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The Resource Curse Reconsidered: Mining Expansion and Agricultural Performance in South Kalimantan, Indonesia, 2010–2024

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Abstract

The resource curse hypothesis predicts that mining expansion weakens agriculture. We test this prediction at the subnational scale using a 2010–2024 panel of 13 regencies and cities in South Kalimantan, Indonesia (195 regency-year observations). Between 2010 and 2024, absolute agricultural output rose in every unit, by 39% to 63%, even though agriculture's share of total gross regional domestic product (GRDP) fell in all 13 units. Estimates of the mining–agriculture relationship depend heavily on specification: with regency effects only, mining and agricultural output are positively associated ($\beta = +0.459$, $p = 0.008$), whereas adding year effects yields a small negative elasticity ($\beta = -0.065$, $p = 0.020$). Regency-level Granger tests, limited by short series, give no consistent evidence that mining precedes agricultural decline. The fall in agricultural share is consistent with a denominator effect: agriculture grew by 2.92% a year on average against 4.55% for total GRDP, a gap of −1.63 percentage points ($p < 0.001$). No regency shows a simultaneous fall in both absolute output and share. The results are descriptive and do not establish causality, but they suggest that a declining agricultural share in mining regions should not be read, on its own, as evidence of a resource curse. We discuss implications for land protection, revenue sharing, and post-coal transition planning.

Keywords: resource curse; mining–agriculture nexus; denominator effect; structural transformation; panel data; South Kalimantan

1. Introduction

Natural resources are often regarded as a catalyst for development because they generate public revenue, export earnings, employment, and investment. Botswana is the most frequently cited example of a mineral-rich country that converted its resource wealth into sustained growth through sound institutions and careful rent management [1,2]. Nevertheless, a large body of empirical literature points to the opposite conclusion. Beginning with Auty [3] and Sachs and Warner [4,5], many studies report that resource-abundant economies grow more slowly, face greater macroeconomic volatility, and have weaker institutions than resource-poor ones, a pattern known as the resource curse [6,7]. However, the evidence remains inconclusive. Meta-analyses and recent surveys report mixed results that depend on how resources are measured, on the sample, and on the estimator [8–10].

Several mechanisms have been proposed. The classic Dutch disease argument holds that a booming extractive sector causes real exchange rate appreciation and draws labor and capital away from tradable activities, including agriculture [11]. A second line of work

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stresses institutions, arguing that governance, accountability, and rent management decide whether resource abundance becomes a blessing or a curse [12–14]. Both lines of argument tend to treat the interaction between resource endowments and domestic sectors as uniform, and say little about how regional economic structure shapes it. Evidence from Indonesian districts suggests that local conditions matter: the effect of mining booms on manufacturing depends on whether extraction is capital- or labor-intensive [15].

Most resource curse studies compare resource-rich with resource-poor places, which implicitly treats resource-dependent regions as a single group. In practice, extractive frontiers are heterogeneous. Some function as extractive enclaves; others remain agrarian, and many host both activities side by side [16,17]. Where mining and farming overlap, they compete for land, labor, capital, and infrastructure, and national or provincial averages cannot capture that competition. The problem is closely related to spatial non-stationarity, the tendency of economic relationships to vary across space because of local structural, institutional, and environmental conditions [18]. Ignoring such variation can yield uniform policy prescriptions that are poorly suited to many localities.

Indonesia is a particularly relevant setting. It is one of the world's largest coal producers and exporters, with a record output of about 836 million tons in 2024 [19], followed by roughly 790 million tons in 2025, with the government planning to reduce output to about 600 million tons in 2026 [20]. The evidence on what extraction has meant for local development in Indonesia is mixed. Some studies find positive effects on local manufacturing where mining is capital-intensive [15]. Others document stagnant human development, limited structural change, and sharp economic collapse once mines close, as on Singkep Island [21]. Mining expansion has also been linked to land-use conflicts, environmental damage, and the displacement of rural livelihoods. Indonesian licensing and land law tend to favor coal over other land uses, including smallholder food production [22]; research on coal–cropland overlap in China documents farmland and yield losses [23]; and work in India shows agriculture-based livelihoods giving way to coal-based ones as mines expand [24].

Within this national context, South Kalimantan is a useful subnational case. It is one of Indonesia's leading coal-producing provinces, with around 237 million tons in 2024 according to the Ministry of Energy and Mineral Resources [25], roughly 28% of national output, while agriculture remains an important source of rural employment and livelihoods [26]. The province is also internally diverse: some regencies depend heavily on mining; others are predominantly agricultural, and several combine the two [26].

This study addresses an empirical gap by reconsidering the resource curse hypothesis at the subnational level. Earlier work has documented negative associations between extraction and agricultural performance, but it has paid little attention to whether those associations reflect a genuine curse or simply a change in economic structure, and whether they differ across regions with different economic profiles. It is unclear whether regions where mining and agriculture coexist face the same displacement pressures as regions specialized in one sector.

We address three research questions: (1) Is there evidence of a resource curse in South Kalimantan? (2) How does the mining–agriculture relationship vary across space and time? (3) What explains the observed decline in agriculture's share of regional output? To answer them, we use a panel of 13 regencies and cities observed over 15 years.

The study makes three contributions. First, it brings subnational evidence to the resource curse debate by separating share-based from absolute measures of agricultural performance. Second, it shows how the mining–agriculture relationship differs across regional economic structures. Third, it makes explicit and quantifies a denominator effect: a falling agricultural share does not by itself imply a shrinking agricultural sector. Concerns

that ratio-based measures can mislead in resource curse research are not new [27]; we apply the idea directly to regional agricultural performance and measure its size. Absolute agricultural output grew in all 13 regencies, and the negative association found in two-way fixed-effects models is sensitive to specification, as we show below.

2. Materials and Methods

2.1. Study Area

The empirical analysis covers South Kalimantan Province in southeastern Kalimantan (Figure 1). The province has an area of 38,744 km^2 and comprises 11 regencies and two cities, Banjarmasin and Banjarbaru, giving 13 administrative units. For brevity, we refer to all units as regencies. The internal economic diversity noted in the Introduction makes the province a suitable setting for studying spatial heterogeneity in the mining–agriculture relationship.



Figure 1. Study area map of South Kalimantan Province, Indonesia.

2.2. Data Sources

We use secondary data from Statistics Indonesia (Badan Pusat Statistik, BPS) at the regency level for 2010–2024 (Table 1) [28–33]. The panel contains 195 observations from 13 regencies over 15 years and spans both the period before the COVID-19 pandemic and the subsequent period of intensive mining expansion. Because the data cover all 13 administrative units in the province, the analysis is close to a census rather than a sample. All monetary values are expressed as gross regional domestic product (GRDP) at constant 2010 prices. BPS also publishes provisional values for 2025, some of which are volatile; for example, agricultural GRDP in Balangan rises by 17.7% between 2024 and 2025, against roughly 2% to 8% in the other regencies. This value is reported as published by BPS; however, to limit the influence of provisional data, the zone classification (Tables 2 and 3, Figure 2), the endpoint comparison (Table 4, Figure 3), the panel regressions (Tables 5 and 6, Figures 4–6), the Granger tests (Table 7), the growth-gap analysis (Table 8), and the robustness checks (Table 9) use the 2010–2024 series. The 2025 values enter only the sensitivity checks: the estimate that adds 2025 to the panel (Table 9) and Supplementary Table S1.

Table 1. Data types and sources.

