standard deviation level of EQ data from the average value is 7.720 points. Second, the POV condition is 26.594 people every year for all provinces in Indonesia, and the standard deviation level of POV data from the average value is 1.160 people. Third, the GG condition is 2.825 percent every year for all provinces in Indonesia, and the standard deviation level of GG data from the average value is 0.260 percent. Fourth, the POP condition is 1.276 percent every year for all provinces in Indonesia, and the standard deviation level of POP data from the average value is 0.088 percent. Fifth, the ED condition is 71.160 points every year for all provinces in Indonesia, and the standard deviation level of ED data from the average value is 0.088 points. Sixth, the IND condition is 33.240 percent every year for all provinces in Indonesia, and the standard deviation level of IND data from the average value is 4.960 percent. Seventh, LP conditions are 67.650 percent every year for all provinces in Indonesia, and the standard deviation level of LP data from the average value is 0.261 percent. Eighth, the INV condition is 996 billion of rupiah every year for all provinces in Indonesia, and the standard deviation level of INV data from the average value is 394 billion of rupiah. Ninth, the RFP condition is 46.440 points every year for all provinces in Indonesia, and the standard deviation level of RFP data from the average value is 6.830 points. Based on the explanation of all variables related to average and standard deviation, all variables in this study are homogeneous because the standard deviation value is smaller than the average value.

Table 2. Operational definition of variables

Variable	Definition
EQ	A combination of AQI, WQI, and LCI in 34 provinces in Indonesia, as measured in the index (bps.go.id, 2024).
POV	The number of poor people in 34 provinces in Indonesia, as measured in total people (bps.go.id, 2024).
GG	The growth rate of net regional domestic product is reduced by the growth rate of NR depletion in 34 provinces in Indonesia, as measured in percent (bps.go.id, 2024).
POP	Population growth rate in 34 provinces in Indonesia, as measured in percent (bps.go.id, 2024).
ED	Human development index in 34 provinces in Indonesia, as measured in the index (bps.go.id, 2024).
IND	Growth rate of gross regional domestic product in the industrial sector in 34 provinces in Indonesia, as measured in percent (bps.go.id, 2024).
LP	Labor force growth relative to the number of working age population in 34 provinces in Indonesia, as measured in percent (bps.go.id, 2024).
INV	Realization of domestic investment in 34 provinces in Indonesia, as measured in billions of rupiah (bps.go.id, 2024).
RFP	The average of the budget solvency index (BSI), financial independence index (FII), and service solvency index (SIS) in 34 provinces in Indonesia, as measured in the index (bps.go.id, 2024).

2.2 Research Variables

This research groups variable types into two categories, namely endogenous variables (ENV) and exogenous variables (EXV). ENV is a variable determined as the focus of research and consists of EQI, POV, and GG.

Meanwhile, EXV is a variable that will influence ENV stability, which consists of POP, ED, IND, LP, INV, and RFP. Furthermore, explanations for the indicators for each variable are summarized in Table 2.

Based on the information in Table 2, it is necessary to determine the relationship between the variables analyzed in this research. The relationship between variables in this research can be explained through the research conceptual framework summarized in Figure 1, which explains how EXV influences each ENV in this research to formulate the hypothesis (H) that will be tested.

