

Assessing Fiscal Performance in Indonesian Local Governments through Public Sector Accounting Indicators: A K-Means Clustering Approach (2005–2023)

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Abstract

This study analyzes the fiscal performance of Indonesian local governments after fiscal decentralization using a K-Means clustering approach. Drawing on time-series data from regional budgets (APBD) of all districts and cities between 2005 and 2023, the study classifies fiscal performance based on four public sector accounting indicators: the fiscal decentralization ratio, financial independence, local revenue effectiveness, and spending efficiency. The analysis identifies four distinct clusters with different characteristics. Most regions (87.53%) fall into clusters with average to problematic performance, marked by high dependence on central government transfers and efficiency challenges. Only 2.28% of regions belong to the elite cluster with exceptional fiscal independence, while 10.19% are in the self-sufficient cluster that still needs to improve efficiency. The findings confirm significant fiscal disparities across regions and highlight the need for differentiated policy approaches tailored to each cluster's characteristics. The study recommends targeted interventions focusing on underperforming clusters and the replication of best practices from the elite cluster.

Keywords : Fiscal Performance, Fiscal Decentralization, K-Means Clustering, Public Sector Accounting, Local Government

1. INTRODUCTION

Indonesia consists of numerous regions with diverse characteristics, varying geographical conditions, and differing levels of resource availability. These disparities form a fundamental element in achieving regional financial equity. Through fiscal decentralization, local governments are granted greater authority to manage their own finances and resources. This policy is designed to promote income distribution across regions and enhance fiscal independence, enabling local governments to be more innovative in exploring local economic potential, improving spending efficiency, and strengthening transparent and accountable financial management. Ultimately, it aims to reduce regional dependence on central government transfers and foster equitable welfare across Indonesia.

However, after nearly two decades of fiscal decentralization, local governments in Indonesia continue to face challenges in maintaining financial independence and ensuring public spending efficiency. Dependence on central government transfers (TKDD) remains high, while the effectiveness and efficiency of regional budget (APBD) management vary significantly among regions. Widespread budget deficits reveal weaknesses in fiscal discipline and managerial capacity.

Several measures have been developed to assess local government financial performance, one of which is the use of financial ratios based on budget realization. According to Deswira (2022), financial performance measurement aims to evaluate the degree of local financial independence in supporting regional autonomy, assess the effectiveness and efficiency of revenue realization, and determine how well local governments utilize their revenues for public expenditure. The financial ratios used in this study include the fiscal decentralization ratio, financial independence ratio, local revenue (PAD) effectiveness ratio, and regional financial efficiency ratio.

The fiscal decentralization ratio measures the extent to which a local government can finance its operations without relying on central government support, reflecting the contribution of local revenue (PAD) to total regional income. The financial independence

ratio assesses a region's ability to fund its own affairs by comparing local revenue with total income obtained from external sources such as central/provincial transfers and regional loans. A higher ratio indicates lower dependence on external funding. The PAD effectiveness ratio evaluates how effectively a local government achieves its revenue targets, showing the government's ability to collect income from local sources. Meanwhile, the financial efficiency ratio measures how efficiently local governments manage their budgets, comparing realized expenditures to total revenues. A lower ratio (below 100%) indicates efficient performance, where spending aligns with plans and resources are used optimally.

Previous studies show that fiscal performance among Indonesian local governments remains uneven, with ongoing challenges in achieving financial independence and efficiency. T Harto et al (2024) found that local governments in North Sumatra experienced fluctuations in financial conditions, showing improvements in fiscal decentralization and independence but continued inefficiencies in budget management. Conversely, Nikmah and Muhtarudin (2025) reported that Gresik Regency demonstrated very low financial independence and high dependence on central transfers, along with weak spending efficiency. Research by Haryu and Sinurat (2024) in Palangka Raya City revealed low fiscal independence despite strong PAD effectiveness, hindered mainly by limited tax awareness and underutilized local resources. Meanwhile, M Rafsanjani and Sumiati (2024) observed that the financial performance of DKI Jakarta varied across leadership periods, with some governors exhibiting strong fiscal performance while others showed inconsistency.