Data Type	Source	Period	Unit of Analysis	Notes
Agricultural GRDP (constant 2010 prices)	BPS	2010–2024	13 regencies/cities	2025 values are provisional

Table 1. *Cont.*

Data Type	Source	Period	Unit of Analysis	Notes
Mining GRDP (constant 2010 prices)	BPS	2010–2024	13 regencies/cities	2025 values are provisional
Total GRDP (constant 2010 prices)	BPS	2010–2024	13 regencies/cities	2025 values are provisional
Geographic boundaries/coordinates	Badan Informasi Geospasial (BIG); GADM	—	13 regencies/cities	Official geospatial data

Source: Compiled from Badan Pusat Statistik (BPS) annual publications on regency/city GRDP of South Kalimantan (all in Indonesian). By industry: PDRB Kab/Kota di Kalimantan Selatan Menurut Lapangan Usaha 2009–2011 (released 12 December 2012; catalogue no. 9302008.63; publication no. 63550.1205) [28]; Produk Domestik Regional Bruto Kabupaten/Kota Di Kalimantan Selatan Menurut Lapangan Usaha Tahun 2011–2013 (1 October 2014; 9302008.63; 63550.1406) [29]; Produk Domestik Regional Bruto Kabupaten/Kota se Kalimantan Selatan Menurut Lapangan Usaha 2014–2018 (16 August 2019; 9302008.63; 63550.1907) [30]; Produk Domestik Regional Bruto Kabupaten/Kota se-Kalimantan Selatan Menurut Lapangan Usaha 2017–2021 (5 April 2022; 9302008.63; 63000.2205) [31]; and Produk Domestik Regional Bruto Kabupaten/Kota di Provinsi Kalimantan Selatan Menurut Lapangan Usaha 2020–2024 (11 April 2025; 9302008.63; 63000.25006; ISSN 2460-2981) [32]. The provisional 2025 values come from Tinjauan Produk Domestik Regional Bruto Kabupaten/Kota se-Provinsi Kalimantan Selatan 2025 (released 5 June 2026; catalogue no. 9399001.63; publication no. 63000.26015; ISSN 2460-2973) [33]. All publications were accessed on 20 June 2026, and the editions were combined manually in a spreadsheet. Where editions overlap (2011, 2017–2018, and 2020–2021), the values from the most recent edition covering that year were used.

2.3. Variable Specifications

Dependent variables. The first outcome is agricultural share, defined as agricultural GRDP (Y^{A}_{it}) as a percentage of total regional GRDP (Y^{T}_{it}) for regency i in year t:

$$S^{A}_{it} = Y^{A}_{it}/Y^{T}_{it} \times 100$$

The second outcome, used in the panel regressions, is the natural log of absolute agricultural GRDP ($\ln Y^{A}_{it}$). It does not depend on the size of other sectors and so addresses the denominator problem directly.

Independent variables. Mining share is mining GRDP (Y^{M}_{it}) as a percentage of total regional GRDP:

$$S^{M}_{it} = Y^{M}_{it}/Y^{T}_{it} \times 100$$

For the mining–agriculture comparison we also use a two-sector definition:

$$S^{M,2s}_{it} = Y^{M}_{it}/(Y^{M}_{it} + Y^{A}_{it}) \times 100$$

2.4. Economic Zone Classification

Regencies were grouped into three zones by their average two-sector mining share over 2010–2024: mining-dominated (>50%), mixed (25–50%), and agriculture-dominated (<25%) (Table 2). Alternative cutoffs (40%, 45%, 55%, and 60%) left the classification largely unchanged (Section 3.5). Because two-sector shares ignore services and industry, which dominate the two cities, the classification of Banjarbaru as mining-dominated reflects its very small agricultural base (Table 4) rather than a large mining sector.

Table 2. Economic zone classification.

Zone	Criteria	Regencies
Mining-dominated	>50%	Balangan, Tabalong, Tanah Bumbu, Banjarbaru, Tapin, Tanah Laut, Kotabaru, Banjar
Mixed	25–50%	Hulu Sungai Selatan
Agriculture-dominated	<25%	Hulu Sungai Tengah, Hulu Sungai Utara, Barito Kuala, Banjarmasin

Note: Banjarmasin is classified as agriculture-dominated based on its two-sector shares, although services and industry dominate its total GRDP (see the text above).

2.5. Analytical Framework

Panel models. The baseline is a two-way fixed-effects model:

$$\ln Y^{A}_{it} = \alpha + \beta \ln(1 + Y^{M}_{it}) + \mu_i + \lambda_t + \varepsilon_{it}$$

where $\ln Y^{A}_{it}$ and $\ln(1 + Y^{M}_{it})$ are the natural log of agricultural GRDP and the natural log of mining GRDP plus one, respectively, with GRDP in million IDR at constant 2010 prices; μ_i are regency fixed effects, λ_t are year fixed effects, and ε_{it} is the error term. Standard errors are clustered by regency. We also estimate a model with regency effects only and a between-regency model on long-run averages. All analyses were conducted in R (version 4.5.2; R Foundation for Statistical Computing, Vienna, Austria) using RStudio (version 2026.05.0, Build 218; Posit Software, PBC, Boston, MA, USA) and the fixest package (version 0.14.0).

Banjarmasin has zero mining GRDP throughout the period. To retain the observation in the panel and avoid dropping a unit, we use ln(1 + Mining GRDP) as the independent variable, with mining GRDP in million IDR at constant 2010 prices (labeled ln(1 + Mining) in Table 5). This transformation preserves the zero-mining observation while allowing the log specification to be estimated; because mining GRDP is large relative to one million IDR in the mining regencies, the coefficient can be read as an approximate elasticity. As a robustness check, we also estimated the models excluding Banjarmasin; the estimates were qualitatively similar (Section 3.5). N = 195 for M1 and M2 (13 regencies × 15 years).

Decomposition of variation. We split the total variation in agricultural output into between-regency and within-regency components using an ANOVA split to assess how much variation remains for fixed-effects estimation to exploit.

Granger causality. For each regency, we test whether lagged mining output helps predict agricultural output, and vice versa, using one lag. Because the level series are trending, the tests are applied to first-differenced series (Table 7). Banjarmasin is excluded because its mining output is zero throughout the period.

Robustness checks. We re-estimate the models with and without year fixed effects, with alternative definitions of mining share, with alternative zone cutoffs, and over different time windows.

2.6. Limitations

The analysis is observational and cannot establish causal effects. With only 13 spatial units, statistical power is limited, especially for between-regency comparisons. The 2020–2024 period includes the COVID-19 pandemic and subsequent commodity price shocks, which year effects only partly absorb. Classifying the two cities by two-sector shares is also imperfect (Section 2.4). Regency-level data on land conversion, employment, and environmental degradation are unavailable for the full period. Section 4.6 returns to these points.

3. Results

3.1. Spatial Economic Dualism in South Kalimantan

South Kalimantan shows spatial economic dualism: mining-intensive regencies sit alongside agriculture-dominated ones within a single provincial boundary. Using the long-run average two-sector mining share for 2010–2024, we classify eight regencies as mining-dominated, one as mixed, and four as agriculture-dominated. This structure is the basis for examining heterogeneity in the mining–agriculture relationship.

Table 3 gives the classification of all 13 regencies with their average mining and agricultural shares over the 15 years. The mining-dominated zone (Balangan, Tabalong, Tanah Bumbu, Banjarbaru, Tapin, Tanah Laut, Kotabaru, and Banjar) has an average mining share of 68.3% and an agricultural share of 31.7%. The mixed zone consists only of Hulu Sungai Selatan, with a mining share of 31.1% and an agricultural share of 68.9%. In the agriculture-dominated zone (Hulu Sungai Tengah, Hulu Sungai Utara, Barito Kuala, and Banjarmasin), agriculture accounts for 98.9% of the combined output of the two sectors and mining for only 1.1%. All shares in Table 3 are two-sector shares, that is, relative to mining plus agriculture rather than to total GRDP.

Table 3. Mining and agricultural shares by zone (two-sector shares), average 2010–2024.

Zone	Criteria (Mining Share)	Regencies	Average Mining Share	Average Agricultural Share
Mining-dominated	>50%	8 regencies	68.3%	31.7%
Mixed	25–50%	1 regency	31.1%	68.9%
Agriculture-dominated	<25%	4 regencies	1.1%	98.9%

Source: Analysis results, 2026.