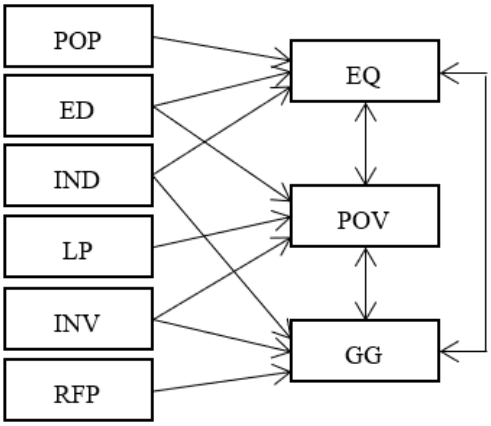

Figure 1. Research conceptual framework

2.3 EQ Determination

EQ can be seen in EQI as a program to improve the quality of the environment. The EQI is a national environmental management performance index, which is a generalization of the EQI. Based on a review of previous literature, there are several variables that influence the stability of EQ, including POV having a high dependence on NR for its survival and causing worsening of EQ (Fahrika et al., 2020; Song et al., 2020). Then, GG is a program that encourages improvements in EQ because it requires economic actors to use environmentally friendly inputs (Bandiera et al., 2017; Hickel & Kallis, 2020). Furthermore, POP contributes to high rates of deforestation, so EQ will be even lower (Noormalitasari & Setyadharma, 2021; Rahma et al., 2019; Siddique & Kiani, 2020). In addition, ED will provide learning activities to help the public understand EQ, with the goal of increasing environmental protection and responsibility (Baker et al., 2020; Jamir, 2021). On the other hand, IND tends to have a bad effect on EQ because its activities produce waste, which has the potential to reduce the carrying capacity of the environment (Baselgia & Foellmi, 2023; Jia et al., 2017; Kim & Thurbon, 2015).

H1: POV has a significant influence on EQ.
H2: GG has a significant influence on EQ.
H3: POP has a significant influence on EQ.
H4: ED has a significant influence on EQ.
H5: IND has a significant influence on EQ.

2.4 POV Determination

POV is a condition of economic inability to meet the average standard of living, which is characterized by a low ability of income to meet basic needs (Baker et al., 2020). Based on studies from previous literature, there are several variables that influence POV stability, including low EQ, which tends to increase POV because people are very dependent on the environment to support their needs (Jia et al., 2017). Then, GG is an instrument to control POV (Baselgia & Foellmi, 2023; Bruckner et al., 2022; Kim & Thurbon, 2015). Furthermore, ED contributes to lowering POV as it prepares society for a competitive labor market (Lv et al., 2021; Sohag et al., 2021; Surya et al., 2020; Yahman & Setyagama, 2023). Additionally, high LP will trigger POV because labor supply is greater than demand in the labor market (Ben Jebli & Ben Youssef, 2017; Yahman & Setyagama, 2023). On the other hand, INV encourages increased employment, which in the long term will reduce POV (Hao et al., 2021; Pan et al., 2018).

H6: EQ has a significant influence on POV.
H7: GG has a significant influence on POV.
H8: ED has a significant influence on POV.
H9: LP has a significant influence on POV.
H10: INV has a significant influence on POV.

2.5 GG Determination

GG is an approach to achieving sustainable development goals by avoiding environmental damage, building resilience to extreme climate changes in the long term, and using resources more efficiently (Nambiar, 2021; Kopnina, 2018). Based on a study of previous literature, there are several variables that influence GG stability, including EQ, which is prioritized by the government and will encourage an increase in GG (Sun et al., 2020). Then, POV is an inhibiting factor in achieving the GG target (Luckyardi et al., 2022; Tormo-Carbó et al., 2016; Zhang & Zhang, 2020). Furthermore, IND causes severe environmental degradation, resulting in a slowdown in achieving GG. In addition, INV has a multiplier effect on the economy because it facilitates the provision of capital goods to support GG programs (Fernando et al., 2019; Zheng & Shi, 2017). On the other hand, the implementation of the RFP is a form of economic decentralization to encourage GG in each region (D'Alessandro et al., 2020).

H11: EQ has a significant influence on GG.
H12: POV has a significant influence on GG.
H13: IND has a significant influence on GG.
H14: INV has a significant influence on GG.
H15: RFP has a significant influence on GG.

2.6 Data Analysis Technique

This research applies a SEM because it has more than one equation and has a causal relationship between ENV and is also influenced by several EXV (Das, 2019). Then, the form of SEM used in this research can be seen in Eqs. (1)-(3).

$$EQ_{it} = \alpha_{1.0} + \alpha_{1.1}POV_{it} + \alpha_{1.2}GG_{it} + \alpha_{1.3}POP_{it} + \alpha_{1.4}ED_{it} + \alpha_{1.5}IND_{it} + \varepsilon_{1it} \quad (1)$$

$$POV_{it} = \alpha_{2.0} + \alpha_{2.1}EQ_{itt} + \alpha_{2.2}GG_{it} + \alpha_{2.3}ED_{it} + \alpha_{2.4}LP_{it} + \alpha_{2.5}IND_{5t} + \varepsilon_{2it} \quad (2)$$

$$GG_{it} = \alpha_{3.0} + \alpha_{3.1}EQ_{it} + \alpha_{3.2}POV_{it} + \alpha_{3.3}IND_{it} + \alpha_{3.4}INV_{it} + \alpha_{3.5}RFP_{it} + \varepsilon_{3it} \quad (3)$$

where, α is a parameter; t is the time series; i is the cross section; ε is the error term.

