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Beyond Aggregate Environmental Performance: A Multidimensional Analysis of Environmental Quality Across Indonesian Local Governments

Dyah Setyaningrum[1*], Nanda Ayu Wijayanti[2]

[1,2] Faculty of Economics and Business, Universitas Indonesia, Indonesia

ABSTRACT

Purpose: To examine environmental quality performance among Indonesian local governments during 2021–2024 and assess differences across environmental dimensions, fiscal capacity groups, and government types.
Methodology: The study uses secondary data from the Environmental Quality Index (IKLH) and its components (IKA, IKU, IKL, and IKAL). Performance trends were analyzed and mean-difference tests were conducted across local government groups.
Findings: Environmental quality improved gradually over the study period, although progress varied across dimensions. Air quality showed the highest performance, while water quality remained the weakest despite experiencing the largest improvement. Higher-fiscal-capacity governments achieved significantly better environmental outcomes overall, except in air quality, where lower-fiscal-capacity governments performed better. Regencies generally outperformed cities, particularly in air quality.
Implication: The findings highlight the importance of fiscal capacity in environmental management and the need for context-specific policies to support sustainable development across different local government settings.
Originality: This study provides recent empirical evidence on multidimensional environmental quality disparities among Indonesian local governments by simultaneously comparing performance across environmental dimensions, fiscal capacity levels, and government types during 2021–2024.
Keywords: Environmental Performance, Environmental Quality Index, Fiscal Capacity, Local Governments, Sustainable Development.

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Corresponding Author:
Dyah Setyaningrum
(dsetyani@ui.ac.id)

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1. Introduction

Environmental quality is a fundamental pillar of sustainable development because it supports human well-being, economic productivity, and ecosystem resilience. However, economic growth, urbanization, and industrialization often generate environmental pressures such as pollution, land degradation, and ecosystem decline (Purvis et al., 2019); (Biermann et al., 2022). As a result, environmental performance has become an important dimension of government accountability and sustainability assessment, particularly in developing countries such as Indonesia, where rapid economic transformation and population growth have intensified pressures on natural resources.

In Indonesia, environmental conditions are monitored using the Environmental Quality Index (Indeks Kualitas Lingkungan Hidup, IKLH), a composite indicator that integrates water quality (IKA), air quality (IKU), land quality (IKL), and marine water quality (IKAL) (KLHK, 2025); (BPS, 2025). Composite indicators are valuable for environmental monitoring and policy evaluation because they facilitate benchmarking and performance assessment (OECD, 2019); (Jain & Mohapatra, 2023). Nevertheless, aggregate measures may conceal disparities across environmental dimensions. A local government may achieve a favorable IKLH score while still experiencing environmental problems in specific areas such as water pollution, land degradation, or coastal ecosystem deterioration. Therefore, examining the individual components of IKLH is essential for understanding environmental conditions more comprehensively.

Environmental quality is influenced not only by ecological conditions but also by socioeconomic and institutional factors. Previous studies show that economic growth, population density, and urbanization tend to increase environmental pressure, while human development, governance quality, and institutional effectiveness contribute positively to environmental outcomes (Wafiq & Suryanto, 2021); (Wang et al., 2021); (Ulibarri et al., 2023). Within Indonesia's decentralized governance system, fiscal capacity is particularly important because governments with stronger financial resources are generally better able to finance environmental protection, pollution control, waste management, and sustainable infrastructure investments (Zhang et al., 2024). However, fiscally stronger regions are often associated with more intensive economic activities that may also create environmental pressures.

Despite the growing attention to environmental sustainability, empirical evidence at the local-government level remains limited. Existing studies primarily examine the determinants of IKLH using provincial-level data and aggregate environmental indicators (Aldilla et al., 2024); (Jonatan & Salam, 2025); (Sihombing et al., 2025). Consequently, little is known about how environmental quality varies across individual environmental dimensions, whether environmental outcomes differ according to fiscal capacity, and how environmental performance compares between regencies and cities.

