THE JOURNAL OF INDONESIA SUSTAINABLE DEVELOPMENT PLANNING

VOL. 6 NO. 3 - DECEMBER 2025

E-ISSN: 2722-0842 | P-ISSN: 2721-8309

Available online at
http://journal.pusbindiklatren.bappenas.go.id/

Research Paper

Decentralisation and Distribution
A Multi-Dimensional Taxonomy of Indonesian Districts

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Abstract

Indonesia's fiscal decentralisation devolves expenditure authority to districts, yet heavy reliance on central transfers and persistent spatial disparities indicate that a single, formula-based approach is ill-equipped to address heterogeneous needs. This study develops a multidimensional taxonomy of 403 districts, drawing on the World Bank's INDO-DAPOER dataset and audit indicators, and applies hierarchical clustering. This study identifies four distinct clusters that differ systematically in structural transformation, human evelopment, local governance and autonomy. ANOVA confirms significant between-cluster differences, with population size, health and social protection expenditures exhibiting the strongest discriminating power. Policy-relevant profiles emerge: Cluster 1 concentrates poverty and weak governance yet depends most on transfers; Cluster 2 is agriculture-dependent with infrastructure emphasis; Cluster 3 is densely populated with strong human capital but limited fiscal capacity; Cluster 4 is economically advanced, least transfer-dependent but with room to improve governance. Findings inform targeted transfer design—combining performance-based incentives, differentiated sectoral allocations and capacity support—advancing decentralisation objectives by aligning resources to cluster-specific needs and strengthening accountability, local matching and service delivery.

Keywords: Cluster Analysis; Decentralisation; Transfer Formula, Indonesia.

ARTICLE INFO
Received: February 19, 2025
Received in revised form: June 18, 2025
Accepted: December 01, 2025

doi: 10.46456/jisdep.v6i3.438

THE JOURNAL OF INDONESIA SUSTAINABLE DEVELOPMENT PLANNING
Published by Centre for Planners' Development, Education, and Training (Pusbindiklatren), Ministry of National Development Planning/National Development Planning Agency (Bappenas), Republic of Indonesia

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Supported by Indonesian Development Planners Association (PPPI)

Please cite this article in APA Style as:
Wardhana, D. (2025). Decentralisation and Distribution: A Multi-dimensional Taxonomy of Indonesian Districts. *The Journal of Indonesia Sustainable Development Planning, Vol 6(3),* 388-409. https://doi.org/10.46456/jisdep.v6i3.438

1. Introduction

Since 2001, Indonesia has implemented a complex system of fiscal decentralisation, devolving significant authority and fiscal power to the tier-2 level (district and municipalities). The primary goal of this policy is to improve local economic development and mitigate social problems like poverty. Despite these reforms, most districts hitherto remain heavily reliant on transfers from the central government and regional disparities persist. Poverty rates, for instance, are substantially higher in the eastern part of Indonesia (Figure 1 and 2) although three-quarters of the nation's poor reside in the more densely populated islands of Java and Sumatera. Seemingly, the current transfer formula fails to account for multidimensional disparities in governance capacity, economic structure, and human development. This one-size-fits-all approach has led to inefficient resource allocation, disincentives for local revenue generation, and minimal convergence in regional development. This presents a conundrum for resource allocation: how should the central government distribute resources to address both the high concentration of poor people in the west and the high rates of poverty in the east?

The current system attempts to address this through a single transfer formula for determining allocations to each district. This formula considers variables for 'fiscal needs' (e.g., population, area size, human development index) and 'fiscal capacity' (e.g., local revenue). However, this approach has been criticized as inadequate for reducing regional inequalities, as its mechanisms do not sufficiently differentiate between the diverse needs and challenges of different areas. Furthermore, studies suggest the allocation process is prone to political interference and may create disincentives for local governments to raise their own revenue. Previous classifications used by the central government often categorize districts based on single dimensions, such as income per capita or an official designation as a 'lagged' region. This narrow approach fails to capture the multifaceted nature of development, where districts face a complex interplay of economic, social, governance, and autonomy challenges.

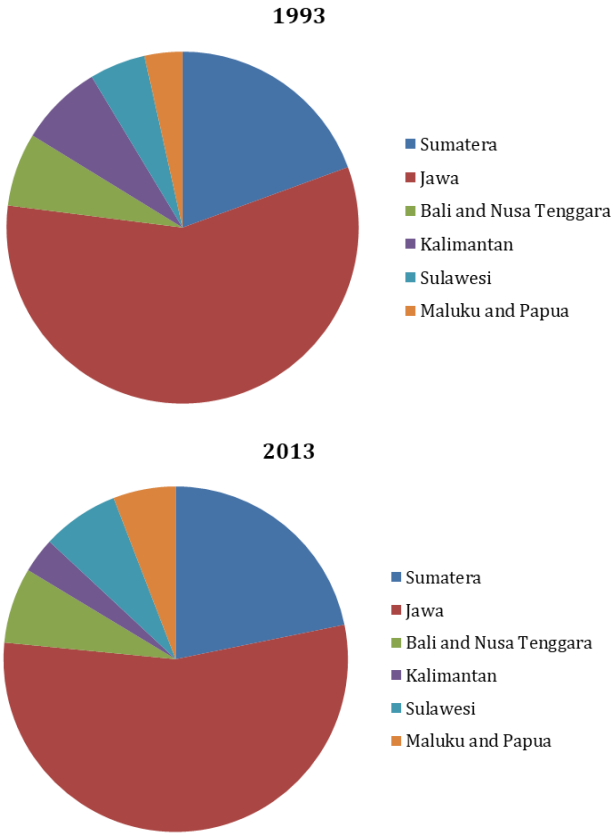

Figure 1. Location of the Poor (1993 and 2013)

Meanwhile, Figure 2 shows the poverty rates by district. The chart is in line with the findings from Miranti et al. (2013) which finds that regional disparities persist at the district level with substantial differences in poverty rates. The poverty incidence is substantially higher in the eastern part of Indonesia. This presents Indonesia with a different kind of poverty fiscal conundrum: Most of Indonesia's poor are situated in the densely populated western part of the archipelago. However, in terms of poverty rate, it is far higher in the eastern provinces. Given this situation, how should the central government distribute central government resources?

