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The Effect of Economic Policy on Environmental Damage Control: Empirical Evidence from Gorontalo Province, Indonesia

Sri Hantuti Paramata[1*], Ramlah Alkatiri[2], Umar Sako Baderan[3]

[1,2]Development Economics Study Program, Faculty of Social Sciences, Universitas Muhammadiyah Gorontalo, Indonesia.
[3]Public Administration Study Program, Universitas Muhammadiyah Gorontalo, Indonesia.
*Corresponding author: tutiparamata@umgo.ac.id
https://orcid.org/0000-0002-7867-270X

Abstract

Environmental degradation has become a major challenge to sustainable regional development, requiring effective economic policies to balance economic growth and environmental sustainability. This study examines the effect of Environmental Policy Expenditure, Environmental Regulation Implementation, and Sustainable Development Programs on Environmental Damage Control in Gorontalo Province, Indonesia. A quantitative explanatory approach was employed using annual secondary time-series data from 2015 to 2025, analyzed through multiple linear regression. The results reveal that Environmental Policy Expenditure (β = 0.438; p = 0.002), Environmental Regulation Implementation (β = 0.397; p = 0.005), and Sustainable Development Programs (β = 0.512; p < 0.001) each have a positive and significant effect on Environmental Damage Control, with Sustainable Development Programs showing the strongest influence. The regression model explains 68.2% of the variation in Environmental Damage Control (R^2 = 0.682). These findings support Environmental Economics Theory by demonstrating that integrated fiscal policies, effective regulatory enforcement, and sustainability-oriented development collectively strengthen environmental governance and contribute to sustainable regional development.

Keywords: Environmental Damage Control; Environmental Policy Expenditure; Environmental Regulation Implementation; Sustainable Development Programs; Environmental Economics

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INTRODUCTION

Environmental degradation has become one of the most pressing challenges to sustainable development worldwide, given its far-reaching consequences for ecological integrity, public health, economic productivity, and long-term social welfare. Global assessments indicate that climate change, biodiversity loss, land degradation, pollution, and unsustainable natural resource exploitation continue to intensify interconnected environmental risks, with particularly severe implications for developing regions whose economic activities remain highly dependent on natural resources (IPCC, 2023; UNEP, 2022). In many developing economies, rapid economic expansion, population growth, land-use conversion, industrialization, and intensive resource utilization have accelerated ecological deterioration and weakened environmental resilience. Deforestation, river pollution, unmanaged waste, and declining land productivity consequently constrain regional development by reducing ecosystem services, increasing social and economic vulnerability, and undermining the productive foundations on which local communities depend. Balancing economic growth with environmental sustainability has therefore become a strategic policy priority for governments seeking to pursue inclusive, resilient, and sustainable development (Todaro & Smith, 2021; World Bank, 2022).

Economic development frequently presents a fundamental dilemma between achieving sustained economic growth and preserving environmental sustainability. While economic expansion is indispensable for increasing regional income, employment opportunities, and social welfare, uncontrolled production, consumption, and natural resource exploitation often generate negative environmental externalities that accelerate ecosystem degradation and reduce ecological carrying capacity (Grossman & Krueger, 1995). From the perspective of environmental economics, such environmental degradation arises because many environmental resources possess the characteristics of public goods and common-pool resources, resulting in market failures when environmental costs are not adequately internalized within economic decision-making processes (Field & Field, 2017). Consequently, government intervention through well-designed economic policies becomes essential to correct market failures, internalize environmental externalities, and promote more sustainable patterns of production and resource utilization. These policy interventions encompass a broad range of economic instruments, including environmental regulations, environmental taxation, public environmental expenditure, green fiscal incentives, and sustainability-oriented development planning, all of which are intended to align economic activities with environmental conservation objectives. Accordingly, environmental governance has increasingly shifted from relying solely on regulatory approaches toward integrating economic policy instruments capable of simultaneously fostering environmental

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protection, economic efficiency, and long-term sustainable development (Pearce & Turner, 1990; OECD, 2021).

