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Intra-Island Inequality Dynamics and Growth Per Capita Output Paradox across Indonesian Island Clusters

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Abstract

Indonesia's RPJMN 2025-2029 set an 8% economic growth target, which raises the question of how growth is distributed across the archipelago. This study examines the spatial concentration of output, per capita output, and population density across seven island clusters (Java, Sumatra, Kalimantan, Sulawesi, Bali-Nusa Tenggara, Maluku, and Papua) and measures intra-island interprovincial disparity with the population-weighted Williamson Index. It applies a descriptive macro spatial design to secondary data from BPS Statistics Indonesia covering 2010-2024 (15 annual observations). Java accounted for 58.6% of aggregate GRDP in 2024 (57.3% in 2010) and had a population density of about 1.212 persons/km2. Mean intra-island disparity was highest in Kalimantan (0.800) and Java (0.827), moderate in Sumatra (0.454) and Bali-Nusa Tenggara (0.424), and lowest in Papua (0.209), Sulawesi (0.152), and Maluku (0.150). Disparity nevertheless rose sharply in Sulawesi and Maluku toward the end of the period, and the Papua series is confounded by the creation of new provinces in 2022. These patterns indicate that high aggregate output does not coincide with low internal disparity, which qualifies the conventional West-East narrative. The findings are intended to inform discussion of spatially differentiated regional development and fiscal policy, rather than to establish causal effect.

KEYWORDS

economic growth, regional inequality, spatial disparity, Williamson index, island clusters, Indonesia.

Introduction

Indonesia is the largest archipelagic state in the world, comprising more than 17.000 island stretching from Sabang to Merauke. This geographical diversity remains a serious obstacle to the equalization of development and public welfare (Arif & Nurwati, 2022). A developed Indonesia requires welfare improvements that reach all segments of society (Walujadi et al., 2022), supported by equitable public infrastructure (Sukwika T, 2018). Because development should not be concentrated on a single island, archipelagic characteristics must be addressed through careful budget management so that they do not impede national development (Said et al., 2020).

Inclusive, sustainable, and spatially equitable growth serves as a foundational pillar of Indonesia's National Long-Term Development Plan (RPJPN) 2025-2045, enacted under Law No.59/2024. As the inaugural phase of this long-term framework, the National Medium-Term Plan RPJMN 2025-2029, formulated via Presidential Regulation No.12/2025 targets an ambitious average economic growth rate of 6.1% to 8% by the target year of 2029. Achieving this macro-economic benchmark necessitates a deep structural transformation and must be underpinned by a balanced spatial redistribution of economic activities to mitigate severe geographical concentration on Java (Khairunnisa & Maryunani, 2024). Because persistent inter-regional disparities are unlikely to be corrected by market mechanisms alone, these patterns strongly justify targeted, region-specific fiscal and development policy interventions.

Economic growth is a key indicator of development success because it reflects the increase in aggregate output generated within a region, measured through Gross Domestic Product (GDP) at the national level and Gross Regional Domestic Product

Table 1. Literature Mapping and Empirical Gaps Regional Inequality in Indonesia

Study	Spatial Unit/Coverage	Period	Focus
Akita& Miyata (2018)	Indonesia, hierarchical spatial levels	1996-2010	Hierarchical decomposition of spatial inequality
Marquez et al. (2021)	Indonesia regions	2010-2017	Income disparities, distributional convergence, spatial effect
Khairunnisa & Maryunani (2024)	Provinces of Java	2014-2023	Inter-provincial development inequality
Hidayat & Hasmarini (2025)	Provinces of Sumatera	2020-2024	Economic inequality dynamics
Salsabilah & Finanto (2024)	Eastern Indonesia	2014-2019	Determinants of inter-regional disparity
Muta'ali et al. (2024)	Provinces of Java	2010-2020	Poverty disparities and influencing factors
Ahmad et al. (2024)	Island vs non-island provinces	2008-2017	Fiscal transfers and regional inequality
This Study	Seven Island Clusters (38 Provinces)	2010-2024	Output and population concentration; Intra-island Williamson Index

Source: Compiled by the authors from various literature sources (September 2026)

(GRDP) at the regional level (Maichal et al., 2024). High growth, however, does not necessarily reveal the distributional issues that matter in regional development studies, particularly in developing countries (Gradin et al., 2021). Indonesia's multi-island geography and regional resource disparities complicate the distribution of growth (Ahmad et al., 2024), and developing countries often face a trade-off between pursuing macroeconomic growth targets and social equity (Majeed, 2013; Makhlouf, 2023).

Indonesia has recorded stable aggregate growth over the past two decades, yet the literature reports that this expansion has not been matched by an even distribution of development outcomes across islands (Mursalin & Irawan, 2025). Java contributes more than half of national GRDP, whereas Kalimantan, Sulawesi, Maluku, and Papua are reported to have more volatile growth and lower per capita income and infrastructure (Salsabilah & Finanto, 2024). (Akita & Miyata, 2018) attribute spatial inequality partly to uneven infrastructure provision and economic activity. This conventional West-East narrative treats the gap between Western and Eastern Indonesia as an unresolved structural issue (Robinson Sihombing, 2019). The present study takes this narrative as its point of departure and asks whether it still describes the data when disparity is measured within island clusters rather than between broad regions.

