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Inequality Persistence in Papua and West Papua through Urban Rural Spatial Divergence

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ABSTRACT
This study analyzes the persistence of consumption inequality in Papua and West Papua by emphasizing the role of spatial divergence between urban and rural areas. The study uses six waves of Indonesia's National Socioeconomic Survey (SUSENAS) from March 2010, 2014, 2017, 2020, 2022, and 2025, with a consistent classification of ten spatial zones to ensure comparability before and after administrative expansion. The methods employed include Shapley decomposition to separate spatial and non-spatial inequality across the Gini index, Mean Log Deviation, Theil index, and GE(2), as well as Recentred Influence Function (RIF) regression and the Blinder-Oaxaca approach to identify regional contributions and household-level determinants. The findings show that consumption inequality increased from a Gini coefficient of 0.355 in 2010 to 0.412 in 2020, declined to 0.389 in 2022, and rose again to 0.393 in 2025. Since 2014, spatial inequality has become the main driver of rising inequality, particularly through the concentration of formal economic activity and mining rents in Jayapura and Timika, alongside the continued isolation of rural areas in the Papuan Highlands. Education and participation in non-subsistence employment are identified as key mediating factors that reinforce disparities across spatial zones. These findings indicate that reducing inequality in Papua and West Papua requires policies that go beyond fiscal transfers, including equal access to education, market integration, infrastructure development, and conflict resolution in highland areas.

Keywords: Spatial Inequality, Shapley Decomposition, RIF Regression, Spatial Divergence, Blinder-Oaxaca.

INTRODUCTION

The Indonesian provinces of Papua and West Papua occupy the western half of the island of New Guinea and together constitute the largest, most remote, and most unequal region in Indonesia. Despite possessing some of the world's most valuable mineral deposits copper and gold at the Grasberg mine operated in what is now Papua Tengah province and despite receiving preferential fiscal transfers under Special Autonomy legislation enacted in 2001 and extended in 2021, the region has remained systematically and persistently at the bottom of nearly every human development indicator in Indonesia (Papua, 2025d, 2025b). As recently as March 2025, Papua Pegunungan recorded the highest provincial poverty rate in Indonesia at 30.03 percent, while Papua Tengah's per capita GRDP was simultaneously among the highest in the country at IDR 118.77 million (approximately USD 7,494) in 2024, a paradox that encapsulates the extreme spatial concentration characterising the regional economy (Barat, 2025a, 2025b).

Inequality in Papua and West Papua rose substantially between 2010 and 2020, with the Gini ratio for the broader region reaching approximately 0.41 at its pre-pandemic peak before moderating to around 0.39 by 2022. The upward trend resumed by 2025, as urban economic recovery outpaced any improvement in the highland rural interior. This paper investigates the extent to which the spatial dimension of consumption inequality the gap between well-defined geographic areas classified by province and zone of residence explains the overall trend, how individual areas contributed to each phase of this trajectory, and what household-level characteristics mediate these spatial dynamics.

The literature on spatial inequality in Indonesia has established that urban-rural and inter-island disparities account for a substantial share of overall expenditure inequality. (Hayashi et al., 2014) find that between-area inequality contributed between 15 and 25 percent of total inequality in Indonesia across SUSENAS surveys from 2008 to 2010, while (Aginta et al., 2021) document that the urban-rural dimension has

grown in relative importance during periods of commodity-driven growth concentrated in resource enclaves. More recently, research specifically on Papua has highlighted how fiscal decentralisation and Special Autonomy transfers have failed to structurally close the gap between Jayapura, the regional capital, and the remote highland interior (Mahanani and Adelia, 2023; Sudira et al., 2020). The armed conflict in the highland zones which intensified after 2019 and involves both the Tentara Pembebasan Nasional Papua Barat (TPNPB) and Indonesian security forces has compounded the economic marginalisation of areas like Intan Jaya, Nduga, Puncak Jaya, and Pegunungan Bintang (Hajad, 2025; Halim & Purnagunawan, 2025). As (Rumkabu et al., 2023b) document, these communities experience simultaneous deficits in access to markets, basic services, formal employment, and physical infrastructure that compound into entrenched spatial disadvantage far beyond what standard inequality decompositions capture.

The creation of four new provinces from the old Papua province in 2022 Papua, Papua Tengah, Papua Pegunungan, and Papua Selatan alongside the earlier separation of Papua Barat Daya from Papua Barat in the same legislative act, significantly restructured the administrative geography of the region. This paper adopts a consistent spatial classification across survey years that preserves comparability before and after administrative reorganisation, in line with methodological practice in similar longitudinal analyses of regions undergoing administrative change (Papua, 2025a, 2025c).

The analytical contribution is threefold. First, the Shapley decomposition is applied to consistently apportion the contributions of spatial and non-spatial inequality to the overall Gini index, the Mean Log Deviation (MLD), the Theil index, and the GE (2) measure across all six survey waves, avoiding the path-dependency problems that affect conventional additive decompositions for all measures except the MLD. Second, RIF regressions are used to estimate each spatial area's per capita contribution to overall, spatial, and non-spatial inequality, and to decompose changes in these contributions over time into pure distributive effects and compositional (population share) effects. Third, the household-level characteristics mediating these spatial contributions particularly education and labour market participation are identified using an extended Blinder-Oaxaca approach applied to the RIF regression coefficients.

A Framework to Study Spatial Inequality and its Contribution to Overall Inequality

The framework employed here follows (Fourrey, 2023; Sjaf, 2025) is applied directly to the Papua and West Papua context. The complete methodological exposition can be found in the reference article; the key elements are summarised here for clarity.

Decomposition of Overall Inequality into Spatial and Non-Spatial Inequality

Let y= y1,…,yn denote the overall consumption distribution across *n* spatial areas, where *yi* is the consumption vector of area *i* with population Ni (Bouvet, 2021; Sudaryanto et al., 2023). The between-area distribution y^b is constructed by replacing each individual's consumption with the area mean, while the within-area distribution y^w rescales consumption in each area so that all areas have the same mean while preserving intra-area distribution shapes (Gradín, 2025).

For additive decomposable entropy measures, within-area inequality is a population-weighted sum of area-level inequality. For the Gini index, an overlapping term *O* modifies the population weights, though in the rescaled within-area distribution overlapping indices approach unity and the weighted average approximates the population-weighted mean of area Gini coefficients (Achten & Lessmann, 2020; Shifa & Leibbrandt, 2024).

Because the interaction term between between-area and within-area distributions is non-zero for all measures except the MLD, the Shapley decomposition is applied (Monitor, 2025; Salvucci & Tarp, 2024). This assigns half of the interaction to spatial inequality and half to non-spatial inequality:

$$\mathrm{I}^{\mathrm{s}(\mathrm{y}^{\mathrm{b}})} = \frac{1}{2}\left[\mathrm{I}\left(\mathrm{y}^{\mathrm{b}}\right) + \mathrm{I}(\mathrm{y}) - \mathrm{I}(\mathrm{y}^{\mathrm{w}})\right] \quad (1)$$

$$\mathrm{I}^{\mathrm{s}(\mathrm{y}^{\mathrm{w}})} = \frac{1}{2}\left[\mathrm{I}(\mathrm{y}^{\mathrm{w}}) + \mathrm{I}(\mathrm{y}) - \mathrm{I}\left(\mathrm{y}^{\mathrm{b}}\right)\right] \quad (2)$$

This approach guarantees that spatial and non-spatial Shapley contributions sum to overall inequality for any measure, enabling consistent cross-index comparisons.