Despite the growing body of empirical evidence supporting the role of economic policy in improving environmental quality, significant challenges remain in many developing countries, including Indonesia, where rapid regional economic development and the implementation of decentralization policies have intensified pressures on natural resources and ecosystem sustainability. Several provinces continue to experience environmental degradation driven by agricultural expansion, mining activities, forest conversion, urbanization, and disparities in environmental governance capacity. National environmental assessments consistently indicate that maintaining environmental quality while sustaining economic growth remains a major challenge for regional governments, particularly in regions whose economic development depends heavily on natural resource-based sectors (UNEP, 2022; World Bank, 2022). Within this context, Gorontalo Province represents a relevant empirical setting because its economy relies substantially on agriculture, fisheries, and other natural resource-based activities that contribute to regional income and employment while simultaneously increasing environmental pressures through land degradation, water pollution, and ecosystem disturbance. These regional characteristics underscore the need to evaluate whether existing economic policy instruments have been effective in supporting environmental damage control while maintaining sustainable regional economic development.

Recent empirical studies have increasingly highlighted the importance of economic policy instruments in improving environmental quality and supporting sustainable development. Li et al. (2024) demonstrated that effective environmental regulation contributes not only to ecological capital utilization but also to high-quality economic development by encouraging more sustainable patterns of resource management. Similarly, Chu and Tran (2022) found that stronger environmental regulatory frameworks significantly reduce ecological footprints, indicating that regulatory enforcement plays a crucial role in mitigating environmental degradation. From a fiscal perspective, recent evidence suggests that environmental policy expenditure is an important mechanism for enhancing environmental performance. Local environmental fiscal expenditures have been shown to facilitate industrial restructuring while reducing carbon emission intensity, emphasizing the role of public environmental investment in promoting greener economic transformation (Frontiers in Environmental Science, 2024). Likewise, Sun et al. (2023) reported that sustained government commitment to environmental protection expenditure strengthens environmental governance and supports long-term environmental sustainability. Furthermore, Dahmani (2024) demonstrated that integrating environmental

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taxation, environmentally related technologies, and research and development expenditure significantly improves environmental quality, highlighting the importance of combining multiple economic policy instruments rather than relying on a single policy approach. Collectively, these studies confirm that economic policies constitute effective instruments for environmental protection; however, existing empirical evidence has primarily examined these policy dimensions separately or within cross-country settings, leaving limited evidence regarding their integrated effects at the provincial level in developing regions such as Gorontalo Province, Indonesia.

Although recent empirical studies consistently demonstrate that environmental regulations, environmental expenditures, and sustainability-oriented policy instruments contribute positively to environmental quality, several important research gaps remain. First, previous studies have predominantly examined these policy dimensions independently, providing limited understanding of their relative and simultaneous contributions within a single analytical framework. Second, much of the existing evidence has been generated from cross-country analyses or national-level investigations, while empirical studies focusing on provincial or regional governments in developing countries remain comparatively scarce. Third, regional heterogeneity in economic structure, institutional capacity, and natural resource dependence suggests that policy effectiveness may vary considerably across regions, making context-specific empirical evidence essential for designing effective environmental policies. In the case of Gorontalo Province, empirical evidence examining the combined effects of environmental policy expenditure, environmental regulation implementation, and sustainable development programs on environmental damage control has not been sufficiently documented. Therefore, this study addresses these gaps by simultaneously evaluating the influence of these three dimensions of economic policy on environmental damage control, thereby providing empirical evidence that contributes to the literature on environmental economics and supports evidence-based regional policy formulation in Indonesia.

Based on the identified research gaps, this study aims to examine the effects of environmental policy expenditure, environmental regulation implementation, and sustainable development programs on environmental damage control in Gorontalo Province, Indonesia. Using a quantitative approach and multiple linear regression analysis, this study evaluates the relative contribution of each policy dimension to environmental damage control within a regional context characterized by high dependence on natural resource-based economic activities. Beyond examining the proposed relationships, this study contributes to the environmental economics literature by providing integrated empirical evidence on the effectiveness of multiple economic policy instruments at the provincial level,

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an area that has received limited scholarly attention in developing countries. The findings are expected to enrich current understanding of regional environmental governance while providing evidence-based recommendations for policymakers in designing more effective and integrated economic policies that simultaneously promote environmental protection and sustainable regional development.

THEORETICAL REVIEW

Environmental Economics Theory provides the principal theoretical foundation for understanding the relationship between economic activities, public policy, and environmental sustainability. The theory argues that environmental degradation primarily arises from market failures, particularly when environmental resources are treated as public goods and the environmental costs associated with production and consumption are not fully reflected in market prices (Field & Field, 2017). As a result, economic activities frequently generate negative environmental externalities, including pollution, ecosystem degradation, and excessive exploitation of natural resources. To address these inefficiencies, Environmental Economics emphasizes the importance of government intervention through economic policy instruments that internalize environmental externalities, improve resource allocation, and promote environmentally responsible behavior (Pearce & Turner, 1990). Contemporary environmental governance therefore recognizes that sustainable economic development depends not only on economic growth but also on the effective integration of environmental protection into public policy and regional development planning. This theoretical perspective provides the conceptual foundation for examining how environmental policy expenditure, environmental regulation implementation, and sustainable development programs contribute to environmental damage control in Gorontalo Province.