This study addresses these gaps by examining environmental quality performance among Indonesian local governments during 2021–2024 using both the aggregate IKLH and its four constituent dimensions. Specifically, the study analyzes trends and disparities in environmental quality, compares environmental performance between regencies and cities, and assesses differences between local governments with high and low fiscal capacity. This study is guided by three research questions: (1) How did environmental quality and its constituent dimensions evolve across Indonesian local governments during 2021–2024? (2) Are there significant differences in environmental quality performance between regencies and cities? and (3) Are there significant differences in environmental quality performance between local governments with high and low fiscal capacity?

The novelty of this study lies in its multidimensional assessment of environmental quality at the local-government level and its simultaneous comparison of environmental outcomes across fiscal-capacity groups and local-government types. By doing so, the study contributes to the literature on environmental governance, fiscal decentralization, and public-sector performance, while providing evidence to support more targeted and context-sensitive environmental policies.

Literature Review and Research Framework

Environmental Quality Index

Environmental quality is an essential element of sustainable development because it reflects the condition of natural resources that support economic activities and human well-being. To monitor environmental conditions, Indonesia adopts the Environmental Quality Index (Indeks Kualitas

Lingkungan Hidup/IKLH), a composite indicator developed by the Ministry of Environment and Forestry that integrates water quality (IKA), air quality (IKU), land quality (IKL), and marine water quality (IKAL). Composite environmental indicators are widely used because they simplify environmental monitoring, facilitate policy evaluation, and enable comparisons across regions (OECD, 2019); (Jain & Mohapatra, 2023).

Although IKLH provides a comprehensive measure of environmental performance, aggregate indicators may conceal variation among environmental dimensions. Regional governments with similar IKLH scores may face substantially different environmental challenges in terms of water, air, land, or marine ecosystems. Therefore, examining individual environmental dimensions is necessary to obtain a more comprehensive understanding of environmental conditions and policy priorities.

Environmental Performance Measurement

From a public-sector perspective, environmental quality constitutes an important dimension of government performance because governments are responsible for balancing economic development with environmental sustainability. Performance Measurement Theory suggests that government performance should be assessed using indicators that capture policy outcomes and public value creation (Bouckaert & Halligan, 2007). In the environmental context, environmental quality indicators serve as outcome-based measures of government effectiveness in environmental management.

Previous studies indicate that environmental performance is influenced by various socioeconomic factors. Economic growth and population density were found to negatively affect environmental quality in Indonesia, suggesting that increasing economic activities may intensify environmental pressure when not accompanied by adequate environmental management (Wafiq & Suryanto, 2021). Likewise, population density and waste generation contribute negatively to environmental quality, while improvements in sanitation positively affect environmental outcomes (Aldilla et al., 2024). These findings imply that environmental performance reflects not only ecological conditions but also the effectiveness of public policies and environmental governance.

Fiscal Capacity and Environmental Performance

Fiscal capacity represents the ability of governments to mobilize financial resources for public services and development programs. According to Fiscal Decentralization Theory (Oates, 1972), governments with stronger fiscal resources possess greater flexibility to provide public services that correspond to local needs, including environmental protection and conservation programs. Higher fiscal capacity enables governments to finance investments in environmental infrastructure, waste management systems, pollution control, environmental monitoring, and ecosystem restoration.

Empirical evidence generally supports the importance of fiscal resources for environmental sustainability. Human development and public spending have been found to contribute positively to environmental quality across Indonesian provinces, while the effectiveness of fiscal interventions depends on governance quality and expenditure priorities (Nugroho et al., 2025). Recent evidence further suggests that fiscal capacity alone does not automatically improve environmental outcomes; institutional quality and effective budget utilization play an important mediating role in translating financial resources into environmental improvements. Consequently, differences in fiscal capacity may lead to disparities in environmental performance among local governments.

Decentralization and Local Government Environmental Performance

Indonesia's decentralization system assigns substantial responsibility for environmental management to local governments. Under decentralized governance, regencies and cities possess varying demographic, economic, ecological, and fiscal characteristics that may influence environmental outcomes. Decentralization theory argues that local governments are better positioned to identify local environmental problems and design policies that match local conditions (Oates, 1972). However, variations in fiscal resources and administrative capacity may also produce unequal environmental outcomes across jurisdictions.