Based on Eqs. (1)-(3), it is not possible to obtain numerical values for each parameter in each equation because these equations cannot be differentiated by observation, so the application of SEM requires an identification test as a prerequisite. One type of identification testing proposition is the order condition (OC). In SEM, which consists of three analysis models and has several EXVs, the following rules apply:

If K – k = m – 1, then the equation is identified.
If K – k > m – 1, then the equation is over identified.
If K – k < m – 1, then the equation is unidentified.

where, K is the number of EXVs in the model; k is the number of EXVs in the equation; m is the number of ENVs in the equation.

Based on this explanation, the OC results for the three SEMs in this study are overidentified, which can be seen in Table 3.

Table 3. OC results

Eq.	Calculation	Decision
1	6 – 3 > 3 – 1 → 3 > 2	Over identified
2	6 – 3 > 3 – 1 → 3 > 2	Over identified
3	6 – 3 > 3 – 1 → 3 > 2	Over identified

Furthermore, if the OC results are overidentified, then the SEM analysis uses the two-stage least squares (TSLS) method, which is implemented using ordinary least squares in two stages (Das, 2019). In the first stage, each ENV is regressed against all predetermined variables of a system so that a reduced form of equation is obtained. In the second stage, the predicted values are used to estimate the model's structural equation, which is obtained by inputting the EXV observation values into a simple equation. Furthermore, the estimated ENV value is not correlated with confounding errors, so TSLS produces consistent structural parameter estimates.

The prerequisites for carrying out the significance test stages for each EXV against ENV for each analysis model are that the classical assumption test criteria must first be met. The simultaneous model is said to be good if it

meets several classical assumptions, namely, non-heteroscedasticity, normally distributed errors, and non-multicollinearity. Based on this explanation, it is necessary to carry out several types of feasibility assumption tests. First, the heteroscedasticity test is to determine whether the variance of the error is constant or changing. The simultaneous model is said to be good if the error has a constant variance. Second, use the use the normality test to see the normality of the error. Normality testing was carried out using the Kolmogorov-Smirnov test. Third, a multicollinearity test to test the correlation between the EXV for each equation.

3. Results and Discussion

3.1 Classical Assumption Test Results

3.1.1 Heteroscedasticity

Based on the results of the heteroscedasticity tests that have been carried out, the results obtained for probability value (PV) can be seen in Table 4.

Table 4. Heteroscedasticity test results

Eq.	PV								
	EQ	**POV**	**GG**	**POP**	**ED**	**IND**	**LP**	**INV**	**RFP**
1	-	0.597	0.987	0.197	0.351	0.216	-	-	-
2	0.481	-	0.041	-	0.236	-	0.941	0.836	-
3	0.153	0.263	-	-	-	0.302	-	0.035	0.847

Based on the information in Table 4, it is known that all EXV variables for each equation have PV values greater than 5 percent, which indicates that these variables are not significant. From the results of these calculations, all equations in this study are free from heteroscedasticity because all EXV in each model is not significant.

3.1.2 Normality

Based on the results of the normality tests that have been carried out, the results obtained can be seen in Table 5.