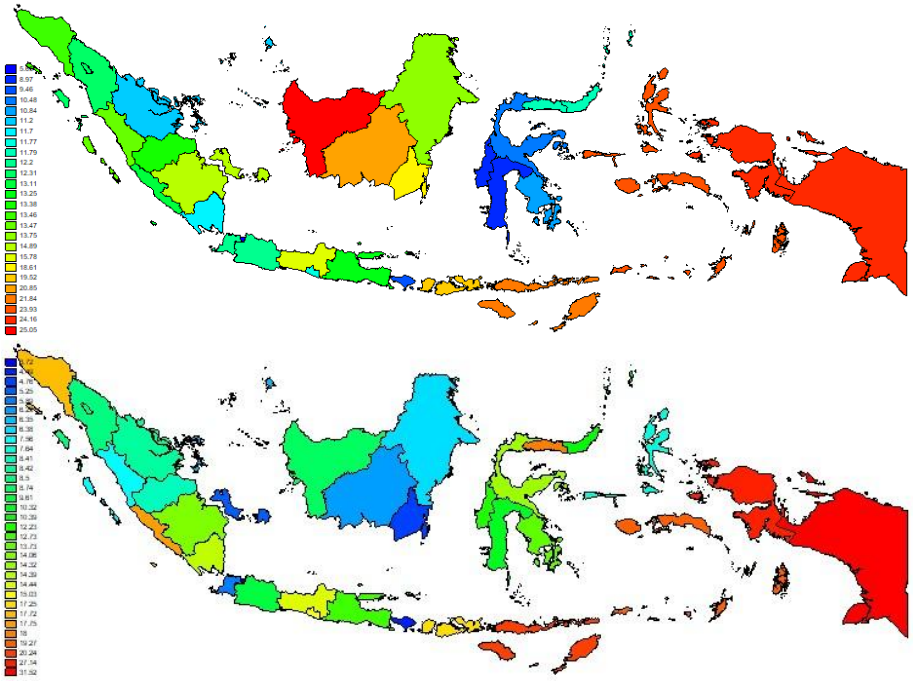

Figure 2. Poverty Rates by Provinces (1993 and 2013)

These quick comparisons point towards the limited impact of decentralisation so far in terms of addressing disparities between provinces. The current allocation of central government resources to provinces is based on a formula composed of variables for 'fiscal needs' measured by GDP per capita, the human development index (of which GDP per capita is major component), population and area size and inflation and 'fiscal capacity' is defined as local revenue, tax revenue sharing[1] and natural resource revenue sharing[2] . Results from Fajri & Munawaroh (2023) and Zevaya et al. (2024) reveal some macroeconomic variables that have a significant effect on regional autonomy.

According to Brodjonegoro (2009), the inter-governmental transfer scheme is still far from optimal due to political interference in the formulation of intergovernmental transfers comprising General Purpose Grant (*Dana Alokasi Umum*, DAU), special allocation fund (*Dana Alokasi Khusus*, DAK), the natural resource revenue sharing fund, and tax revenue sharing fund. The centre piece of Indonesian fiscal decentralisation is the DAU which gives the full autonomy to local governments in spending and managing the allocated grant. The DAU utilizes a formula to allocate the regular grant to all provincial and district governments in Indonesia. In most local governments, DAU is the operational day-to-day budget which is very significant in the local budget. As argued by von Haldenwang (2017), this situation of heavy dependence to DAU may create disincentives for local governments to raise or intensifying the collection of local revenue (*pendapatan asli daerah*, PAD). Brodjonegoro and Vazquez (2005) find a significant negative correlation between the size of DAU and PAD.

One important indicator of regional autonomy is the ability of the local governments to find their own sources of revenue and to reduce their dependence on the central government transfer. A

[1] Tax revenue comprises shares from land tax, building title transfer duty, and income tax, of which around 65% is transferred to districts.

[2] Natural resource revenue ranges from various revenue source of forestry, fisheries, mining, oil, gas, and geothermal, of which around 20 to 85% are transferred to central government account.

comparison indicates that pre-decentralisation growth of local revenue is much higher (20 per cent annual growth) than during the decentralisation period (five per cent annual growth) (Brodjonegoro, 2009). Central government in Indonesia however remains reluctant to give more tax raising power to districts (e.g. the failure to transfer the authority for property tax to the local government is one example). The net impact of a grant allocation below needs and weak local tax raising powers is likely to have contributed to the growth of illegal charges, levies or fees by local governments to generate additional revenue.

The determination of the allocation to districts is based on the formula that adopts the concept of a fiscal equalisation grant. The formula has been determined by the regional autonomy council that supervises the implementation of regional autonomy and fiscal decentralisation program. The central government distributes unconditional block grants (*dana alokasi umum* or DAU) to the regions using a formula accounting for both 'fiscal needs' and 'economic capacity'. These DAU are the main mechanism through which the central government provides funds to finance provincial and districts (*kabupaten*) government expenditures in Indonesia (Shah, Qibthiyyah, and Dita, 2012). The total pool of these transfers is arbitrarily set at 19 percent of national state budget or equal to 70 percent of total government transfers in 2014. A fifth of the total pool is allocated to provinces and the remaining eight per cent to all cities and districts.

Fiscal needs are determined separately for each of these groups by developing a composite index based upon population, land area size, construction price index (newly introduced index to capture price disparity of materials to build infrastructure), the inverse human development index (comprising arbitrary weights for life expectancy, literacy rate, average years of schooling and purchasing power adjusted relative real GRDP per capita) and the inverse of nominal per capita GRDP. In order to adjust the formula to increase the 'fairness' aspect, the weights for the above-mentioned factors vary for provinces and districts/cities and over time for each group based upon the specified value.

Fiscal devolution which largely gives much power to district rather than provincial level is reflected in the formulation of 'fiscal capacity'. The fiscal capacity of a province is determined by percentage share as follows: 50% of own source revenues, of which consisting 80% of non-resource tax sharing and 95% of resource and mining tax sharing. Meanwhile, the 'fiscal capacity' of a city or district government on the other hand is based upon 93% of own source revenues, 100% of non-resource tax revenue sharing and 63% of resources and mining tax revenue sharing, hence this calculation gives more fiscal power to district and municipal levels.

