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ANALYSIS OF THE INFLUENCE OF ENVIRONMENTAL EXPENDITURE AND ENERGY CONSERVATION THROUGH GRDP ON ENVIRONMENTAL QUALITY INDEX ON JAVA AND BALI ISLAND

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Abstract

The objective of this paper is as follows: analyse the effect of government spending on environmental protection and energy conservation through Gross Regional Domestic Product (GRDP) on the Environmental Quality Index (EQI). This paper includes panel data on government spending on environmental protection and energy conservation as independent variables, GRDP as an intervening variable, and EQI as a dependent variable in Java and Bali Island in 2015-2023 using the Partial Least Squares Structural Equation Modeling (PLS-SEM) method. The results of the study found a significant positive effect between government spending on environmental protection on GRDP and energy conservation on EQI. When the government spends the budget on environmental programmes, the currency circulating in the community can create jobs, thereby increasing local revenue. In addition, increasing the use of energy, especially renewable energy, also supports the creation of a healthier and more sustainable environment. The results find no evidence for a positive effect of energy conservation on GRDP, government spending on environmental protection on EQI, and GRDP on EQI. We conjecture that weak institutional quality can explain these results.

Keywords: Environmental Quality Index, Environmental Spending, Energy Conservation.

INTRODUCTION

In order to fulfil the desire for high economic value, many humans do not care about the preservation of nature. As a result, environmental damage occurs (Said, 2019). In 2015, Indonesia experienced forest fires that spread to neighbouring countries, and Indonesia became the country with the worst environmental ranking in ASEAN (Bloomberg, 2015). From 2016 to 2019, Indonesia became the country with the worst environment in ASEAN (IQAir, 2019). In 2020, Indonesia was ranked in the top 30 as the country with the worst environment in the world (Earth Org, 2021). In 2021, Indonesia was ranked as the country with the worst environment in ASEAN (Verisk Maplecroft, 2021). In 2022, Indonesia became one of the countries with the worst environmental ranking in the world as seen from the Environmental Performance Index, ranked 164 out of 180 countries (Yale and Columbia University, 2022). In 2023, Indonesia was only slightly better than the previous year but was still one of the countries with the worst environmental rankings in the world with a rank of 162 (Yale and Columbia University, 2023). In addition, based on the Environmental Quality Index for the period 2015-2023, provinces in Java and Bali are among those with consistently lower Environmental Quality Index scores than other islands in Indonesia.

In the face of growing environmental challenges, governments have a range of tools at their disposal, including regulations, programmes, innovation policies, environmental taxes, subsidies, and environmental spending. The role of government with coercive power is very important to realise sustainable development (Handoyo and Furry, 2019, p. 78). The government in this case is the Ministry of Environment and Forestry, which is implemented

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through the OPD of the Environment and Forestry Service in all provinces in Indonesia as an institution that handles environmental issues and is expected to improve environmental quality through its programmes. This is also stated in Law Number 23 of 2014 concerning Regional Government (State Gazette of the Republic of Indonesia of 2014 Number 25, Supplement to the State Gazette of the Republic of Indonesia Number 4437) concerning the division of environmental sub-fields mandated to be carried out by the government at the provincial level.

Government spending to help improve environmental quality plays an important role (Azwardi et al., 2022, p. 18). Efforts to conserve natural resources and the environment, which have become the national development agenda, are supported by budget allocations (Diniyanti and Halimatussadiah, p. 94). Improving environmental quality requires some level of government intervention. Environmental protection is a public good which cannot be done by market forces, therefore environmental protection is the responsibility of the government which is implemented through the government budget and therefore the government uses national spending on environmental protection as one of the policy instruments to achieve environmental standards and targets in overcoming market failures (Huang, 2018). However, the results of Moshiri and Daneshmand (2020) found no support for the EKC hypothesis and no evidence for a positive effect of environmental spending on environmental quality in their case study. In addition, programme budgets are not significantly meaningful if they are not fully utilised (Kabullah et al., 2020).

A budget is a state expenditure plan for a particular year that is linked to plans and projects for a longer period of time. In Article 23 Paragraph 1 of the 1945 Constitution (Amendment), it is stated that, "The state revenue and expenditure budget as a form of state financial management is determined annually by law and implemented openly and responsibly for the greatest prosperity of the people". There are several types of central government expenditure by function, including public service functions, defence functions, order and security functions, economic functions, environmental protection functions, housing and public facilities functions, health functions, tourism functions, religious functions, education functions, and social protection functions.