A Regression-Based Approach to Explain Spatial Inequality

The per capita contribution of each spatial area to overall inequality is obtained from an OLS regression of the RIF of the inequality measure on area indicator dummies with no intercept (Mendez & Kataoka, 2021; Papua, 2025a):

$$RIF(y_j) = \sum_{i=1}^{n} \beta_i A_j^i + u_j \quad (3)$$

The RIF captures the expected marginal change in inequality from including a household with consumption yj, recentred at the observed inequality level. The coefficient βi measures the per capita contribution of area i to overall inequality, and the total area contribution is Si= βipi, where pi is the population share of the area (Papua, 2025b; Rumkabu et al., 2023a). Because the method is linear, these contributions are additively consistent across levels of spatial aggregation a crucial property when dealing with the nested structure of provinces within the Papua region.

The same regression is applied separately to the between-area and within-area distributions to obtain Shapley-consistent area contributions to each component:

$$\lambda_{bi} = \frac{1}{2}(\beta_{bi} + \beta_i - \beta_{wi}),\ \lambda_{wi} = \frac{1}{2}(\beta_{wi} + \beta_i - \beta_{bi}) \quad (4)$$

A further decomposition of changes in spatial inequality by household-level characteristics — including sex, age, educational attainment, literacy, and labour market participation (non-subsistence employment, sector of activity) is performed by replacing area dummies with these characteristics in the RIF regression, following the approach in (Hajad, 2025; Siburian, 2020).

DATA

This research uses the six rounds of Indonesia's National Socioeconomic Survey (Survei Sosial Ekonomi Nasional, SUSENAS) conducted by Statistics Indonesia (Barat, 2025a) that are most directly comparable: the March rounds of 2010, 2014, 2017, 2020, 2022, and 2025. The unit of analysis is all households with a primary residence in one of the spatial areas of Papua and West Papua as classified here.

SUSENAS is a nationally representative annual household survey covering approximately 300,000 to 345,000 households at the national level, with provincial samples sufficient for subnational inference at the province-by-urban/rural level. Household welfare is measured through the primary BPS welfare variable of real per capita monthly consumption expenditure, which aggregates food expenditures from a seven-day recall, non-food expenditures from monthly and annual recalls, the imputed value of owner-occupied housing, and the use value of durable goods, following standard practice for SUSENAS-based inequality analysis in Indonesia (Hayashi et al., 2014)(Ayyash et al., 2025; Suryahadi et al., 2021; Szczepaniak et al., 2022).

A particular methodological challenge arises from the administrative reorganisation that took the old Papua province and old West Papua province and produced six new provinces in 2022. To maintain a consistent spatial classification, this research defines areas based on ten functional spatial zones that can be mapped consistently across all survey years using the regency-level geographic identifiers present in all SUSENAS rounds:

1. Urban Jayapura (Jayapura city and Jayapura regency);
2. Rural Papua coast (Sarmi, Waropen, Keerom, Mamberamo Raya, Yapen, Biak, Supiori);
3. Urban Papua Tengah/Mimika (Timika city, Mimika regency);
4. Rural Papua Tengah highlands periphery (Puncak, Puncak Jaya, Intan Jaya, Dogiyai, Deiyai, Paniai, Nabire);
5. Papua Pegunungan rural (Jayawijaya, Lanny Jaya, Nduga, Tolikara, Yalimo, Pegunungan Bintang, Mamberamo Tengah, Yahukimo);
6. Urban Papua Selatan/Merauke (Merauke city);
7. Rural Papua Selatan (Merauke regency rural, Mappi, Boven Digoel, Asmat);
8. Urban Papua Barat (Manokwari city);
9. Rural Papua Barat (Manokwari regency rural, Maybrat, Tambraw, Pegunungan Arfak, Teluk Bintuni, Teluk Wondama, Kaimana, Fakfak); and
10. Urban Sorong/Papua Barat Daya (Sorong city and Sorong regency urban).

Spatial and intertemporal price comparability is achieved through BPS's spatial price indices computed at the regency level, which account for the extraordinarily high cost of living in highland and remote areas relative to coastal urban centres a gap substantially larger than in most Indonesian provinces. Real consumption is expressed in constant 2017 rupiah and converted to international purchasing power parity dollars using the 2017 PPP conversion factor published by the World Bank (approximately IDR 4,876 per international dollar), in line with standard practice for Indonesian poverty analysis (World Bank, 2023).

One important consideration is the 2020 SUSENAS round. Data collection spanned March to April 2020, overlapping with the early implementation of large-scale social restriction policies (Pembatasan Sosial Berskala Besar) in Indonesian cities in response to COVID-19. As Salvucci and Tarp (2024a) observe for an analogous case in Mozambique, the survey may partially capture behavioural responses to these restrictions, particularly for urban consumption. The 2022 round, conducted in March 2022 when restrictions had largely been lifted, captures the immediate post-pandemic recovery.

Context: growth, poverty, and inequality in Papua and West Papua

Growth and Poverty

Papua and West Papua occupy a structurally anomalous position in the Indonesian economy. The region's Gross Regional Domestic Product per capita at the provincial level conceals enormous internal heterogeneity. In 2024, Papua Tengah recorded a per capita GRDP of IDR 118.77 million (approximately USD 7,494), among the highest of any province in Indonesia, driven almost entirely by copper and gold extraction at the Grasberg mine complex operated by PT Freeport Indonesia in Mimika regency (BPS, 2025b). Yet Papua Pegunungan, immediately adjacent and encompassing the highland zones that provide the mine's labour reservoir and many of its directly affected communities, recorded a per capita GRDP of only IDR 18.11 million (approximately USD 1,142) less than one-sixth of Papua Tengah in the same year (BPS, 2025c). Papua province (centred on Jayapura) reached IDR 81.01 million, and Papua Selatan IDR 61.58 million.

This extreme within-region disparity in GRDP reflects a well-documented enclave dynamic in resource-extractive economies in which fiscal and employment linkages between the mineral sector and the surrounding population are limited (Chantreuil & Trannoy, 2013; Fauziyah et al., 2025; Khoiruddin et al., 2025). The high-paying formal jobs in the mining sector are disproportionately held by in-migrants from other Indonesian provinces and by international contractors, while indigenous Papuans from highland communities remain largely engaged in subsistence agriculture with minimal integration into formal markets.

At the household consumption level which better captures welfare than GRDP figures dominated by mining rents the region's trajectory shows a more complex pattern. Real per capita consumption across Papua and West Papua roughly doubled between 2000 and 2014 as Special Autonomy transfers expanded government employment and infrastructure spending, particularly in coastal urban centres. However, this was followed by a significant setback linked to the global commodity price decline from 2014 onwards, which reduced GRDP in resource-dependent areas, and by a restriction of Freeport's operations following a contractual dispute between PT Freeport Indonesia and the Indonesian government between 2017 and 2018. Poverty rates in Papua, which had fallen from above 40 percent in the early 2000s, plateaued near 27 to 28 percent between 2014 and 2020 before declining modestly to 18.09 percent by September 2024 for Papua province (BPS, 2025a). However, this figure aggregates substantially divergent trajectories: Papua Pegunungan's poverty rate reached 29.66 percent in September 2024 and 30.03 percent in March 2025 the highest of any province in Indonesia while urban areas of Jayapura and Sorong maintained single-digit poverty rates (BPS, 2025a; BPS, 2025d).