In addition, to reduce inequalities between regions, poorer provinces and districts are eligible for additional grants from the central government. These include specific allocation funds (*dana alokasi khusus* or DAK), Special Autonomy grants for Aceh, Papua and Papua Barat, adjustment compensation funds (*dana penyesuaian* or DP), and regional incentive funds (*dana insentif daerah* or DID) and grants (*hibah*) (Shah et al., 2012). DAK are intended to influence local government spending on areas of national priority, and account for 6% of central transfers and fund 5% of subnational expenditures. DP funds provide special *ad hoc* assistance. According to Ministry of Finance and World Bank estimates for 2009, DAU represent the main source of revenue for local governments with a share of 49% of total revenues; while 18% come from DAK and only 17% from PAD. According to the World Bank (2011), the current system used for funding transfers is inadequate in reducing inequalities between regions as its allocation mechanisms insufficiently differentiate between the needs and challenges in different areas. An additional problem with DAU is that under its current allocation mechanism, districts have incentives to split off into new regions (Harjowiryono in Ministry of Finance, 2011), which is known as "*pemekaran*" or proliferation. Indeed, the incentives given by Indonesia's grant disbursement mechanism is summed up as follows: "two new districts get effectively twice as much as the larger old districts from which they were formed" (Fitrani et al., 2005).

An alternative allocation of resources might seek to cover not only income per capita, human development but also such aspects of local autonomy and governance. This paper identifies a critical gap in the existing literature and policy framework: the absence of a nuanced, multi-dimensional classification of Indonesian districts that can serve as a more effective basis for fiscal decentralisation policies. While past studies have analyzed the effects of decentralisation on specific outcomes like public service provision or macroeconomic stability, few have attempted to create a holistic taxonomy that reflects the diverse development profiles of districts.

Therefore, this study aims to address this gap by pursuing the following objectives:

1. To develop a multi-dimensional taxonomy of Indonesian districts using cluster analysis, based on indicators of structural transformation, human development, local good governance, and local autonomy.
2. To identify and characterize the distinct profiles of the resulting district clusters.
3. To provide a robust, evidence-based alternative to single-dimension classifications, thereby offering a more effective tool for designing targeted fiscal transfers and development policies in Indonesia.

2. Methods

2.1. Research Approach

One important rationale for developing a multi-dimensional taxonomy beyond income is that development itself is multidimensional and incorporates economic, social and political dimensions that are lost in an approach based largely on income per capita (Sumner & Vázquez, 2014; Tezanos Vázquez & Sumner, 2013). A secondary rationale that the proliferation of newly created districts in Indonesia raises question marks about some of the existing classifications such as the 'lagged' districts taking the Ministry of Village, Disadvantaged Regions, and Transmigration definition. Criteria for determining disadvantaged areas are defined by the assessment of population and location using an approach based on the calculation of the six base criteria (Ministry of Village Disadvantaged Regions and Transmigration, 2005) as follows: (i) local economy; (ii) human resources capacity; (iii) infrastructure readiness; (iv) fiscal capacity; (v) accessibility; (vi) local specific characteristics as consideration.[3] The central government does treat districts differently if they are not categorised as backward or lagged. For example, in April 2015, Minister of Village, Disadvantaged Regions, and Transmigration officially lodged request to review criteria for deciding lagged regions in order to add the number of regions currently receiving additional budget for development acceleration.

We take 'development' with reference to decentralisation to mean four aspects of progress: Development as structural transformation (economic development); development as human development; development as good governance and development as local autonomy. To measure development as structural transformation we use data for economic structural change (GDP in non-agriculture), natural resource dependency (GDP in non-oil sectors), and purchasing power (RGDP per capita). These indicators were chosen for their relevance to this domain of development and because of the good coverage of available data sets. Although indicators reflecting workforce and employment seem relevant in capturing the shift from informal to formal sectors in the economy, we decide not to include such indicators because the employment data is contentious due to definitions taken. To measure development as human development we use population, income poverty rates ($1.50 a day poverty headcount in 2005 PPP), health (the morbidity rate), and education (the net enrolment ratio for primary, junior, and senior high school). To measure development as good governance we use audit opinion from the Supreme Audit Board (*Badan Pemeriksa Keuangan*, BPK) that are commonly used in governance-related research and based on audited budget performance.

These days, the audit process involves both administrative and substantive aspects of budget spending. The improved procedure has been proven effective in deterring budget deviation or corruption to significant extent. Having this instrument, BPK can exert its function as the overseer of budget and its effectiveness. Finally, and crucially for decentralisation we include measures of local autonomy. Most studies focus on decentralisation's effects on public sector outputs, such as investment levels, public service provision, education and health indicators, and macroeconomic stability. Good summaries of this research can be found in Rondinelli et al. (1983), Manor (1999), Treisman (2007), and Faguet (2012).

[3] These six criteria are derived into 27 operational indicators are as follows: 1) poverty rate; 2) consumption per capita; 3) life expectancy rate; 4) enrolment rate; 5) literacy rate; 6) paved road; 7) strengthened road; 8) soil road; 9) other types of road; 10) electrification rate; 11) telephone users; 12) clean water users; 13) village market; 14) health infrastructure; 15) health personnel; 16) compulsory education infrastructure; 17) fiscal gap; 18) average distance to district centre; 19) average distance to education facilities; 20) village with health infrastructure; 21) earthquake-prone area; 22) landslide-prone area; 23) flood-prone area; 24) other disaster-prone area; 25) preserved land 26) infertile land size; 27) conflict-prone area

Comparatively few studies investigate decentralisation's effects on the quality of governance; some exceptions include Bardhan (2002), de Mello and Barenstein (2001), and Oxhorn, Tulchin, and Selee (2004).

The reasons for this are not hard to fathom: (i) the data required to empirically examine decentralisation's effects on aspects such as health investment or school enrolment are more commonly available than for governance-type issues like accountability, political competition, and participation in public decision-making. The strongest theoretical argument in favour of decentralisation is that (a) it will improve the accountability and responsiveness of government by altering its structure so as to increase citizen voice and change the deep incentives that public officials face (Faguet, 2012, 2014).

To create a taxonomy of districts, this study employs cluster analysis, a numerical technique ideal for classifying a heterogeneous sample into a limited number of homogeneous groups. The rationale for this multidimensional approach is that development is not solely about income but also encompasses economic, social, and political dimensions that are often overlooked. The analysis is based on a dataset that includes all Indonesian districts for which complete data were available for the year 2011, resulting in a final sample size of 403 districts.

2.2. Data and Variables

The analysis utilizes the World Bank's INDO-DAPOER dataset, supplemented with audit data from the Supreme Audit Board of Indonesia. We selected 14 proxy variables to represent four key dimensions of development within the context of decentralisation:

1. Development as Structural Transformation: Measured by RGDP per capita, the share of GDP from non-agricultural sectors, and the share of GDP from non-oil sectors.
2. Development as Human Development: Measured by population size, poverty rate (at $1.50/day 2005 PPP), morbidity rate, and net enrolment ratios for primary, junior, and senior high school.
3. Development as Good Governance: Measured by the official state audit result from the Supreme Audit Board (BPK), a commonly used proxy for budget performance and transparency.
4. Development as Local Autonomy: Measured by district-level government revenue and expenditures across key sectors (social protection, economy, education, health, and infrastructure) to reflect local fiscal capacity and priorities.