The government has also included the environment in the 2015-2019 national medium-term development plan (RPJMN), which aims to develop Indonesia towards the quality of natural resource management that is equitable and environmentally sound (Bappenas, 2014). The following year's RPJMN also still places the environment as a strategic issue (Bappenas, 2019).

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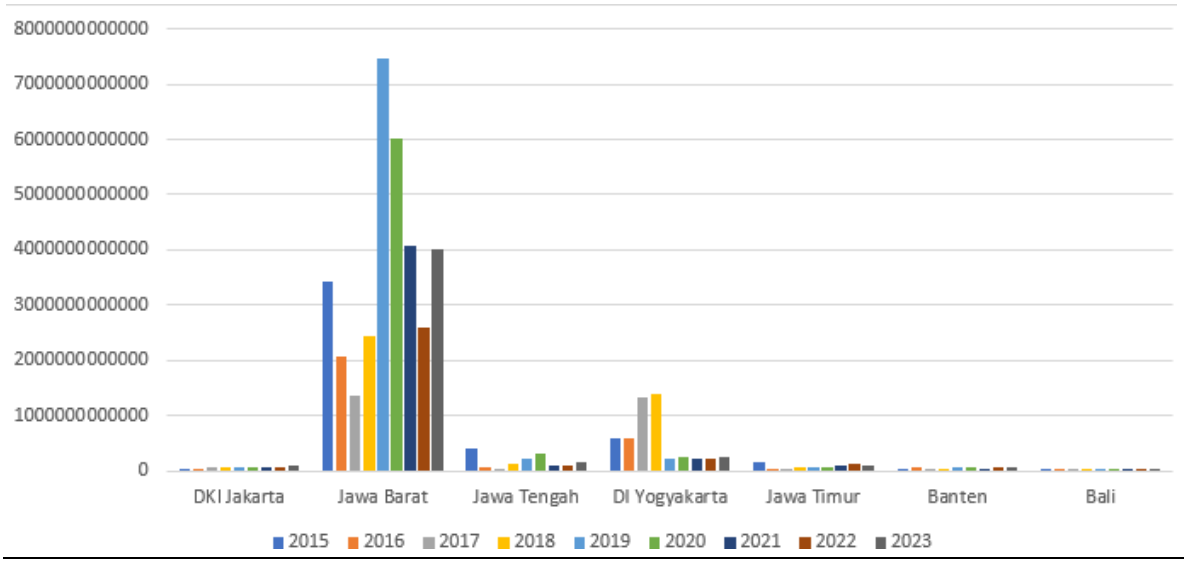

Figure 1. Government Spending on Environment in 7 Provinces in Java and Bali from 2015-2023
Data Source: Ministry of Environment and Forestry, data processed

From Figure 1 it can be seen that environmental protection expenditure in Indonesia varies on average. In general, ideally, the level of environmental degradation in a region will decrease as spending on environmental protection increases.

The Environmental Quality Index (EQI) is a measure of the results of policy efforts to improve the quality of the environment in Indonesia as reflected in improved water, air and land quality (Ministry of Environment, 2021). The EQI in Java and Bali has varied over the past nine years (2015-2023). The lower the value of 100, the greater the environmental protection and management efforts that must be carried out.

