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Relative Efficiency of Education, Health, and Infrastructure Spending in Southeast Sulawesi (2018–2022): A Data Envelopment Analysis Approach

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Abstract:
This study aims to analyze the relative efficiency of education, health, and infrastructure spending in Southeast Sulawesi Province. During the 2018–2022 period, the province experienced relatively strong economic growth along with increased public spending, but gaps in outcomes and sectoral performance between districts remained evident. This study employed a quantitative approach using Data Envelopment Analysis (DEA) with an input-output orientation. A balanced panel dataset of 17 districts/cities observed over five years (85 Decision-Making Units) was analyzed to measure the relative efficiency of education, health, and infrastructure spending. The results indicate that the average efficiency of education (0.97) and health (0.98) spending is higher than that of infrastructure (0.79). Urban areas and optimally planned areas exhibit full efficiency (score 1.00), while remote areas experience relatively suboptimal efficiency levels. Some districts consistently achieve full efficiency, indicating effective resource allocation and service delivery. Conversely, geographically remote areas exhibit inefficiencies due to the uneven distribution of teachers, health workers, and infrastructure quality. This study contributes by providing a subnational efficiency assessment using DEA and offering policy recommendations focused on targeted allocation, cross-sector integration, and performance-based budgeting.

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INTRODUCTION

During the 2018–2022 period, Southeast Sulawesi experienced relatively strong economic growth, reaching 5.53% in 2022, supported mainly by the mining, manufacturing, and agricultural sectors. Nevertheless, this growth was accompanied by structural challenges, including inflation that reached 7.39% at the end of 2022—one of the highest rates nationally—and disparities in purchasing power across districts and cities. At the same time, regional budget realization continued to increase, reflecting the expanding fiscal capacity of local governments (Fitria et al., 2025; Gałecka et al., 2022; Wenjuan & Zhao, 2023). Despite these achievements, questions remain regarding whether higher spending has translated into optimal socioeconomic outcomes, particularly in terms of regional productivity and public welfare.

The provincial government consistently receives unqualified opinions from the Supreme Audit Agency of the Republic of Indonesia and has earned national recognition for its high revenue realization from a governance perspective. However, high revenue realization and favorable audit opinions do not automatically guarantee efficient

expenditure performance. Fiscal management regulations require accountability and performance-based budgeting (Situmorang et al., 2023), yet inefficiencies can still occur at the district/city level in allocating and utilizing public funds (M. Azam & Bouckaert, 2025; Jiang & Chi, 2024). Therefore, assessing regional financial performance requires a methodological approach capable of measuring the relative efficiency of regional governments, rather than relying solely on budget absorption indicators.

A substantial body of literature has examined the relationship between government spending and public welfare, demonstrating that efficient fiscal allocation can improve economic growth and social indicators (Abid et al., 2024; Topuz, 2022). Other studies also find that government expenditure contributes to welfare through economic growth channels (Challoumis, 2024; Hung & Thanh, 2022; Malla & Pathranarakul, 2022). However, empirical findings remain mixed, particularly across regions with heterogeneous economic structures and fiscal capacities (Williams & Tierney, 2023). Moreover, most prior studies focus on national or provincial aggregates and employ conventional econometric approaches, providing limited insight into relative efficiency at the district/city level. The inclusion of economic growth as a mediating variable is also still relatively limited, creating a gap in understanding the transmission mechanism between fiscal efficiency and public welfare outcomes.

Agency theory provides a basic framework for understanding accountability and efficiency in public financial management. An agency relationship arises when a principal delegates authority to an agent to perform tasks on their behalf, potentially creating a conflict of interest due to information asymmetry (Musawir, 2025; Sukendri, 2024). Citizens act as principals in the public sector, while government officials serve as agents entrusted with managing public resources (Agu et al., 2024; Bodó & Janssen, 2022; Lee, 2024). Such delegation implies obligations for transparency, accountability, and performance orientation in the use of public funds.

Performance-based budgeting and financial accountability serve as instruments to reduce agency costs in public administration. The quality of financial reporting and service delivery reflects the extent to which government agencies align their actions with public expectations (Anto & Yusran, 2023; Estep et al., 2024). However, formal compliance—such as obtaining a favorable audit opinion—does not always guarantee efficient or results-oriented spending. Thus, agency theory emphasizes not only procedural accountability but also performance efficiency in generating measurable public value.