A detailed list of these variables and their sources is provided in Table 1.

Table 1. Development dimensions/concepts and data used, 2011.

Development dimensions/conceptions	Sub-dimensions	Proxies	Sources
I. Development as Structural transformation	1.1. Purchasing power	RGDP per capita	World Bank (2014)
	1.2. Structural change	GDP in non-agricultural sectors (% of GDP)	World Bank (2014)
	1.3. Dependency on natural resources	GDP in non-oil sectors (% of GDP)	World Bank (2014)
II. Development as human development	Population	Population size	World Bank (2014)
	2.2. Poverty	Poverty rate at $1.50 (2005PPP)	World Bank (2014)
	2.3. Health	Morbidity rate	World Bank (2014)
	2.4. Education	Net enrolment ratio – primary	World Bank (2014)
		Net enrolment ratio – junior	World Bank (2014)
		Net enrolment ratio – senior	World Bank (2014)
III. Development as local good governance	3.1. Transparency	State audit result	Supreme Audit Board (2014)
IV. Development as local autonomy	4.1. Local economic capacity	District level government revenue	World Bank (2014)

Development dimensions/conceptions	Sub-dimensions	Proxies	Sources
		District level government expenditure	World Bank (2014)
	4.2. Social welfare	District level l social protection expenditure	World Bank (2014)
	4.3. Economy	District level economic expenditure	World Bank (2014)
	4.4. Education	District level education expenditure	World Bank (2014)
	4.5. Health	District level health expenditure	World Bank (2014)
	4.6. Infrastructure	District level infrastructure expenditure	World Bank (2014)

Cluster analysis is considered suitable for classifying a sample of heterogeneous districts in a limited number of groups between the districts that comprise it (Sumner & Vázquez, 2014; Tezanos Vázquez & Sumner, 2013). The initial data set included 14 variables that proxy different development dimensions. Some high correlations are retained in the analysis to investigate further the impact of each variable to districts classifications, echoing the argument from Allison (2012). Table 2 shows the correlations between variables. Yellow highlights in Table 5 indicate 0.01 level of correlation significance.

Table 2. Correlation matrix.

		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
A	Pearson	1.00																
	Sig. (2-tailed)																	
	N	495																
B	Pearson	0.418	1.00															
	Sig. (2-tailed)	0.000																
	N	495	495															
C	Pearson	-0.4973	-0.2036	1.00														
	Sig. (2-tailed)	0.000	0.000															
	N	495	495	495														
D	Pearson	0.0636	0.2887	0.0269	1.00													
	Sig. (2-tailed)	0.1574	0.000	0.5506														
	N	495	495	495	495													
E	Pearson	-0.1553	-0.2602	0.0733	-0.2497	1.00												

		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
	Sig. (2-tailed)	0.0006	0.000	0.1059	0.000													
	N	488	488	488	488	488												
F	Pearson	-0.1979	-0.3883	0.011	-0.2051	0.508	1.00											
	Sig. (2-tailed)	0.000	0.000	0.8068	0.000	0.000												
	N	495	495	495	495	488	495											
G	Pearson	-0.0832	-0.0941	0.0523	-0.0112	0.0594	0.0861	1.00										
	Sig. (2-tailed)	0.0642	0.0364	0.2453	0.8032	0.1904	0.0554											
	N	495	495	495	495	488	495	495										
H	Pearson	0.0637	0.1021	-0.0554	0.1224	-0.3742	-0.4276	0.003	1.00									
	Sig. (2-tailed)	0.1573	0.0231	0.2182	0.0064	0.000	0.000	0.9471										
	N	495	495	495	495	488	495	495	495									
I	Pearson	0.1545	0.2497	-0.0504	0.2284	-0.4329	-0.4227	-0.0566	0.656	1.00								
	Sig. (2-tailed)	0.0006	0.0000	0.2634	0.0000	0.0000	0.0000	0.2088	0.0000									
	N	495	495	495	495	488	495	495	495	495								

		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
J	Pearson	0.1787	0.3206	-0.1075	-0.0505	-0.2596	-0.3329	-0.0099	0.3669	0.6554	1.00							
	Sig. (2-tailed)	0.0001	0.000	0.0169	0.2628	0.000	0.000	0.8259	0.0000	0.0000								
	N	493	493	493	493	486	493	493	493	493	493							
K	Pearson	-0.0711	-0.2890	0.0105	-0.2174	0.4368	0.4642	0.0478	-0.2637	-0.363	-0.2723	1.00						
	Sig. (2-tailed)	0.1163	0.0000	0.8164	0.0000	0.0000	0.0000	0.2910	0.0000	0.0000	0.0000							
	N	489	489	489	489	488	489	489	489	489	489	489						
L	Pearson	-0.1673	-0.2769	0.0779	-0.2649	0.987	0.5198	0.0709	-0.3863	-0.4513	-0.2531	0.4429	1.00					
	Sig. (2-tailed)	0.0002	0.0000	0.0857	0.0000	0.0000	0.0000	0.1179	0.0000	0.0000	0.0000	0.0000						
	N	488	488	488	488	488	488	488	488	488	488	488	488					
M	Pearson	-0.111	-0.2065	0.0514	-0.2599	0.3706	0.4227	0.0108	-0.4390	-0.4128	-0.3270	0.3016	0.3853	1.00				
	Sig. (2-tailed)	0.0251	0.0000	0.3013	0.0000	0.0000	0.0000	0.8277	0.0000	0.0000	0.0000	0.0000	0.0000					
	N	407	407	407	407	406	407	407	407	407	405	407	406	407				
N	Pearson	-0.1012	-0.2137	0.0314	-0.2656	0.6762	0.5123	-0.0167	-0.4670	-0.4898	-0.3316	0.4550	0.6836	0.6980	1.00			
	Sig. (2-tailed)	0.0412	0.0000	0.5278	0.0000	0.0000	0.0000	0.7368	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000				