Within the framework of Environmental Economics, government intervention through economic policy is considered essential for correcting market failures and promoting sustainable resource management. Environmental policy expenditure provides the financial capacity required to implement environmental protection programs, strengthen pollution control, conserve natural resources, and improve environmental infrastructure. At the same time, effective environmental regulation establishes legal and institutional mechanisms that encourage compliance with environmental standards, reduce environmentally harmful activities, and enhance environmental governance. Sustainable development programs further complement these policy instruments by integrating economic development with environmental conservation and social well-being, thereby promoting balanced and long-term regional development. Collectively, these policy

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dimensions contribute to environmental damage control by reducing environmental degradation, improving ecosystem resilience, and supporting sustainable economic development. Consequently, regions that consistently strengthen environmental expenditure, regulatory implementation, and sustainability-oriented development programs are expected to achieve better environmental quality and more effective environmental governance than regions where such policy instruments are implemented less effectively.

Recent empirical studies have consistently demonstrated that economic policy instruments play a crucial role in improving environmental quality and promoting sustainable development. Li et al. (2024) found that effective environmental regulation enhances ecological capital utilization while supporting high-quality economic development, indicating that regulatory effectiveness contributes to better environmental outcomes. Similarly, Chu and Tran (2022) reported that stronger environmental regulatory frameworks significantly reduce ecological footprints, emphasizing the importance of regulatory enforcement in mitigating environmental degradation. From a fiscal perspective, Sun et al. (2023) showed that sustained government commitment to environmental protection expenditure strengthens environmental governance and improves long-term environmental sustainability. In addition, recent evidence published in Frontiers in Environmental Science (2024) demonstrated that environmental fiscal expenditure facilitates industrial upgrading while reducing carbon emission intensity, highlighting the strategic role of public environmental investment. Furthermore, Dahmani (2024) argued that integrating environmental fiscal policies with environmentally related technologies and research investment produces greater improvements in environmental quality than isolated policy interventions. Collectively, these findings indicate that environmental damage control is more effectively achieved when environmental expenditure, regulatory implementation, and sustainability-oriented development policies operate in an integrated and mutually reinforcing manner.

The theoretical perspectives and empirical evidence discussed above indicate that economic policy constitutes a fundamental instrument for achieving effective environmental damage control. Anchored in Environmental Economics Theory, this study posits that environmental policy expenditure, environmental regulation implementation, and sustainable development programs collectively strengthen environmental governance by reducing negative environmental externalities, improving natural resource management, and enhancing ecosystem sustainability. Accordingly, these three dimensions are conceptualized as key components of economic policy that are expected to contribute positively to environmental damage control in Gorontalo Province. This theoretical

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proposition provides the basis for developing the conceptual framework presented in the following section. The conceptual relationships among the variables are illustrated in Figure 1, which serves as the foundation for formulating the research hypotheses.