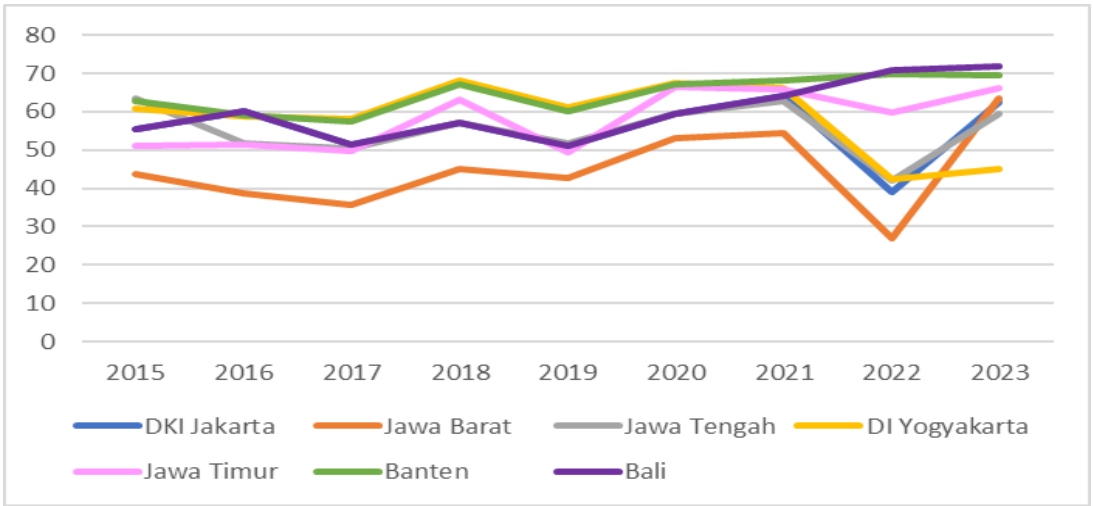

Figure 2. Environmental Quality Index in Java Island 2015-2023Data Source: Ministry of Environment and Forestry, data processed

Based on the data, while environmental expenditure is increasing, the environmental quality index in provinces in Java Island is not necessarily increasing as well. Based on the

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data, environmental expenditure is increasing at the same time as the environmental quality index is decreasing.

The challenge of sustainable development highlights the importance of changes in environmental quality. The promotion of environmental quality is an important strategic goal in most countries of the world. Developing countries face particular challenges in this area as these developing countries have to deal with the economic problems they face. In the case of developing countries, economic performance plays an important role (Sineviciene et al., 2018). People's environmental awareness also almost always follows economic growth because once people have reached a relatively satisfactory level of income, they may pursue other means to achieve a higher standard of living (Cui et al., 2021, p. 4). In addition, the high average growth of GRDP (Gross Regional Domestic Product) in each province in Java in the last nine years has not necessarily been followed by environmental development.

The government also strives for renewable energy. New and Renewable Energy (EBT) is the main choice to develop sustainable development (Ministry of Energy and Mineral Resources, 2015). This is also stated in the government's work plan in Indonesia where increasing the role of new renewable energy is a priority programme (Presidential Regulation, 2016). However, the increase in energy conservation is not always followed by an increase in the environmental quality index.

LITERATURE REVIEW

The aggregate demand theory of Keynes (1936) explains that according to Keynes, government spending including environmental spending can increase aggregate demand, which in turn encourages economic growth (GRDP). When the government spends on environmental programmes, the currency circulating in the community can create jobs and thus increase local income. Environmental projects usually involve local labour, purchase of local goods/services, and use of local infrastructure, all of which have a multiplier effect on the local economy. Environmental investment can be an economic stimulus and environmental spending can be considered a long-term investment and can reduce the cost of damage from environmental disasters and attract investors who care about ESG (Environmental, Social, Governance) aspects, which in turn contributes to GRDP. Environmental quality encourages economic competitiveness because a healthy environment as a result of spending can also increase the attractiveness of investment and tourism which can encourage the economic sector to grow. Public spending on the environment can also encourage private sector participation such as recycling business opportunities and encourage tourism SMEs. From Keynesian theory, it can be explained that green stimulus is needed as a contribution made to growth by investment in natural capital and correction of market failures through environmental policies (Harris, 2013, p. 69). In addition, innovation is also important in generating green growth. State spending on green causes can simultaneously save the planet from destruction. Governments that intervene in the purchase of increased goods and services by targeting this government spending on environmental projects simultaneously, will generate environmental benefits. Then further

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developed the EKC theory by Grossman & Krueger (1991) which states that the level of environmental damage will increase along with economic development and at a certain point (turning point) in achieving economic growth, the level of environmental damage will decrease along with the increase in economic growth characterised by an inverted u curve. The results of Hermawan's research (2020) also state that spending on environmental functions has an effect on increasing economic growth.

The Energy-Led Growth Hypothesis (Stern, 1993) explains that energy consumption can increase production capacity, which in turn can drive economic growth. Energy is an important input in the modern production process, both in industry, transport, and technology. Esen's research (2017) states that there is a positive and statistically significant relationship between energy consumption and economic growth in the long term. Al-Ayouty's research also (2020) states that energy contributes positively to GRDP. Ula (2019) in his research stated that renewable energy consumption makes a positive contribution to economic growth.