Regional expenditure is a key instrument of fiscal policy aimed at stimulating development and improving welfare. Government Regulation No. 12 of 2019 defines regional expenditure as all regional government obligations within a fiscal year that reduce equity and are non-refundable (Lewis, 2023; Mboi et al., 2022). Public expenditure should conceptually be allocated fairly and productively to improve infrastructure, human capital, and public services. Efficient allocation of production factors from a development economics perspective contributes to increased aggregate output and income (Jia, 2023). Indicators relevant to this construct include capital expenditures, operational expenditures, and sectoral allocations, which directly impact regional productivity.

Economic growth serves as an intermediate outcome linking fiscal policy and welfare. Classical and neoclassical theories view growth as an increase in output driven by the accumulation of production factors and increased allocative efficiency (Azizah,

2022; Sgroi, 2022). Empirically, growth is generally measured through Gross Domestic Product (GDP) or Gross Regional Domestic Product (GDP) at the subnational level (Ru et al., 2023). Growth reflects the expansion of goods and services produced in a region and signals increased economic capacity. Economic growth serves as a mediating variable that captures how efficient government spending translates into broader macroeconomic performance.

Public welfare is the primary objective of government spending and economic development. Well-being is multidimensional, encompassing material, social, and psychological dimensions (VanderWeele & Johnson, 2025; Wang, 2024). It reflects the extent to which individuals achieve satisfaction and security in meeting their physical and social needs (Mosca et al., 2023). Well-being is inherently relative, influenced by income levels, access to services, and perceived quality of life. Well-being is often represented by indicators such as poverty rates, the Human Development Index (HDI), per capita income, and employment rates.

The conceptual framework of this study positions government spending efficiency as the primary independent variable, economic growth as the mediating variable, and public welfare as the dependent variable. The core issue lies in whether efficient fiscal management reduces agency problems, increases regional output, and ultimately improves public welfare. Concepts and discussions on the strength and relationship between fiscal management and government spending have yielded mixed results (Adebayo & Samour, 2024; W. Azam et al., 2023; Idrus, 2024), indicating the need for contextual analysis at the regional level.

This study addresses these gaps by applying the Data Envelopment Analysis (DEA) approach to measure the relative efficiency of government spending across 17 district and city governments in Southeast Sulawesi during 2018–2022. By treating each region-year observation as a Decision-Making Unit (DMU), DEA enables the identification of best-performing regions and the magnitude of inefficiency among others. The efficiency scores are subsequently analyzed to examine their effect on public welfare, with economic growth incorporated as a mediating variable. This approach offers a more comprehensive evaluation framework that integrates efficiency measurement with outcome-based analysis.

The novelty of this research lies in the integration of DEA-based efficiency measurement with an empirical examination of its impact on public welfare through the economic growth channel at the sub-provincial level. By combining efficiency analysis and welfare outcomes within a balanced panel of district/city data, this study provides a more nuanced understanding of fiscal performance in a resource-based region. The findings are expected to contribute to the theoretical discourse on public finance efficiency and regional development, while also offering evidence-based recommendations for improving the quality of local government spending in Southeast Sulawesi.

RESEARCH METHOD

Research Design

This study employs a quantitative evaluative research design to measure the relative efficiency of government spending in Southeast Sulawesi Province during the 2018–2022 period (Duckett, 2021). The study focuses on evaluating how effectively sectoral public spending is converted into development outputs. This analysis does not aim to test causality, but rather to assess comparative efficiency across regions.

Therefore, this study identifies variations in fiscal performance among districts and cities operating under similar regulatory frameworks. The findings are interpreted descriptively in relation to regional welfare conditions.

This study adopts Data Enveloping Analysis (DEA) as a non-parametric frontier technique to estimate efficiency scores. DEA is well-suited for evaluating public sector performance because it accommodates multiple outputs without requiring assumptions about functional form or statistical distribution. Efficiency is measured relative to the best-performing unit in the observed sample (Pregoner, 2025). A score of one indicates a region is on the efficiency frontier, while a score below one indicates relative inefficiency. Unlike a single aggregate model, this study estimates efficiency separately for each expenditure category (Nasir & Sukmawati, 2023). Three independent DEA models are constructed: health expenditure efficiency, education expenditure efficiency, and economic/infrastructure expenditure efficiency.