Despite growing research on environmental sustainability, empirical studies in Indonesia mainly focus on identifying the determinants of IKLH at the provincial level (Wafiq & Suryanto, 2021); (Aldilla et al., 2024). Limited attention has been given to environmental disparities among regencies and cities, particularly across different dimensions of environmental quality. Moreover, little evidence exists regarding whether local governments with different fiscal capacities achieve

significantly different environmental outcomes. Addressing these gaps is important because local governments play a central role in implementing environmental policies and achieving sustainable development targets within Indonesia's decentralized governance framework.

Given the exploratory and descriptive-comparative nature of this study, the analysis is not designed to test causal relationships between fiscal capacity and environmental quality. Instead, the study seeks to identify whether environmental quality differs across local government types and fiscal-capacity groups and how environmental performance evolves over time. Accordingly, the study addresses the research questions outlined in the Introduction rather than testing formal hypotheses.

2. Methodology

This study employs a quantitative descriptive-comparative approach to assess environmental quality performance among Indonesian local governments during 2021–2024. The population consists of all regency and city governments in Indonesia, with local government-year observations as the unit of analysis. Using purposive sampling based on data availability, only local governments with complete data for the Environmental Quality Index (IKLH), its four component indices (IKA, IKU, IKL, and IKAL), fiscal capacity, and local government type were included in the sample. Fiscal capacity is measured by the ratio of locally generated revenue (PAD) to total revenue, reflecting the degree of fiscal independence, while local government type is classified as either a regency or a city. Data on the Environmental Quality Index (IKLH) and its component indices (IKA, IKU, IKL, and IKAL) were obtained from publications of the Ministry of Environment and Forestry of Indonesia (KLHK). Fiscal data, including locally generated revenue (PAD) and total revenue, were collected from local government financial statistics published by the Ministry of Finance. Data were compiled for the period 2021–2024 and matched at the local government level. After applying the selection criteria, the final dataset comprises 2,032 local government-year observations representing 508 local governments over four years.

Observations with missing values for any of the variables used in the analysis were excluded from the dataset. Because the study relies on secondary administrative data, no imputation procedures were applied. Only local governments with complete information for IKLH, its component indices, fiscal capacity, and local government type during the observation period were retained for analysis. Data analysis was conducted in two stages. First, descriptive statistics were used to examine trends and variations in IKLH and its component indices across local governments and over time. Second, environmental performance was compared across fiscal-capacity groups and local government types. Local governments were classified into high- and low-fiscal-capacity groups using the median PAD-to-total-revenue ratio as the cutoff point. Before conducting mean-difference analyses, the distribution of each environmental quality indicator was assessed using the Shapiro-Wilk test and graphical inspection through histograms and Q-Q plots. For variables analyzed using independent-samples t-tests, homogeneity of variance was evaluated using Levene's test. Independent-samples t-tests were employed when normality and variance assumptions were reasonably satisfied, whereas the Mann-Whitney U test was used when normality assumptions were not met. When homogeneity-of-variance assumptions were violated, Welch's t-test was applied. These procedures ensure that the selected statistical tests were appropriate for the characteristics of the data. The analyses are intended to identify statistically significant differences between groups rather than establish causal relationships.

3. Results and Discussion

Environmental Quality Performance of Indonesian Local Governments

The Environmental Quality Index (IKLH) of Indonesian local governments exhibited a positive trend during 2021-2024. The average IKLH increased from 62.91 in 2021 to 69.77 in 2024, indicating an overall improvement in environmental quality. In addition to the increase in average scores, the declining standard deviation and upward movement of the median suggest that environmental progress was experienced by a broad range of local governments rather than being concentrated among a small number of high-performing jurisdictions. Nevertheless, variation in performance

remained substantial, indicating that environmental quality improvements were not uniformly distributed across regions.