Table 5. Normality test results

Eq.	Skewness	Kuortis	Jarque-Bera	PV
1	-0.245	2.778	1.085	0.581
2	0.342	3.669	3.436	0.179
3	-0.533	3.593	5.594	0.060

Based on Table 5 for Eq. (1), the skewness value is -0.245, meaning that the slope of the data distribution is skewed to the right because the skewness value obtained is negative. The kuortis value is 2.778, meaning that the data is sharp or tends to be clustered (homogeneous) because the kuortis value obtained is positive. The PV value is (0.581) greater than 5 percent, so it can be concluded that the data is normally distributed in Eq. (1), which means the classic assumption of normality is met. Then, for Eq. (2) the skewness value is 0.341, meaning that the slope of the data distribution is skewed to the left because the skewness value obtained is positive. The kuortis value is 3,669, meaning that the data is sharp or tends to be clustered (homogeneous) because the kuortis value obtained is positive. The PV value is (0.179) greater than 5 percent, so it can be concluded that the data is normally distributed in Eq. (2), which means the classic assumption of normality is met. Furthermore, for Eq. (3) the skewness value is -0.533, meaning that the slope of the data distribution is skewed to the right because the skewness value obtained is negative. The kuortis value is 3.593, meaning that the data is sharp or tends to be clustered (homogeneous) because the kuortis value obtained is positive. The PV value is (0.060) greater than 5 percent, so it can be concluded that the data is normally distributed in Eq. (3), which means the classic assumption of normality is met.

3.1.3 Multicollinearity

Based on the results of the multicollinearity test that has been carried out, the results obtained can be seen in Table 6.

Based on Table 6, all the correlation coefficient values between EXV for each equation are smaller than 0.80. Thus, it can be said that every equation in this research does not contain multicollinearity problems. This means that in each equation, there is no strong relationship between EXV.

Table 6. Multicollinearity test results

Eq. (1)					
EXV	**POV**	**GG**	**POP**	**ED**	**IND**
POV	1.000	0.540	-0.024	0.536	-0.368
GG	0.750	1.000	-0.134	0.478	-0.297
POP	-0.024	-0.134	1.000	0.512	-0.396
ED	0.536	0.478	0.512	1.000	-0.523
IND	-0.368	-0.297	-0.396	-0.523	1.000
Eq. (2)					
EXV	**EQ**	**GG**	**ED**	**LP**	**INV**
EQ	1.000	-0.341	0.192	0.063	0.321
GG	-0.341	1.000	-0.129	0.035	-0.142
ED	0.192	-0.314	1.000	0.314	0.193
LP	0.063	0.035	0.036	1.000	-0.081
INV	0.321	-0.205	0.186	-0.075	1.000
Eq. (3)					
EXV	**EQ**	**POV**	**IND**	**INV**	**RFP**
EQ	1.000	-0.211	0.192	0.113	-0.038
POV	-0.211	1.000	-0.024	-0.159	0.822
IND	0.192	-0.024	1.000	0.022	-0.193
INV	0.113	-0.159	0.022	1.000	-0.467
RFP	-0.038	0.822	-0.193	-0.467	1.000

3.2 SEM Results

3.2.1 SEM for EQ

Based on the SEM analysis using the TSLS approach that has been carried out, the magnitude of each EQ determination coefficient (C) and PV level is obtained in Table 7.

Table 7. Hypothesis test (HT) results for EQ in Indonesia

H	C	PV	Decision
H1: POV has a significant influence on EQ	-0.235	0.043	Accepted
H2: GG has a significant influence on EQ	0.197	0.025	Accepted
H3: POP has a significant influence on EQ	-0.425	0.013	Accepted
H4: ED has a significant influence on EQ	0.324	0.017	Accepted
H5: IND has a significant influence on EQ	-0.531	0.031	Accepted

Based on the information in Table 7, a model can be created that explains EQ fluctuations in Indonesia based on the directional C of each determination and its level of significance for EQ. Then, the SEM interpretation for EQ in Indonesia can be seen in Eq. (4).

$$EQ_{it} = -0.235POV_{it}^{*} + 0.197GG_{it}^{*} - 0.425POP_{it}^{*} + 0.324ED_{it}^{*} - 0.531IND_{it}^{*} \quad (4)$$

* (indicates significant at PV 5 percent (%))