Sample and Data Collection

This study covers all 17 local governments in Southeast Sulawesi Province, consisting of 15 regencies and 2 municipalities. Each region was observed annually over the 2018–2022 period, resulting in 85 region-year observations. In the DEA framework, each region-year observation is treated as a Decision-Making Unit (DMU), allowing intertemporal and cross-sectional efficiency comparisons. The use of balanced panel data ensures consistency in observation structure and comparability across regions and time periods.

Secondary quantitative data were obtained through systematic documentation from official institutional sources, including the Directorate General of Fiscal Balance for realized expenditure data, the Central Statistics Agency for sectoral development indicators, and Bank Indonesia for supporting macroeconomic information. All fiscal variables were adjusted to constant prices to control for inflationary effects during the study period. Full population coverage was applied to eliminate sampling bias and to provide a comprehensive evaluation of provincial fiscal performance (Taherdoost, 2022). The data were then organized according to sectoral categories for separate DEA estimations in health, education, and infrastructure spending (see Table 1-3).

Table 1. Health Spending Efficiency Model

Variable Type	Variable	Measurement Indicator
Input	Health Expenditure	Realized health spending (constant price)
Output	Life Expectancy	Average life expectancy (years)
Output	Number of Health Workers	Total medical personnel
Output	Number of Health Centers	Total public health centers

Table 2. Education Spending Efficiency Model

Variable Type	Variable	Measurement Indicator
Input	Education Expenditure	Realized education spending (constant price)
Output	Literacy Rate	Percentage of literate population
Output	Number of Teachers	Total teachers (SD, SMP, SMA/SMK)
Output	Number of Schools	Total schools (SD, SMP, SMA/SMK)

Table 3. Economic/Infrastructure Spending Efficiency Model

Variable Type	Variable	Measurement Indicator
Input	Economic/ Infrastructure Expenditure	Realized infrastructure spending (constant price)

Output	Road Quality	Percentage of roads in good and moderate condition
Output	Road Length	Total road length (KM)

Data Analysis

Efficiency scores are estimated using the Variable Returns to Scale (VRS) model developed by Rajiv D. Banker, Abraham Charnes, and William W. Cooper. The VRS specification is selected because local governments operate at different economic capacities and fiscal scales. This assumption allows efficiency to be evaluated without imposing constant proportionality between inputs and outputs. An output-oriented approach is employed in all three sectoral models. The interpretation of efficiency is relative, meaning that regions are compared to the best-performing peers within the sample. Scores below one indicate that outputs could be proportionally increased without additional input, based on benchmark regions. The estimation process is conducted using STATA 17 software. The results are presented in the form of average annual efficiency and sectoral efficiency comparisons. Subsequent discussion interprets disparities across regions and sectors in relation to public service performance and welfare conditions, without conducting regression or causal inference analysis.

RESULTS AND DISCUSSION

Government Spending Efficiency

An entity will work relatively efficiently if the score value shows the number 1. If the efficiency score value obtained is less than 1, then it is certain that the entity is working inefficiently. Based on the results of the efficiency measurement estimation from the Data Envelopment Analysis (DEA) method, the average level of efficiency of Southeast Sulawesi provincial government spending each year is shown in the following Table 4.

Table 4. Average Efficiency of Southeast Sulawesi Provincial Government Spending

DMU	Regency/City	Year					Average	Result
		2018	2019	2020	2021	2022		
1	Kendari	1.00	1.00	1.00	1.00	1.00	1.00	*Efficient*
2	Konawe	1.00	1.00	1.00	1.00	1.00	1.00	*Efficient*
3	Konawe Selatan	1.00	1.00	1.00	1.00	1.00	1.00	*Efficient*
4	Konawe Utara	1.00	1.00	1.00	1.00	1.00	1.00	*Efficient*
5	Konawe Kepulauan	1.00	1.00	1.00	1.00	0.99	1.00	*Efficient*
6	Kolaka	1.00	0.98	1.00	1.00	1.00	1.00	*Efficient*
7	Kolaka Utara	1.00	1.00	1.00	0.99	1.00	1.00	*Efficient*
8	Kolaka Timur	1.00	1.00	1.00	1.00	1.00	1.00	*Efficient*
9	Bombana	1.00	1.00	1.00	1.00	1.00	1.00	*Efficient*
10	Bau-Bau	1.00	1.00	1.00	1.00	0.99	1.00	*Efficient*
11	Buton	1.00	1.00	1.00	1.00	1.00	1.00	*Efficient*
12	Buton Utara	1.00	1.00	1.00	0.99	0.98	0.99	*Inefficient*
13	Buton Tengah	1.00	1.00	1.00	1.00	1.00	1.00	*Efficient*
14	Buton Selatan	0.96	1.00	1.00	1.00	1.00	0.99	*Inefficient*
15	Muna	1.00	1.00	1.00	1.00	1.00	1.00	*Efficient*
16	Muna Barat	0.98	1.00	1.00	1.00	0.98	0.99	*Inefficient*
17	Wakatobi	0.99	0.97	0.98	0.96	0.98	0.98	*Inefficient*