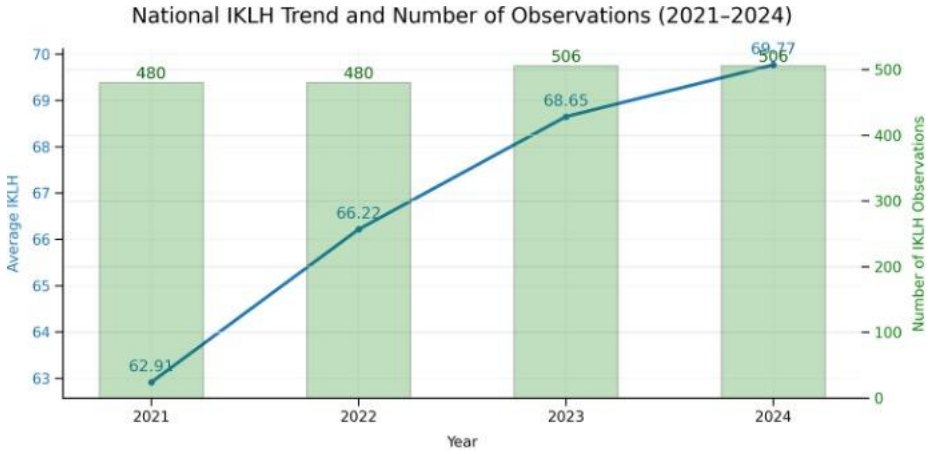


Figure 1. Trend of Environmental Quality Index (IKLH) 2021-2024

Although national environmental quality improved, substantial disparities persisted among local governments. Several local governments consistently achieved very high environmental quality scores, while others remained at relatively low performance levels. This finding indicates that improvements in average IKLH may conceal significant regional heterogeneity. To illustrate the magnitude of these disparities, Appendix A presents the five highest- and lowest-performing local governments in 2021 and 2024. The results show that the highest-performing jurisdictions were dominated by regencies, whereas the lowest-performing group comprised both regencies and cities. This pattern suggests that environmental quality is influenced by local socioeconomic and ecological characteristics rather than administrative status alone.

One possible explanation for environmental disparities is the difference between regency and city governments. Regencies and cities operate under similar institutional arrangements but face different environmental pressures. Cities are generally characterized by higher population density, greater industrial concentration, and more intensive transportation activities, whereas regencies tend to retain larger proportions of natural land cover and agricultural areas. Consequently, differences in environmental quality may reflect contrasting ecological and development contexts.

Table 1. Mean Difference in IKLH between Regencies and Cities

Type	Mean IKLH	Mean Difference	p-value
Regency	67.92	5.18	0.00
City	62.74		

Source: Author Calculation

Table 1 confirm significant differences in environmental performance between the two local government types. Regencies recorded an average IKLH score of 67.92, compared with 62.74 for cities, representing a statistically significant difference of 5.18 points ($p < 0.001$). The magnitude of this gap suggests that environmental pressures associated with urbanization remain an important challenge for city governments. Higher concentrations of population, transportation activities, industrial production, and land conversion can increase pollution and environmental degradation, thereby reducing environmental quality despite stronger economic performance. Conversely, regencies typically possess more extensive natural ecosystems and lower development intensity, which may contribute to better environmental outcomes.

These findings support the sustainable development perspective that environmental performance is shaped by interactions among ecological conditions, economic activities, and institutional capacity (Purvis et al., 2019); (Biermann et al., 2022). The results also align with public-sector performance literature, which views environmental quality as an important outcome indicator of government effectiveness in managing development and environmental sustainability simultaneously (Van Der Kolk, 2022). However, the considerable variation observed within both regencies and cities suggests that local government type alone cannot fully explain environmental

performance differences. Other factors, particularly fiscal capacity, may also play a critical role and are therefore examined in the following section.

Environmental Performance Across Environmental Dimensions

Although aggregate environmental quality improved during the study period, important differences emerged across environmental dimensions. Examining the individual components of IKLH is therefore necessary to understand which dimensions contributed most to environmental improvement and where environmental disparities remain most pronounced.