Mining and agricultural shares follow a clear spatial pattern. Mining-dominated regencies lie mostly along the eastern and southeastern coalfield belt, where coal deposits are abundant and have been working for decades (including Tanah Laut, Tanah Bumbu, and Kotabaru). Agriculture-dominated regencies cluster in the central and southern lowlands, where fertile land supports rice and plantation crops. This pattern is consistent with spatial dependence in regional economies [34] and supports examining spatial heterogeneity [18].

Figure 2 plots the two-sector mining share against the two-sector agricultural share for the 13 regencies. Because both shares are measured relative to mining plus agriculture, they sum 100% for every regency, so the negative relationship between them follows mechanically from their definition. It describes the composition of the two-sector economy and is not independent evidence of economic substitution between mining and agriculture. The panel analysis below uses output levels to examine the relationship.

Both axes use two-sector shares (relative to mining plus agriculture), so the two shares sum 100% for each regency. Colors indicate the three economic zones of Table 2: mining-dominated (green), mixed (purple), and agriculture-dominated (orange). Banjarbaru and Banjarmasin are classified as mining-dominated and agriculture-dominated, respectively, based on their two-sector shares, although services and industry dominate their total GRDP.

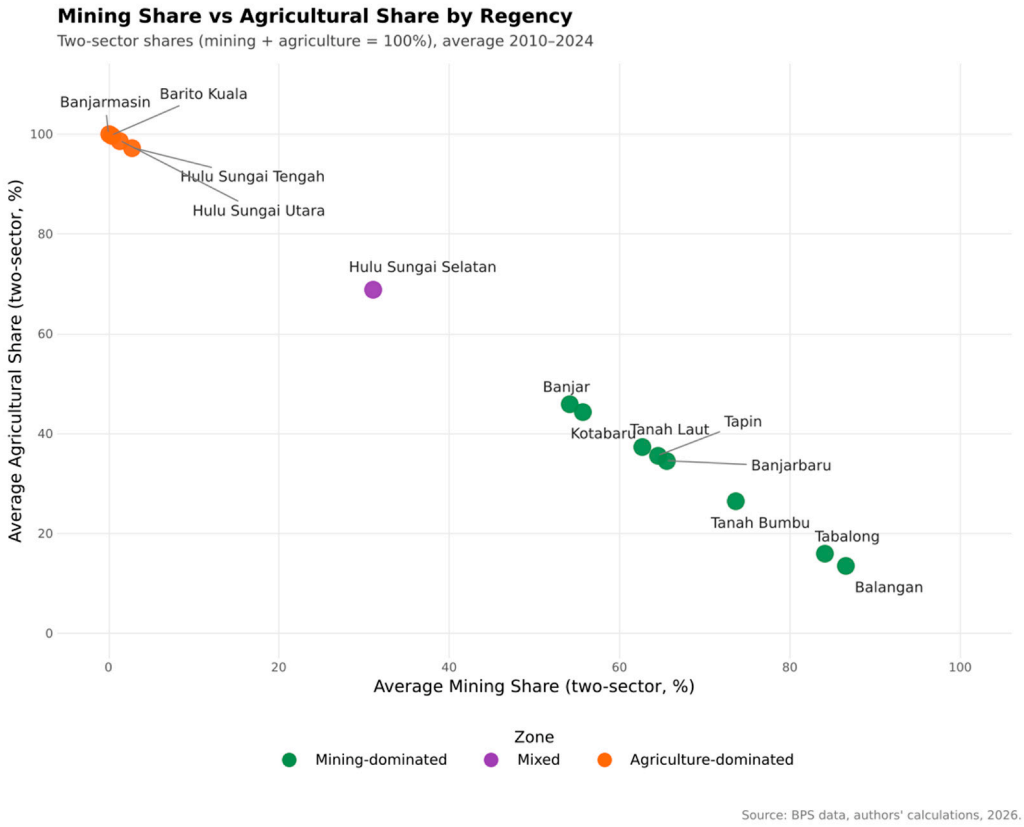


Figure 2. Mining share and agricultural share by regency, average 2010–2024.

3.2. Agricultural Performance: Share Decline Versus Absolute Growth

Between 2010 and 2024, agriculture in South Kalimantan followed a seemingly paradoxical path. Absolute agricultural output grew in all 13 regencies (from +39.1% in Tapin to +62.8% in Tanah Bumbu). However, because total regional GRDP grew faster, agriculture's share of total GRDP declined in all 13 regencies, (by 0.7 to 8.8 percentage points), including the 12 mining-active ones. This divergence between share and absolute measures is the central empirical finding of the study.

Table 4 reports the change in agricultural output for every regency between 2010 and 2024: the absolute change, the percentage growth, and the change in agricultural share. Output rose everywhere, with growth from 39.1% (Tapin) to 62.8% (Tanah Bumbu) and a mean of about 49%. The largest absolute increases were in Kotabaru (+1,255,305 million IDR), Tanah Bumbu (+1,082,705 million IDR), and Tanah Laut (+699,026 million IDR); the smallest were in Banjarbaru (+44,622 million IDR) and Banjarmasin (+209,194 million IDR).

Table 4. Change in agricultural output and share, 2010–2024.

Regency	Agricultural GRDP 2010 (Million IDR)	Agricultural GRDP 2024 (Million IDR)	Δ Absolute (Million IDR)	% Growth	Δ Share of Total GRDP (pp)	Classification
Balangan	724,359	1,110,720	+386,361	+53.3%	−1.5	Denominator effect
Tanah Bumbu	1,723,395	2,806,100	+1,082,705	+62.8%	−1.2	Denominator effect
Tabalong	1,112,928	1,656,146	+543,218	+48.8%	−1.3	Denominator effect
Kotabaru	2,415,773	3,671,078	+1,255,305	+52.0%	−3.2	Denominator effect
Tanah Laut	1,442,854	2,141,880	+699,026	+48.4%	−3.2	Denominator effect

Table 4. *Cont.*

Regency	Agricultural GRDP 2010 (Million IDR)	Agricultural GRDP 2024 (Million IDR)	Δ Absolute (Million IDR)	% Growth	Δ Share of Total GRDP (pp)	Classification
Banjar	1,529,965	2,181,016	+651,051	+42.6%	−4.3	Denominator effect
Tapin	909,588	1,265,182	+355,594	+39.1%	−5.7	Denominator effect
Hulu Sungai Selatan	876,868	1,227,531	+350,663	+40.0%	−8.8	Denominator effect
Barito Kuala	1,246,767	1,746,445	+499,678	+40.1%	−7.0	Denominator effect
Hulu Sungai Tengah	845,330	1,320,517	+475,187	+56.2%	−4.9	Denominator effect
Hulu Sungai Utara	391,485	605,401	+213,916	+54.6%	−3.6	Denominator effect
Banjarbaru	90,846	135,468	+44,622	+49.1%	−0.9	Denominator effect
Banjarmasin	391,390	600,584	+209,194	+53.4%	−0.7	Denominator effect

Source: Analysis results, 2026. Δ Share is the change in agricultural GRDP as a percentage of total GRDP. Classification: "Denominator effect" = absolute output grew, but the share of total GRDP declined.

The contrast is the sharpest in Hulu Sungai Selatan, where agricultural output grew by 40.0% while agriculture's share fell by 8.8 percentage points, the largest share decline in the province. Kotabaru shows a similar pattern, with a 52.0% rise in output and a 3.2-percentage-point drop in share. In both cases agriculture's share fell not because the sector contracted but because total regional GRDP grew faster.

Figure 3 shows this divergence in two panels. Panel A gives the change in agricultural share, which is negative in all 13 regencies. Panel B gives the change in absolute agricultural GRDP, which is positive in all regencies. Read side by side, the panels show how share-based measures can be misled when used alone.