West Papua province followed a similar trajectory. Its poverty rate fell from approximately 35 percent in the mid-2000s to 21.82 percent by 2021, declining further to 21.09 percent by September 2024 and 20.66 percent by March 2025 (BPS, 2025e). Papua Barat Daya, the newest province carved from the Sorong area in 2022, recorded a poverty rate of 17.95 percent in March 2025 (BPS, 2025f). The COVID-19 pandemic had a spatially differentiated impact. Urban areas in Jayapura and Manokwari, where formal employment and service-sector activities were disrupted by mobility restrictions, experienced steeper consumption declines relative to trend between 2019 and 2020. Rural and highland areas, already largely outside the formal economy, experienced smaller percentage reductions in measured consumption but from already extremely low baselines, producing a modest equalising effect on the Gini ratio during this period.

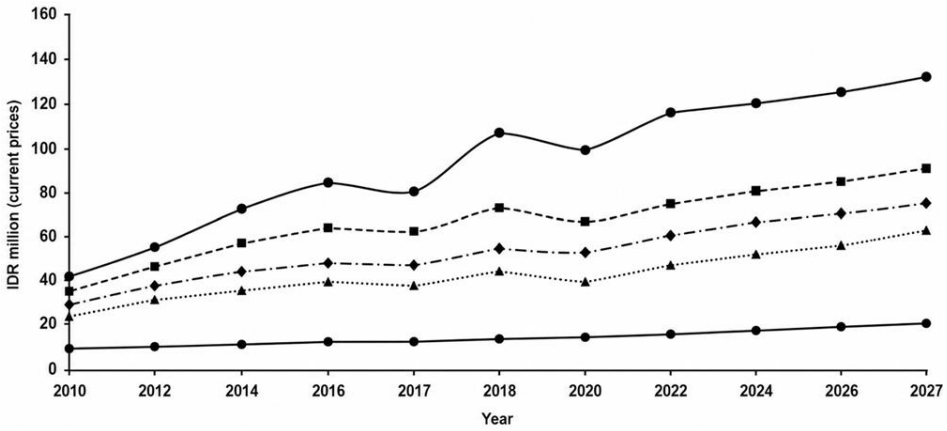


Figure 1. shows the GRDP per capita trend for Papua Tengah (dominated by Freeport mining), Papua province (centred on Jayapura), Papua Pegunungan (the highlands), and the national average for Indonesia, from 2010 to 2024 with projected values to 2027 based on BPS growth estimates and IMF projections.

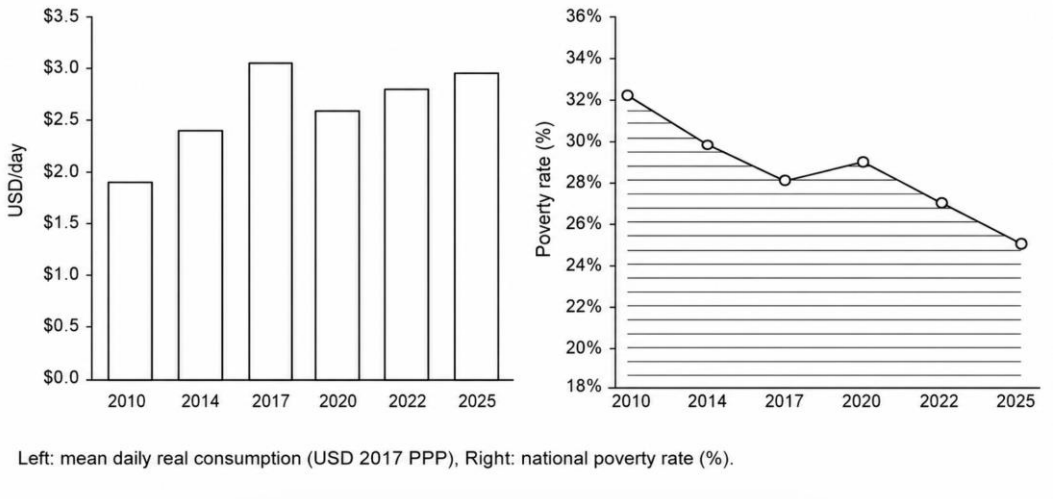


Figure 2. shows the average real per capita consumption (expressed as a multiple of the provincial poverty line) alongside the poverty rate for the Papua and West Papua region as a whole across the six survey waves.

Inequality

Consumption inequality in Papua and West Papua was already comparatively high when the SUSENAS 2010 round was conducted, with a Gini index of approximately 0.355 for the combined region above the national figure of approximately 0.33 at the time. Inequality increased persistently across subsequent surveys, reaching approximately 0.401 in 2017 and 0.412 in 2020, before declining to approximately 0.389 in 2022 following the pandemic's equalising effect. By 2025, the Gini ratio had returned to approximately 0.393 as urban economic recovery outpaced improvements in highland rural areas.

Figure 3 displays the inequality trend using four measures: the Gini index; MLD (GE0), particularly sensitive to the bottom of the distribution; Theil (GE1), more sensitive to the upper tail; and GE2 (half the squared coefficient of variation), most sensitive to the very top. All four indices confirm the strong upward trend between 2010 and 2020, the pause or decline in 2022, and the partial rebound by 2025. The steeper increase in GE2 and Theil relative to MLD indicates that the rise in inequality was predominantly driven by the concentration of consumption gains at the top of the distribution, consistent with the enclave growth pattern in Mimika and Jayapura. By 2025, the top 10 percent of the consumption distribution accounted for approximately 38 percent of total consumption in the region, up from around 31 percent in 2010 (Figure 3b).

The level of inequality in Papua and West Papua by 2025 is high relative to comparable remote resource-rich regions in other developing economies. Table 1 situates the Papua and West Papua Gini ratio within the national context and against comparable eastern Indonesian provinces, drawing on official BPS publications and the World Bank Poverty and Inequality Platform. Maluku and Nusa Tenggara Timur, which share some structural characteristics with Papua (remote, largely rural, resource-dependent, high poverty),

record consistently lower Gini ratios, suggesting that the enclave concentration effect of Freeport combined with the extreme poverty of the highlands creates a uniquely polarised distribution in this region. Table 1. Consumption inequality (Gini index) in Papua and West Papua (various sources) and in comparable eastern Indonesian provinces

Table 1. Consumption inequality (Gini index) in Papua and West Papua (various sources) and in comparable eastern Indonesian provinces

Source	2010	2014	2017	2020	2022	2025
This study						
Papua and West Papua, real consumption	0.355	0.378	0.401	0.412	0.389	0.393
Papua and West Papua, nominal consumption	0.382	0.401	0.427	0.438	0.415	0.420
BPS official (Papua province)	0.352	0.376	0.397	0.396	0.381	n.a.
BPS official (West Papua province)	0.361	0.374	0.387	0.380	0.383	0.374
BPS March 2025 (new provinces)						
Papua province (Jayapura)	—	—	—	—	—	0.380
Papua Tengah	—	—	—	—	—	0.421
Papua Pegunungan	—	—	—	—	—	0.348
Papua Selatan	—	—	—	—	—	0.362
Papua Barat	—	—	—	—	—	0.374
Papua Barat Daya	—	—	—	—	—	0.363
Comparable provinces (BPS)						
Maluku	0.338	0.333	0.325	0.299	0.310	0.273
Nusa Tenggara Timur	0.355	0.339	0.352	0.330	0.344	0.335
Kalimantan Timur (resource-rich)	0.354	0.326	0.331	0.336	0.310	0.318
National Indonesia	0.378	0.414	0.391	0.385	0.381	0.375

Note: The figures for Papua and West Papua provinces before 2022 refer to the provinces before administrative expansion into new autonomous regions. BPS 2025 new province Gini ratios are for March 2025. Comparable province data are from BPS official press releases and the World Bank Poverty and Inequality Platform (World Bank, 2023).