Overall, these findings confirm significant fiscal disparities across regions in Indonesia, influenced by differences in fiscal capacity, PAD management effectiveness, and public spending efficiency. Therefore, this study titled "Assessing Fiscal Performance in Indonesian Local Governments through Public Sector Accounting Indicators: A K-Means Clustering Approach (2005–2023)" aims to provide a comprehensive mapping of local government fiscal performance in Indonesia using public sector accounting indicators, including fiscal decentralization, financial independence, PAD effectiveness, and financial efficiency ratios. Through the K-Means clustering approach, the study identifies patterns and groups of regions based on their fiscal performance levels over nearly two decades of fiscal decentralization.

2. REVIEW OF LITERATURE

Several studies examining the financial performance of local governments in Indonesia are as follows:

No	Penulis	Tahun	Judul Penelitian	Hasil Penelitian
1	Triono Harto & Junawan (Universitas Pembangunan Panca Budi)	2024	Financial Condition Analysis of North Sumatra Local Government	The financial condition of North Sumatra's local government during 2019–2023 was fluctuating. The fiscal decentralization degree improved from Good to Very Good (58%–57%). Financial independence was high, following a Delegative pattern (reaching 138% in 2022). PAD effectiveness varied, ranging from Very Effective (2020–2021) to Less Effective (2023). Financial management efficiency was low, between 78% and 108%. The proportion of operational expenditure decreased (88%→58%), while capital expenditure increased (12%→19%).

N o	Penulis	Tahun	Judul Penelitian	Hasil Penelitian
2	Namariq Nurul Nikmah & Muhtarudin (Kab. Gresik)	2025	Financial Performance Analysis of Gresik Regency Government for Fiscal Years 2020–2024	Financial independence was very low, averaging 75.77%, while financial dependence was very high at 87.50%. The fiscal decentralization level was moderate at 39.23%. PAD effectiveness was fairly effective at 82.53%, but financial efficiency was low at 128.33%. Although PAD grew over the period, it declined in 2023. Improvements are needed in budget planning, spending efficiency, and optimization of local resources.
3	An. Nagita Amadea Haryu & Marja Sinurat (IPDN)	2024	Financial Independence Analysis of Palangka Raya City (2021–2022)	Financial independence was low, following a Consultative pattern. PAD effectiveness was very high, yet financial dependence remained very high and fiscal decentralization was low. Tax effectiveness was considered effective, BMD contribution was low, and the debt ratio increased. Challenges included low tax awareness, underutilized natural resources, limited human resource competence, and inadequate infrastructure. Improvement efforts involved tax socialization, digitalization of services, employee training, and optimization of local resources.
4	Mahdi Rafsanjani & Sumiati (Universitas Brawijaya)	2024	Financial Performance Analysis of DKI Jakarta Government (2012–2022)	The analysis revealed differences in financial performance across governors. Basuki Tjahaja Purnama ranked highest across all ratios—including fiscal decentralization, financial independence, efficiency, PAD effectiveness, growth, and alignment. Anies Baswedan frequently ranked in the top three, but also recorded the lowest results four times across the tested ratios.

3. METHOD

This study employs a quantitative exploratory approach, integrating public sector accounting indicators with machine learning techniques to assess and classify the fiscal performance of Indonesian Local Authorities. The approach is data-driven, focusing on pattern recognition and clustering rather than conventional hypothesis testing.

The main analytical method used is the K-Means Clustering algorithm, implemented through the KNIME Analytics Platform. Its primary objective is to identify hidden structures or patterns in local government fiscal performance based on four key public accounting indicators derived from regional budget (APBD) data spanning 2005–2023, sourced from reports published by Financial Affairs Ministry via the Directorate General of Fiscal Balance (DJPK).