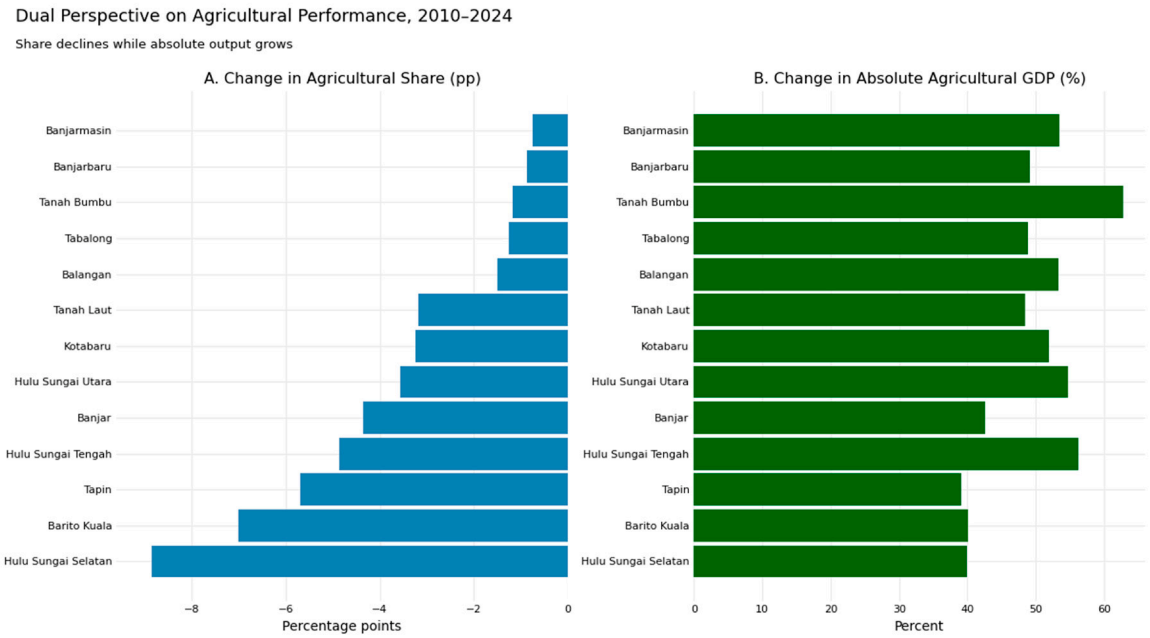


Figure 3. Dual perspective on agricultural performance, 2010–2024. Panel (**A**): Change in agricultural share (pp). Panel (**B**): Change in absolute agricultural GRDP (%).

3.3. Panel Regression Results

To examine the relationship between mining and agricultural output formally, we estimated three panel specifications on the 15-year dataset (195 observations; Table 5): (M1) a two-way fixed-effects model with regency and year effects, (M2) a one-way fixed-effects model with regency effects only, and (M3) a between-regency model on long-run averages.

Table 5. Panel regression results, 2010–2024.

Model	Specification	ln(1 + Mining)	SE	*p*-Value	N	Notes
M1	Within (with year FE)	−0.065 **	0.024	0.020	195	Small elasticity; year effects remove the common trend
M2	Within (without year FE)	+0.459 ***	0.145	0.008	195	Positive and significant
M3	Between	+0.081	0.051	0.143	13	Positive, not significant

Notes: Standard errors are clustered at the regency level with the small-sample correction implemented in the R package fixest; *p*-values for M1 and M2 are from the t distribution with 12 degrees of freedom (13 clusters). *** $p < 0.01$, ** $p < 0.05$. N = 195 for M1 and M2 (13 regencies × 15 years); N = 13 for M3 (regency averages).

The estimates are sensitive to specifications. The two-way model (M1) gives a negative, statistically significant coefficient (−0.065, $p = 0.020$); read at face value; it would suggest that mining expansion is associated with lower agricultural output. Its size is small, though: a 10% increase in mining output corresponds to roughly a 0.6% reduction in agricultural output. When year effects are dropped (M2), the coefficient turns positive and significant (+0.459, $p = 0.008$). The between-regency model (M3) is also positive (+0.081) but not statistically significant ($p = 0.143$). Because there are only 13 clusters, cluster-robust inference can be unreliable [35], and these *p*-values should be read with caution.

To see why the sign flips, we decomposed total variation in agricultural output into between-regency and within-regency components using an ANOVA split (Table 6). Most of the variation lies between regencies: the between-regency component accounts for 97.62% of the total sum of squares, while the within-regency component accounts for only 2.38%. Regency effects remove the stable differences in scale among regencies, which leaves little within-regency variation, and year effects then remove the trend shared by all regencies. The specifications therefore estimate different quantities. M2 uses changes over time within each regency, including the trend that all regencies share. M1 also removes year's effects, so it uses only deviations from both the regency mean and the common trend. The small within-regency share means that M1 rests on a limited part of the total variation; this limits what the estimate can tell us, but it does not by itself show that the estimate is unreliable. We take the M1 coefficient as a small, statistically significant negative conditional association, and the sign change between M1 and M2 as showing that the association is not robust to the treatment of common time trends. We do not read either coefficient as evidence for or against a curse.

Table 6. Decomposition of variation in agricultural output.

Source	Sum of Squares	Proportion
Between regencies	128.59	97.62%
Within regencies	3.14	2.38%
Total	131.73	100.00%

Source: Analysis results, 2026. Decomposition based on ANOVA split of log agricultural GRDP for 195 regency-year observations.

The correlation between yearly averages of log mining and log agricultural output is +0.98 (Figures 4–6). Both sectors grew over the 15 years, and the near-perfect correlation reflects that shared upward trend. A correlation between two trending series cannot show that the sectors reinforce one another, but it is difficult to reconcile with a pattern in which mining growth came at the expense of agricultural output.

We also ran Granger causality tests separately for each regency (Table 7), using one lag. No regency shows significant Granger causality from mining to agriculture at the 5% level. Three regencies (Banjar, Hulu Sungai Tengah, and Tanah Laut) are significant in the opposite direction (agriculture to mining, $p = 0.028$, 0.020, and 0.029). With 24 tests, about one rejection at the 5% level is expected by chance, and none of the three survives a Bonferroni correction, so we do not interpret them individually. With only 15 annual observations per regency (13 after differencing and lagging) and a single lag, these tests have low power, so they are a weak check. The tests use first-differenced series because the level series are trending (Figure 6). A failure to detect a predictive relationship under this sample and specification is compatible with several explanations, including shared drivers such as regional growth, infrastructure, and population, but the tests cannot distinguish among them.