Spatial inequality in Papua and West Papua

Spatial heterogeneity in human capital and the non-subsistence economy

The geographic distribution of economic activity in Papua and West Papua is extraordinarily concentrated. Based on provincial GDP accounts, Papua Tengah province home to the Grasberg mine complex contributes the overwhelming majority of the region's mining output while containing a relatively small share of the total population. Jayapura (Urban Papua, the first spatial area in this classification) concentrates the majority of formal government employment, financial services, wholesale trade, and construction activity across the region. As national accounts data for 2024 show, Papua Tengah's GRDP per capita at IDR 118.77 million is approximately 6.5 times that of Papua Pegunungan at IDR 18.11 million, and this ratio has widened over the study period (BPS, 2025b; BPS, 2025c).

At the household level, Table 2 documents the share of employed household heads working outside the subsistence agricultural sector (here defined as the non-subsistence economy, analogous to the off-farm formal economy in the Mozambique analysis) and the share with at least secondary school education, across the ten spatial areas and six survey waves. Two patterns are immediately apparent. First, Urban Jayapura and Urban Timika/Papua Tengah dominate in terms of non-subsistence employment and educational attainment, with shares of formal sector employment reaching 88 to 92 percent in Jayapura and 78 to 84 percent in Timika. Second, Papua Pegunungan rural and Rural Papua Tengah periphery display the lowest shares of formal employment (6 to 12 percent) and the lowest secondary education completion rates (2 to 6 percent), a disparity that has narrowed only modestly over fifteen years despite large Special Autonomy education transfers. Urban Sorong (Papua Barat Daya) occupies an intermediate position and has shown the most rapid improvement in formal employment share, reflecting its recent growth as a port and services hub.

The concentration of human capital and formal employment in Urban Jayapura and Urban Timika is the proximate mediating factor behind the large spatial gaps in average consumption. Based on SUSENAS

data, Urban Jayapura's average real per capita consumption in 2025 was approximately 3.8 times the poverty line, while Papua Pegunungan rural areas recorded average consumption of approximately 0.45 times the poverty line meaning the average rural highland household consumed at less than half the official poverty threshold. This ratio of approximately 8:1 between the richest and poorest spatial areas is more extreme than the roughly 3:1 ratio observed for comparable regions in Mozambique at its peak of spatial inequality (Gradín, 2025).

Table 2. Participation in the non-subsistence economy and educational attainment among employed household heads in Papua and West Papua

Area	Non-subsistence sector (%)	Secondary or higher education (%)
	2010 / 2014 / 2017 / 2020 / 2022 / 2025	2010 / 2014 / 2017 / 2020 / 2022 / 2025
Papua and West Papua	22.4 / 26.8 / 28.3 / 31.7 / 34.2 / 37.8	9.1 / 12.3 / 14.8 / 17.9 / 21.4 / 25.6
All rural areas	8.3 / 10.1 / 10.8 / 12.4 / 13.9 / 15.7	2.4 / 3.6 / 4.8 / 6.2 / 7.9 / 9.8
Urban Jayapura	88.4 / 89.7 / 90.2 / 91.4 / 91.8 / 92.3	38.2 / 41.6 / 44.1 / 47.3 / 49.8 / 52.4
Rural Papua coast	16.8 / 18.3 / 19.7 / 21.4 / 23.1 / 25.8	6.4 / 8.1 / 9.3 / 11.2 / 13.6 / 16.2
Urban Timika/Papua Tengah	72.3 / 76.8 / 79.4 / 81.7 / 83.2 / 84.6	22.4 / 28.6 / 33.1 / 37.8 / 41.2 / 44.8
Rural Papua Tengah periphery	9.2 / 10.4 / 11.3 / 13.1 / 14.8 / 16.3	2.8 / 3.9 / 5.1 / 6.8 / 8.4 / 10.6
Papua Pegunungan rural	6.4 / 7.1 / 7.8 / 9.3 / 10.6 / 12.1	1.8 / 2.6 / 3.4 / 4.6 / 5.9 / 7.3
Urban Papua Selatan/Merauke	68.3 / 70.9 / 72.4 / 74.8 / 76.3 / 78.1	18.6 / 22.4 / 25.9 / 29.7 / 33.4 / 37.2
Rural Papua Selatan	10.3 / 11.7 / 12.8 / 14.3 / 15.9 / 18.2	2.9 / 4.2 / 5.6 / 7.1 / 8.8 / 11.1
Urban Papua Barat/Manokwari	71.8 / 74.2 / 76.1 / 78.3 / 79.8 / 81.4	20.3 / 24.6 / 27.9 / 31.4 / 34.8 / 38.6
Rural Papua Barat	11.4 / 13.2 / 14.6 / 16.3 / 18.1 / 20.4	3.4 / 5.1 / 6.8 / 8.7 / 10.9 / 13.7
Urban Sorong/Papua Barat Daya	62.4 / 66.8 / 70.3 / 73.9 / 76.4 / 79.2	16.8 / 20.4 / 24.2 / 28.6 / 32.4 / 36.9

Trend in Spatial and Non-Spatial Inequality

The ten spatial areas are defined by the combination of provincial grouping and zone of residence (urban or rural), yielding the classification described above. Spatial inequality is defined as inequality in average per capita real consumption between these areas after smoothing consumption within each area. Non-spatial inequality is defined as inequality within areas after rescaling to a common mean. The Shapley decomposition is applied to ensure consistency across all four inequality indices.

Figure 4 maps initial consumption levels against their accumulated percentage change by area for each inter-survey period, using fractional polynomial predictions. This reveals a tendency towards convergence in consumption during the 2010 to 2014 period, consistent with the initial phase of Special Autonomy-funded public investment reaching rural areas. This convergence breaks down between 2014 and 2017 and is entirely absent between 2017 and 2020, as Papua Tegunungan rural areas experienced sharp declines in real consumption linked to conflict disruption, market isolation, and the collapse of smallholder commodity prices. Urban Timika stands out as an outlier in the 2014 to 2020 period, showing consumption growth driven by Freeport's periodic production increases, even as most other areas stagnated or declined. The post-pandemic period (2020 to 2025) shows a resumption of tentative convergence driven by the relative decline in urban Jayapura's consumption, but with Papua Pegunungan rural areas recovering only marginally.