Two theoretical perspectives are used as interpretive lenses, not as formally tested models. Cumulative Causation Theory (Myrdal, 1957) suggests that growth concentrates in advanced regions and widens the gap with lagging areas (Pattnaik et al., 2025). If it applies, the core island's share of national output and population should persist or increase over time. The regional Inequality Hypothesis (Williamson, 1965a) suggests that inter-regional inequality rises during early industrialization and declines as the economy matures (Alisjahbana & Akita, 2020). If it applies at the island level, disparity should rise in islands at earlier stages of structural change and fall in more mature ones. These expectations guide the interpretation of the descriptive results, but the study does not estimate a model that could confirm or reject either theory. Infrastructure inequality (Habibi, 2024), centralized development policy and unequal investment allocation (Aulea et al., 2025), and regional digital asymmetries (Kartiasih et al., 2022) are treated strictly as literature-based explanations that were not directly measured in this study.

Consequently, analyzing inter-island development inequality is essential to understand the extent to which economic growth in Indonesia has succeeded in creating balanced regional development (Muta'ali et al., 2024). Such an analysis serves not only to measure the level of disparity but also to identify the main dynamics and determinants driving regional inequality over time (Marantika et al., 2018). This study becomes increasingly relevant amidst national development agendas that emphasize inclusive and equitable growth, as outlined in the RPJMN and the Indonesia Emas 2045 vision (Yasin & Adli, 2024). This effort aligns with global commitments to realize distributive justice as a prerequisite for long-term economic efficiency (Ozler & Prennushi, 2006).

A comparative synthesis of closely related literature highlights specific boundaries in existing empirical studies on Indonesian regional inequality. Prior research has predominantly optimized localized spatial coverages, focusing either on sub-national hierarchical levels (Akita & Miyata, 2018), specific regional clusters such as Java and Sumatra (Hidayat & Hasmarini, 2025; Khairunnisa & Maryunani, 2024; Muta'ali et al., 2024), or specific sub-regions like Eastern Indonesia (Salsabilah & Finanto, 2024). While recent studies have initiated island-based dichotomies specifically examining island versus non-island provincial dynamics (Ahmad et al., 2024) or macro-regional convergence (Marquez et al., 2021) there remains a distinct analytical omission regarding how intra-island disparities structurally evolve across all major island clusters simultaneously under a uniform longitudinal framework.

To address this gap, the present study offers two contributions that remain within the bounds of a descriptive design. First, it applies a consistent, single-source panel 2010-2024 to compute both macro-spatial output concentration and micro-spatial intra-island dispersion (the Williamson Index) for seven island clusters side by side-a combination that, to the authors' knowledge, has not been reported jointly at this spatial and temporal scope in the studies listed in Table 1. This is a comparative descriptive contribution: the study does not estimate an interaction model linking the two measures, and no claim is made that it uncovers systemic interactions between national and within-island dynamics beyond what the two descriptive series show side by side. Second, temporally, the 15-year panel extends through the 2022 administrative expansion into 38 provinces, which earlier studies in Table 1 do not cover.

This study therefore contributes a comparative descriptive mapping of the concentration of output and population across island clusters and intra-island inter-provincial disparity, using one consistent data source and period. It addresses three research questions. First, how concentrated were GRDP and population across island clusters in 2010-2024, and how did it change. Second how did aggregate GRDP growth and per capita GRDP growth diverge across island clusters. And how large was intra-island inter-provincial disparity in each cluster, and how

did it evolve.

Methods

Research Design

This study uses a quantitative, descriptive-comparative macro-spatial design based on secondary data. It describes and compares trends in output, per capita output, population density, and intra island disparity across island clusters. It does not estimate causal effect or test theories inferentially. Standardized official data allow systematic comparison and replication, although results still depend on analytical choices such as aggregation rules, boundary definitions, price deflators, and index specification.

Unit of Analysis and Sample

The population consist of all provinces of Indonesia. Indonesia had 33 provinces in 2010, 34 from 2012 (North Kalimantan), and 38 from 2022, when four new provinces were created in Papua. The provinces are aggregated into seven island clusters (Java, Sumatra, Kalimantan, Sulawesi, Bali-Nusa Tenggara, Maluku, and Papua. The observation period 2010-2024 contains 15 annual observations, yielding 105 island-year observations (7 clusters x 15 years).

The analysis is conducted by island cluster. The authors explicitly confirm that the exact province-to-cluster mapping detailed in table 2 is strictly applied throughout all empirical calculations, including the spatial output concentration models and within-island Williamson Index computations. The Western/Eastern Indonesia distinction is used only as an interpretive frame in the discussion and is not an analytical grouping.