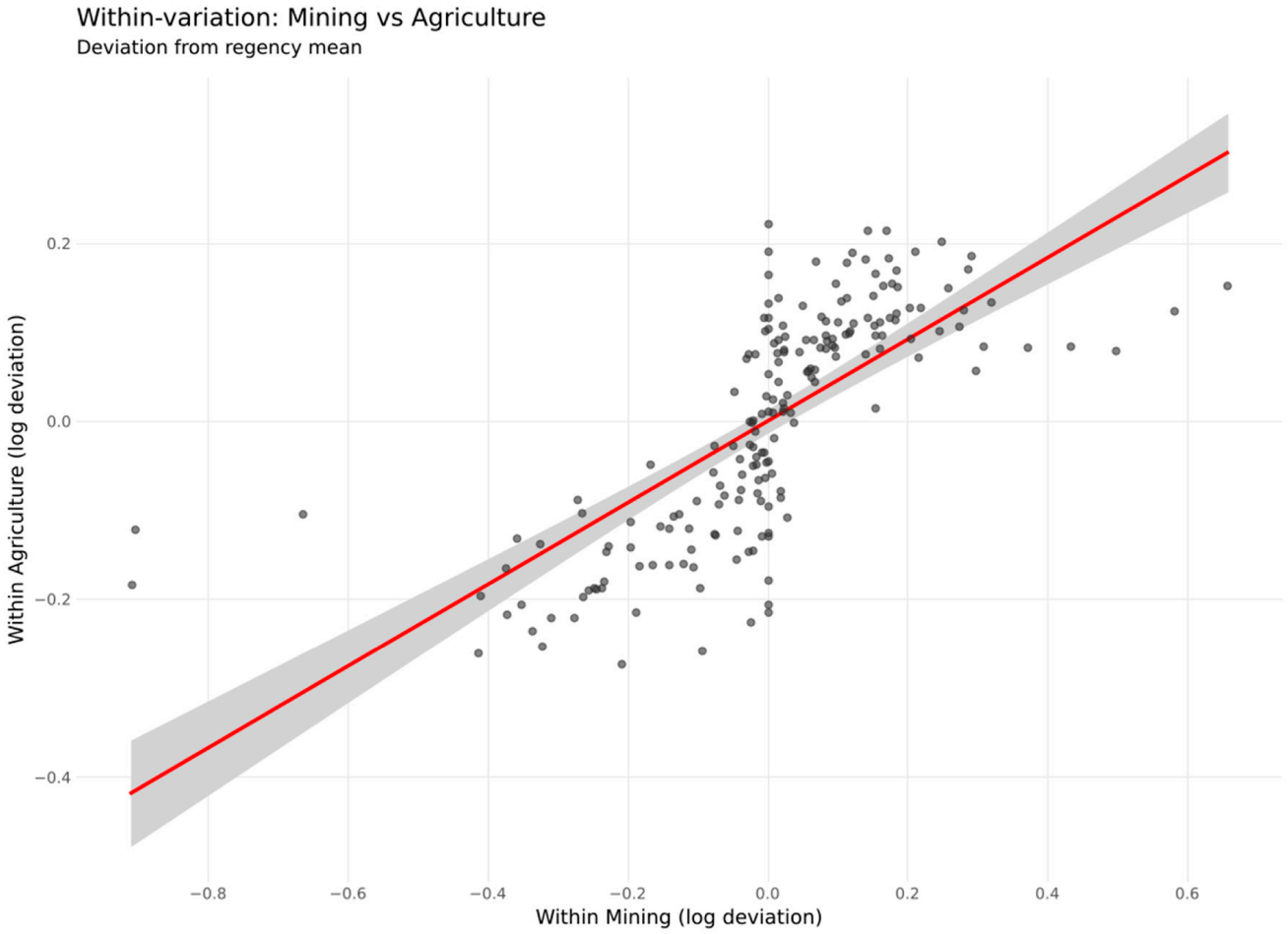


Figure 4. Within-variation: Mining versus Agriculture. Grey points show regency-year observations; the red line is the fitted linear trend and the grey band is its confidence interval.

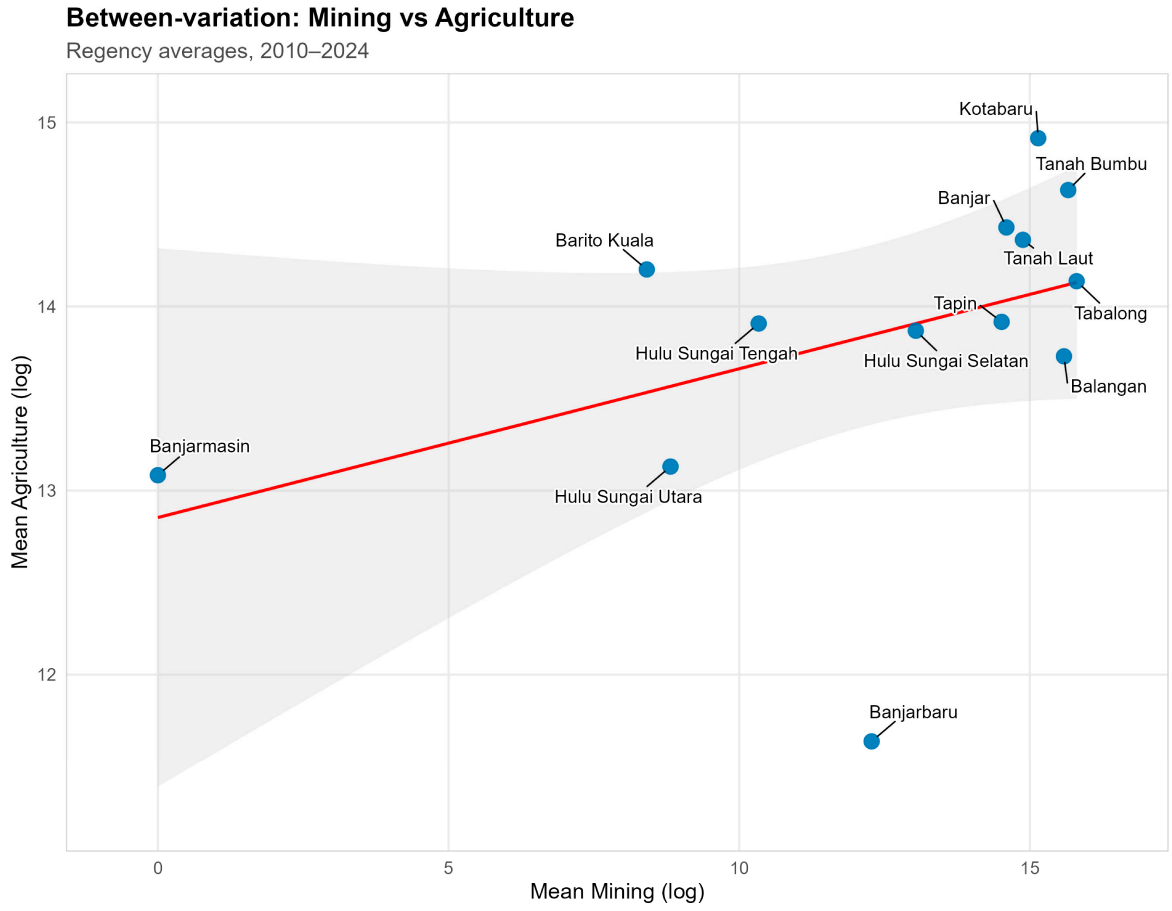


Figure 5. Between-variation: Mining versus Agriculture. Blue points show regency averages; the red line is the fitted linear trend and the grey band is its confidence interval.

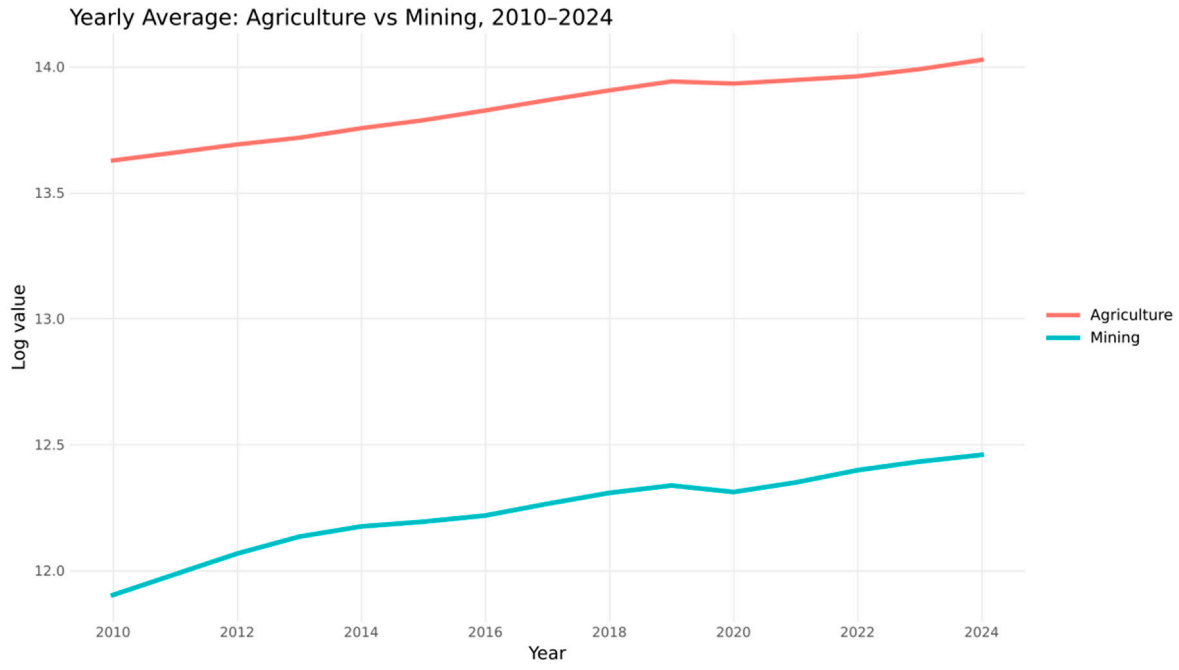


Figure 6. Yearly trend: Agriculture versus Mining, 2010–2024.