Source: STATA Data Processing Results, 2024

The results of the Data Envelopment Analysis (DEA) analysis on the data above show the level of efficiency of government spending in Southeast Sulawesi Province during the 2018-2022 period, including education, health, and infrastructure spending.

Most districts/cities such as Kendari, Konawe, South Konawe, and Kolaka show efficient results in education spending. This can be attributed to the even distribution of the number of teachers, the increase in the number of schools, and the success of programs that support increasing literacy rates. In health spending, these areas also recorded positive results thanks to the increase in the number of health workers, the construction of new health centers, and contributions to increasing life expectancy.

On the other hand, several districts such as Konawe Islands, Central Buton, and Wakatobi show inefficient results in certain years, especially in education and health spending. In the education sector, it is said to be inefficient because of the inadequate number of teachers or their uneven distribution to remote areas. In addition, the limited number of schools and geographical challenges that are difficult to reach also affect the quality of education and literacy rates in the area. In the health sector, the lack of health workers and health centers in remote areas worsens community access to health services, which contributes to stagnant life expectancy. For infrastructure spending, inefficiency is seen from the length of existing roads but with low quality, so that it does not support community mobility to access education and health services effectively. The following is the efficiency of each region based on each expenditure in Table 5.

Tabel 5. Average Efficiency of Southeast Sulawesi Provincial Government Spending Per Spending

Regency/City	Education Spending		Health Spending		Infrastructure Spending	
	Average	Rank	Average	Rank	Average	Rank
Kendari	**1.00**	-	**1.00**	-	0.82	9
Konawe	**1.00**	-	**1.00**	-	0.90	4
Konawe Selatan	**1.00**	-	0.98	10	**1.00**	-
Konawe Utara	0.98	9	**1.00**	-	0.70	13
Konawe Kepulauan	0.99	7	0.95	17	0.48	17
Kolaka	0.99	6	0.99	9	0.97	3
Kolaka Utara	0.97	11	0.96	15	0.74	11
Kolaka Timur	0.99	8	**1.00**	-	0.99	2
Bombana	0.97	12	**1.00**	-	0.86	6
Bau-Bau	**1.00**	-	0.99	8	0.71	12
Buton	0.94	15	**1.00**	-	0.84	7
Buton Utara	0.98	10	0.96	13	0.76	10
Buton Tengah	0.96	13	0.96	14	0.66	14
Buton Selatan	0.94	14	0.95	16	0.84	8
Muna	**1.00**	-	**1.00**	-	0.87	5
Muna Barat	0.92	17	0.97	11	0.64	15
Wakatobi	0.94	16	0.96	12	0.59	16
Rata-Rata	***0.97***		***0.98***		***0.79***	

Source: STATA Data Processing Results, 2024

Education Spending

Education spending in Southeast Sulawesi province recorded a relatively high average efficiency (0.97), but there are still disparities between regions. Efficient regions can serve as examples of best practices by focusing on redistributing teachers to areas in

need, increasing access to schools in remote areas, and literacy programs specifically designed to reach underserved community groups. Meanwhile, inefficient regions require more attention in budget planning, community involvement in supporting education, and strengthening infrastructure to support better access. With these steps, the efficiency of education spending can be improved as a whole in Southeast Sulawesi province. The following is a description of the distribution of education expenditure from 2018-2022 in Southeast Sulawesi province in Figure 1.