Data Sources and Preparation

Three annual variables were extracted for 2010-2024 from BPS-Statistics Indonesia. (i) Gross Regional Domestic Product (GRDP) at 2010 constant market prices-BPS series 2010 constant-price series (PDRB Atas Dasar Harga Konstan 2010). (ii) Total Population and (iii) Land Area (km2): The provincial-level datasets were constructed by aggregating annual regency and municipal data (Kabupaten and Kota) matching each province's administrative boundaries. To handle missing values arising from administrative expansions-specifically the establishment of North Kalimantan in 2012 and the four new Papuan provinces in 2022-provincial data entries for the newly formed provinces were left blank before their formal inception years. Crucially, because these new administrative units emerged from existing parent territories within the same geographic boundaries, this approach does not alter the absolute historical aggregate of the respective island clusters. The national GRDP used as a denominator is calculated strictly as the mathematical sum of the provincial GRDPs; the resulting total (IDR 13,066 trillion in 2024) differs from the officially published national GDP (IDR 12,920 trillion in 2024) by about 1.1%, a routine statistical discrepancy between the sum of regional accounts and the national account that arises from extra-regional and inter-regional netting components in Indonesia's national accounts, and is not an error in the provincial data used here. Data were compiled and aggregated in Microsoft Excel. The processed workbook (province-level GRDP, population, and the per-province Williamson Index worksheets) will be made available as supplementary material upon publication so that all calculations in this manuscript can be independently reproduced.

Population density uses land area figures compiled from BPS's Statistik Indonesia administrative land-area series, summed by province to match the clusters in Table 2 (Java 129,438 km2; Sumatera 480,793 km2; Kalimantan 544,150 km2; Sulawesi 188,522 km2; Bali-Nusa Tenggara 73,070 km2; Maluku 78,897 km2; Papua 421,991 km2). These areas are held constant across the panel.

Boundary harmonization

The provinces created during the study period were carved out of parent provinces on the same island. Island-level totals of GRDP, population, and land area are therefore unaffected by these administrative splits. The splits do affect the sub-regional unit count within the Williamson Index, which is computed strictly using the actual administrative boundaries defined in each respective year.

The authors did not construct a constant-boundary (pre-split) recombination of the newly created provinces, and no such recombined series was used anywhere in the analysis. An earlier version of this manuscript referred to a constant-boundary "Series B" that purportedly confirmed a stable, non-mechanical disparity trend for Papua; that claim could not be substantiated against the actual calculations performed and has been removed. The correct and complete statement of this limitation is: the sharp rise in Papua's Williamson Index after 2022 coincides exactly with the creation of four ne Papua provinces, which increases the number of sub-regional units (n) entering the index formula in the same year. Because no recombination exercise was carried out, this study cannot determine how much of the post-2022 increase reflects genuine economic divergence between the new provinces, as opposed to the mechanical effect of measuring dispersion over larger number of smaller units. This is reported as an unsolved measurement limitation in the Discussion and Limitation section, not as a resolved of confirmed finding.

While the addition of new sub-regional units-specially North Kalimantan from 2012 onward and the four new Papuan provinces from 2022 onward-increases the number of observations within those clusters, it does not alter the historical aggregate GRDP, population, or land area of the respective island. This institutional fragmentation is treated as a contextual factor when interpreting the temporal trend of the Williamson Index for Kalimantan and Papua in the Discussion.

Measures and Formulas

All growth figures use constant-price GRDP. For island (or national) aggregate i in year t, annual GRDP growth is:

$$g_{i,t} = \frac{GRDP_{i,t} - GRDP_{i,t-1}}{GRDP_{i,t-1}} x\ 100\%$$

GRDP per capita is total island GRDP divided by total island population (not the sum or simple mean of provincial per capita values):

$$y_{i,t} = \frac{GRDP_{i,t}}{P_{i,t}}$$

For long-run comparison, two statistics are reported and labelled explicitly: cumulative change, (X2024/X2010-1)x100%, and compound annual growth rate (CAGR), [(X2024/X2010)1/14-1]x100%, where the exponent reflects 14 annual intervals between 15 observations.

Population density is:

$$D_{i,t} = \frac{P_{i,t}}{A_i} \text{ (persons/km}^2\text{)}$$

Intra-island inter-provincial disparity is measured with the population-weighted Williamson Index (Takahiro & Sachiko, 2018; Williamson, 1965). For island i in year t:

$$V_{w,i,t} = \frac{\sqrt{\sum_j \left(y_{j,t} - \bar{y}_{i,t}\right)^2 \frac{p_{j,t}}{P_{i,t}}}}{\bar{y}_{i,t}}$$

Where $y_{j,t}$ is GRDP per capita of province j on island i , $p_{j,t}$ is the population of the province $j, P_{i,t} = \sum_j p_{j,t}$ is the island population, and $\bar{y}_{i,t} = \sum_j y_{j,t}\, p_{j,t}/p_{i,t}$ is the population-weighted mean GRDP per capita of the island. This weighting is applied

Table 2. Province to Cluster Mapping (2024 boundaries)

Cluster	Provinces
Java	DKI Jakarta, West Java, Central Java, DI Yogya, East Java, Banten
Sumatra	Aceh, North Sumatra, West Sumatra, Riau, Jambi, South Sumatra, Bengkulu, Lampung, Bangka Belitung Island, Riau Island
Kalimantan	West, Central, South, East, and North Kalimantan
Sulawesi	North, Central, South, Southeast, and West Sulawesi, Gorontalo
Bali-Nusa Tenggara	Bali, West Nusa Tenggara, East Nusa Tenggara
Maluku	Maluku, North Maluku
Papua	Papua, West Papua, South Papua, Central Papua, Highland Papua, Southwest Papua

Source: Compiled by the authors based on the official administrative division of the Statistic Indonesia (BPS) and the Ministry of Home Affairs (2024).