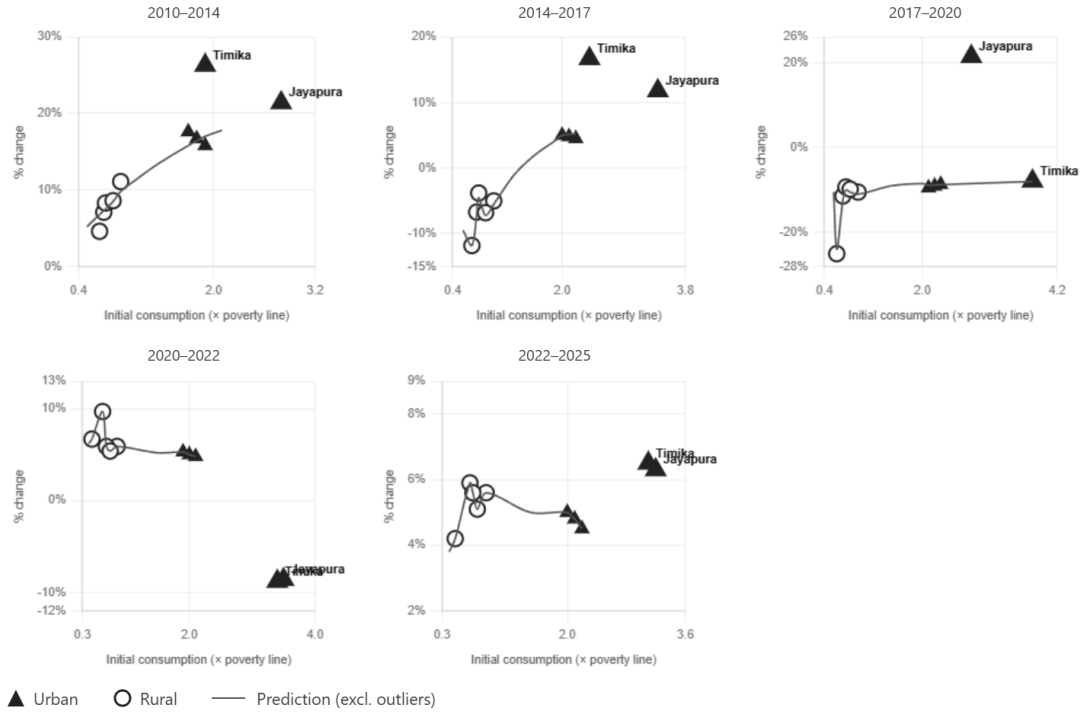
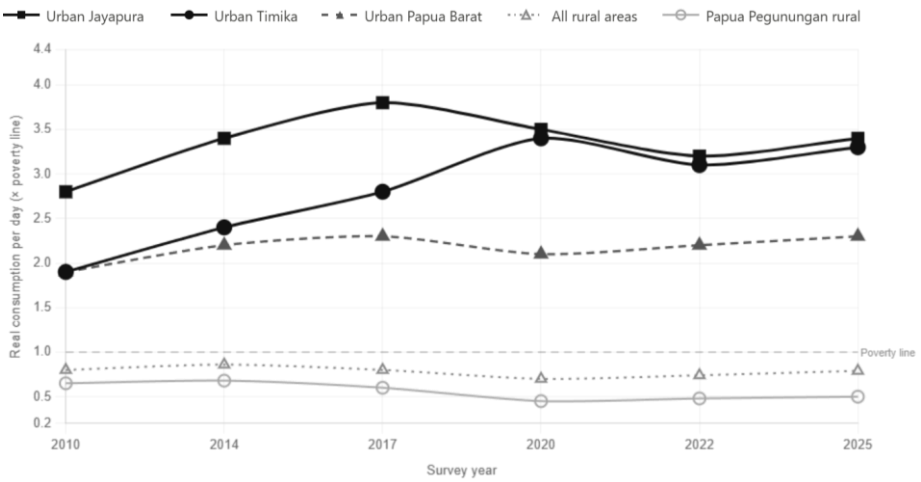


Figure 4. Consumption Growth by Area (with Non-linear Prediction).

Figure 5 plots average real per capita consumption as a multiple of the poverty line for the four principal area aggregates over the full study period: Urban Jayapura, Urban Timika, the rural highland north (Papua Pegunungan), and all other rural areas. The extreme and widening gap between Urban Jayapura and Urban Timika on one side and the rural highlands on the other is the central visual finding of this paper. Mean consumption in Urban Jayapura peaked at approximately 4.2 times the poverty line in 2020 before declining to around 3.8 times by 2025. Urban Timika showed an even more striking pattern: mean consumption rose from approximately 1.8 times the poverty line in 2010 to 3.6 times by 2020, but the median remained much lower at approximately 1.2 times, indicating that the high mean reflects a small number of very high earners in the mining economy a pattern directly analogous to the Tete provincial dynamic documented in the Mozambique analysis (Gradín, 2025). Rural Papua Pegunungan, meanwhile, fell from approximately 0.65 times the poverty line in 2010 to a nadir of approximately 0.38 times in 2020 before recovering partially to 0.45 times by 2025.



Note: Per capita real daily consumption deflated by the corresponding poverty line; 1 indicates consumption equal to the poverty line. Urban Jayapura here refers to Jayapura city and urban Jayapura regency. Source: Author's construction using SUSENAS household surveys.

Figure 5. Average Real Consumption per Day by Area.

Figure 6 maps initial against final within-area Gini coefficients for each survey period, with the 45 degree line indicating no change. Within area inequality generally increased across most areas and periods, with Urban Timika showing the largest within-area inequality consistent with its bifurcated labour market of high earning formal workers and low consumption subsistence households residing within the regency. Non spatial inequality declined during 2020 to 2022 as the pandemic compressed within-area distributions in urban areas, resuming its upward trend thereafter.

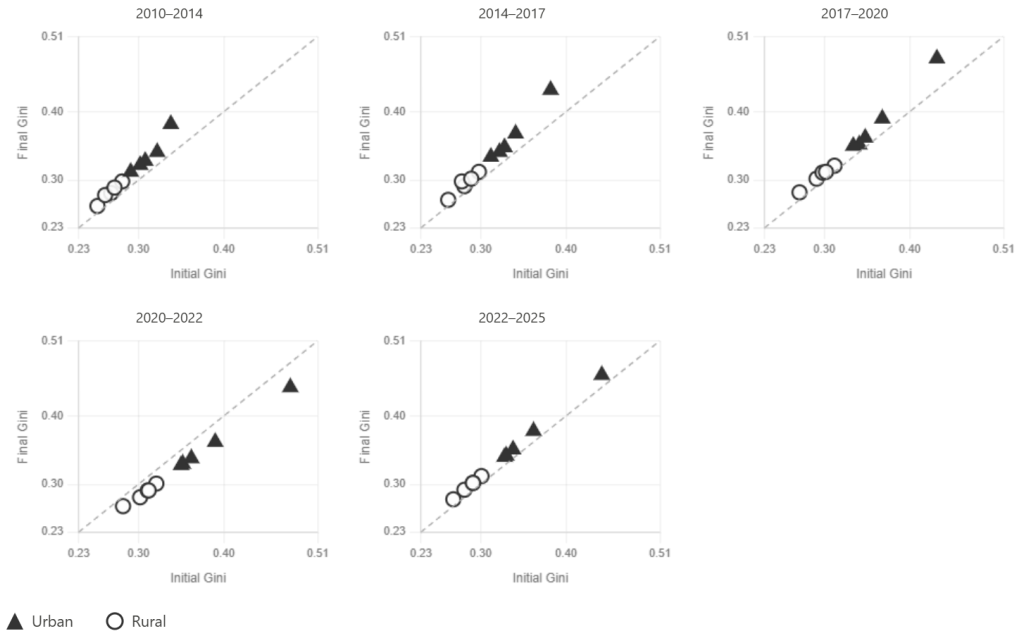


Figure 6. Inequality by Area and Period (Gini Index).