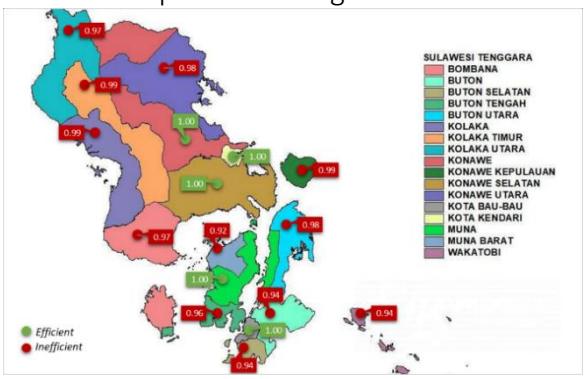

Figure 1. Map of Average Distribution of Education Spending Efficiency

Health Spending

The average efficiency of health spending in Southeast Sulawesi Province reached 0.98, which shows a relatively good achievement, although there are still some areas that need to be improved. Areas with full efficiency scores can be used as models to improve inefficient areas, with strategies such as increasing the number and distribution of health workers, adding health centers in remote areas, and using telemedicine technology to reach areas that are difficult to access. Local governments also need to ensure that the allocation of the health budget is actually used to improve accessibility and quality of services, so that life expectancy can increase evenly throughout the province. The following is a picture of the distribution of health spending from 2018-2022 in Southeast Sulawesi Province in Figure 2.

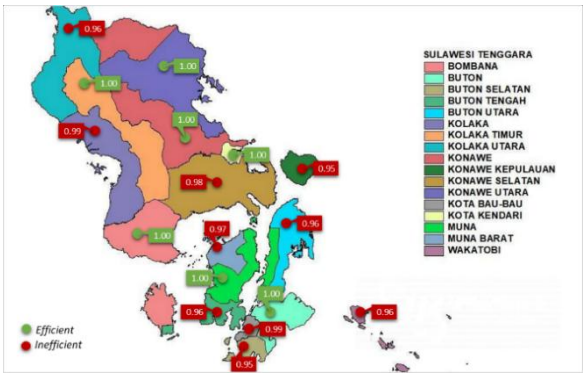

Figure 2. Map of Average Distribution of Health Spending Efficiency

Infrastructure Spending

The average efficiency of infrastructure spending in Southeast Sulawesi reached 0.79, which is lower than education and health spending. This shows that road infrastructure still requires special attention, especially in inefficient areas. Strategies that can be taken are to ensure road construction that is in accordance with regional needs,

prioritize improving road quality in remote areas, and strengthen supervision of infrastructure project implementation. In addition, the integration of infrastructure planning with other sectors such as education and health will increase synergy so that infrastructure spending can provide maximum benefits for all people in Southeast Sulawesi province. The following is a picture of the distribution of infrastructure spending from 2018-2022 in Southeast Sulawesi province in Figure 3.

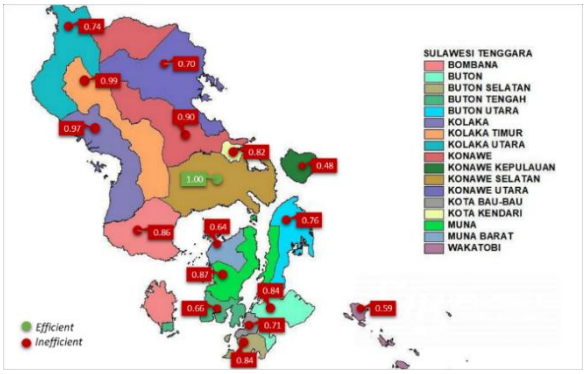

Figure 3. Map of Average Distribution of Infrastructure Spending Efficiency

Discussion

The findings indicate that education and health spending in Southeast Sulawesi demonstrate relatively high efficiency levels compared to infrastructure spending. Social sector expenditures tend to produce more measurable short-term outputs than capital-intensive sectors (Bodó & Janssen, 2022). Education and health services generally have standardized performance indicators such as literacy rates and life expectancy, making output transformation more observable. In contrast, infrastructure projects often involve longer gestation periods and higher capital rigidity, which may reduce short-term efficiency scores. Similar patterns were found in regional efficiency studies in Indonesia, where education and health expenditures consistently outperformed infrastructure spending in relative efficiency analysis (Aritenang & Chandramidi, 2023; Rambe et al., 2022).