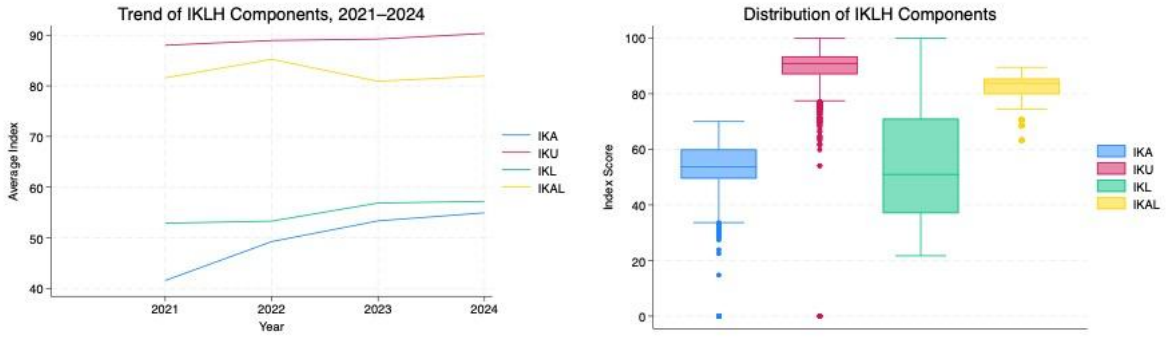


Figure 2. Trend and Distribution of IKLH Components

Figure 2 reveals that air quality (IKU) consistently recorded the highest scores throughout the observation period, followed by marine water quality (IKAL). In contrast, water quality (IKA) and land quality (IKL) remained comparatively lower. However, water quality exhibited the largest improvement between 2021 and 2024, while land quality improved more gradually. These findings indicate that improvements in Indonesia's environmental quality were driven primarily by progress in water and land management.

Substantial disparities were also observed across environmental dimensions. Water and land quality displayed considerably wider distributions than air and marine quality, suggesting that environmental management capability and ecological conditions vary substantially across local governments. This evidence reinforces the argument that composite environmental indicators may obscure important differences among underlying performance dimensions (Jain & Mohapatra, 2023). Consequently, improvements in aggregate IKLH scores should not be interpreted as uniform environmental progress because challenges remain concentrated in specific environmental domains, particularly water-resource management and land conservation.

Fiscal Capacity and Environmental Quality Performance

Fiscal capacity has often been associated with local-government performance because it reflects the availability of resources that may support public service delivery and development programs. In the environmental context, greater fiscal resources enable governments to invest in environmental infrastructure, monitoring systems, waste management, ecosystem conservation, and pollution control. Accordingly, differences in environmental quality may be observed across local governments with varying levels of fiscal capacity.

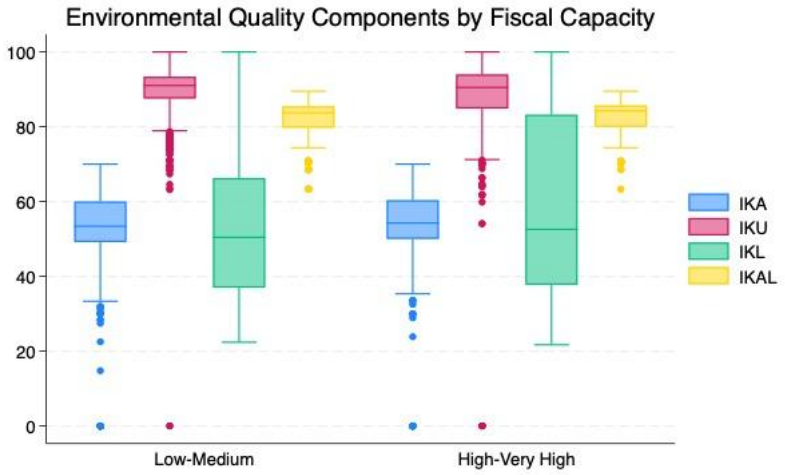


Figure 3. Boxplot of IKLH Components by Fiscal Capacity

Figure 3 suggests that local governments with higher fiscal capacity generally achieve better environmental outcomes. The distinction is particularly evident for IKLH, water quality, and land quality, where the distributions of high-fiscal-capacity local governments are shifted toward higher values. Nevertheless, substantial overlap remains between the two groups, indicating that fiscal resources are only one of several factors influencing environmental performance.

Table 2. Mean Difference Test of IKLH Components by Fiscal Capacity

Variable	Low Fiscal Capacity	High Fiscal Capacity	t-statistic	p-value
IKLH	66.63	67.71	2.34	0.0195
IKA	49.38	51.13	1.98	0.0479
IKU	89.75	87.69	4.97	<0.001
IKL	53.41	59.19	5.28	<0.001
IKAL	82.23	82.84	2.59	0.0096

Source: author calculation. Local governments with PAD above the median are categorized as having high fiscal capacity, whereas those with PAD below the median are classified as having low fiscal capacity.