Government allocation function theory (Musgrave, 1959) explains that the government has an allocation function to finance public goods and services, including environmental protection. Environmental expenditure is a fiscal instrument to maintain environmental quality. When the government allocates funds for environmental management programmes, environmental quality will improve. Research by Ercolano & Romano (2018) says that higher environmental performance is positively correlated with public spending in the environmental domain. Research by Halkos & Paizanos (2017) also states that there is a significant reduction in the direct effect of government spending on emissions which increases along with the level of economic growth. Liu et al. (2020) stated that government subsidies have a positive role in encouraging green process innovation, or the so-called leverage effect. In a study conducted by Diniyanti & Halimatussadiah (2020) showed that government spending on forest protection activities has an effect on controlling the rate of deforestation. However, other studies have found that the amount of government spending on the environment has a negative and significant effect on environmental damage (Azwardi et al., 2022).

Ecological Economics Theory (Daly, 1996) emphasises that the use of clean and renewable energy is key to sustainable development. Economic growth and environmental protection can go hand in hand through energy innovation. The utilisation of green energy will create growth with minimal negative impact on the environment, reduce emissions and pollution, and support quality of life. Modernisation and technology (including energy) can be used to address environmental issues. Environmental quality is strongly influenced by the energy sources used. Research from Pramudiyanto & Suedy (2020) also states that renewable energy can reduce negative impacts on the environment.

Welfare Economics theory (Pigou, 1920) states that the higher the GRDP, the higher the ability of local governments to allocate budgets for public services, including the environment. High GRDP increases the potential of local revenue, which enables the government to finance environmental management programmes, thus improving EQI.

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Huang (2018) states that as GRDP increases, emissions will decrease. This is also explained in Sineviciene's research (2018) which states that GDP per capita has the most significant explanatory power regarding the environmental quality of developing countries.

METHOD

This research uses a quantitative approach with the Structural Equation Modelling method based on Partial Least Square (SEM-PLS) and processed using WarpPLS 8.0 software. The structural model used can be formulated as follows:

$GDRP = \beta 1 ENEXP + \beta 2 ENERGY$

$EQI = \beta 3 GDRPC + \beta 4 ENEXP + \beta 5 ENERGY$

Notes:

ENEXP = Government expenditure on environmental protection

ENERGY = Energy conservation

GDRPC = Gross Regional Domestic Product

EQI = Environmental Quality Index

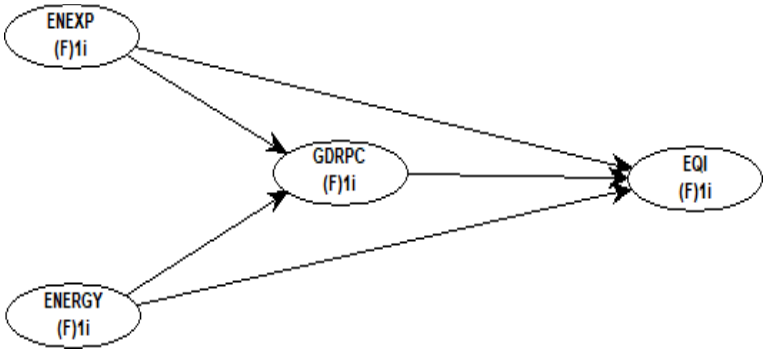

Figure 3. Research Model

The data used is panel data from 2015 to 2023. The amount of data used is 64 data from each variable sourced from the Ministry of Environment and Forestry (KLHK), the Environmental Service (DLH), and the Central Statistics Agency (BPS).

Symbol	Variable	Operational Definition	Unit	Reference
ENEXP	Government Expenditure for Environmental Protection	Total budget spent by local government for environmental conservation, pollution control, and natural resources management activities	IDR	Hermawan (2020); Moshiri & Daneshmand (2020); Diniyanti & Halimatussadiah (2020)

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Symbol	Variable	Operational Definition	Unit	Reference
ENERGY	Energy Conservation/Renewable Energy Expenditure	Value of government budget for energy efficiency programmes and renewable energy development, including subsidies and clean energy infrastructure	IDR	Moshiri & Daneshmand (2020); Liu et al. (2020); Bappenas (2020); Hermawan (2020)
GDRPC	Constant Gross Regional Domestic Product	Total value of goods and services produced in a given region at constant prices (base year prices)	Billion Rupiah	BPS (2023); Hermawan (2020); Musgrave (1959); Keynes (1936)
EQI	Environmental Quality Index	A composite index that measures the	Index (0-100)	U.S. EPA (2012); Cui et al. (2021);

RESULTS AND DISCUSSION

Structural Model Evaluation

Evaluation of the structural model is seen from the *goodness* of *fit* test or evaluation of the feasibility of the WarpPLS-based SEM model. The *goodness of fit* test shows that this model is suitable for further analysis.