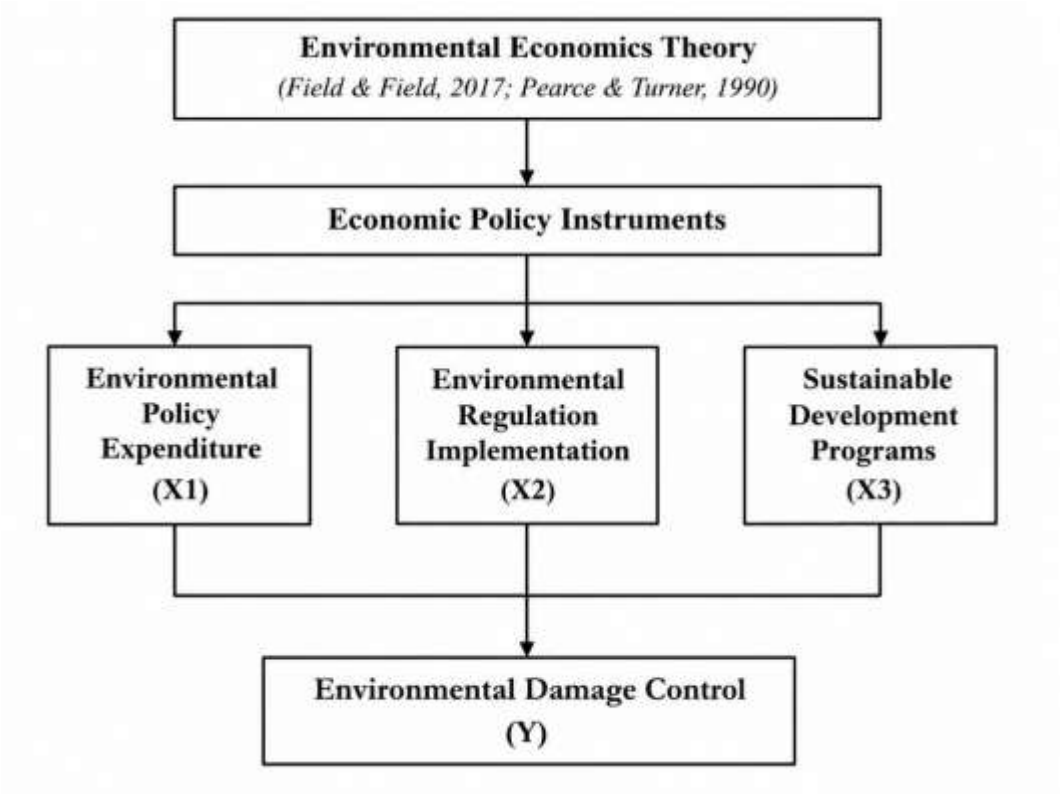


Figure 1. Thinking Framework

Based on the conceptual framework, the following hypotheses are proposed:

H1: Environmental Policy Expenditure has a positive and significant effect on Environmental Damage Control in Gorontalo Province.

H2: Environmental Regulation Implementation has a positive and significant effect on Environmental Damage Control in Gorontalo Province.

H3: Sustainable Development Programs have a positive and significant effect on Environmental Damage Control in Gorontalo Province.

H4: Environmental Policy Expenditure, Environmental Regulation Implementation, and Sustainable Development Programs simultaneously have a positive and significant effect on Environmental Damage Control in Gorontalo Province.

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METHOD

Research Design

This study employed a quantitative research approach using an explanatory research design to examine the effect of economic policy on environmental damage control in Gorontalo Province. The explanatory design was adopted because the study aims to analyze the causal relationships between environmental policy expenditure, environmental regulation implementation, sustainable development programs, and environmental damage control through hypothesis testing. Quantitative explanatory research is appropriate for evaluating relationships among measurable variables and testing theoretical propositions derived from Environmental Economics Theory (Creswell & Creswell, 2018; Saunders et al., 2019). The study utilized annual secondary time-series data covering the period 2014-2025, enabling an assessment of the dynamic relationship between government environmental policies and environmental damage control over time.

Data Source and Variables

The study employed secondary data obtained from official publications of the Central Bureau of Statistics (Badan Pusat Statistik/BPS), the Ministry of Environment and Forestry of the Republic of Indonesia (KLHK), the Environmental Agency of Gorontalo Province (DLH), and other relevant regional government reports related to environmental management and sustainable development. The observation period covered annual data from 2014 to 2025.

The study consisted of one dependent variable and three independent variables. The dependent variable was Environmental Damage Control (Y), representing government performance in preventing and mitigating environmental degradation. The independent variables included Environmental Policy Expenditure (X_1), Environmental Regulation Implementation (X_2), and Sustainable Development Programs (X_3), which collectively represent the principal dimensions of economic policy for environmental management. The selection of these variables was based on Environmental Economics Theory, which emphasizes that fiscal instruments, regulatory enforcement, and sustainability-oriented development policies jointly contribute to improving environmental quality and reducing environmental degradation (Field & Field, 2017; Pearce & Turner, 1990).

Operational Definition of Variables

The study consisted of one dependent variable and three independent variables. Environmental Damage Control was specified as the dependent variable, whereas Environmental Policy Expenditure, Environmental Regulation Implementation, and Sustainable Development Programs were specified as the independent variables representing the principal dimensions of economic policy for environmental sustainability.

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The operational definitions, measurements, and data sources for each variable are presented in Table 1.