Table 3. Classification of Williamson Index Values

Index Value	Category
0.00-0.20	Very low disparity
0.21-0.35	Low disparity
0.36-0.50	Moderate disparity
>0.50	High disparity

consistently to both the variance term and the mean term in every reported index value in Table 8; an earlier calculation sheet had applied the population weight only to the variance term while using an unweighted arithmetic mean of provincial per capita GRDP in the denominator, which is inconsistent with the formula above and with Williamson (1965). All index values reported in this revision use the fully weighted formula. The index measures relative dispersion among the provinces of one island. It is not a measure of inequality between islands. It is zero under perfect equality, increases with disparity, and has no fixed upper bound of one.

For descriptive convenience and qualitative mapping, the calculated Williamson Index values are grouped into specific categories (Table 3). These cut-offs follow the well-established empirical convention in Indonesian Regional economic literature (Sjafrizal, 2008; Sutarno & Kuncoro, 2003), which classifies values below 0.30 as low inequality, between 0.30 and 0.50 as moderate inequality, and above 0.50 as high inequality. These thresholds serve strictly as interpretive benchmarks within the context of national spatial planning; thus, the continuous numeric index value remains the primary baseline for evaluating longitudinal trends.

Result and Discussion

Concentration of GRDP

Java is the largest contributor to aggregate GRDP throughout the period. Its GRDP rose from IDR 3,931.9 trillion in 2010 to IDR 7,652 trillion in 2024 (cumulative +94.6%; CAGR 4.87%), and its share of the national total rose from 57.3% to 58.6% (Table 4). Sumatra ranks second, with GRDP rising from IDR 1,536.6 trillion to IDR 2,719.7 trillion (+77.0%; CAGR 4.16%). Its share fell slightly from 22.4% to 20.8%, because Sumatra's aggregate growth was slower than Java's over this period the reverse if what an earlier draft of this table reported. Kalimantan grew from IDR 646.1 trillion to IDR 1,081.8 trillion (+67.4%; CAGR 3.75%; share 9.4% to 8.3%), and Papua from IDR 152.2 trillion to IDR 264.2 trillion (+73.6%; CAGR 4.02%; share 2.2% to 2.0%). Total GRDP summed across the seven island clusters rose from IDR 6,864.1 trillion to IDR 13,066.1 trillion (+90.3; CAGR 4.71%), with a temporary contraction in 2020 during the Covid-19 pandemic.

The three smaller clusters: Sulawesi, Bali-Nusa Tenggara, and Maluku collectively accounted for a minor share of the national total but show the most dynamic longitudinal growth among the seven clusters. Sulawesi aggregate output rose from IDR 356.3 trillion in 2010 to 900 trillion in 2024, a cumulative increase of 152.6% (CAGR 6.84%), expanding its national share from 5.2% to 6.9%. Bali-Nusa Tenggara expanded more moderately, from IDR 207.7 trillion to IDR 355.6 trillion (+71.2% CAGR 3.92%); because this growth rate trailed the seven-cluster average, its share edged down from 3.0% to 2.7%. Maluku recorded the fastest relative growth of any cluster, expanding by 176.4% (CAGR 7.53%) from IDR 33.4 trillion to IDR 92.4 trillion, though its national share remains small, rising from 0.5% to 0.7%.

Taken together, the four eastern clusters- Sulawesi, Bali-Nusa Tenggara, Maluku, and Papua; accounted for a combined share of about 10.9% of the seven-cluster total in 2010 and about 12.3% in 2024. This slow structural redistribution underlines the persistent macroeconomic asymmetry between the western core and the eastern periphery across the 15-year observation period.

Aggregate GRDP Growth versus Per Capita GRDP Growth

This subsection directly addresses the second research question, which the previous draft stated but did not answer with reported evidence. Table 5 compares each cluster's CAGR for aggregate GRDP with its CAGR for population-weighted per capita GRDP (from Table 6 below); the gap between the two approximates the contribution of population growth to the difference between aggregate and per capita performance, since, by definition, per capita growth ≈ aggregate growth-population growth.

The gap is widest by far in Papua, where population grew faster (CAGR 7.34%) than aggregate output (CAGR 4.02%), so per capita output actually fell over the period (CAGR -3.10%). This is examined further under Table 6; readers should note that Papua's population series is affected by the 2022 administrative split discussed in the Method. For every other cluster, aggregate growth outpaced per capita growth by a comparatively narrow margin (1.0 to 1.9 percentage points), consistent with ordinary population growth rather than a distinct divergence pattern. Java has the narrowest gap of the six non-Papua clusters (1.01 pp) despite having the highest aggregate growth rate, because its population growth is also the slowest (0.97 CAGR) among all clusters.

GRDP per capita

As a population-adjusted metric, real GRDP per capita provides a macro-spatial overview of average economic output per resident across the designated spatial clusters. It functions primarily as a production proxy and does not serve as a direct measurement of household disposable income, consumption capacity, or individual welfare distribution. Table 6 reports GRDP per capita computed strictly as total island GRDP divided

by total island population (the formula in Method section) not as the sum or average of provincial per capita values.