Table 7. Granger causality tests, per regency.

Regency	Mining → Agriculture (*p*-Value)	Agriculture → Mining (*p*-Value)
Balangan	0.452	0.204
Banjar	0.170	**0.028**
Banjarbaru	0.543	0.824
Banjarmasin	—	—
Barito Kuala	0.058	0.524
Hulu Sungai Selatan	0.433	0.990
Hulu Sungai Tengah	0.879	**0.020**
Hulu Sungai Utara	0.713	0.640
Kotabaru	0.673	0.087
Tabalong	0.746	0.346
Tanah Bumbu	0.984	0.256
Tanah Laut	0.866	**0.029**
Tapin	0.340	0.582

Notes: Granger causality tests using one lag on first-differenced series to address non-stationarity. Banjarmasin is excluded because it has zero mining activity throughout the period, so the test is not identified. Bold indicates $p < 0.05$. With 24 tests (12 regencies × 2 directions), approximately one rejection at the 5% level is expected by chance. Results should be interpreted with caution given the short series (15 annual observations per regency).

3.4. The Denominator Effect: Quantifying the Growth Gap

To quantify the denominator effect, we computed the average annual growth rates of agricultural GRDP and of total GRDP for each regency over 2010–2024. The growth gap is agricultural growth minus total GRDP growth. The average growth rates are arithmetic means of annual year-on-year growth rates over 2010–2024, not compound (geometric) growth rates. A negative gap means that agriculture grew more slowly than the regional economy. Because a share is a ratio, the gap approximates the annual proportional change in agriculture's share, but only as a local approximation: the realized change over 2010–2024 depends on the initial share and on the whole path of annual growth rates.

Table 8 gives the results. The mean gap across the 13 regencies is −1.63 percentage points (95% CI: −2.05 to −1.21, based on the t distribution with 12 degrees of freedom; $p < 0.001$): on average, agricultural output grew 1.63 percentage points a year more slowly than total regional GRDP. The gap is negative in all 13 regencies and significant at the 10% level or better in eleven of them; it is not significant in Balangan and Tanah Bumbu.

Table 8. Growth gap between agriculture and total GRDP, 2010–2024.

Regency	Avg. Growth Agriculture (%)	Avg. Growth Total GRDP (%)	Gap (pp)	Significance
Balangan	3.12	4.15	−1.03	ns
Banjar	2.58	4.38	−1.80	***
Banjarbaru	2.91	5.95	−3.04	***
Banjarmasin	3.13	5.27	−2.14	***
Barito Kuala	2.46	4.21	−1.75	***
Hulu Sungai Selatan	2.46	4.95	−2.49	***

Table 8. *Cont.*

Regency	Avg. Growth Agriculture (%)	Avg. Growth Total GRDP (%)	Gap (pp)	Significance
Hulu Sungai Tengah	3.26	4.65	−1.40	***
Hulu Sungai Utara	3.22	4.70	−1.48	*
Kotabaru	3.04	4.28	−1.24	***
Tabalong	2.89	3.81	−0.92	*
Tanah Bumbu	3.56	4.12	−0.55	ns
Tanah Laut	2.88	4.11	−1.23	*
Tapin	2.46	4.57	−2.12	**
Mean	2.92	4.55	−1.63	***

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, ns = not significant. Gap = agricultural growth − total GRDP growth. Means are simple averages of the 13 regencies. Growth rates are arithmetic means of annual year-on-year rates (14 annual observations per regency). Stars for individual regencies come from one-sample t-tests of whether the mean annual gap differs from zero; because annual growth rates can be serially dependent, these *p*-values are descriptive indicators rather than formal tests. The test for the cross-regency mean (−1.63 pp) is a separate one-sample t-test across the 13 regency means (12 degrees of freedom; $p < 0.001$).

The largest gaps are in Banjarbaru (−3.04 pp), Hulu Sungai Selatan (−2.49 pp), Banjarmasin (−2.14 pp), and Tapin (−2.12 pp). The smallest are in Tanah Bumbu (−0.55 pp) and Tabalong (−0.92 pp), both mining-dominated regencies; Tanah Bumbu also has the fastest average agricultural growth (3.56% a year). The gaps vary across regencies, which suggests that the size of the denominator effect depends on local economic structure and on how fast total output is growing.

Tables 4 and 8 measure different things. Table 4 compares the 2010 and 2024 end-points, whereas Table 8 summarizes arithmetic mean annual growth rates over the same period, so in principle the sign of the average gap need not match the sign of the full-period change in share. In Tables 4 and 8, the two agree in all 13 regencies: the average gap is negative, and the share of total GRDP declined. For Hulu Sungai Utara, Banjarbaru, and Banjarmasin, for example, total GRDP grew more between 2010 and 2024 than agricultural GRDP (+89.8% versus +54.6%, +123.8% versus +49.1%, and +104.6% versus +53.4%, respectively), so the share of agriculture in total GRDP fell by 3.6, 0.9, and 0.7 percentage points.

3.5. Robustness Checks

We ran several robustness checks. First, we re-estimated the panel models with alternative definitions of mining share: share of total GRDP and share of the two-sector total. The within-regency associations remained positive without year's effects, and the two-way estimates remained negative, as in the baseline; they were significant for the two-sector's share but not for the share of total GRDP (Table 9). Table 9 reports the two-way estimates for these checks. The alternative share measures are on a different scale, so their magnitudes are not comparable with the baseline. The M2 row of Table 9 reports the estimate without year effects.

Second, we dropped Banjarmasin, the only unit with zero mining activity. The two-way coefficient was −0.057 ($p = 0.083$; N = 180), similar in sign and size to the baseline of −0.065 but significant only at the 10% level, so the sign does not depend on this unit although the estimate is less precise (Table 9).

Third, we varied the zoning cutoffs (40%, 45%, 55%, and 60%). Lowering the cutoff to 40% or 45% changes no classification, because no regency has an average mining share between 40% and 50%. At a cutoff of 55%, Banjar (54.1%) moves from mining-dominated to mixed, and at 60% both Banjar and Kotabaru (55.7%) do. Under every cutoff, the other 11

regencies keep their zone. Only these two regencies are therefore sensitive to the threshold, and the classification is largely robust to the cutoff chosen.

Fourth, we estimated the models separately for 2010–2019 and 2020–2024. The coefficient was negative in both periods (−0.041 and −0.066) but not statistically significant in either ($p = 0.221$ and $p = 0.348$; Table 9). These subperiod estimates are imprecise, so we do not claim that the pandemic left the mining–agriculture relationship unchanged.

Fifth, adding the provisional 2025 observations to the panel (N = 208) gave a two-way coefficient of −0.073 ($p = 0.008$), close to the baseline (Table 9). Including 2025 in the endpoint comparison of Table 4 changes, the share declines to between 0.2 and 9.3 percentage points and leaves the conclusions unchanged (Supplementary Table S1, Panel A). Including 2025 in the growth gap of Table 8 gives a mean gap of −1.45 percentage points (95% confidence interval −1.94 to −0.95; $p < 0.001$), negative in all 13 regencies (Supplementary Table S1, Panel B).