Table 1. Operational Definition of Variables

Variable	Definition	Measurement	Data Source
Environmental Damage Control (Y)	Government efforts to prevent, reduce, and restore environmental degradation through environmental management and protection policies.	Environmental damage control index or relevant environmental performance indicators (%)	KLHK, DLH, BPS
Environmental Policy Expenditure (X_1)	Government expenditure allocated to environmental protection, conservation, pollution control, and ecosystem management.	Annual environmental expenditure (IDR)	Regional Government, BPS
Environmental Regulation Implementation (X_2)	The effectiveness of implementing environmental laws, regulations, monitoring, and compliance mechanisms.	Environmental regulatory performance index or compliance indicator	KLHK, DLH
Sustainable Development Programs (X_3)	Government programs integrating environmental protection, economic development, and social sustainability.	Number or index of sustainable development programs implemented annually	Regional Government, BPS, DLH

Based on the operational definitions presented in Table 1, the data were analyzed using multiple linear regression to examine the effect of economic policy on environmental damage control in Gorontalo Province.

Data Analysis

The data were analyzed using IBM SPSS Statistics through multiple linear regression analysis to examine the effects of Environmental Policy Expenditure, Environmental Regulation Implementation, and Sustainable Development Programs on Environmental Damage Control. Multiple linear regression is widely applied to estimate the magnitude and direction of relationships between several independent variables and a dependent variable while testing the proposed hypotheses (Gujarati & Porter, 2009; Hair et al., 2019).

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Prior to estimating the regression model, classical assumption tests were conducted to ensure compliance with the assumptions of the Ordinary Least Squares (OLS) method. These tests included the normality test, multicollinearity test, heteroscedasticity test, and autocorrelation test (Gujarati & Porter, 2009; Hair et al., 2019).

Hypothesis testing was performed using the t-test to examine the partial effect of each independent variable, the F-test to assess their simultaneous effect, and the coefficient of determination (R^2) to evaluate the explanatory power of the regression model. The regression equation employed in this study is expressed as follows:

$$Y=\alpha+\beta_1X_1+\beta_2X_2+\beta_3X_3+\varepsilon$$

where:
Y = Environmental Damage Control
X_1 = Environmental Policy Expenditure
X_2 = Environmental Regulation Implementation
X_3 = Sustainable Development Programs
α = Constant
β_1, β_2, β_3 = Regression coefficients
ε = Error term.

RESULTS AND DISCUSSION

RESULTS

Environmental and Economic Policy Overview

During the observation period from 2015 to 2025, Gorontalo Province experienced increasing environmental challenges alongside continuous regional economic development. Economic activities in agriculture, fisheries, infrastructure development, and natural resource utilization contributed positively to regional economic growth; however, these activities also intensified environmental pressures through land degradation, increasing waste generation, declining ecosystem quality, and the overexploitation of natural resources. These conditions highlight the growing need to balance economic development with environmental sustainability through effective public policy interventions.

In response to these challenges, the regional government implemented various economic policy instruments aimed at strengthening environmental protection and controlling environmental degradation. These initiatives included increasing environmental policy expenditure, strengthening the implementation of environmental regulations, promoting reforestation and ecosystem restoration, expanding waste management

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programs, and integrating sustainable development principles into regional planning. Government expenditure allocated to environmental management generally increased during the observation period, reflecting a stronger institutional commitment to environmental governance and sustainable regional development.

Despite these policy initiatives, several environmental problems remained evident, particularly in areas characterized by intensive agricultural activities, land conversion, urban expansion, and increasing pressure on natural resources. These conditions suggest that although environmental policies have become an important component of regional development planning, their effectiveness depends on the integration of fiscal commitment, regulatory enforcement, and sustainability-oriented development programs. Consequently, evaluating the influence of these economic policy instruments on environmental damage control is essential for assessing the effectiveness of environmental governance in Gorontalo Province.

Multiple Linear Regression Analysis

To examine the effect of economic policy on environmental damage control in Gorontalo Province, multiple linear regression analysis was performed using Environmental Policy Expenditure, Environmental Regulation Implementation, and Sustainable Development Programs as the independent variables. The analysis was conducted to determine both the direction and magnitude of the influence of each variable on environmental damage control. The results of the regression analysis are presented in Table 2.

Table 2. Results of Multiple Linear Regression Analysis

Variables	Coefficient	t-value	Sig.
Constant	1.102	1.845	0.071
Environmental Policy Expenditure	0.438	3.582	0.002
Environmental Regulation Implementation	0.397	3.104	0.005
Sustainable Development Programs	0.512	4.216	0.000

Source: Secondary Data Processed, 2026

The regression results indicate that Environmental Policy Expenditure has a positive and statistically significant effect on environmental damage control, with a regression coefficient of 0.438 and a significance value of 0.002 ($p < 0.05$). This finding suggests that increasing government expenditure on environmental protection, conservation, and pollution control contributes substantially to improving environmental quality and mitigating environmental degradation.