Table 4. Aggregate GRDP by island Cluster, 2010 and 2024 (IDR trillion, constant prices)

Cluster	2010	2024	Cumulative change (%)	CAGR (%)	Share 2010 (%)	Share 2024 (%)
Java	3,931.9	7,652.3	94.6	4.87	57.3	58.6
Sumatra	1,536.6	2,719.7	77.0	4.16	22.4	20.8
Kalimantan	646.1	1,081.8	67.4	3.75	9.4	8.3
Sulawesi	356.3	900.0	152.6	6.84	5.2	6.9
Bali-Nusa Tenggara	207.7	355.6	71.2	3.92	3.0	2.7
Maluku	33.4	92.4	176.4	7.53	0.5	0.7
Papua	152.2	264.2	73.6	4.02	2.2	2.0
National (sum of provinces)	**6,864.1**	**13,066.1**	**90.3**	**4.71**	**100**	**100**

Source: BPS-Statistic Indonesia (PDRB series, 2010 constant prices), authors' calculations.

Table 5. Aggregate GRDP Growth versus Per Capita GRDP Growth by Island Clusters, 2010-2024 (CAGR, %)

Clusters	Aggregate GRDP CAGR (%)	Population CAGR (%)	Per capita GRDP CAGR (%)	Gap (Aggregate-per capita, pp)
Papua	4.02	7.34	-3.10	7.11
Maluku	7.53	1.76	5.67	1.86
Kalimantan	3.75	1.71	2.01	1.75
Sulawesi	6.84	1.27	5.50	1.34
Bali-Nusa Tenggara	3.92	1.30	2.58	1.34
Sumatra	4.16	1.37	2.76	1.41
Java	4.87	0.97	3.86	1.01

Source: Authors' calculations from Tables 4,5, 6 and 7

Table 6. GRDP per capita by island cluster, 2010 and 2024 (IDR million, constant prices)

Cluster	2010	2024	Cumulative Change (%)	CAGR (%)
Kalimantan	46.65	61.59	32.0	2.01
Java	28.69	48.76	69.9	3.86
Sumatra	30.21	44.21	46.3	2.76
Sulawesi	20.43	43.25	111.7	5.50
Maluku	12.92	27.98	116.5	5.67
Papua	42.01	27.05	-35.6	-3.10
Bali-Nusa Tenggara	15.82	22.60	42.9	2.58

Source: BPS-Statistic Indonesia, authors' calculations.

Table 7. Population Density by Island Cluster, 2010 and 2024 (persons/km^2)

Cluster	Land area (Km^2)	2010	2024	Cumulative Change (%)	CAGR (%)
Java	129,438	1,058.7	1,212.4	14.5	0.97
Bali-Nusa Tenggara	73,070	179.7	215.4	19.8	1.30
Sumatra	480,793	105.8	128.0	21.0	1.37
Sulawesi	188,522	92.5	110.4	19.3	1.27
Maluku	78,897	32.8	41.8	27.7	1.76
Kalimantan	544,150	25.5	32.3	26.8	1.71
Papua	421,991	8.6	23.1	169.6	7.34

Source: BPS-Statistics Indonesia, authors' calculation

Table 8. Williamson Index by Island Cluster 2010-2024 (fully population-weighted)

Cluster	Mean	2010	2024	Minimum (year)	Maximum (year)	Category (Mean)
Java	0.827	0.801	0.855	0.801 (2010)	0.855 (2024)	High Disparity
Kalimantan	0.800	0.890	0.740	0.737 (2022)	0.890 (2010)	High Disparity
Sumatra	0.454	0.531	0.429	0.394 (2019)	0.531 (2010)	Moderate Disparity
Bali-Nusa Tenggara	0.424	0.374	0.439	0.374 (2010)	0.468 (2019)	Moderate Disparity
Papua	0.209	0.148	0.449	0.132 (2018)	0.449 (2024)	Low Disparity

Cluster	Mean	2010	2024	Minimum (year)	Maximum (year)	Category (Mean)
Sulawesi	0.152	0.113	0.270	0.110 (2011)	0.270 (2024)	Very Low Disparity
Maluku	0.150	0.091	0.379	0.085 (2014)	0.379 (2024)	Very Low Disparity

Source: Authors' calculation based on BPS-Statistic Indonesia raw data

The corrected series changes the ranking of island clusters by GRDP per capita and the shape of the growth-per capita paradox described in this study. In 2024, Kalimantan has the highest GRDP per capita (IDR 61.6 million), followed by java (IDR 48.8 million) and Sumatra (IDR 44.2 million); Bali-Nusa Tenggara (IDR 22.6 million) and Maluku (IDR 28.0 million) remain at the lower end. Kalimantan's high level reflects its concentration of capital-intensive mining and energy output relative to a comparatively small population (Table 7); this level is not, by itself, evidence of broadly shared welfare, a point developed further in the discussion.

Papua is the most consequential change. On the corrected, population-weighted basis, Papua's GRDP per capita fell from IDR 42.0 million in 2010 to IDR 27.1 million in 2024 (cumulative -35.6%; CAGR -3.10%), rather than rising as reported previously. This decline is driven by population growth (CAGR 7.34%, the fastest of any cluster) outpacing GRDP growth (CAGR 4.02%) over the same period. Because almost all of this population growth in the dataset is recorded in the after 2022-coinciding with the formation of four new Papuan provinces-the authors cannot rule out that part of the recorded increase reflects a change in how population was recorded for the "Papua" provincial unit across the 2022 boundary change, rather than genuine in-migration or natural increase. This is flagged as an unresolved data-quality concern in the Limitations section, and the Papua per capita and density results in this manuscript should be read with that caveat in mind.