Table 1. WarpPLS General Results Output (data processed)

Indicator	Value	General Criteria	Description	Reference
Average Path Coefficient (APC)	0.393	p-value < 0.05	Significant	Kock (2015); Hair et al. (2019)
p-value (APC)	< 0.001	< 0.05	Qualified	Kock (2015)
Average R-squared (ARS)	0.535	p-value < 0.05	Significant	Hair et al. (2019)
p-value (ARS)	< 0.001	< 0.05	Qualified	Kock (2015)
Average Adjusted R- squared (AARS)	0.501	p-value < 0.05	Significant	Hair et al. (2019)
p-value (AARS)	< 0.01	< 0.05	Qualified	Kock (2015)
Goodness of Fit (GoF)	0.731	GoF ≥ 0.36 = large/strong model	Very good	Tenenhaus et al. (2005); Kock (2015)

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Average Variance Inflation Factor (AVIF)	3.647	≤ 5.0 (ideal ≤ 3.3)	No serious multicollinearity	Kock & Lynn (2012)
Average Full Collinearity VIF (AFVIF)	3.391	≤ 5.0 (ideal ≤ 3.3)	Acceptable	Kock & Lynn (2012)

Measurement Model Evaluation

Evaluation of the measurement model aims to see indicators can measure constructs validly and reliably. Evaluation of the measurement model is done by looking at the significance of weights, multicollinearity test, reliability test, convergent validity, and discriminant validity. Formative indicators must have significant weights for their constructs ($p < 0.05$) to be valid. Each formative construct in the study had significant indicators forming the construct with $p < 0.001$. VIF value = 0.000 indicates no collinearity at all (ideal). SE (Standard Error) values <0.1 - 0.2 are considered quite stable and acceptable in the formative model. The WLS (Warped Loading Score) = 1 and ES (Effect Size) = 1 values indicate model stability and indicate no model anomalies (Kock, 2015).

Table 2. Evaluation Table of Relationship between Constructs and Multicollinearity (data processed)

Construct	Type	SE	p-value	VIF	WLS	ES	Description
ENEXP	Formative	0.099	< 0.001	0.000	1	1.000	Significant, not multicollinear
ENERGY	Formative	0.099	< 0.001	0.000	1	1.000	Significant, not multicollinear
GDRPC	Formative	0.099	< 0.001	0.000	1	1.000	Significant, not multicollinear
EQI	Formative	0.099	< 0.001	0.000	1	1.000	Significant, not multicollinear

All constructs in the model meet the reliability and validity criteria because the composite reliability and Cronbach's alpha = 1,000, the AVE value is also perfect (1,000) indicating convergent validity is very well met. Full collinearity VIF of all constructs < 5 except GDRPC (5.521) which is slightly above the ideal threshold but still acceptable because it is < 10 (Hair et al., 2019). The GDRPC and ENEXP constructs have very high R^2 and Q^2 values (0.94 & 0.91) meaning that the model predictions are very strong. EQI has a low R^2 (0.129) meaning that the model does not explain EQI well. Some constructs did not pass normality (Normal-JB & RJB = No), especially ENEXP and GDRPC, but this is not a big problem in PLS SEM which does not assume normal data (Hair et al., 2019).

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Table 3. Reliability Test (Data Processed)

Statistical Indicators	ENEXP	ENERGY	GDRPC	EQI	Evaluation Criteria
R-squared	0.940	0.000	0.940	0.129	High R^2 = variation in endogenous constructs explained by exogenous constructs
Adjusted R-squared	0.938	0.000	0.938	0.065	Correction of R^2 to the number of predictors
Composite Reliability	1.000	1.000	1.000	1.000	≥ 0.7= Reliable (Hair et al., 2019)
Cronbach's Alpha	1.000	1.000	1.000	1.000	≥ 0.7 = High internal consistency
Average Variance Extracted (AVE)	1.000	1.000	1.000	1.000	≥ 0.5 = Convergent validity met
Full Collinearity VIF	4.243	2.375	5.521	1.426	≤ 5 = No serious multicollinearity (Kock & Lynn, 2012)
Q-squared (predictive relevance)	0.914	0.000	0.914	0.335	> 0 = Model has predictive power
Skewness	2.381	-0.161	1.533	-0.698	< ±2 = near normal distribution (Hair et al., 2019)
Excess Kurtosis	5.300	-0.549	0.463	-0.050	< ±7 = acceptable distribution (Kline, 2015)
Unimodal-RS	Yes	Yes	No	Yes	Data distribution has one peak (mode)
Normal-JB	No	Yes	No	No	Jarque-Bera (JB) normality test