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Similarly, Environmental Regulation Implementation demonstrates a positive and statistically significant effect on environmental damage control, with a regression coefficient of 0.397 and a significance value of 0.005 ($p < 0.05$). This result indicates that stronger regulatory enforcement, effective environmental monitoring, and higher compliance with environmental standards enhance the government's capacity to control environmentally harmful activities and promote sustainable environmental management.

Among the independent variables, Sustainable Development Programs exhibit the largest regression coefficient (0.512) and the highest level of statistical significance ($p = 0.000$). These findings indicate that integrated sustainability initiatives, including ecosystem restoration, waste management, environmental conservation, and pollution control programs, provide the strongest contribution to environmental damage control in Gorontalo Province. This result underscores the importance of integrating environmental protection into long-term regional development strategies

Coefficient of Determination

To evaluate the explanatory power of the regression model, the coefficient of determination (R^2) was calculated. This statistic indicates the proportion of variation in environmental damage control explained by the independent variables included in the model. The results are presented in Table 3.

Table 3. Coefficient of Determination Results

Model	R	R Square	Adjusted R Square
Regression Model	0.826	0.682	0.657

Source: Secondary Data Processed, 2026

The results presented in Table 3 indicate that the regression model has an R Square value of 0.682, demonstrating that 68.2% of the variation in environmental damage control can be explained jointly by Environmental Policy Expenditure, Environmental Regulation Implementation, and Sustainable Development Programs. The remaining 31.8% of the variation is attributable to other factors not included in the present research model.

Furthermore, the Adjusted R Square value of 0.657 indicates that, after accounting for the number of explanatory variables included in the model, the regression equation retains satisfactory explanatory power. These findings suggest that the selected dimensions of economic policy collectively make a substantial contribution to explaining environmental damage control in Gorontalo Province during the study period.

DISCUSSION

The Effect of Environmental Policy Expenditure on Environmental Damage Control

The regression analysis demonstrates that Environmental Policy Expenditure has a positive and statistically significant effect on Environmental Damage Control, as indicated

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by a regression coefficient of 0.438 and a significance value of 0.002 ($p < 0.05$). These findings indicate that increasing government expenditure on environmental protection contributes substantially to reducing environmental degradation and improving environmental quality in Gorontalo Province. Public investment in environmental management enables the government to finance pollution control initiatives, ecosystem restoration, environmental monitoring, conservation programs, and waste management systems, thereby strengthening environmental governance and supporting sustainable regional development.

These findings are consistent with Environmental Economics Theory, which argues that environmental degradation largely results from market failures in which environmental externalities are not adequately reflected in market prices (Field & Field, 2017). Consequently, government intervention through public expenditure becomes necessary to internalize environmental costs and provide environmental public goods that are generally underprovided by the private sector (Pearce & Turner, 1990). Within this theoretical framework, environmental policy expenditure functions as an important fiscal instrument for correcting environmental externalities while simultaneously improving environmental quality and long-term social welfare.

The empirical findings of this study are also consistent with recent research. Sun et al. (2023) reported that sustained government expenditure on environmental protection significantly strengthens environmental governance and improves long-term environmental sustainability. Likewise, the study by Frontiers in Environmental Science (2024) demonstrated that environmental fiscal expenditure facilitates industrial structure upgrading while reducing carbon emission intensity, indicating that environmental spending contributes not only to ecological protection but also to sustainable economic transformation. Collectively, these findings reinforce the argument that environmental expenditure represents an essential economic policy instrument for strengthening environmental management.

In the context of Gorontalo Province, the positive relationship observed in this study suggests that increasing environmental policy expenditure has enhanced the government's capacity to implement environmental protection programs more effectively. Consequently, strengthening environmental budgets should remain a strategic priority for regional policymakers seeking to improve environmental quality, reduce ecological degradation, and support sustainable regional development.

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The Effect of Environmental Regulation Implementation on Environmental Damage Control

The regression results further indicate that Environmental Regulation Implementation has a positive and statistically significant effect on Environmental Damage Control, with a regression coefficient of 0.397 and a significance value of 0.005 ($p < 0.05$). This finding suggests that stronger enforcement of environmental regulations improves the effectiveness of environmental governance by reducing environmentally harmful activities, strengthening compliance with environmental standards, and encouraging more sustainable patterns of natural resource utilization. This result supports Environmental Economics Theory, which emphasizes that environmental regulations function as corrective policy instruments designed to address market failures arising from negative environmental externalities (Field & Field, 2017). By establishing environmental standards, monitoring systems, and legal enforcement mechanisms, governments encourage economic actors to internalize environmental costs that would otherwise be ignored under market conditions (Pearce & Turner, 1990). Effective regulatory implementation therefore promotes environmentally responsible behavior while protecting ecosystem integrity and supporting sustainable development.