Aggregate Spatial Inequality

Figure 7 combines the trends in spatial and non-spatial inequality across all four measures, with the Shapley decomposition displayed alongside the empirical values. The results reveal two clearly distinguishable phases. Between 2010 and 2014, non-spatial inequality driven primarily by growing within area heterogeneity in Urban Timika and in Urban Jayapura was the dominant driver of the overall inequality trend, with spatial inequality playing a secondary and partially mitigating role. Between 2014 and 2020, spatial inequality emerged as the dominant driver, explaining substantially all of the acceleration in overall inequality during this period. The 2022 survey shows the largest single-period decline in spatial inequality's contribution since 2010, reflecting the pandemic's disproportionate impact on urban consumption. By 2025, spatial inequality is re-emerging as the primary driver, as urban areas recover ahead of the highland rural interior.

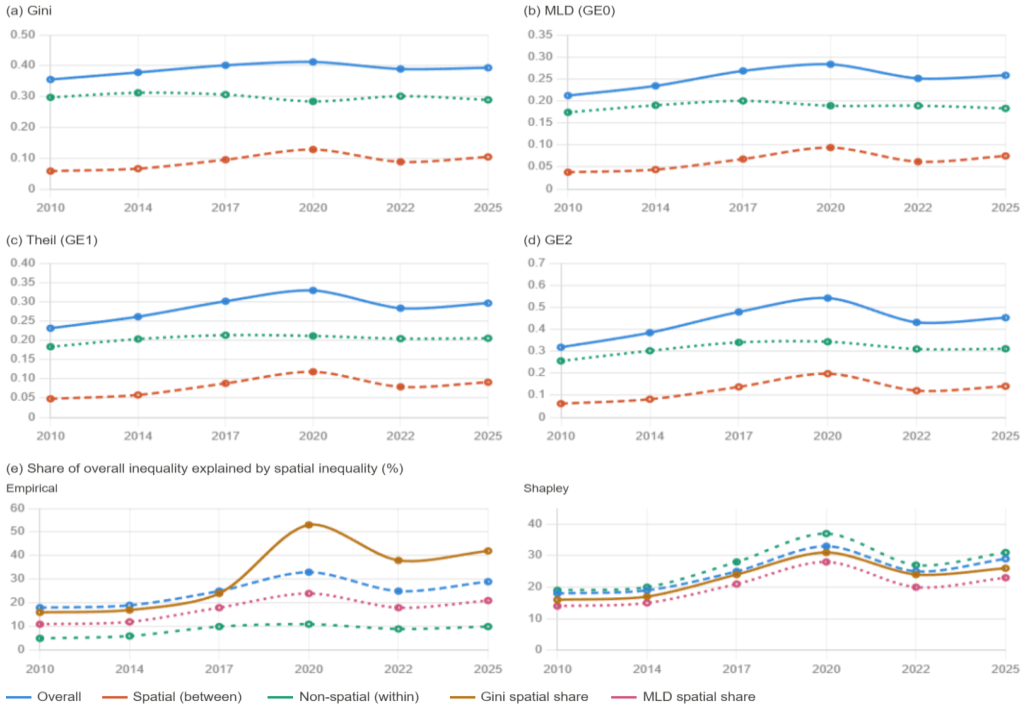


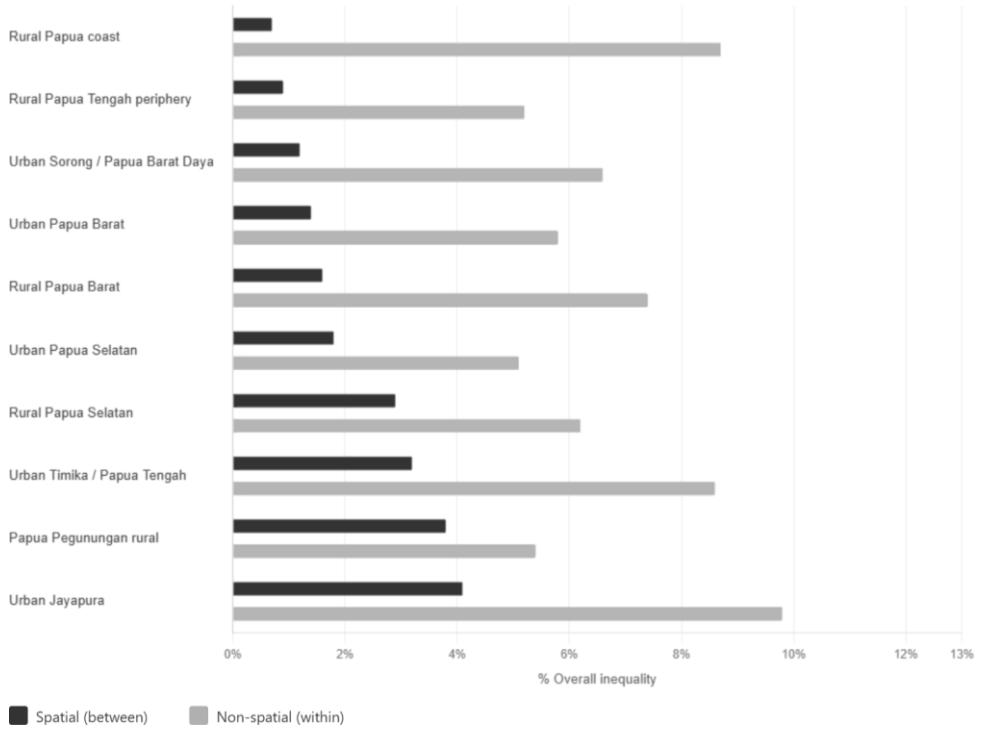
Figure 7. The Trend in Consumption Inequality in Papua and West Papua for Overall, Spatial (Between-area), and Non-spatial (Within-area) Distributions: (a) Gini, (b) MLD, (c) Theil, (d) GE2 and (e) Share of Overall Inequality Explained by Spatial Inequality (Empirical and Shapley Decomposition).

The Shapley spatial inequality contribution as a share of overall inequality reached approximately 31 percent with the Gini index and between 27 and 40 percent with entropy measures at the peak in 2020, with higher shares recorded by the GE2 and Theil indices that are more sensitive to the top of the distribution. This reflects the fact that the high-end outliers driving GE2 and Theil are disproportionately concentrated in specific spatial areas Urban Jayapura and Urban Timika rather than distributed throughout the within-area distribution. Figure 7e summarises the share of overall inequality attributable to the spatial component under both empirical and Shapley decompositions across the full study period.