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Normal-RJB	No	Yes	No	Yes	Robust JB normality test

Testing discriminant validity with the Fornell-Larcker method shows that the model qualifies because the root AVE value is greater than the correlation with other constructs in the same row/column (Hair et al., 2019). The diagonal numbers (bold) are the square roots of the AVE of each construct.

Table 4. Fornell-Larcker Criterion Table (Data Processed)

Construct	ENEXP	ENERGY	GDRPC	EQI
ENEXP	**(1.000)**	-0.717	0.855	-0.282
ENERGY	-0.717	**(1.000)**	-0.745	0.295
GDRPC	0.855	-0.745	**(1.000)**	-0.483
EQI	-0.282	0.295	-0.483	**(1.000)**

Research shows that government spending on environmental protection (ENEXP) to Gross Regional Domestic Product (GDRPC) has a significant positive effect ($p < 0.001$), energy conservation (ENERGY) to Gross Regional Domestic Product (GDRPC) has a significant negative effect (significant ($p < 0.001$), government expenditure on environmental protection (ENEXP) to environmental quality index (EQI) negative insignificant effect ($p = 0.061$), energy conservation (ENERGY) to environmental quality index (EQI) positive significant effect ($p = 0.049$), and Gross Regional Domestic Product (GRDP) to EQI negative significant effect ($p < 0.001$) (Hair et al, 2019).

Table 5. Significance of Inter-Construct Correlation (p-value)

The construct	ENEXP	ENERGY	GDRPC	EQI
ENEXP	1.000	<0.001	<0.001	0.061
ENERGY	<0.001	1.000	<0.001	0.049
GDRPC	<0.001	<0.001	1.000	<0.001
EQI	0.061	0.049	<0.001	1.000

Structural Model Evaluation

The R^2 value shows how much the proportion of endogenous latent variables can be explained by exogenous latent variables. The value of R^2 ranges from 0-1, getting to 0 means that the exogenous latent variable does not explain the endogenous latent variable at all, if $R^2 = 1$ means that the exogenous latent variable explains 100% of the variation of the endogenous latent variable. From this study, 93% of the variance of Gross Regional Domestic Product (GDRP) can be explained by government spending on environmental protection (ENEXP) and energy conservation (ENERGY) and 45% of the variance of the environmental quality index (EQI) can be explained by Gross Regional Domestic Product (GDRP).

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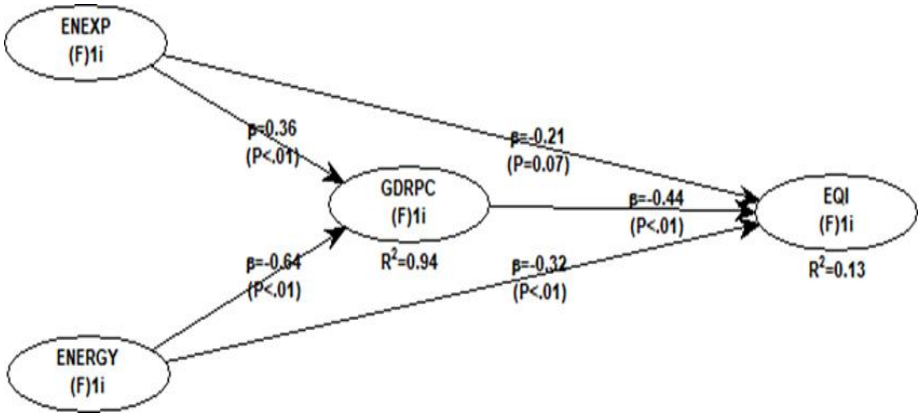

Figure 3. Model Estimation Results

Table 6. WarpPLS SEM Structural Model Evaluation (data processed)