		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
	N	407	407	407	407	406	407	407	407	407	405	407	406	407	407			
O	Pearson	-0.2504	-0.3051	0.1405	-0.2878	0.6949	0.3815	0.1400	-0.2341	-0.3297	-0.1021	0.3022	0.707	0.4782	0.5948	1.00		
	Sig. (2-tailed)	0.0000	0.0000	0.0046	0.0000	0.0000	0.0000	0.0047	0.0000	0.0000	0.0402	0.0000	0.0000	0.0000	0.0000			
	N	406	406	406	406	405	406	406	406	406	404	406	405	406	406	406		
P	Pearson	-0.1615	-0.2148	0.0916	-0.2787	0.6779	0.4386	0.1314	-0.3945	-0.4545	-0.1824	0.3596	0.695	0.5808	0.6858	0.9065	1.00	
	Sig. (2-tailed)	0.0011	0.0000	0.0647	0.0000	0.0000	0.0000	0.0080	0.0000	0.0000	0.0402	0.0000	0.0000	0.0000	0.0000	0.0000		
	N	407	407	407	407	406	407	407	407	407	405	407	406	407	407	406	407	
Q	Pearson	-0.0819	-0.1660	0.0356	-0.1595	0.9299	0.3329	0.0843	-0.1925	-0.2975	-0.1488	0.3125	0.9186	0.267	0.5648	0.7300	0.6950	1.00
	Sig. (2-tailed)	0.0990	0.0008	0.4743	0.0012	0.0000	0.0000	0.0894	0.0001	0.0000	0.0027	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	
	N	407	407	407	407	406	407	407	407	407	405	407	406	407	407	406	407	407

Legends for Table 2:

A	GDP per capita
B	Non-agriculture GDP
C	Non-oil GDP
D	Population
E	Local government revenue
F	Poverty rate
G	Morbidity rate
H	Net enrolment ratio - primary
I	Net enrolment ratio - junior
J	Net enrolment ratio - senior
K	Audit result
L	Total local expenditure
M	Social protection expenditure
N	Economic expenditure
O	Education expenditure
P	Health expenditure
Q	Infrastructure expenditure

2.3. Analysis Procedure

The cluster analysis was performed using a hierarchical method with Ward's linkage, which minimizes the variance within clusters. To determine the optimal number of clusters, a three-step procedure was used:

1. Scree Plot: A scree plot (Figure 3) was generated to visualize the distance at which clusters are merged. A distinct 'elbow' in the plot, indicating a large jump in distance, suggests an optimal number of clusters.
2. Dendrogram: A dendrogram (Figure 4) was used to graphically depict the hierarchical merging of districts, providing a rough guide that a two- to four-cluster solution may be appropriate.
3. Variance Ratio Criterion (VRC): To objectively confirm the number of clusters, the Calinski-Harabasz (1974) VRC was calculated. This method identifies the number of clusters that maximizes the ratio of between-cluster variation to within-cluster variation. The VRC results strongly suggested that the optimum number of clusters is four.

The scree plot displays the clusters combined at each stage and the distances at which clusters merge. This schedule is used to determine the optimum number of district groups. By plotting these distances against the number of clusters we can identify a distinct break or 'elbow' (that is, where an additional combination of two clusters occurs at a greatly increased distance). In this way, and despite the high number of districts included in the graph, the scree plot shows a distinct break due to the increase in distance when switching from a three to a four-clusters. The scree plot in Figure 6 displays the distances at which districts (and clusters of districts) are joined.

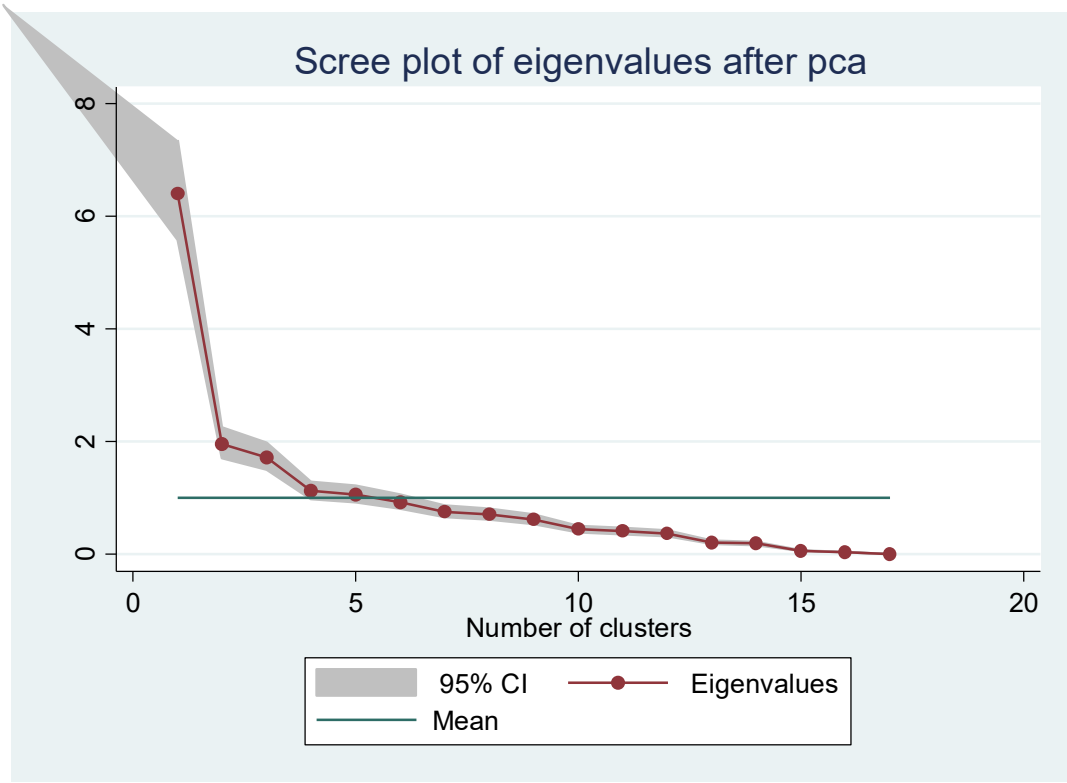

Figure 3. Scree plot

The dendrogram depicts the distances at which districts (and clusters of districts) are joined. It is read from left to right; vertical lines are districts joined together –their position indicates the distance at which the mergers take place–. This graph provides a rough guidance regarding the number of groups to retain, suggesting that between 2 to 4-clusters solutions may be appropriate.