As in the Mozambique reference analysis, the empirical (non-Shapley) spatial share for the Gini index substantially overstates the spatial contribution due to path dependency. The empirical figures for GE2 similarly distort in the opposite direction for some periods, confirming the importance of the Shapley approach for obtaining internally consistent inequality shares across measures.

Detailed contributions to inequality by area

Figure 8 shows each area's contribution to spatial and non-spatial inequality as a percentage of overall inequality in the most recent survey wave (2025). Urban Jayapura makes the largest single spatial inequality contribution (approximately 13 percent of between-area inequality, or nearly 4 percent of overall inequality) because it is both the most affluent area and contains a substantial share of the regional population. Papua Pegunungan rural areas contribute the second largest spatial share (approximately 11 percent of between-area inequality) by virtue of being the furthest below the regional mean. Urban Timika/Papua Tengah contributes a disproportionately large spatial share relative to its population share due to its extreme position at the upper tail of the area mean distribution.



Note: Areas sorted by their contribution to spatial inequality. Source: Author's construction using SUSENAS household surveys.

Figure 8. Contributions to Spatial (Between-area) and Non-spatial (Within-area) Inequality (Gini Index) by Area in 2025 (% Overall Inequality), Shapley Decomposition.

The largest overall contributions to total inequality, combining spatial and non-spatial channels, originate from Urban Jayapura (approximately 14 percent of total Gini inequality) and the Papua Pegunungan rural cluster (approximately 12 percent), primarily through their within-area and between-area components respectively. Rural Papua coast and rural Papua Barat areas contribute substantially to within-area inequality relative to their population shares due to moderate internal heterogeneity, while contributing modestly to spatial inequality because they sit closer to the regional mean consumption.

Phase I: 2010 to 2014

The period from 2010 to 2014 is characterised by moderate but sustained overall inequality growth driven primarily by increasing within-area inequality in urban areas most notably Urban Jayapura and Urban Timika alongside a weakly mitigating spatial inequality component (Azzarri & Signorelli, 2021; Cörvers & Mayhew, 2021). This phase coincides with the early expansion of Freeport operations and the acceleration of Special Autonomy fiscal transfers, both of which concentrated their primary income effects among existing formal-sector workers in urban areas rather than distributing broadly across the regional population.

The most important drivers of the inequality increase during this period were the rising consumption share of the top quintile in Urban Jayapura, where the rapidly expanding government payroll and construction boom predominantly benefited households with existing connections to formal employment networks, and the initial income surge among contract workers and formal employees in Urban Timika. Spatial inequality declined slightly as Special Autonomy transfers expanded government employment even in smaller towns and in some rural regencies, producing a modest convergence effect that partially offset the rising within-area divergence.

Figure 9, top left panel, shows that the inequality contributions of most rural areas to the change in overall inequality were small and relatively uniform during this period, with Urban Jayapura's large positive spatial distributive contribution being the main structural feature(Aginta et al., 2021; Aginta & Someya, 2022). This is consistent with early-phase development dynamics in which the capital's advantages compound while the non-capital urban and rural areas lag without systematically diverging.

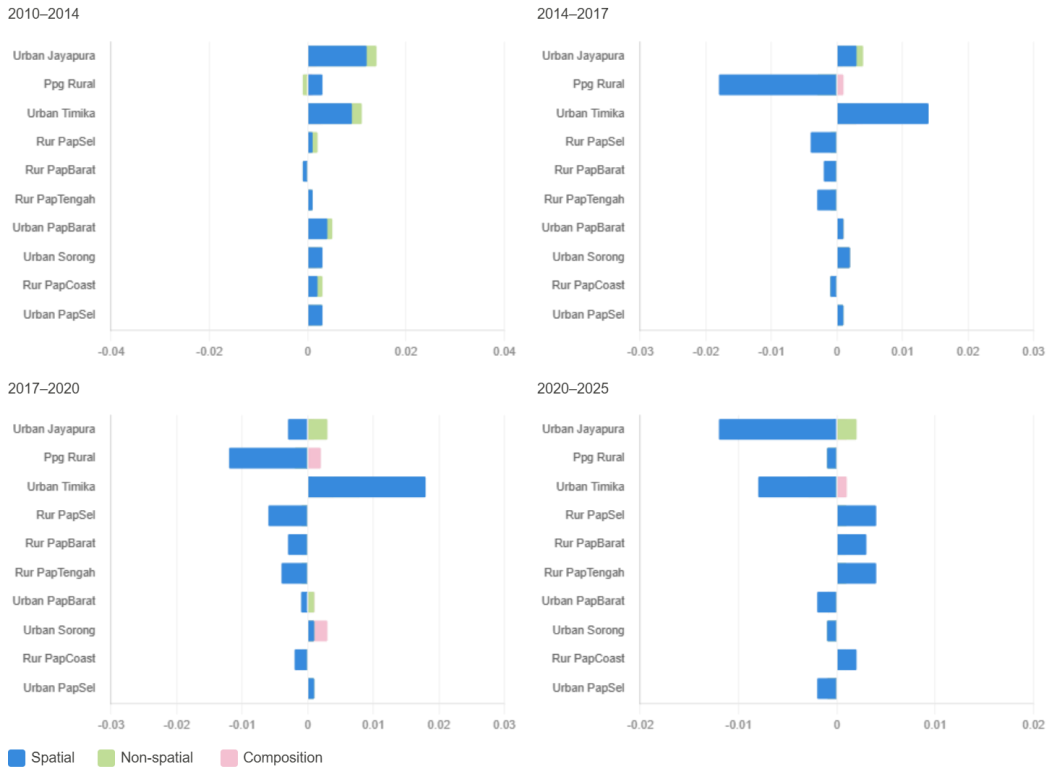


Figure 9. Contributions to the Change in Inequality by Area through Spatial (Between-area) and Non-spatial (Within-area) Inequality (Gini Index, Shapley Decomposition).

Phase II: 2014 to 2022

Contrary to the earlier period, spatial inequality entirely explains the dramatic upward movement in inequality between 2014 and 2020 and then accounts for most of the partial decline observed in 2022. This phase encompasses the commodity price downturn (from 2014), the Freeport operational dispute and production contraction (2017 to 2018), the intensification of armed conflict in highland areas (from 2019 onwards), and the COVID-19 pandemic (2020).

Between 2014 and 2017, the growing spatial divergence was driven primarily by the deepening consumption deficit in Papua Pegunungan rural areas, which experienced a combination of conflict-induced market disruption (particularly in Nduga, Intan Jaya, Puncak Jaya, and Lanny Jaya), the contraction of agricultural output following weather shocks, and the withdrawal of some government services from conflict-affected areas. The declining rural hinterland areas (Papua Pegunungan rural, rural Papua Tengah periphery, and rural Papua Barat) together account for approximately 58 percent of the increase in overall inequality during the 2014 to 2017 period. Urban Timika simultaneously experienced a relative consumption decline as Freeport's operational disputes curtailed mining royalties and reduced local contract employment.