Based on the information in Eq. (4), it is known that POV, POP, and IND have a negative and significant effect on EQ. On the other hand, GG and ED have a positive and significant effect on EQ. First, POV contributes to reducing EQ because POV problems tend to result in the use of NR that exceeds their carrying capacity, so that increasingly extreme POV pressure is not commensurate with the EQ recovery process. Then, POV has a very strong dependence on input from nature to fulfill their basic needs, so it tends to result in excessive exploitation. These results are strengthened by the findings of Fahrika et al. (2020) and Song et al. (2020), who recommend that POV needs to be paid attention to by the government to improve EQ. Second, GG contributes to increasing EQ because its implementation considers environmental aspects in encouraging EG to realize the principle of sustainability as the main goal. Apart from that, its implementation is also more integrated and comprehensive because of the interdependence between social and environmental factors in the implementation of economic activities. This concept is the government's strategy for mitigating environmental risks affected by climate change with various policy mixes, both in substance, institutions, and financing. This result is strengthened by the findings of Bandiera et al. (2017) and Hickel & Kallis (2020) that the government needs to target GG as a solution to improving EQ. Third, POP contributes to lowering EQ because increasing POP activity will cause increased stress on environmental functions and will ultimately cause EQ to be degraded. In addition, an increase in POP will

trigger the quantity of waste in the environment to approach or exceed the EQ threshold. This result is strengthened by the findings of Rahma et al. (2019), Siddique & Kiani (2020), and Noormalitasari & Setyadharma (2021) that increasing POP is an indicator of accelerating pollution and other resource problems. Fourth, ED contributes to increasing EQ because ED is an important sector in encouraging public awareness of EQ. People who take part in the education sector will be provided with environmental education with the aim of improving EQ management as an important effort in producing human resources who have sensitivity to or awareness of EQ. This result is strengthened by the findings of Baker et al. (2020) and Jamir (2021) that ED will direct aspects of people's attitudes and behavior to understand the importance of EQ. Fifth, IND contributes to reducing EQ because it tends to trigger land conversion to support intensive economic activities, where the activity process will also produce dangerous residues in water, air, and soil. This result is strengthened by the findings of Baselgia & Foellmi (2023), Jia et al. (2017), and Kim & Thurbon (2015) that industrial waste has a vital impact on EQ.

3.2.2 SEM for POV

Based on the SEM analysis using the TSLS approach that has been carried out, the magnitude of each POV determination C and PV level is obtained in Table 8.

Table 8. HT results for POV in Indonesia

H	C	PV	Decision
H6 : EQ has a significant influence on POV	-0.391	0.002	Accepted
H7 : GG has a significant influence on POV	-0.201	0.018	Accepted
H8 : ED has a significant influence on POV	-0.367	0.027	Accepted
H9 : LP has a significant influence on POV	0.592	0.148	Rejected
H10 : INV has a significant influence on POV	-0.158	0.134	Rejected

Based on the information in Table 8, a model can be created that explains POV fluctuations in Indonesia based on the directional C of each determination and its level of significance for POV. Then, the SEM interpretation for POV in Indonesia can be seen in Eq. (5).

$$POV_{it} = -0.391EQ_{it}^{*} - 0.201GG_{it}^{*} - 0.367ED_{it}^{*} + 0.592LP_{it} - 0.158INV_{it} \quad (5)$$

* (indicates significant at PV 5 percent (%))