Evaluation Aspect	Result Value	Evaluation Condition	Description	Reference
R² GDRPC	0.94	R² ≥ 0.75 = strong	Very strong	Hair et al. (2019)
R² EQI	0.13	R² ≥ 0.10 = weak, ≥ 0.25 = moderate, ≥ 0.50 = strong	Weak	Hair et al. (2019)
ENEXP → GDRPC	β = 0.36, p < 0.01	p < 0.05 → significant	Positively significant	Hair et al. (2019)
ENERGY → GDRPC	β = -0.64, p < 0.01	p < 0.05 → significant	Negative significant	Hair et al. (2019)
ENEXP → EQI	β = 0.21, p = 0.07	p ≥ 0.05 → not significant	Not significant	Hair et al. (2019)
ENERGY → EQI	β = -0.32, p < 0.01	p < 0.05 → significant	Negative significant	Hair et al. (2019)
GDRPC → EQI	β = -0.44, p < 0.01	p < 0.05 → significant	Negative significant	Hair et al. (2019)
Multicollinearity (VIF)	All VIF < 5.521	VIF ≤ 5 (ideal ≤ 3.3) → no serious multicollinearity	Acceptable	Kock & Lynn (2012); Hair et al. (2019)
Significance of path p-value	p < 0.05 (except ENEXP→EQI = 0.07)	p < 0.05 → significant	Majority of relationships are significant	Hair et al. (2019); Kock (2015)

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Effect of Government Spending on Environmental Protection on GRDP

Government spending on environmental protection has a significant positive effect on GRDP in accordance with the theory of aggregate demand from Keynes that according to Keynes government spending including environmental spending can increase aggregate demand, which in turn encourages economic growth (GRDP). An increase in environmental budgets can be a driver of national economic growth through the creation of productive activities and improvements in green infrastructure (Hermawan, 2020). When environmental spending is appropriately directed, the results are positive for economic output. Environmental spending can boost economic growth, especially in developing regions (Moshiri & Daneshmand, 2020). Government environmental spending is effective in reducing environmental degradation and supporting economic growth in the medium term. This is part of the transition to sustainable development. (Cui et al, 2021). In research produced by Ercolano & Romano (2018), governments that consistently fund the environmental sector tend to have more resilient regional economies and support the argument that environmental spending is a long-term investment for growth. According to Krajewski (2023), increased public spending on environmental protection has been shown to significantly boost long-term economic growth as it creates green jobs. Stern and team from the London School of Economics (2024) stated that public investment in green transitions, such as environmental protection, is more effective at stimulating GDP growth than ordinary fiscal policies such as tax cuts. Munthe (2023) also showed that government spending on green sectors significantly impacts the increase of regional GRDP. Fadillah, Rahmawati, and Yuniarti (2024) through a VAR model showed that public environmental spending contributed to driving economic growth.

The Effect of Government Spending on Environmental Protection on EQI

Government expenditure on environmental protection on EQI suggests that it may not be effective, not on target, or take longer to show tangible results on environmental quality. This is in line with Diniyanti & Halimatussadiah's (2020) research that the government budget has not been effective in reducing environmental damage, especially in conservation areas because the large amount of budget allocation does not automatically have an impact on reducing environmental damage due to weak implementation and planning. Budget expenditure for environmental damage control does not have an optimal impact due to alienated policies and minimal community participation. As a result, environmental quality remains poor despite budget increases (Kabullah et al., 2020). Environmental spending by the central government does not always have a significant impact on reducing emissions depending on regional effectiveness and policy coordination (Huang, 2018). In many cases, large expenditures have no impact on environmental outcomes due to weak institutions and oversight (Moshiri & Daneshmand, 2020). Maulida and Raisa (2021) found that increased local government spending on the environment significantly reduced environmental quality in certain regions, due to consumption effects that exceeded local environmental capacity. Aykut and Uzar (2019) in their study found that public sector spending on the environment

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actually increased the ecological deficit, showing a significant negative effect on environmental quality.