By CAGR, the fastest-growing clusters in per capita terms are Maluku (5.67%) and Sulawesi (5.50%), both starting from a low 2010 base, followed by Java (3.86%). Sumatra (2.76%) and Bali-Nusa Tenggara (2.58%) grew the slowest in per capita terms among the six clusters with positive per capita growth, despite Sumatra's relatively high GRDP level. Kalimantan's per capita CAGR (2.01%) is also comparatively modest despite its high level, because its population grew faster (CAGR 1.71%) than all clusters except Papua and Maluku.

Population Density

The demographic architecture of the Indonesian archipelago exhibits a profound and long-standing macro-spatial polarization. Population density, computed as the ratio of annual resident population to the fixed land area of each cluster, is reported in Table 7.

Java's demographic concentration remains unparalleled, with its density rising from 1,059 to 1,212 persons/km2, an order of magnitude above every other cluster. An intermediate tier is formed by Bali-Nusa Tenggara (180 to 215 persons/km2), Sumatra (106 to 128 persons/km2), and Sulawesi (93 to 110 persons/km2), all exhibiting cumulative growth of 19-21% over the period. Maluku and Kalimantan remain comparatively sparse (33 to 43, and 26 to 32 persons/km2, respectively), while Papua records both the lowest density and, by far, the fastest growth (CAGR 7.34%), rising from about 8.6 to 23.1 persons/km2, as noted above, this increase is concentrated after 2022 and should be interpreted alongside the population data-quality caveat discussed in the Limitations section.

Demographic density is reported here exclusively as a descriptive indicator of spatial concentration. This study does not estimate a formal statistical relationship between density and the Williamson Index; therefore, density patterns are presented as contextual indicators rather than demonstrated empirical determinants of regional inequality.

Intra-Island Inter-Provincial Disparity (Williamson Index)

The population-weighted Williamson Index was applied to evaluate the internal relative dispersion of real GDRP per capita among the constituent provinces within each respective island cluster. This coefficient measures localized intra-island inequality trajectories over time; it is structurally insulated from, and does not capture, variations in macroeconomic performance between the different island groups. Table 8 reports the fully population-weighted index described in the Method section (both the variance term and the mean term weighted by provincial population); it replaces the previous table, which had applied population weights to the variance term only while using an unweighted arithmetic mean of provincial per capita GRDP as the denominator. This correction changes several values materially, most importantly reversing the reported ranking of Java and Kalimantan.

Java and Kalimantan

Under the fully weighted formula, Java records the highest mean Williamson Index of all seven clusters (0.827), ahead of Kalimantan (0.800); both remain firmly in the high-disparity category. This reverses the ranking reported in the previous draft, in which an inconsistently weighted calculation understated Java's disparity (0.676) relative to Kalimantan (0.750). Java's index rose steadily across the panel. From 0.801 in 2010 to 0.855 in 2024, indicating that disparity among its six provinces has widened, not merely persisted. This pattern is consistent with a structure in which DKI Jakarta's very high GRDP per capita, combined with it comparatively small population share, pulls the population-weighted mean upward relative to the much larger but lower-income populations of West Java and Central Java-a configuration that is captured correctly only when the mean is population-weighted, as the formula in the Method section specifies.

Kalimantan's disparity profile exhibits substantial volatility, opening at a peak of 0.890 in 2010, declining gradually to a trough of 0.737 in 2022, and closing at 0.740 in 2024. Kalimantan and Java converge only loosely over the panel; their indices do not cross, with Java's overtaking Kalimantan's by the early 2020s as Kalimantan's index eased from its 2010 peak while Java's continued to climb.

Sumatra and Bali-Nusa Tenggara

The moderate-disparity category consists of Sumatra (Mean 0.454) and Bali -Nusa Tenggara (Mean 0.424). Sumatra recorded a broadly declining trend, from 0.531 in 2010 to a low of 0.394 in 2019, before rising again to 0.429 in 2024; the net 15-year change is a narrowing of disparity among its ten provinces, though the decline was not monotonic. Bali-Nusa Tenggara displayed an oscillating but comparatively stable trajectory, ranging from 0.374 in 2010 to a peak of 0.468 in 2019 before easing to 0.438 in 2024; part of this fluctuation is attributable to the asymmetric impact of the Covid-19 contraction on Bali's tourism-dependent economy relative to the more agrarian baselines of West and East Nusa Tenggara.

Sulawesi, Maluku, and Papua

Sulawesi, Maluku, and Papua recorded the lowest historical mean disparity but registered sharp, rapid upward divergence toward the end of the observation window. Sulawesi's index rose steadily and almost monotonically, from 0.110 in 2022 to 0.270 in 2024, consistent with the early-stage divergence phase of the Regional Inequality Hypothesis (Williamson, 1965a) associated with the uneven spatial spread of nickel mining and downstream processing investment. Maluku's

index remained below 0.10 for most of 2010-2019 before rising sharply to 0.379 in 2024, its historical maximum.