The study's variables consist of four main financial ratios serving as fiscal performance indicators, representing the dimensions of efficiency, effectiveness, fiscal decentralization, and fiscal independence. The operational definitions are presented as follows:

Dimension	Indicator	Formula	Interpretation
Fiscal Efficiency	Spending Efficiency Ratio	Realized Expenditure / Budgeted Expenditure	Measures how optimally a local government uses its budget.
Fiscal Effectiveness	PAD Effectiveness Ratio	Realized PAD / Budgeted PAD	Indicates the local government's ability to achieve the targeted local revenue.
Fiscal Decentralization	Fiscal Decentralization Ratio	PAD / Total Revenue	Reflects the contribution of local revenue (PAD) to total regional revenue as an indicator of fiscal capacity.
Fiscal Independence	Financial Independence Ratio	PAD / Central Transfers (TKDD)	Measures the degree of a region's reliance on central government transfers (TKDD: Transfers to Regions and Village Funds).

Source, processed data 2025

The data analysis will be conducted entirely using the KNIME Analytics Platform. KNIME's strengths lie in its visual workflow design, seamless integration with R and Python, and its ability to handle large-scale data processing efficiently..

4. RESULT & DISCUSSION

Data Overview

Before performing the clustering process, a descriptive analysis was conducted on the four main fiscal performance ratios: spending efficiency ratio, PAD effectiveness ratio, fiscal decentralization ratio, and financial independence ratio.

Table 1. Descriptive Statistics of Spending Efficiency Data

Name	Minimum	Maximum	Mean	Standard Deviation	Count rows
Tahun	2005	2023	2014,505557	5,29	9627
Anggaran belanja	49.220.490.000	80.902.089.842.504	1.578.552.752.467	3.221.425.706.128	9627
Realisasi belanja	67.638.267.103	66.770.609.628.414	1.499.731.580.667	2.818.583.334.456	9627
Rasio efesiensi belanja	20,72	526,43	96,34	12,73	9627

Source, processed data 2025

Table 2. Descriptive Statistics of PAD Effectiveness Data

Name	Minimum	Maximum	Mean	Standard Deviation	Count
Tahun	2.005,00	2.023,00	2.014,51	5,29	9.612,00
Realisasi PAD	414.791.682,00	49.139.745.715.234,00	360.118.764.171,74	1.826.202.657.735,49	9.612,00
Anggaran PAD	20.000.000,00	57.561.162.309.490,00	353.214.054.656,14	1.957.072.606.212,83	9.612,00
Rasio efektivitas	7,17	6.505,23	122,06	133,02	9.612,00

Source, processed data 2025

Table 3. Descriptive Statistics of Fiscal Decentralization Data

Name	Minimum	Maximum	Mean	Standard Deviation	Count
Tahun	2.005,00	2.023,00	2.014,51	5,29	9625
Total Realisasi Pendapatan	3.601.388.775,00	71.065.534.207.722,00	1.520.822.764.315,48	2.908.925.018.200,29	9625
Total Realisasi PAD	414.791.682,00	49.139.745.715.234,00	359.660.140.736,18	1.825.011.814.456,03	9625
Rasio Desentralisasi fiskal	0,14	100,00	11,60	13,29	9625

Source, processed data 2025

Figure 4. Descriptive Statistics of Financial Independence Data

Name	Minimum	Maximum	Mean	Standard Deviation	Count
Tahun	2.005,00	2.023,00	2.014,51	5,29	9627
Realisasi TKDD	29.743.080.000,00	22.673.794.344.052,00	1.031.867.241.565,26	1.178.617.049.459,04	9627
Realisasi PAD	407.740.000,00	49.139.745.715.234,00	339.347.232.482,76	1.809.782.579.517,27	9627
Rasio kemandirian	0,15	903,13	17,73	35,80	9627

Source, processed data 2025

Based on the descriptive statistical analysis, the study reveals the fiscal performance landscape of Indonesian local governments as highly heterogeneous with several policy anomalies. On average, the spending efficiency ratio was 96.34%, indicating an overall optimal budget absorption. However, a standard deviation of 12.73% and a value range from 20.72% to 526.43% reflect extreme disparities in fiscal capacity across regions, where some areas experienced large surpluses while others faced worrying deficits.