Based on the information in Eq. (5), it is known that EQ, GG, and ED have a negative and significant effect on POV. However, LP and INV did not have a significant effect on POV. First, EQ contributes to reducing POV because improvements in EQ indicate that sustainable development policies have been implemented, thereby changing consumption and production patterns that do not support maintaining EQ. Furthermore, improved EQ can reduce POV due to the improved health of the population, thereby increasing their chances of earning income. This result is strengthened by the findings of Jia et al. (2017) that a decrease in EQ will worsen POV due to the reduction in the benefits they obtain from the environment. Second, GG contributes to reducing POV because GG is an indicator of the success of socially inclusive, sustainable development. The process of increasing output from increasing GG requires a series of inputs, such as labor resources, so that GG is also accompanied by a decreasing unemployment rate due to the higher level of labor absorption. This condition will increase people's income, so that people's ability to meet their needs will be better. This result is strengthened by the findings of Baselgia & Foellmi (2023), Bruckner et al. (2022) and Kim & Thurbon (2015) that GG is an inclusive growth target that will improve the welfare of society and the environment. Third, ED contributes to reducing POV because ED is an element of POV risk reduction that can prevent the occurrence of another, much poorer generation. Apart from that, increasingly improving ED will encourage labor productivity, thus encouraging an increase in the ability of the workforce to produce production goods. Then, ED also creates great opportunities for people to be able to work in the formal sector, so that their welfare is more guaranteed. This result is strengthened by the findings of Lv et al. (2021), Sohag et al. (2021), and Surya et al. (2020) that ED needs to be encouraged to improve community welfare by reducing POV. Fourth, LPs do not contribute to POV because they do not only focus on the formal employment sector, where they are already equipped with the ability to develop micro, small, and medium enterprises (MSMEs). This condition makes people less dependent on the government's role in providing employment opportunities because they can independently find work for themselves to fulfill their needs. Most of the MSMEs in Indonesia are household business activities that can absorb a lot of labor. Based on data from the Ministry of Cooperatives and SMEs, in Indonesia in 2022, there will be 65.4 million MSMEs with a total of 65.4 million business units, which can absorb a workforce of 123.3 thousand. This proves that the impact and contribution of MSMEs are very large in reducing POV levels in Indonesia. This result is strengthened by the findings of Yahman & Setyagama (2023) that an increase in LP accompanied by the development of the informal

employment sector tends not to increase POV. Fifth, INV does not contribute to POV because entrepreneurs are more interested in investing in the service sector or manufacturing industry, which is capital- or technology-intensive rather than labor-intensive. This condition implies that, although there has been an increase in INV in Indonesia, it has not contributed to absorbing the unemployed workforce, so its implementation has no impact on increasing people's income to get out of the POV problem. This result is strengthened by the findings of Ben Jebli & Ben Youssef (2017) that INVs that contribute to lowering POV are labor-intensive.

3.2.3 SEM for GG

Based on the SEM analysis using the TSLS approach that has been carried out, the magnitude of each GG determination C and PV level is obtained in Table 9.

Table 9. HT Results for GG in Indonesia

H	C	PV	Decision
H11: EQ has a significant influence on GG	0.373	0.015	Accepted
H12: POV has a significant influence on GG	-0.402	0.026	Accepted
H13: IND has a significant influence on GG	-0.104	0.038	Accepted
H14: INV has a significant influence on GG	0.673	0.010	Accepted
H15: RFP has a significant influence on GG	0.731	0.402	Accepted

Based on the information in Table 9, a model can be created that explains GG fluctuations in Indonesia based on the directional C of each determination and its level of significance for GG. Then, the SEM interpretation for GG in Indonesia can be seen in Eq. (6).

$$GG_{it} = 0.373EQ_{it}^{*} - 0.402POV_{it}^{*} - 0.104IND_{it}^{*} + 0.673INV_{it}^{*} + 0.731RFP_{it}^{*} \quad (6)$$

* (indicates significant at PV 5 percent (%))

Based on the information in Eq. (5), it is known that EQ, INV, and RFP have a positive and significant effect on GG. On the other hand, POV and IND have a negative and significant effect on GG. First, EQ contributes to increasing GG because protection against EQ indicates that the environmental carrying capacity will be maintained through reducing the use of inputs sourced from nature to prevent NR exploitation activities from occurring. This condition will result in decreased NR depletion, which will have an impact on increasing GG. This result is strengthened by the findings of Sun et al. (2020) that GG will increase if there is an EQ priority policy. Second, POV contributes to reducing GG because POV tends to depend on the environment, so it will result in increased NR depletion, which has an impact on reducing GG. This result is strengthened by the findings of Luckyardi et al. (2022) and Tormo-Carbó et al. (2016) that poor people will reduce EQ, which has an impact on hampering the achievement of GG. Third, IND contributes to reducing GG because IND growth will indeed encourage conventional EG, but IND can trigger NR depletion and environmental degradation. A degraded environment will reduce its carrying capacity, which will reduce GG. Fourth, INV contributes to increasing GG because INV activities can encourage increased quantity and quality of infrastructure to realize green EG. Infrastructure development in environmental management efforts, which provides a multiplier effect in creating GG. This result is strengthened by the findings of Zheng & Shi (2017) that INV provides positive integration with GG. Fifth, RFP contributes to improving GG because it can improve environmental conservation projects and better EQ management efforts. Furthermore, the RFP will also contribute to opening job opportunities, increasing income equality, and increasing GG. This result is strengthened by the findings of D'Alessandro et al. (2020) that the development of the RFP has the potential to increase GG because it promotes local green financing.