The relatively high efficiency of education spending (average 0.97) supports human capital theory, which emphasizes the role of educational investment in improving measurable development outcomes (McKee & Gauch, 2020). Regions such as Kendari and Konawe demonstrate that optimal allocation of teachers and school facilities can enhance literacy indicators without proportionally increasing expenditure. Institutional management quality plays a crucial role in maximizing education spending performance (Bag & Pretorius, 2022). However, the persistence of disparities across regions indicates that fiscal capacity alone does not guarantee uniform efficiency. Structural factors such as geographical constraints and administrative capability may moderate the transformation of inputs into outputs.

Similarly, the high average efficiency of health spending (0.98) reflects the effectiveness of local governments in translating fiscal resources into improvements in life expectancy and service coverage. Regions operating near the frontier have optimized input-output combinations relative to their peers (Aritenang & Chandramidi, 2023; Yi et al., 2021). Empirical evidence from regional health expenditure studies also shows that increasing the number of medical personnel and health facilities tends to improve measurable outcomes when allocation is managed efficiently (Fasya et al., 2024; Medias

et al., 2021). Nevertheless, inefficiencies observed in island and remote districts suggest that geographic dispersion and limited accessibility remain critical constraints. These contextual limitations are consistent with findings from decentralized health system evaluations in developing regions.

In contrast, infrastructure spending demonstrates lower average efficiency (0.79), indicating potential underutilization or suboptimal allocation of capital expenditure. Infrastructure development often requires long-term investment horizons, and its impact may not be immediately reflected in output indicators such as road quality or length. According to public investment efficiency theory, capital-intensive sectors are more vulnerable to procurement inefficiencies and coordination failures. Road infrastructure efficiency tends to lag behind social sector spending due to maintenance costs and project implementation delays (Qurtubi, 2024). Therefore, lower efficiency scores in infrastructure do not necessarily indicate failure but may reflect structural and temporal characteristics of capital investment.

An important finding of this study is that regions with high education spending efficiency do not automatically exhibit lower poverty rates. This observation is consistent with multidimensional poverty theory, which argues that welfare outcomes depend on a combination of structural, economic, and social variables beyond public expenditure efficiency (Azmi et al., 2023; Perović & Kosor, 2020). Fiscal efficiency alone cannot directly reduce poverty without complementary economic growth and labor market expansion (AlQahtany, 2022). The descriptive comparison in this study suggests that while efficient spending improves sectoral outputs, poverty reduction may require integrated policy interventions. Thus, efficiency should be viewed as a necessary but not sufficient condition for welfare improvement.

The implications of this study highlight the importance of sector-specific fiscal management strategies. Local governments with high efficiency scores may serve as benchmarking references for peer regions, particularly in optimizing teacher distribution, health workforce allocation, and infrastructure planning. Policymakers should focus not only on increasing budget allocation but also on improving managerial effectiveness and coordination mechanisms. Furthermore, infrastructure planning should integrate long-term maintenance and cross-sector synergy to enhance output realization. From a policy perspective, efficiency evaluation using DEA can support evidence-based budgeting and performance monitoring at the regional level. Future research may expand this framework by incorporating dynamic efficiency analysis or examining external socioeconomic determinants to deepen understanding of regional welfare disparities.

CONCLUSIONS

The efficiency of regional government performance in Southeast Sulawesi during 2018–2022 varies across districts and cities, indicating differences in the ability to transform fiscal capacity into development outcomes. By applying the Data Envelopment Analysis (DEA) approach, region-year observations were evaluated as Decision Making Units (DMUs), enabling the identification of relatively efficient and inefficient regions within a comparable analytical framework. The findings confirm that higher fiscal input does not automatically guarantee proportional development output, suggesting the presence of managerial, structural, and governance-related inefficiencies. These results strengthen the argument in public sector efficiency theory that performance is not solely determined by resource availability, but also by institutional capacity and allocation

effectiveness.

Regional governments should strengthen expenditure quality, improve budget targeting, and enhance governance mechanisms to optimize the conversion of fiscal resources into measurable socio-economic outcomes. Local policymakers are encouraged to adopt benchmarking strategies using efficient regions as performance references and to implement evidence-based budgeting practices. For future research, it is recommended to incorporate a two-stage DEA analysis or integrate qualitative institutional variables to further explain sources of inefficiency. Expanding the observation period or comparing inter-provincial performance may also provide broader insights into regional fiscal efficiency dynamics in Indonesia.

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