Table 9. Robustness checks: coefficient on the mining variable in the two-way fixed-effects model.

Specification	Coefficient	SE	*p*-Value	N	Sig.
Baseline (M1)	−0.065	0.024	0.020	195	**
Within, without year effects (M2)	+0.459	0.145	0.008	195	***
Excluding Banjarmasin	−0.057	0.030	0.083	180	*
Pre-COVID (2010–2019)	−0.041	0.032	0.221	130	ns
Post-COVID (2020–2024)	−0.066	0.068	0.348	65	ns
Adding 2025 (provisional)	−0.073	0.023	0.008	208	***
Alt. mining measure (two-sector share)	−0.004	0.001	0.014	195	**
Alt. mining measure (total share)	−0.004	0.002	0.167	195	ns

Notes: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, ns = not significant. Standard errors are clustered at the regency level with the small-sample correction implemented in the R package fixest, and *p*-values are from the t distribution with G − 1 degrees of freedom (12; 11 when Banjarmasin is excluded), as in Table 5. Each row re-estimates the two-way fixed-effects specification (M1). The alternative mining measures are shared (percentage points), so their coefficients are not comparable in magnitude with the log specification. All rows use 2010–2024 except for the row that adds the provisional 2025 data (N = 208, 2010–2025). The M2 row omits year effects and repeats the estimate in Table 5.

4. Discussion

4.1. Reconsidering the Resource Curse Hypothesis: Evidence from 195 Regency-Year Observations

The central result is narrower than a verdict on the resource curse: in South Kalimantan, a declining agricultural share does not by itself indicate a shrinking agricultural sector, and so cannot on its own establish a resource curse. Between 2010 and 2024, absolute agricultural output grew in all 13 regencies, from 39.1% in Tapin to 62.8% in Tanah Bumbu, with a mean of about 49% (Table 4).

The continued growth of absolute output is inconsistent with the prediction that mining expansion reduces agricultural output through Dutch disease [11], institutional weakening [13], or direct competition for land and labor [22,23]. A curse that took the form of an absolute decline would manifest as falling or stagnating agricultural output in the mining-dominated regencies, which we do not observe. A curse could also operate by slowing agricultural growth relative to what would have happened without mining, and rising output cannot rule that out: agriculture might have grown faster still without mining expansion, and our design cannot identify that counterfactual. Our evidence therefore supports only the narrower conclusion that a falling agricultural share does not necessarily mean falling absolute output.

Three factors could explain why the displacement predicted by the conventional model is not observed; we have not tested these factors directly. First, agriculture in the province, mainly rice and plantation crops, may serve largely local and domestic markets, and distance, transport costs, and local demand may insulate it from the exchange-rate channel of Dutch disease. Open-pit coal extraction is also relatively capital-intensive, and in Indonesian districts where mining is capital-intensive, mining booms put little upward pressure on local manufacturing wages [15], which would weaken the labor-market channel as well. Second, revenue-sharing transfers from mining (Dana Bagi Hasil, DBH) may have been partly reinvested in irrigation, farm roads, and machinery. The transfer rules are set in national law [36], but we have no regency-level data on how the funds were spent. Third, mining and agriculture may both benefit from common drivers such as population growth, infrastructure, and rising regional income.

The Granger tests detect no predictive relationship from mining to agriculture at the 5% level in any regency (Table 7), under the sample and specification used (one lag, first-differenced series). With such short series the tests have low power, so this result neither rules out displacement nor shows that the two sectors are driven only by common factors.

4.2. The Denominator Effect and Share-Based Measures

The third contribution is to make the denominator effect explicit and to measure it. Agriculture's share of regional GRDP fell in all 13 regencies between 2010 and 2024, including the 12 mining-active ones, even though absolute agricultural output grew in all 13. This gap between share-based and absolute measures matters how resource curse research is done.

The mechanism is arithmetic. A sector share is the ratio of its output to total output, so its proportional change is approximately the difference between its own growth rate and the growth rate of the total. In South Kalimantan, agriculture grew by 2.92% a year on average and total GRDP by 4.55%, a simple-average gap of −1.63 percentage points across the 13 regencies ($p < 0.001$). As an approximation, the typical regency agricultural share therefore shrinks by roughly 1.63% of its own level each year, whether agricultural output is rising or falling. This is a local approximation based on a simple average of regency gaps. It is not the realized annual change in the provincial agricultural share, which depends on regency weights, initial shares, and the full path of annual growth.

This matters because many studies measure resource abundance or dependence with ratios, such as resource exports or production relative to GDP [4,6], and sectoral shares are a natural indicator of the contraction in non-resource sectors that Dutch disease predicts [11]. If mining raises total GRDP growth, share-based indicators will decline even when other sectors perform well. Studies that do not separate share-based from absolute measures may then infer a resource curse from data in which every sector is growing. Related concerns about how resource dependence is measured are well established [10,27].

The denominator effect is not unique to South Kalimantan. It can arise in any resource-rich region where the extractive sector, or the economy overall, grows faster than agriculture. Its size depends on the growth differential, on the initial share of the sectors involved, and on the length of the period. It is probably substantial here because mining and total output grew quickly over 15 years. A falling agricultural share is also a standard feature of structural transformation as economies grow [37], which is why it cannot be read on its own as a sign of harm.

Our result is consistent with earlier cautions about ratio-based indicators [27]. By quantifying the effect at the regency level, we offer a simple template for separating genuine resource curse effects from mechanical shifts in shares.

4.3. Interpreting Two-Way Fixed-Effects Estimates

A further point concerns how to read two-way fixed effects estimates in this setting. Our two-way model, with regency and year effects, gives a small negative and statistically significant coefficient (-0.065, $p = 0.020$), whereas the model with regency effects only gives a positive one ($+0.459$). Which is more informative depends on what variation is left once the effects are removed.

As Section 3.3 showed, the most variation in agricultural output is between regencies, with only about 2.4% within regencies. Year's effects then absorb the trend that all regencies share, so M1 identifies the coefficient from deviations around both the regency means and the common trend. The two specifications estimate different quantities: M2 uses within-regency changes over time, including the common trend, whereas M1 uses only deviations around both the regency means and that trend. The small within-regency share of variation limits what M1 can tell us, but it does not show that the estimate is dominated by measurement error. Measurement error, local shocks, and timing differences are possible explanations for a small negative association, but we have not tested them and treated them as conjectures. We therefore report M1 as a small, statistically significant negative conditional association, not as a structural or causal effect. The positive M2 coefficient partly reflects the fact that both sectors grew over time, but we cannot say how much.

The yearly average correlation of $+0.98$ (Figure 6) points to that shared trend. Year effects remove it, which is appropriate when the aim is to control common shocks, but it leaves only idiosyncratic deviations to identify the coefficient.

For resource curse research, the lesson is practical. Researchers should decompose the variation before choosing an estimator, report several specifications, and avoid strong conclusions from a coefficient that changes sign when year effects are added.

This concern is related to, though distinct from, recent work on two-way fixed effects. That literature shows that TWFE estimates of treatment effects can be biased when effects differ across groups or over time [38–40]. Our setting has a continuous regressor rather than a staggered treatment, so those results do not apply directly. We cite them to emphasize that TWFE coefficients need careful interpretation, not as a formal diagnosis of our model.

4.4. Comparison with Previous Research

Our findings agree with research that finds heterogeneous effects of resource extraction depending on local economic structure, institutions, and the type of resource [12,13,15]. They differ from studies that report uniformly negative effects of resource abundance on growth, particularly those that use ratio-based measures [4,5]. Meta-analytic evidence suggests that support for a curse is weak once publication bias and methodological heterogeneity are taken into account [10].