Effect of Energy Conservation on EQI

Findings show that energy conservation has a significant positive effect on EQI. Investments in green energy have been shown to reduce emissions, improve air quality, and support the achievement of better environmental indices (Boersma et al., 2023; Gyimah et al., 2024; Frontiers, 2022). In addition, energy consumption supported by strong policies and funding also strengthens sustainable development (Rahmi et al., 2024; MDPI, 2023; Springer, 2025). These results emphasise the important role that public and private spending on the energy sector plays in driving environmental quality improvement. Renewable energy greatly contributes to reducing emissions and improving environmental quality (Pramudiyanto & Suedy, 2020). Research by Marina et al. (2020) also proves that renewable energy is proven to reduce pollution levels. Renewable energy also has a positive impact on the environment by reducing dependence on fossil energy (Ula&Affandi, 2019). According to MDPI (2021), green public consumption policies, namely energy conservation (via government spending), are proven to significantly promote equitable improvement in environmental quality. According to Ma (2024), the implementation of energy spending has also been shown to have a significant positive impact on improving environmental quality globally. Gong, Zhang, and Wang (2022) found that government fiscal spending on environmental protection, especially increased investment in clean technology, contributed significantly to pollution reduction.

Effect of Energy Conservation on GRDP

Energy conservation shows a significant negative effect on GRDP. In many developing regions or those in energy transition, renewable energy use is not yet dominant. In some regions, the adoption of renewable energy has not been large enough to directly drive economic growth (Gyimah et al., 2024). Marina et al. (2020) also revealed in their research that renewable energy does not have a strong short-term causal relationship with economic growth and clean energy has not been able to replace fossil energy in supporting large economic activities. According to Ula & Affandi (2019), the share of renewable energy is still small so that it has not had a real impact on GRDP. Algaeed (2022) also found that increased energy spending by the government has a significant negative effect on economic growth in the long run, due to high fiscal dependence and low productivity of energy spending. According to Revika and Yenni (2021), energy consumption in the long run shows a significant negative relationship with economic growth because it is not accompanied by energy efficiency or transition to clean energy. Sarrakh et al. (2020) showed that an increase in energy subsidies as part of government energy expenditure suppresses the growth of other sectors, thus having an overall negative impact on national economic output. Samir et al. (2025) showed that a fossil energy subsidy of 1% of GDP reduces economic growth by 0.19% as it hampers the efficiency of budget allocation. A CGE study in Thailand (2022)

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revealed that energy spending in the form of subsidies causes market price distortions, discourages investment in other sectors, and has a significant negative effect on GDP in the short term.

Effect of GRDP on EQI

GRDP shows a significant negative effect on EQI, which supports the Environmental Kuznets Curve (Grossman & Krueger, 1992). This theory states that in the early stages of economic growth, pressure on the environment increases. Only after the economy reaches a certain income point does environmental quality begins to improve (Cui et al., 2021). This means that economic growth that is not environmentally friendly is still a big challenge in sustainable development. Research from Azwardi et al. (2022) shows that economic growth (GRDP) is actually one of the factors that worsen environmental quality mainly due to industrial expansion and environmentally unfriendly development. Halkos & Paizanos (2017) explained that economic growth can have a negative impact on the environment if it is not balanced with adequate environmental regulations. In some cases, increased income actually increases resource consumption and pollution. Fadilah and Rahajeng (2024) found that GRDP per capita has a significant negative impact on environmental quality. Ma et al. (2017) stated that GDP per capita does not support the improvement of environmental quality. Seri and de Juan Fernandez (2021) through revealed that GDP per capita is positively correlated with carbon and shows a negative impact on environmental quality. According to the MDPI study (2021), an increase in GDP per capita in fossil fuel-intensive developing countries is significantly associated with increased emissions and declining environmental quality.

CLOSING

Conclusion

This study highlights the important role of government spending on environmental protection, energy conservation, and gross regional domestic product in achieving successful environmental management. The results show that government spending on environmental protection is proven to boost regional economic growth (GRDP), but has not directly impacted on improving the Environmental Quality Index (EQI). Energy conservation contributes significantly to the improvement of environmental quality, but has a negative effect on economic growth. Economic growth (GRDP) has a negative impact on EQI, indicating that development is still not ecologically sustainable. The structural model evaluation results show that 93% of the variation in GRDP can be explained by government spending and energy conservation, while 45% of the variation in EQI.

Suggestions and Acknowledgments

These results show that energy expenditure has a dominant role in influencing environmental quality directly compared to economic expenditure and growth, so the government needs to focus on improving the energy transition towards cleaner sources in an

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effort to maintain and improve environmental quality. Suggestions for the community are that people must increase awareness in environmentally friendly behaviour, actively participate in government or environmental community programmes, and be wise in using energy in order to create synergy between government policies and citizen actions to improve environmental quality in a sustainable manner.

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