Between 2017 and 2020, the dynamics shifted markedly. Urban Timika's consumption surged as Freeport resolved its contractual dispute with the Indonesian government and resumed full operations, with the divestiture agreement of 2018 further stimulating local procurement and employment. This area's positive distributive spatial contribution accounts for approximately 28 percent of the increase in overall inequality during this period. Simultaneously, the continued deterioration of conditions in Papua Pegunungan rural areas driven by sustained conflict, the COVID-19 disruption of supply chains to remote areas, and the displacement of highland communities contributed an additional 34 percent of the inequality increase through negative spatial distributive effects. Urban Jayapura, relatively less affected by Freeport dynamics and experiencing a pre-pandemic consumption plateau, contributed a mitigating spatial effect as its advantage over other areas narrowed marginally.

The 2022 post-pandemic survey shows a reduction in overall inequality driven almost entirely by spatial effects. Urban Jayapura and Urban Timika both recorded consumption declines relative to their 2020 levels, reflecting the delayed impact of the pandemic on formal employment, government payroll constraints, and

the disruption of commodity export logistics. Simultaneously, the partial recovery of some rural areas particularly along the coastal strip of Papua province where mobility restrictions were less severe and subsistence food production was less disrupted reduced the spatial gap modestly. Together, these effects account for the majority of the 2020 to 2022 decline in the Gini index from approximately 0.412 to 0.389.

The 2022 to 2025 period shows a partial reversal. Urban areas are recovering their relative position as formal employment expands and the government resumes capital expenditure following post-pandemic fiscal consolidation. Papua Pegunungan rural areas, still subject to active conflict in multiple regencies, have experienced only limited consumption recovery. This is consistent with the pattern documented by the Human Rights Monitor (2022, 2025) and Arfiansyah (2026), who note that the conflict in highland Papua remained unresolved and indeed intensified in intensity and geographic scope between 2022 and 2025, with security operations disrupting livelihoods and mobility in Intan Jaya, Nduga, Yahukimo, and other highland regencies. Figure 9, middle and lower panels, details these contributions area by area for both the 2014 to 2020 and 2020 to 2025 periods under the Shapley decomposition, distinguishing spatial distributive, non-spatial distributive, and compositional effects.

Household-Level Driving Factors of Spatial Inequality

Figure 10 presents the decomposition of changes in spatial inequality by household-level characteristics. Changes in the distribution of educational attainment (the share of household heads with secondary or higher education) are the dominant explained factor driving spatial inequality increases in every inter-survey period, consistent with the finding in Table 2 that education remains extraordinarily spatially concentrated in Urban Jayapura and Urban Timika. The education composition effect accounts for approximately 42 percent of the explained increase in spatial inequality during the 2017 to 2020 period the sharpest phase of spatial divergence and approximately 38 percent during the 2014 to 2017 period.

Figure 11 shows that educational distribution changes also substantially raise within-area (non-spatial) inequality between 2010 and 2020, while the consumption returns to education operated in an equalising direction throughout most of the period meaning that education inequality within areas was partly offset by falling educational wage premiums within each area. During 2020 to 2025, labour characteristics took on greater importance in driving within-area changes, with the post-pandemic labour market reorganisation differentially affecting formal and informal workers.

Figures 10 & 11. Decomposition of Changes in Spatial (Figure 10) and Non-spatial (Figure 11) Inequality by Household-level Characteristics: (a) Composition (Explained) Effect; (b) Distributive (Unexplained) Effect.

Labour market characteristics (sector of employment, formal-informal status, and type of activity) contribute additionally in later periods, reflecting the growing importance of the formal employment premium in driving spatial inequality as off-farm wages diverged more sharply between the Timika-Jayapura axis and the highland rural areas. The unexplained (intercept) component remains substantial throughout, indicating that differences in consumption returns to given levels of education and labour market participation likely reflecting geographic access to services, market integration, and asset ownership also play a significant role that the observed characteristics do not fully capture.

Robustness Check, Controlling for The Impact of Outliers

The use of relatively small area samples particularly for Papua Pegunungan rural and rural Papua Tengah periphery, which together have fewer than 3,000 observations in some survey rounds creates sensitivity to extreme consumption values. The robustness analysis replicates the main findings using distributions with bottom and top coding of extreme values defined as those lying more than three times the interquartile range above the third quartile or below the first quartile in the log distribution, (Miranti, 2021; Rumkabu et al., 2023b; Wahyuni et al., 2022).

The main findings are robust: the trend in overall, spatial, and non-spatial inequality is preserved under top and bottom coding, and the qualitative contribution patterns for Urban Jayapura, Urban Timika, and Papua Pegunungan rural areas are maintained. The most notable difference is that the contribution of Urban Timika to the 2017 to 2020 inequality increase is reduced under smoothing, consistent with the observation that its large mean consumption is partly driven by a small number of very high earners whose measured consumption may be subject to recall or imputation error (Sudira et al., 2020)(Gradín, 2020; Gunawan et al., 2021). The highland rural areas' contribution is essentially unchanged under smoothing, confirming that their inequality contribution operates through the spatial channel (low area means) rather than through extreme within-area observations.

CONCLUSION

Concluding Remarks

Papua and West Papua have maintained one of the highest and most persistent levels of consumption inequality in Indonesia over the past fifteen years, with the spatial dimension of this inequality the gap between well-defined areas defined by province and urban-rural zone emerging as the primary driver of the upward trend from 2014 onwards. This paper has applied an innovative regression-based decomposition framework grounded in the Recentred Influence Function and the Shapley approach to demonstrate this finding consistently across multiple inequality measures and to identify its area-level and household-level determinants. The central spatial tension driving inequality in the region is threefold. First, Urban Jayapura concentrates government employment, financial services, and formal sector activity in ways that deliver high and growing consumption levels to a relatively small share of the regional population. Second, Urban Timika in Papua Tengah captures the fiscal and wage rents from Freeport's mineral extraction, producing extraordinary average GRDP but a highly skewed household consumption distribution that benefits a small number of formal workers and contractors disproportionately. Third, Papua Pegunungan rural areas containing a large share of the total population are systematically excluded from both dynamics by geographic isolation, active armed conflict, infrastructural deficits, and limited formal market integration.

Several concerns about the future trajectory of inequality are worth highlighting. The Indonesian government's plans to expand LNG extraction from the Blok Wabu and Abadi fields in Papua Barat Daya and the surrounding area, and the continued growth of palm oil concessions in Papua Selatan's Merauke regency, risk reproducing the enclave dynamic already observed in Timika if fiscal linkages to surrounding communities and indigenous landowners are not structurally different from the Freeport experience. As Sudira et al. (2020) and Rumkabu et al. (2023b) document, the pattern by which resource extraction benefits concentrate in an urban enclave while the communities bearing the externalities remain in deep poverty is deeply entrenched and has proved resistant to Special Autonomy transfers in their current design. The Special Autonomy framework's ability to structurally reduce spatial inequality depends critically on whether funds are directed to areas where spatial disadvantage is most severe which are disproportionately the highland zones where conflict and isolation compound rather than being captured by existing administrative structures concentrated in coastal urban centres.

Climate-related risks add a further concern. Papua's biodiversity-rich lowlands are highly exposed to flooding, while highland areas face increasing landslide risk associated with deforestation. As these events disproportionately affect communities already at the bottom of the consumption distribution, they may widen the spatial gap further even in the absence of other adverse developments. The findings here suggest that a sustained policy commitment to reducing spatial inequality in Papua and West Papua requires not only fiscal redistribution but also a resolution of the armed conflict in highland areas, which is both a cause and a consequence of the extreme spatial deprivation documented in this paper.

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