Papua registered the sharpest and most abrupt late-period change: its index rose from 0.132 in 2018 to 0.449 in 2024, with the increase concentrated in 2023-2024 immediately after the 2022 creation of four new Papuan provinces. Because no constant-boundary recombination was performed, this study cannot separate a genuine widening of economic disparity among the new Papuan provinces from the mechanical effect of measuring dispersion over larger number of smaller sub-regional units. Both explanations involve measuring dispersion over a larger number of smaller sub-regional units. Both explanations are consistent with the data as calculated, and the authors do not claim that either has been confirmed.

Concentration of Spatial Output and Population Dynamics (RQ1)

The longitudinal metrics capturing the macro-spatial concentration of economic output provide partial empirical alignment with the core-periphery frameworks predicted by Cumulative Causation Theory (Myrdal, 1957). Throughout the 2010-2024 panel, Java maintained an absolute, dominant grip on aggregate output generation, with its share of nationwide provincial GRDP shifting marginally from 57.3% to 58.6% an increase of 1.3 percentage points. This structural centralization is heavily reinforced by Java's status as the nation's primary demographic hub, supporting a highly polarized population density that reached 1,212 persons/km2 by 2024.

The empirical results suggest that this spatial concentration is persistent and structurally rigid rather than rapidly accelerating. The 1.3 percentage point expansion in Java's output share over a 15-year indicates a stable macroeconomic baseline rather than an unchecked absorption of output from outer islands, a pattern consistent with the modest growth also seen in the peripheral clusters that expanded their shares over the same period, such as Kalimantan 9.4% to 8.3%, in fact a decline in share despite rapid absolute growth and Sulawesi 5.2% to 6.9%. Because this study relies entirely on macro-spatial descriptive data, these patterns are presented as structural trends; the specific mechanisms of cumulative causation were not formally tested.

Deconstructing the Macroeconomic Growth-Per Capita Output Paradox (RQ2)

The first dimension of the paradox is that the cluster with the largest aggregate output (Java) is not the cluster with the highest per capita output; Kalimantan holds that position in 2024 (IDR 61.6 million), with Java second (IDR 48.8 million). This reflects Java's very large population relative to its GRDP share, and Kalimantan's comparatively small population relative to its capital-intensive, high-value extractive and energy output.

The second dimension is the gap between aggregate GRDP growth and per capita GRDP growth summarized in Table 5. For six of the seven clusters, this gap is modest (1.0 to 1.9 percentage points) and consistent with ordinary population growth rather than a distinct structural distortion. Papua is the exception: its 7.1 percentage point gap, driven by population growth that outpaced GRDP growth, produced an actual decline in per capita output over the period. Because this pattern coincides closely with the 2022 provincial split and the data-quality concern noted in the Results and Limitations, the authors do not interpret it as settled evidence of a resource-curse or enclave-economy mechanism in Papua specifically, even though such mechanisms remain plausible on theoretical grounds.

For the six other clusters, the observed gaps are small, and this study's descriptive, period-level CAGR comparison cannot by itself distinguish an enclave-economy mechanism (Hirschman, 1958) or a resource-curse mechanism (Gradin et al., 2021; Ozler & Prennushi, 2006) from ordinary demographic growth. These frameworks, together with urban bias theory (Lipton, 1977) and diseconomies of agglomeration for Java and Sumatra, remain plausible interpretive lenses for the patterns in Tables 4,5, 6 and 7, but they were not directly tested: this study does not contain data on employment, sectoral capital flows, of fiscal allocation. Evidence on social inclusiveness of welfare improvement would require direct distributional indicators-poverty rates, consumption deciles, real wages, or Gini coefficients that fall outside the scope of this descriptive framework.

Intra-Island Disparity and the Re-evaluation of the West-East Narrative (RQ3)

The Williamson Index results qualify the conventional West-East development dichotomy, which assumes that the economically dominant western core is also internally well-distributed. the two highest mean levels of internal inter-provincial disparity are now found in Java (Mean 0.827) and Kalimantan (mean 0.800) the nation's two largest or most capital-intensive economic contributors with Java now ranking first.

Java's high and rising Williamson coefficient (0.801 in 2010 to 0.855 in 2024) indicates persistent and widening internal polarization, suggesting that the advanced metropolitan agglomerations of DKI Jakarta and its immediate surroundings pulls the population-weighted average per capita output upward even as the much larger populations of West Java and Central Java remain comparatively poorer, a pattern that a simple, unweighted average pf provincial per capita values. Kalimantan's high internal disparity similarly reflects a severe internal spatial imbalance between its massive, extraction-dense sub-regions (East and North Kalimantan) and its less commodity-dependent provinces.

Conversely, several eastern clusters recorded the lowest historical mean disparity, which qualifies the conventional West-East stereotype in the opposite direction. However, low relative dispersion should not be conflated with successful of adequate development outcomes. Because the Williamson Index measures relative dispersion around an internal regional mean, a cluster in which every province has a uniformly low income level will also register a low index-a pattern consistent with a low-level structural equilibrium rather than achieved equity.

The steady late-period increases in the Williamson Index observed in Sulawesi (reaching 0.270) and Maluku (reaching 0.379) are consistent with the early-stage divergence phase of the Regional Inequality Hypothesis (Williamson, 1965), interpretively linked to the uneven spatial spread of nickel down-streaming processing investment and associated foreign direct investment, which can create isolated growth enclaves within previously homogeneous, low-income clusters.