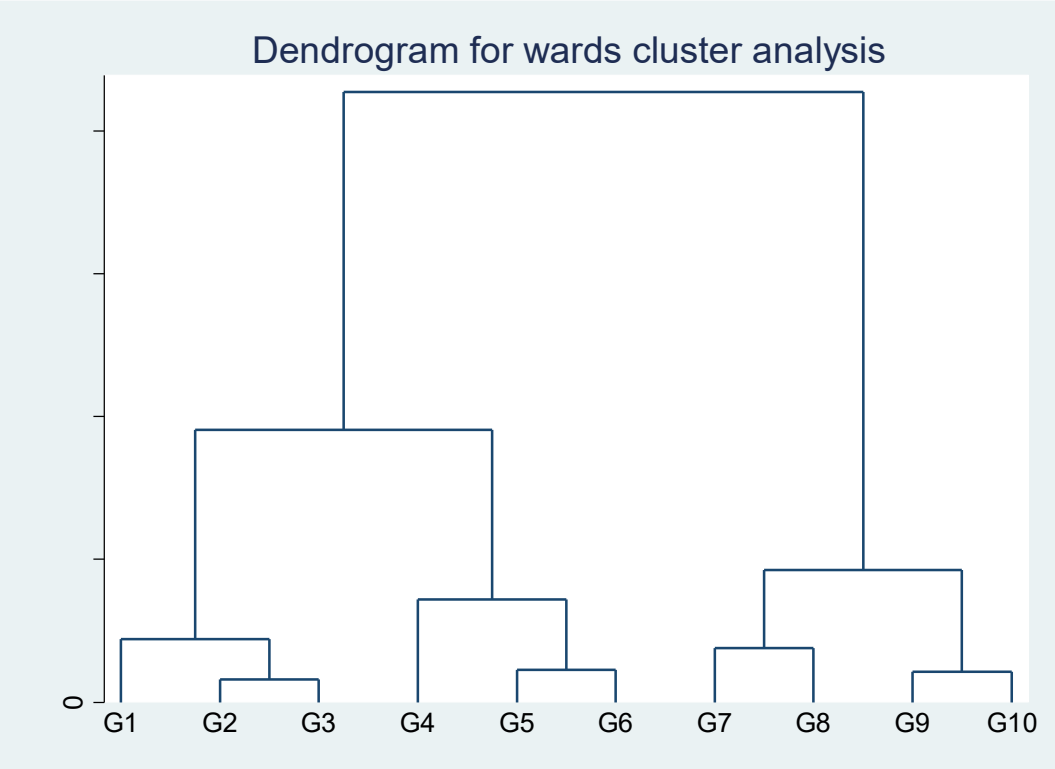

Figure 4. Dendrogram

The 'variance ratio criterion' (VRC) gives hint in choosing the number of clusters that maximises the ratio between the overall between- cluster variation and the overall within-cluster variation with regards to all clustering variables (that is, a good clustering yields groups of districts with small within-cluster variation but high between- cluster variation). In our case, this suggests that the optimum number of clusters is four. Therefore, using the three procedures (the distances scree plot, the dendrogram and the VCR) we take the optimum number of clusters to be four.

Table 3. Variance Ratio Criterion.

Calinski/Number of clusters	Harabasz pseudo-F
2	733.47
3	562.61
4	969.48
5	944.79
6	816.27
7	881.11
8	821.65
9	2219.12
10	2122.58
11	3375.87
12	3236.89
13	3331.83
14	3553.28

Before comparing the characteristics of these four clusters, it is worthwhile to distinguish which variables are more influential in discriminating between districts. This step is particularly important as cluster analysis sheds light on whether the groups of districts are statistically distinguishable (that is, whether the clusters exhibit significantly different means in the development indicators). A more precise and objective method for determining the optimum number of clusters was proposed by Calinski and Harabasz (1974), which has proven to work well in many situations (Milligan & Cooper, 1985). The number of clusters is suggested by "variance ratio criterion" (VRC) that maximises the ratio between the overall between-cluster variation and the overall within-cluster variation with regard to all clustering variables

(i.e. a good clustering yields groups of countries with small within-cluster variation but high between-cluster variation). In our case, this suggests that the optimum number of clusters is four (Table 3).

2.4. Validation

To verify that the resulting four clusters were statistically distinct, a one-way ANOVA was performed (Table 4). This analysis compares the means of each of the 14 variables across the four clusters to confirm that the differences are statistically significant. Additionally, the robustness of the cluster solution was evaluated by re-running the analysis with a different linkage method (single linkage) and by re-arranging the order of districts in the dataset to ensure stability. These tests showed only moderate variations, confirming the stability of the four-cluster solution.

It is important to ensure that the cluster solutions of our analysis are 'robust'. As recommended by Mooi and Sarstedt (2011) we verify the robustness of the cluster analysis by means of the following three-step check: firstly, we evaluate the stability of the results by using different clustering procedures, distance measures and standardisation methods on the same data and we test whether these yield similar development taxonomies. However, there is a caution that – as noted, among many others, by Everitt et al. (2011), and Mooi and Sarstedt (2011) – it is common for results to change even when the cluster solution is adequate, so some degree of variation is expected if the cluster procedure is changed. Therefore, to check for stability, the order of the districts needs to be re-arranged. The results should not depend on the order of the data set, unless there are outliers that influence the results. In our tests, the first check shows moderate variations in the results. Changing the clustering procedure, from Ward to the single linkage (nearest neighbour), only affects 17 out of the 403[4] districts (all of them are changes to the nearest cluster in terms of development).

Table 4. ANOVA Output.

		Sum of squares	Df	Mean square	F	Sig.
GDP per capita	Between	109.667	3	36.556	0.39	0.758
	Within	37107.086	399	93.000		
	Total	37216.753	402			
Non-agriculture GDP	Between	0.513	3	0.171	5.71	0.001
	Within	11.959	399	0.030		
	Total	12.473	402			
Non-oil GDP	Between	0.030	3	0.010	0.83	0.477
	Within	4.742	399	0.012		
	Total	4.771	402			
Population	Between	118,670,000,000	3	39,558,000,000	969.48	0.000
	Within	16,280,000,000	399	40,803,000,000		
	Total	134,950,000,000	402			
Local government revenue	Between	60.745	3	20.248	11.14	0.000
	Within	725.058	399	1.817		
	Total	785.804	402			

[4] The exercise utilises the data set for entire districts in Indonesia (497 as of the year 2014). However, due to incomplete variables for several districts, the result was reduced to only for 403 districts.