The statistical results in Table 2 indicate significant differences in environmental quality across local governments with different levels of fiscal capacity. Local governments in the high-fiscal-capacity group exhibited significantly higher environmental quality scores than those in the low-fiscal-capacity group. The largest difference occurred in land quality, indicating that environmental conservation and land-management initiatives may be particularly dependent on fiscal resources.

These findings are consistent with Fiscal Decentralization Theory, which argues that governments with stronger fiscal resources possess greater capacity to provide environmental public goods and services (Oates, 1999). Environmental improvement frequently requires substantial investment in monitoring systems, conservation programs, regulatory enforcement, and pollution-control infrastructure. Consequently, local governments with greater fiscal autonomy are generally better positioned to translate environmental objectives into measurable outcomes.

Interestingly, air quality exhibited the opposite pattern. Local governments with lower fiscal capacity reported significantly higher air-quality scores than their higher-capacity counterparts. This finding suggests that air quality is influenced not only by governance capacity but also by structural characteristics associated with economic development and urbanization. Regions with stronger fiscal capacity are frequently characterized by greater industrial activity, transportation intensity, and population concentration, all of which generate environmental pressures that may offset the benefits of greater public resources. This interpretation is consistent with Environmental Kuznets Curve arguments and helps explain why regencies generally outperform cities in environmental quality indicators.

Overall, the results indicate that environmental performance depends on both institutional capacity and local development conditions. Therefore, policy interventions should be differentiated according to local environmental challenges. While cities may require stronger air-pollution control and green urban development strategies, regencies may benefit more from watershed protection, ecosystem conservation, and sustainable land-management initiatives.

4. Conclusion

This study examined environmental quality across Indonesian local governments during 2021–2024 using the Environmental Quality Index (IKLH) and its four dimensions: water quality (IKA), air quality (IKU), land quality (IKL), and marine water quality (IKAL). The findings show a steady improvement in overall environmental quality, reflected in rising IKLH scores over the study period. However, progress was uneven across dimensions. Air quality consistently recorded the highest performance, while water quality showed the largest improvement despite remaining relatively weak. Land quality also improved but exhibited substantial variation across local governments. These results highlight the multidimensional nature of environmental quality and suggest that aggregate IKLH scores may mask important disparities across environmental domains.

The study further reveals that fiscal capacity is associated with environmental performance. Local governments classified as having higher fiscal capacity exhibited significantly higher scores in overall environmental quality, water quality, land quality, and marine water quality than those in the lower fiscal-capacity group. This pattern is consistent with the view that fiscal resources may help local governments address environmental challenges; however, the descriptive-comparative design does not permit conclusions regarding causal effects. Consistent with Fiscal Decentralization Theory, financially stronger local governments appear better equipped to provide environmental public goods and services. Nevertheless, lower-fiscal-capacity governments recorded better air quality, while regencies generally outperformed cities in overall environmental quality. These findings suggest that environmental outcomes are shaped not only by fiscal resources but also by urbanization, economic activities, demographic pressures, and ecological characteristics.

This study contributes to the environmental governance and public-sector performance literature by emphasizing the importance of multidimensional environmental assessment and the role of fiscal capacity in shaping environmental outcomes. From a policy perspective, improving aggregate IKLH scores alone is insufficient. Greater attention should be directed toward reducing disparities in water and land quality, where performance gaps remain most pronounced. Environmental strategies should also be adapted to local conditions. Cities may require stronger air-pollution control, sustainable transportation, and green infrastructure, whereas regencies may benefit from ecosystem conservation, watershed protection, and sustainable land-management initiatives.

Several limitations provide opportunities for future research. This study focuses on fiscal capacity and local-government type, while environmental quality is also influenced by factors such as governance quality, environmental expenditure, industrial structure, urbanization, population density, and regulatory effectiveness. In addition, IKLH may not fully capture broader aspects of environmental sustainability, including biodiversity, climate resilience, greenhouse gas emissions, and ecosystem services. Future studies could employ longer observation periods and panel-data or spatial econometric approaches to better understand the causal relationships between fiscal capacity, governance, and environmental quality, as well as explore individual environmental dimensions in greater depth.

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