4. Conclusions

This research found that increasing GG and ED resulted in improvements in EQ in Indonesia. The contrasting conditions of increasing POV, POP, and IND resulted in EQ in Indonesia decreasing. Then, the role of EQ, GG, and ED resulted in POV being reduced in Indonesia. Apart from that, increasing EQ, INF, and RFP resulted in better GG in Indonesia. The contrasting conditions for increasing POV and IND resulted in GG in Indonesia experiencing a decline. Based on the results of this research, in general, this research recommends that the Indonesian government (IG) implement inclusive and sustainable development (ISD) policies. Implementing ISD not only produces economic opportunities but also ensures fair access for all members of society to the economic opportunities created. Then, ISD refers to EG that creates broad access and opportunities for all levels of society in an equitable manner, increases welfare, and reduces disparities between groups and regions. In addition, ISD enables communities to participate and benefit from EG and development on an equal basis. Then, ISD needs to

be accompanied by environmentally friendly and sustainable growth by paying attention to the balance of the environment and ecosystem. This growth strategy does not only pursue high growth targets but focuses more on efforts to increase people's welfare and improve EQ. Then, specifically, this research also recommends that IG focus on variables that have a significant influence on EQ, POV, and GG.

First, the government can increase EQ, including by alleviating POV by establishing job training centers according to the interests and talents of the poor to provide training to the poor so that they no longer depend on nature for their livelihood because they already have the soft skills and skills to work from supplies. entrepreneurial spirit; through targeting GG by using environmentally friendly inputs and outputs so that the range of economic activities no longer reduces EQ; through readiness to face increasing POP by providing sufficient employment opportunities in the formal and informal sectors to avoid their dependence on the environment; through ED by instilling and socializing the importance of environmentally conscious behavior to maintain EQ; through IND by enforcing regulations that require them to process their waste to a threshold limit that does not reduce EQ.

Second, the government can reduce POV, including through EQ by implementing policies so that people do not exploit NR, where people who initially exploit the environment as their economic resource need to be given special training to improve their soft skills, so that they can have other jobs who do not exploit the environment, and their standard of living will also increase; through GG with a targeting method that focuses on a labor-intensive system, so that it will recruit unemployed poor people to help them get out of POV; and through ED by increasing knowledge and productivity so that they are able to compete competitively in the labor market.

Third, the government can improve GG, including through EQ by using environmentally friendly inputs to produce output to encourage sustainable development; through POV by overcoming their dependence on NR and focusing on the use of renewable NR; through IND by requiring them to manage waste from the production process, which has been carried out through reduce, reuse, and recycle activities; through INV by focusing on developing renewable NR sectors to support the use of clean inputs; and through RFP by focusing financing on superior environmentally friendly NR-based sectors to increase green output in each region.

On the other hand, this research is not free from limitations, so the recommendation for future researchers who are interested in developing this study is to apply the error correction model (ECM) approach. The aim is to see the performance of EQ, POV, and GG in the long term and short term and assess the consistency of the empirical model, as well as to avoid the occurrence of biased regression due to data non-stationarity. It is believed that the application of ECM will correct the regression Eq. between variables that are individually not stationary so that they return to their equilibrium values in the long term, with the main requirement being the existence of a cointegration relationship between the constituent variables.

Author Contributions

H. Aimon, correspondent and second author, has contributed in preparing the research conceptual framework, results and discussion. Sabri, the first author, has contributed in preparing all tables, figures, introduction, materials and methods. S. Amar, the third author, has contributed to preparing the conclusions and references.

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Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflict of Interest

The authors declare that they have no conflicts of interest.

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