		Sum of squares	Df	Mean square	F	Sig.
Poverty rate	Between	1126.462	3	375.487	5.19	0.002
	Within	28854.307	399	72.317		
	Total	29980.768	402			
Morbidity rate	Between	71.956	3	23.985	0.36	0.785
	Within	26856.905	399	67.311		
	Total	26928.861	402			
Net enrolment ratio - primary	Between	407.249	3	135.750	2.53	0.057
	Within	21409.855	399	53.659		
	Total	21817.105	402			
Net enrolment ratio - junior	Between	3,368.720	3	1,122.907	10.83	0.000
	Within	41,386.788	399	103.726		
	Total	44,755.508	402			
Net enrolment ratio - senior	Between	596.35	3	198.785	1.21	0.307
	Within	65,668.82	399	164.584		
	Total	66,265.17	402			
Audit result	Between	40.345	3	13.448	10.75	0.000
	Within	499.020	399	1.251		
	Total	539.365	402	1.342		
Total local expenditure	Between	51.018	3	17.006	13.1	0.000
	Within	518.073	399	1.298		
	Total	569.091	402	1.416		
Social protection expenditure	Between	0.010	3	0.003	16.12	0.000
	Within	0.079	399	0.000		
	Total	0.088	402			
Economic expenditure	Between	41,014	3	13,671	14.92	0.000
	Within	365,608	399	916.3		

		Sum of squares	Df	Mean square	F	Sig.
	Total	406,623	402			
Education expenditure	Between	1.429	3	0.476	15.02	0.000
	Within	12.656	399	0.032		
	Total	14.085	402			
Health expenditure	Between	0.401	3	0.134	17.94	0.000
	Within	2.970	399	0.007		
	Total	3.371	402			
Infrastructure expenditure	Between	3.457	3	1.152	4.68	0.003
	Within	98.345	399	0.246		
	Total	101.803	402			

3. Results

The analysis successfully grouped 403 Indonesian districts into four statistically distinct clusters. The one-way ANOVA test confirmed that the differences between the clusters across the 14 variables are significant. The F-statistic from the ANOVA indicates that population size, health expenditure, and social protection expenditure were the variables with the greatest power to discriminate between the groups.

3.1. Cluster Composition and Distribution

In summary, the first cluster (C1) includes 223 districts (100 of them are lagged regions and 17 of them share a border with other countries; the second (C2) is composed of 121 districts (26 lagged regions and five border regions); the third (C3) includes 45 districts (one lagged region, and one border region); the forth (C4) has 14 districts with no lagged or border regions. The four clusters vary significantly in size and composition:

1. Cluster 1 (C1): The largest group, containing 223 districts.
2. Cluster 2 (C2): The second-largest group, with 121 districts.
3. Cluster 3 (C3): A smaller group, composed of 45 districts.
4. Cluster 4 (C4): The smallest group, with just 14 districts.

As shown in the map (Figure 5), these clusters are geographically scattered. However, the two least developed groups (C1 and C2) are predominantly located outside of Java, while another less developed cluster (C3) is concentrated on Java. This distribution highlights the persistent development disparities between Java and other parts of the archipelago.

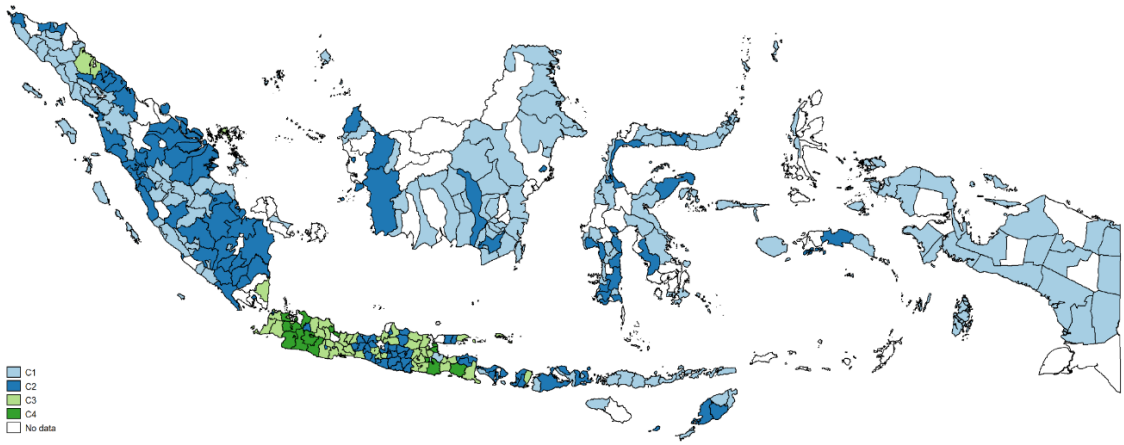

Figure 5. Taxonomy of the districts by clusters3.2.

3.2. Characterisation of Clusters

As it can clearly be seen in the map, the development cluster are scattered across the geographical regions, with the two least development groups (C1 and C2) are mainly located in outside Java Island and another less developed cluster (C3) persists in Java. The map also detects unequal development and the impact of heavy agglomeration which has been concentrated in West Java (including Jakarta), parts of East Java and several locations in Sumatra. Therefore, C1 includes mostly the poorest districts (according to income per capita), followed by C2 and C3; whereas C4 include the districts with the highest incomes. However, our development taxonomy differs notably from the usual income classification used by the Indonesian government. Thus, the rank analysis between the variables regional GDP per capita and the cluster membership shows that both classifications have a limited level of coincidence. Notably many districts commonly labelled 'emerging districts' are not in the emerging clusters because they retain characteristics of poorer districts. A more precise interpretation of the four clusters obtained in the analysis involves examining the cluster centroids (i.e. the clustering variables' average values of all districts in a certain cluster). This comparative procedure enables us to analyze the data on the basis of the grouping variable's values. According to Table 8 the four development clusters can be described as follows. By examining the average values (centroids) of the 14 variables for each cluster (Table 8), we can define their distinct characteristics:

1. Cluster 1: High Poverty Districts with Traditional Economies. This cluster has the highest average poverty rate (16.22%) and the lowest primary education enrolment. The agricultural sector contributes significantly to their local economies, and they have the weakest governance indicators. Despite this, their average local revenue and spending are the highest of all clusters, largely due to a high dependence on central government transfers. These districts tend to be sparsely populated.
2. Cluster 2: Agriculture-Dependent Districts with Moderate Population. These districts have the third-highest rates of poverty and morbidity. Their education indicators are slightly better than C1's. This cluster ranks second in local expenditure and allocates the largest share of its budget to infrastructure development compared to other clusters.
3. Cluster 3: Densely Populated Districts with High Morbidity. This group is characterized by a very large average population size (1.3 million) and the second-highest poverty and morbidity rates. Despite having a relatively high RGDP per capita, their own government revenue and expenditure are low. Notably, this cluster has the highest net enrolment rates for junior and secondary education and the best governance indicator, suggesting strong potential in human capital.
4. Cluster 4: Economically Advanced Districts with Large Populations. This cluster represents the most developed districts, with the highest productivity, the highest share of non-agricultural GDP, and the lowest poverty and morbidity rates. They have a very large average population (2.6 million) and are the least dependent on central government contributions. However, their governance indicators are weaker than those of C3, suggesting a need for improvement.