Recent work also stresses that outcomes depend on context. A 2023 survey finds mixed evidence on the curse and attributes the disagreement to differences in samples, resource proxies, and estimators [8]. Studies of Indonesia show that the local effects of mining depend on how labor-intensive extraction is [15] and that closure can bring severe economic collapse where diversification has not taken place [21]. Recent subnational evidence from Africa shows that mining raises economic activity in mining regions, while effects on non-mining regions are heterogeneous and regions specialized in other sectors are often worse off [41]. We do not find such a decline in absolute agricultural output in South Kalimantan, although our regency-level data cannot show whether the mechanisms differ.

Our findings are also consistent with the idea of overlapping resource frontiers [16]. In South Kalimantan, mining and agriculture share one regional economy, and their interaction depends on land use, infrastructure, and fiscal transfers. We find no consistent negative relationship between the sectors in aggregate output: the association is positive with regency

effects only and small but significantly negative in the two-way model (Table 5). This does not make the sectors complementary in every respect: we cannot observe which land is lost, by whom, or how quickly.

At the same time, our results differ from studies that document serious agricultural displacement near mines. Chen et al. [23] find that coal mining subsidence damages farmland and reduces yield in Shandong, China, and work on Indonesia shows that licensing rules favor coal over other land uses, leaving farmers with weak protection when claims overlap [22]. Our data show no such loss in aggregate agricultural output. The difference may reflect the type of mining (open-pit coal in Kalimantan versus underground mining in Shandong), the regulatory setting, and the scale of analysis: regency-level GRDP can hide local losses in affected villages. The 15-year window may also be too short to capture long-run effects on land quality.

4.5. Policy Implications

Because mining and agriculture have grown together in South Kalimantan, restricting mining expansion is neither the only nor the most useful policy lever. Policymakers should instead manage structural transformation so that agricultural productivity keeps pace with the rest of the economy, and the province is prepared for a decline in coal. The post-coal period is a near-term issue: national output fell from its 2024 peak in 2025, and the government has announced a cut to about 600 million tons for 2026 [20], while just-transition work in Indonesia stresses economic diversification, retraining, and region-specific planning [42]. Table 10 summarizes zone-specific priorities derived from our findings.

Table 10. Zone-specific policy priorities.

Zone	Priority	Recommendations
Mining-dominated	High	Manage structural transformation; invest mining revenue in agricultural infrastructure; prepare for post-mining transition
Mixed	High	Protect agricultural land; manage competition for land and labor; diversify economy
Agriculture-dominated	Medium	Protect agricultural areas; enhance productivity; anticipate spillovers

The zone labels in Table 10 describe only the relative composition of mining and agriculture (two-sector shares), not the dominant structure of the whole regional economy. The recommendations apply mainly to rural regencies. Banjarbaru and Banjarmasin are classified by the small size of their agricultural base, while services and industry dominate their total GRDP, so the agricultural recommendations in Table 10 apply to them only to the extent of their small agricultural sectors, and their policy priorities need a separate assessment.

In mining-dominated zones, the priority is to manage structural change. That means investing a share of mining revenue, including DBH transfers, in irrigation, farm roads, and machinery; diversifying beyond mining; and planning for the post-mining period. The collapse of Singkep Island's economy after its tin mines closed shows what can happen when such preparation is missing [21].

In the mixed zone, where agriculture is still economically important and competition for land and labor may be strongest, the priority is to protect farmland through designation and enforcement of Sustainable Food Agricultural Land (LP2B) under Law No. 41/2009 [43]. Options include restricting mining permits on productive rice fields, compensating affected farmers, and diversifying the local economy. Hulu Sungai Selatan, which had the largest

decline in agricultural share (−8.8 pp between 2010 and 2024) despite solid absolute growth (+40.0%), shows why these competing claims need active management.

In agriculture-dominated zones, direct mining pressure is small, but spillovers from neighboring mining regencies are possible. The priority is to protect agricultural areas, raise productivity through research and extension, and monitor spillovers. Barito Kuala's growth gap (−1.75 pp) is close to the provincial mean even though mining there is minimal, so a gap of this size does not by itself indicate mining pressure.

Finally, policy should be built on the right indicator. Instruments tied to agriculture's share of GRDP, such as targets or subsidies, may be ineffective or counterproductive if the real issue is faster growth elsewhere in the economy. Policies that raise agricultural productivity, such as research, extension, and infrastructure, are more likely to keep agriculture competitive as the regional economy diversifies. This also fits the sustainability agenda: protecting food-producing land and planning a managed post-coal transition bear on the Sustainable Development Goals for zero hunger (SDG 2), decent work and economic growth (SDG 8), and life on land (SDG 15) [44].

4.6. Limitations and Future Research

This study has several limitations. First, it is observational and cannot establish causal effects. Panel data and Granger tests help with temporal ordering, but they cannot rule out omitted variables or reverse causality. Future work could use quasi-experimental designs, such as difference-in-differences around permit approvals or commodity price shocks, with estimators suited to heterogeneous effects [39] and panel Granger tests designed for heterogeneous panels [45].

Second, the 13 spatial units limit statistical power, particularly for between-regency analysis. The between-regency coefficient (+0.081) is positive but not significant, which may reflect low power. Larger samples, such as all coal-producing regencies in Indonesia, would allow more precise estimates.

Third, regency-level data on land conversion, employment, and environmental degradation are not available for the full period. These variables would help clarify the mechanisms behind the coexistence of the two sectors, and household surveys, remote sensing, and environmental monitoring could help fill the gap. GRDP is also an aggregate measure of value added: it says nothing about the distribution of benefits or about losses borne by specific communities.

Fourth, the study concerns coal mining in one province. The findings may not carry over to other minerals (such as nickel, gold, or oil) or other regions, so replication in other resource-producing provinces is needed to assess the generality of the denominator's effect.

Fifth, the 2020–2024 period contains the COVID-19 pandemic and subsequent commodity price shocks, which may have affected mining and agriculture differently across regencies. Year effects only partly absorb this, and the subperiod estimates in Section 3.5 are imprecise, so a change in the relationship after 2019 cannot be ruled out.

Sixth, the 2025 observations are provisional estimates, and some are volatile (for example, agricultural GRDP in Balangan rises by 17.7% between 2024 and 2025). The main analysis therefore uses 2010–2024. Adding 2025 to the panel leaves the two-way coefficient close to the baseline (Table 9), and including 2025 does not change the growth-gap result (Supplementary Table S1).

Despite these limitations, the results indicate that the relationship between mining and agriculture in South Kalimantan is more nuanced than a simple curse narrative suggests. By separating share-based absolute measures and quantifying the denominator effect, the study offers a more careful reading of resource extraction and agricultural performance.

5. Conclusions

This study revisited the relationship between mining expansion and agricultural performance in South Kalimantan from 2010 to 2024, using a 15-year panel of 13 regencies (195 observations). Agriculture's share of regional output fell in all 13 regencies, yet absolute agricultural output grew in all 13, and no regency experienced a simultaneous decline in both. A declining agricultural share therefore does not by itself indicate a resource curse. Because the study is descriptive, it cannot show whether agriculture would have grown faster without mining expansion. The estimated mining–agriculture association depends on specification: it is positive with regency effects only and small and negative once year effects are added. The decline in agriculture's share is consistent with a denominator effect, reflecting faster growth in total regional GRDP rather than agricultural decline.

These findings suggest that research should separate share-based absolute measures when assessing agricultural performance in resource-rich regions. For policy, they point toward managing structural transformation, protecting farmland, and preparing a post-coal economy, rather than focusing only on limiting mining expansion. The results are descriptive and cannot establish causality.

Future research should extend the analysis to other resource-producing provinces, use spatial panel models with larger samples, apply quasi-experimental designs, and incorporate household, employment, and land-use data to understand the mechanisms behind mining–agriculture coexistence.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su182111028/s1, Table S1: End-point comparison (Panel A) and growth gap (Panel B), including the provisional 2025 data.

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