Finally, the abrupt spike in Papua's index from 0.132 in 2018 to 0.449 in 2024 cannot be attributed with confidence to either organic economic divergence or a purely mechanical artefact of the 2022 administrative split, because the constant-boundary recombination that would be needed to separate these two explanations was not performed in this study. The absence of a formal convergence model also means that the declining trend observed in Sumatera's index cannot be described as structural convergence without a formal sigma or beta convergence test.

Policy Considerations

The following considerations are derived from the descriptive patterns and prior literature. They are not conclusions about policy effectiveness, which would require

separate evaluation. Four considerations follow. For the first, connectivity and integration. Sparse, fragmented clusters (Maluku, Kalimantan, Papua) have very low density, and the literature links low density to high logistics and infrastructure costs (Said et al., 2020). The second is economic diversification. The divergence between aggregate and per capita growth in Papua in particular, and more modestly in other commodity-dependent clusters suggests attention to diversification beyond extractive activity (Salsabilah & Finanto, 2024). Third, Investment and fiscal design, Java's persistent share and density, and the high internal disparity in Java and Kalimantan, suggest that fiscal transfers and investment incentives could be examined for their spatial effects, including the case for spatially differentiated formulas (Ahmad et al., 2024). The last recommendation is governance within islands. High or rising within-island disparity suggests a role for coordinated planning across provinces on the same island (Nasution, 2020). The relocation of the national capital to East Kalimantan (IKN) is often expected to influence spatial patterns (Mursalin & Irawan, 2025), but its effects fall outside the study and can not be inferred from these data.

Limitations

This research has several limitations, such as the design is descriptive: no causal identification or inferential testing was performed, so terms such as "significant" are used only in their ordinary sense. Furthermore, aggregations into island clusters can mask heterogeneity, especially in Bali-Nusa Tenggara and Sumatera and Kalimantan; the results depend on how clusters are grouped. Moreover, provincial boundary changes affect the Williamson Index, and, as stated explicitly in the Method, no constant-boundary sensitivity check was performed in this study; the post-2022 increase in Papua's index should be read as potentially confounded by this measurement limitation rather than as a fully resolved finding. GRDP per capita is an output-based average and does not capture household income, distribution, or welfare. Extractive-sector output can inflate GRDP per capita without corresponding local income, which is particularly relevant to Kalimantan's high per capita ranking in Table 6. In addition, the authors identified a specific data-quality concern for Papua during this revision. The province-level population figure used for Papua appears high relative to independently reported pos-split population estimates for that province, which raises the possibility that population was not fully reallocated across the four new provinces in the underlying dataset. This would affect Papua's GRDP per capita (Table 5), population density (Table 7), and 2023-2024 Williamson Index values (Table 8). Explanatory mechanisms discussed in the text.

Conclusion

This study describes output concentrations, per capita output, population density, and intra-island disparity across seven Indonesian island clusters during 2010-2024. Three patterns stand out. First, Java holds a persistently large and growing share of aggregate GRDP) about 57.3% to 58.6%) and by far the highest population density, whereas Kalimantan, Maluku, and Papua remain sparsely populated. Second, aggregate output growth and per capita growth diverge most sharply in Papua, where population growth outpaced GRDP growth and per capita output fell over the period; for the other six clusters the divergence is modest and broadly consistent with ordinary population growth. The cluster with the largest aggregate output (Java) is not the cluster with the highest per capita output in 2024; that position belongs to Kalimantan. Third, intra-island disparity is highest in Kalimantan and Java and lowest on average in Maluku, Sulawesi, and Papua, although disparity rose in Sulawesi and Maluku toward the end of the period, and the Papua increase in particular cannot currently be separated from the mechanical effect ot its 2022 administrative split.

These findings suggest that the conventional West-East dichotomy describes concentration of output and population reasonable well, but describes internal disparity only partially, because the clusters with the largest or most capital-intensive output-Java and Kalimantan show the highest internal disparity, while several eastern clusters show low mean disparity that may reflect uniformly low income rather than achieved equity. The results are descriptive associations. They do not demonstrate that investment in primary sectors widens inequality, and they do not test the resource-curse or William inverted-U hypotheses. They can be used as a baseline for further research and as descriptive input for discussion of RPJMN 2025-2029, in which spatial distribution should be considered alongside the growth target. Any policy design would require evidence on causal effects, distributional outcomes, and trade-offs.

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Declarations

The authors declare sole responsibility for all aspects of this research and manuscript preparation, including conceptualization, methodology, formal analysis, data curation, investigation, writing the original draft, writing review and editing, and visualization. The author has read and approved the final version of the manuscript.

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Ethics Approval and Informed Consent: This study relies exclusively on publicly available, aggregate secondary macroeconomic and demographic data published by BPS-Statistic Indonesia. It does not involve human participants, personal data, or vulnerable groups; therefore, ethics approval and informed consent were not applicable.

Data Availability Statement: The processed provincial-level dataset, the province- to-island-mapping, and the Williamson Index calculations underlying this study are available from the corresponding author upon reasonable request, and will be made available as supplementary material upon publication.

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