It is important to note, as in any development classification, there are districts that do not perfectly fit their assigned development groups. The most notable case in the above taxonomy is districts in Kalimantan Timur province, which is the biggest and the second 'richest' (in terms of per capita GNI) district of cluster. However, districts in Kalimantan Timur has 'poorer' indicators in terms of low autonomy reflected on the development transfer fund which was lower than average. In short, C1 is the 'most similar' group in relation to the 'atypical' development values of East Kalimantan. Furthermore, it is worth noting that there are also important "development gaps" across the clusters, in terms of the 14 development indicators.

4. Discussions

4.1. A Nuanced View of Regional Development

The findings of this study successfully demonstrate that Indonesian districts can be classified into four distinct groups based on a multi-dimensional set of development indicators. This taxonomy provides a more nuanced picture than classifications based solely on income per capita or official "lagged" status. For instance, while C1 includes the districts with the highest poverty rates, C3 districts, which are not the poorest in terms of income, still face severe challenges in health and have low productivity. Similarly, C4 districts, though economically advanced, still require improvements in local governance. This highlights the central argument of this paper: a single-formula approach to fiscal transfers is ill-equipped to address such diverse and multifaceted development challenges. Our results empirically support the need for policies that are tailored to the specific profiles of different district types.

4.2. Linking Findings to Decentralisation Theory

Decentralisation can strengthen accountability and responsiveness when citizens can observe, voice and sanction local performance referring to the accountability hypothesis as discussed by Seabright (1996). Cluster 3's combination of dense populations and strong human capital (high junior/senior enrolment) suggests high demand and capacity for accountability; yet low local revenue and spending constrain the ability to translate voice into outcomes. Targeted instruments—performance- based grants tied to service indicators, transparent reporting, and public financial management support—can close the accountability–capacity gap and convert human capital into improved services.

Decentralisation is expected to improve welfare by aligning public goods to local preferences and cost structures using the framework of local matching capability (Dafflon, 2015). Cluster heterogeneity shows that matching benefits depend on fiscal space and administrative capability. Cluster 1's high poverty and weak governance limit matching despite large transfers whereas Cluster 2's agriculture orientation calls for tailored infrastructure and market access. Meanwhile in Cluster 4, its advanced economies benefit from autonomy but require governance upgrades to sustain quality. For Cluster 3, policies that expand revenue autonomy (e.g., calibrated local taxing powers), reduce compliance costs, and create competitive urban labour demand can unlock matching benefits for its educated populations.

In clusters with stronger human capital but weaker fiscal capacity (e.g., Cluster 3), performance-linked transfers will yield larger improvements in service outcomes than unconditional grants meanwhile in agriculture-dependent clusters (Cluster 2) infrastructure and market-integration spending will have higher returns than equal per-capita transfers. Governance support coupled with moderate autonomy expansion will reduce transfer dependence in high-poverty clusters (Cluster 1).

4.3. Policy Implications for Fiscal Decentralisation

This multi-dimensional taxonomy offers a practical tool for policymakers to refine Indonesia's intergovernmental transfer system. Instead of a one-size-fits-all formula, the central government could design different types of support and incentives for each cluster.

1. For Cluster 1 districts, policy should focus on aggressive poverty reduction programs, strengthening local governance, and improving basic education, while also finding ways to reduce their heavy dependency on transfers.
2. For Cluster 2 districts, support could be geared towards modernising their agricultural sectors and investing in infrastructure to connect them to larger markets.

3. For Cluster 3 districts, the key would be to leverage their strong human capital potential by creating economic opportunities that can absorb their well-educated workforce and boost productivity.
4. For Cluster 4 districts, the focus might be on technical assistance to improve governance and public financial management, ensuring their economic success is matched by institutional quality.

Such a targeted approach could help make fiscal decentralisation a more effective tool for reducing regional disparities, a goal that has so far seen limited success. It could also provide a more rational basis for allocating the large-scale village fund (*Dana Desa*), ensuring resources are directed towards the most pressing needs of each community.

Limitation

This study has several limitations that should be acknowledged. First, the analysis is based on cross-sectional data from 2011, which provides a static snapshot of the districts. A longitudinal analysis with more recent data would be needed to understand the dynamics of how districts evolve and potentially move between clusters over time. Second, the selection of variables was constrained by the availability of consistent data across all districts in the INDO-DAPOER dataset. Other important factors, such as environmental quality, political stability, or social capital, were not included. Finally, cluster analysis is a descriptive technique; it identifies patterns but does not explain the causal reasons why a district belongs to a particular cluster.

Conclusion

This paper responds to the challenge of designing effective fiscal decentralisation in a country as vast and diverse as Indonesia. By moving beyond simplistic, single-dimension classifications, we have developed and operationalized a multi-dimensional taxonomy of Indonesian districts. The analysis reveals four distinct clusters, each with a unique profile of strengths and weaknesses across economic, social, governance, and autonomy dimensions.

The primary contribution of this research is twofold. First, it provides an empirical and more holistic framework for understanding regional disparities in Indonesia. Second, it offers a practical, evidence-based tool for policymakers to design more targeted, and therefore more effective, intergovernmental transfer formulas and development programs. By tailoring policies to the specific needs of each cluster, the Indonesian government can better leverage fiscal decentralisation to achieve its goals of equitable development and poverty reduction.

Building on the limitations of this study, several avenues for future research are apparent. First, future studies should aim to replicate this analysis using longitudinal data to track the development trajectories of districts over the past decade and the most recent binding regulation. Second, qualitative case studies of representative districts from each cluster could provide deeper insights into the on-the-ground realities and causal mechanisms behind the quantitative patterns identified here. Last, further research could also explore the inclusion of additional variables, such as environmental sustainability and political indicators, to create an even more comprehensive development taxonomy.

Acknowledgments

Earlier versions of the paper were submitted as a part of thesis during the author’s postgraduate study at King's College London in 2018.

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