The findings are consistent with previous empirical evidence. Li et al. (2024) found that effective environmental regulation enhances ecological capital utilization and contributes to high-quality economic development through improved resource management. Similarly, Chu and Tran (2022) demonstrated that stronger environmental regulatory frameworks significantly reduce ecological footprints, highlighting the critical role of regulatory enforcement in mitigating environmental degradation. These studies indicate that regulatory effectiveness is an essential determinant of successful environmental management. The findings suggest that environmental regulations in Gorontalo Province have begun to function not merely as legal instruments but also as practical mechanisms for improving environmental governance. Strengthening institutional capacity, monitoring systems, and regulatory compliance is therefore expected to further improve the effectiveness of environmental damage control across the province.

The Effect of Sustainable Development Programs on Environmental Damage Control

Among the independent variables included in the regression model, Sustainable Development Programs exhibit the strongest positive and statistically significant effect on Environmental Damage Control, with a regression coefficient of 0.512 and a significance value of 0.000 ($p < 0.05$). This finding indicates that sustainability-oriented development

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initiatives provide the greatest contribution to improving environmental quality and reducing environmental degradation in Gorontalo Province.

From the perspective of Environmental Economics Theory, sustainable development represents an integrated approach that seeks to balance economic development, environmental conservation, and social welfare through efficient resource utilization and environmentally responsible development planning (Field & Field, 2017). Rather than relying solely on fiscal expenditure or regulatory enforcement, sustainable development programs integrate multiple policy instruments into coordinated environmental management strategies that promote long-term ecological resilience.

The present findings are supported by recent empirical evidence. Li et al. (2024) reported that sustainability-oriented development policies improve ecological capital utilization while simultaneously supporting high-quality economic development. Likewise, Dahmani (2024) demonstrated that integrating environmental fiscal policies with environmentally related technologies and research investment produces stronger improvements in environmental quality than isolated policy interventions. These findings suggest that environmental protection becomes more effective when fiscal policy, environmental regulation, technological innovation, and sustainability programs are implemented in an integrated manner.

The relatively large regression coefficient obtained in this study indicates that sustainable development programs constitute the most influential policy dimension for controlling environmental damage in Gorontalo Province. This finding underscores the importance of integrating environmental protection into regional development planning through ecosystem restoration, sustainable land management, waste reduction, community participation, and long-term environmental conservation initiatives.

Policy Implications for Environmental Management

The overall findings demonstrate that Environmental Policy Expenditure, Environmental Regulation Implementation, and Sustainable Development Programs collectively contribute to improving environmental damage control in Gorontalo Province, with sustainable development programs exhibiting the strongest influence among the variables examined. Furthermore, the coefficient of determination indicates that these three dimensions explain a substantial proportion of the variation in environmental damage control, highlighting the strategic importance of integrated economic policy in environmental governance.

Anchored in Environmental Economics Theory, these findings reinforce the proposition that effective environmental management requires a balanced combination of

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fiscal commitment, regulatory enforcement, and sustainability-oriented development strategies to correct market failures and internalize environmental externalities (Field & Field, 2017; Pearce & Turner, 1990). The empirical evidence presented in this study further demonstrates that these policy instruments become more effective when implemented in a complementary and coordinated manner, thereby strengthening environmental governance and supporting sustainable regional development.

From a policy perspective, the Government of Gorontalo Province should continue increasing environmental policy expenditure while simultaneously strengthening regulatory enforcement and expanding sustainable development programs across sectors. Greater investment in ecosystem restoration, environmental monitoring, pollution control, sustainable agriculture, waste management, and community-based environmental conservation is expected to improve environmental quality while maintaining economic growth. Such integrated policy measures will strengthen environmental resilience and provide a more sustainable foundation for regional development in the future.

CONCLUSION

This study examined the effect of economic policy, represented by Environmental Policy Expenditure, Environmental Regulation Implementation, and Sustainable Development Programs, on Environmental Damage Control in Gorontalo Province during the 2015-2025 observation period. The empirical findings demonstrate that all three independent variables have positive and statistically significant effects on environmental damage control. Among them, Sustainable Development Programs exhibit the strongest influence, followed by Environmental Policy Expenditure and Environmental Regulation Implementation. These findings indicate that integrated economic policy plays a crucial role in strengthening environmental governance, reducing environmental degradation, and supporting sustainable regional development.