Meanwhile, the PAD effectiveness ratio averaged 122.06%, exceeding targets, but the very high standard deviation of 133.02% and a maximum value of 6,505.23% suggest potential under-budgeting practices or inconsistencies in revenue targeting. Furthermore, the financial independence ratio, averaging only 11.60% with wide interregional variation, confirms the structural dependence of local governments on central transfers and reflects deep fiscal capacity inequalities across regions during the 2005–2023 period.

Profile and Characteristics of Fiscal Performance Clusters

The following presents the results of the K-Means clustering analysis conducted using KNIME Analytics Platform, illustrated in the figures below:

Table 5. K-Means Algorithm Results

Cluster	Average Fiscal Decentralization	Average Independence Ratio	Average Effectiveness Ratio	Average Spending Efficiency
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Cluster_0	-0,2418	-0,2941	0,0795	0,5169
Cluster_1	-0,2651	-0,3407	-0,1045	-0,7413
Cluster_2	1,0427	1,7437	-0,0917	-0,1041
Cluster_3	4,9849	4,2185	0,2142	0,1454

Source, processed data 2025

Table 6. Silhouette coefficient results

Cluster	Mean Silhouette Coefficient
cluster_3	0,235
cluster_2	0,378
cluster_1	0,306
cluster_0	0,276
Overall	0,296

Source, processed data 2025

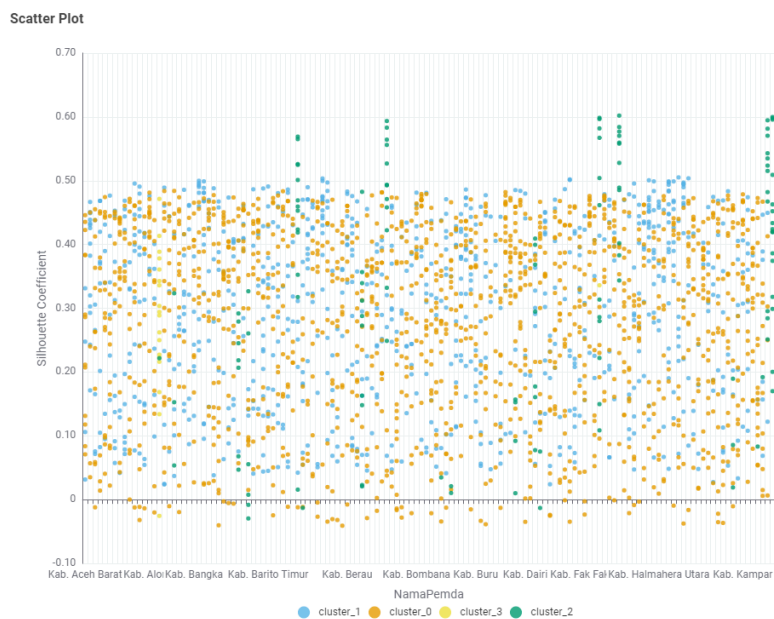


Figure 1. Clustering results for all local governments

Pie Chart

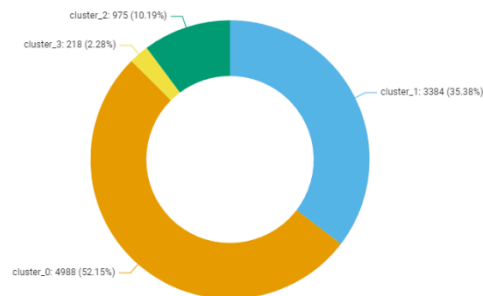


Figure 2. Results of the pie chart of local government clustering

Based on the K-Means clustering analysis, four distinct clusters of local government fiscal performance were identified, each with significantly different characteristics:

1. Cluster 0 - The Majority Group with Average Performance (52.15%)
This cluster represents the largest group, reflecting the general condition of Indonesian local governments. The cluster profile is characterized by fiscal decentralization ratio (-0.242) and self-reliance ratio (-0.294) values below the national average, indicating a high degree of dependence on central government transfers. However, a positive expenditure efficiency value (0.517) demonstrates an adequate capability in budget management. A silhouette coefficient of 0.276 confirms that this cluster has a reasonably cohesive internal structure.
2. Cluster 1 - The Problematic Group with High Inefficiency (35.38%)
As the second-largest cluster, this group displays a concerning performance profile. Negative values across all indicators, particularly in expenditure efficiency (-0.741) and self-reliance ratio (-0.341), reflect structural issues in local financial governance. The cluster's good level of internal cohesion, indicated by the highest silhouette coefficient (0.378), strengthens its identity as a group with homogeneous and acute fiscal problems, thereby requiring fundamental and focused policy intervention.
3. Cluster 2 - The Self-Reliant Group with High Effectiveness (10.19%)
This cluster exhibits superior performance characteristics in fiscal capacity, as reflected by fiscal decentralization ratio (1.043) and self-reliance ratio (1.744) values significantly above the average. These achievements indicate that the regions within this cluster have successfully realized the essence of fiscal decentralization. Nevertheless, an expenditure efficiency value slightly below average (-0.104) suggests room for improvement in budget allocation and absorption optimization.
4. Cluster 3 - The Elite Group with Exceptional Performance (2.28%)
This is the smallest cluster, demonstrating exceptional fiscal performance. The extreme values for the fiscal decentralization ratio (4.985) and self-reliance ratio (4.218) affirm its position as a region with a very high degree of financial autonomy. Although its silhouette coefficient is relatively low (0.235), potentially due to the small number of members, this cluster serves as a representation of best practices and can be used as a benchmark for formulating policies aimed at strengthening local fiscal capacity.

5. CONCLUSION

Based on the clustering analysis of Indonesian local government fiscal performance from 2005 to 2023, the following conclusions can be drawn:

1. There is a Clear and Measurable Fragmentation of Fiscal Performance
The fiscal performance profiles of Indonesian local governments are empirically classified into four significantly distinct clusters. An overall silhouette coefficient of 0.296 indicates that the quality of this grouping is acceptable, while simultaneously confirming a high degree of heterogeneity and disparity in fiscal capacity among regions, which is not revealed through aggregate average analysis.
2. The Distribution of Fiscal Performance Reveals Significant Inequality
The distribution of fiscal performance reveals significant inequality, as indicated by the following:
 - a. The majority of local governments (87.53%) are concentrated in the average-to-problematic performance clusters (Clusters 0 and 1), which are characterized by a high dependence on central government transfers and various efficiency challenges.
 - b. Only 2.28% of the total observations fall into the elite performance category (Cluster 3), which exhibits exceptional fiscal self-reliance.
 - c. The intermediate cluster (Cluster 2), which has achieved self-reliance but still needs to improve efficiency, comprises only 10.19% of the total observations.
3. Each Cluster Requires Specific and Targeted Policy Recommendations
The distinct characteristics of each cluster necessitate specific and targeted policy recommendations. A uniform, one-size-fits-all approach is unsuitable, as the fiscal challenges and opportunities differ fundamentally across these groups.
4. Several policy measures can be formulated for each cluster as follows:
 - a. Cluster 0
Local governments in this cluster may adopt policies aimed at simplifying regional tax administration processes (such as retribution and hotel/restaurant taxes) through digital systems. Additionally, the central government may introduce special incentive allocation funds (DAK) for regions that successfully reduce their dependence on intergovernmental fiscal transfers.
 - b. Cluster 1
For this cluster, the central government may implement a fiscal early-warning system to monitor potential budget deficits. Capacity-building programs targeting local financial management officers, particularly regarding expenditure control and debt management are also recommended. Furthermore, restructuring expenditure patterns through external audits could help identify budget leakages and provide recommendations for reallocating spending toward more productive sectors.
 - c. Cluster 2
Governments within this cluster may adopt value-for-money audit mechanisms to evaluate the effectiveness of capital expenditures and public service delivery. Regional revenue innovation can be enhanced by developing public-private partnership (PPP/KPBU) schemes for infrastructure development and technology-based public services.
 - d. Cluster 3
Local governments in this cluster may be designated as “fiscal ambassadors,” serving as mentors for other regions in improving their fiscal management practices.

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