The results support the propositions of Environmental Economics Theory, which argues that government intervention through fiscal policy, regulatory enforcement, and sustainability-oriented development is essential for correcting market failures arising from environmental externalities. In the context of Gorontalo Province, the findings suggest that effective environmental management depends not only on increasing public expenditure or strengthening environmental regulations independently but also on integrating these policy instruments within comprehensive sustainable development strategies. Consequently, the study contributes to the growing body of literature by providing empirical evidence that coordinated economic policy interventions can substantially improve environmental damage control at the regional level.

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From a practical perspective, the findings imply that the Government of Gorontalo Province should continue strengthening environmental policy expenditure, enhancing the effectiveness of environmental regulation implementation, and expanding sustainable development programs that integrate environmental conservation with regional economic planning. Such coordinated policy measures are expected to improve ecosystem resilience, strengthen environmental governance, and support long-term sustainable development while maintaining regional economic growth.

This study has several limitations. The analysis focuses exclusively on Gorontalo Province and examines only three dimensions of economic policy using annual secondary time-series data. Consequently, other factors that may influence environmental damage control, including institutional quality, technological innovation, community environmental awareness, climate variability, and private sector participation, were not incorporated into the regression model. Future research is therefore encouraged to include additional explanatory variables, employ broader datasets such as provincial panel data or cross-regional comparisons, and utilize more advanced econometric approaches to provide a more comprehensive understanding of the relationship between economic policy and environmental damage control. Such efforts are expected to strengthen the empirical foundation for evidence-based environmental policymaking and sustainable regional development.

Recommendations

Based on the findings of this study, the Government of Gorontalo Province should continue strengthening economic policy instruments as a strategic approach to improving environmental damage control and promoting sustainable regional development. Since Sustainable Development Programs were found to exert the strongest influence on environmental damage control, policymakers should prioritize the implementation of integrated environmental initiatives, including ecosystem restoration, sustainable land management, reforestation, pollution prevention, and community-based environmental conservation. These programs should be incorporated into long-term regional development planning to ensure that economic growth is achieved without compromising environmental sustainability.

Furthermore, regional authorities should enhance the effectiveness of Environmental Policy Expenditure by increasing budget allocations for environmental protection while ensuring that public spending is directed toward measurable environmental outcomes. Strengthening Environmental Regulation Implementation is equally important through improved environmental monitoring, stricter enforcement of environmental standards,

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greater institutional capacity, and enhanced compliance among industries and local communities. In addition, stronger collaboration among regional government agencies, environmental institutions, the private sector, academic institutions, and local communities is recommended to create a more integrated environmental governance system capable of addressing increasingly complex environmental challenges.

Finally, policymakers should promote greater public participation and environmental awareness through education, community empowerment, and sustainability-oriented development programs. Such collaborative efforts are expected to strengthen environmental stewardship, improve the effectiveness of economic policy implementation, and support the achievement of sustainable environmental management and long-term regional resilience in Gorontalo Province.

Limitations and suggestions for further study

This study has several limitations that should be considered when interpreting the findings. First, the analysis was limited to Gorontalo Province, which may restrict the generalizability of the results to other regions with different environmental, economic, and institutional characteristics. Second, the study examined only three dimensions of economic policy, namely Environmental Policy Expenditure, Environmental Regulation Implementation, and Sustainable Development Programs, while other potentially influential factors, such as institutional quality, technological innovation, environmental awareness, climate variability, and private sector participation, were not included in the research model. Third, the analysis relied on annual secondary time-series data for the period 2015 to 2025, which may not fully capture short-term policy dynamics or changes in environmental conditions over time.

Future research is encouraged to expand the geographical scope by conducting comparative studies across provinces or employing panel data to improve the generalizability of the findings. Researchers are also recommended to incorporate additional explanatory variables related to environmental governance, institutional capacity, green technology, public participation, and climate resilience to provide a more comprehensive understanding of the determinants of environmental damage control. Furthermore, the application of more advanced analytical approaches, such as panel data regression, spatial econometric models, or structural equation modeling, may offer deeper insights into the complex relationships between economic policy and environmental sustainability. Such efforts would strengthen the empirical evidence available for designing more effective and integrated environmental policies that support sustainable regional development.

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