SPATIAL DETERMINANTS OF ACCOMMODATION AND FOOD SERVICES SECTOR GRDP IN EAST JAVA: A GEOGRAPHICALLY WEIGHTED PANEL REGRESSION APPROACH

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ABSTRACT

This study investigates spatial heterogeneity in the determinants of Gross Regional Domestic Product (GRDP) in the accommodation and food services sector across 38 districts and cities in East Java Province, Indonesia, over 2022–2024. Using Geographically Weighted Panel Regression (GWPR), we find an extreme spatial concentration (Gini coefficient = 0.82), with Surabaya City contributing 66.36% of provincial sectoral GRDP. The GWPR model significantly outperforms global panel regression, with R^2 increasing from 0.828 to 0.986 and AIC decreasing by 54%, confirming strong spatial heterogeneity. Local coefficient estimates identify four regional typologies with differentiated policy needs: high-efficiency regions (7 regions, all determinants significant), supply-driven regions (9 regions, infrastructure-dependent), demand-driven regions (12 regions, visitor-constrained), and low-efficiency regions (10 regions, structurally constrained). Tourist arrivals show highest elasticity in destination regions (0.94 in Banyuwangi), while accommodation capacity dominates metropolitan cores (1.23 in Surabaya). Results indicate spatially targeted policies aligned with local economic structures are substantially more effective than uniform provincial interventions.

INTRODUCTION

The accommodation and food services sector occupies a strategic position in East Java's economy. At the provincial level, this sector contributed IDR 189.72 trillion to GRDP in 2024 the highest nationally (BPS, 2024). East Java recorded 218.71 million domestic tourist trips and 952,316 international arrivals, supported by 4,055 hotels, reflecting strong demand-side advantages. However, behind these macro-level achievements lies considerable spatial variation. Economic value concentration is extreme: the five largest contributors (Surabaya City, Sidoarjo, Pasuruan, Malang Regency, and Malang City) generate 81.31% of total sectoral GRDP, with Surabaya alone contributing 66.36%. The Gini coefficient of 0.82 and Coefficient of Variation of 405.82% indicate extreme concentration.

This spatial inequality reflects New Economic Geography (NEG) principles emphasizing agglomeration and circular causation strengthening core regions (Krugman, 1991). Surabaya functions as the core region utilizing economies of scale, while peripheral regions face limited absorptive capacity. Most existing studies employ global models assuming uniform inter-variable relationships across locations, yet Zhou et al. (2022) and other recent work demonstrate that tourism variables' influence on economic performance varies significantly across geographical locations, indicating global models often fail to capture inter-regional diversity.

Therefore, this research employs Geographically Weighted Panel Regression (GWPR) to capture spatial variation in determinants' influence on accommodation and food services sector GRDP, enabling spatially-targeted policy

formulation aligned with local economic characteristics. The novel contribution lies in demonstrating that spatial heterogeneity, not just spatial dependence, fundamentally shapes tourism's economic impacts in regional contexts. The research objectives are: (1) to identify spatial clustering patterns of sectoral GRDP; (2) to analyze determinants affecting sectoral GRDP and inter-regional spatial linkages; (3) to prove spatial heterogeneity existence in tourism determinants' influence through local coefficient estimation; and (4) to formulate tourism policy directions based on spatial heterogeneity analysis.

Method

This study analyzes spatial panel data from 38 districts and cities in East Java over 2022–2024, yielding 114 observations sourced from Statistics Indonesia (BPS), the East Java Tourism Office, and regional finance agencies. The dependent variable is GRDP of the accommodation and food services sector (billion IDR at current prices), while the key independent variables capture tourism demand (tourist arrivals in thousands), local purchasing power (per capita expenditure in thousand IDR), supply infrastructure (accommodation capacity measured by available hotel rooms), and public investment (local government tourism budget in billion IDR).

We employ two complementary modeling approaches. First, a global panel regression serves as the baseline, estimating average provincial-level effects through the log-linear specification:

$$\ln (PDRB\_AMM_{it}) = \alpha + \beta_1 \ln (WIS_{it}) + \beta_2 \ln (KAP\_AKOM_{it}) + \beta_3 \ln (PENG\_PK_{it}) + \beta_4 \ln (ANG\_PAR_{it}) + \varepsilon_{it}$$

Chow and Hausman tests selected the Random Effect Model as the preferred global specification. However, recognizing that tourism's economic impacts likely vary across geographic contexts, we develop a Geographically Weighted Panel Regression (GWPR) model that allows each coefficient to vary spatially:

$$\ln (PDRB\_AMM_{it}) = \beta_0(u_i, v_i) + \sum_{k=1}^{4} \beta_k (u_i, v_i) \ln (X_{kit}) + \varepsilon_{it}$$

where $\beta_k(u_i, v_i)$ represents the local coefficient for variable k at geographic coordinates (u_i, v_i). Spatial weighting employs a Gaussian kernel function with adaptive bandwidth optimized through the corrected Akaike Information Criterion (AICc), ensuring each region's parameter estimates reflect influences primarily from nearby locations.

The analysis proceeds in three stages: preliminary diagnostics (multicollinearity via VIF), global model estimation and selection, and GWPR development with spatial heterogeneity testing. Local coefficient estimates then inform a regional typology classification that guides spatially targeted policy recommendations.

RESULT AND DISCUSSION

Spatial Inequality and Economic Concentration Patterns

The accommodation and food services sector in East Java exhibits profound spatial inequality that reflects fundamental differences in economic development across regions. Economic value-added concentrates overwhelmingly in a handful of urban centers, creating a core-periphery structure where growth benefits accrue unevenly. Surabaya City emerges as the dominant economic engine, capturing two-thirds of provincial sectoral output, while peripheral regions like Sampang contribute minimally despite hosting tourist attractions. This pattern reveals more than statistical disparity it demonstrates how agglomeration economies, infrastructure advantages, and market access create self-reinforcing cycles that amplify initial advantages in well-positioned regions while marginalizing those lacking foundational prerequisites for tourism-led growth.

The descriptive statistics in Table 1 illuminate this inequality's magnitude. The mean sectoral GRDP of IDR 4,526.98 billion stands far above the median of IDR 799.40 billion, signaling that a few high-performing regions pull the average upward while most cluster at lower values. The maximum-to-minimum ratio of 1,247 times quantifies the chasm between Surabaya's IDR 126,223 billion and Sampang's IDR 101.16 billion, with the coefficient of variation reaching 404.53% indicating that variability exceeds four times the mean, an extreme level of dispersion rarely observed in regional economic data.

Table 1. Descriptive Statistics of Main Variables (2022-2024)

| Variable	Mean	Median	Std. Dev.	CV (%)	Minimum	Maximum	Max/Min
GRDP of Tourism Sector (Billion IDR)	4,526.98	799.40	18,318.22	404.53	101.16	126,223	1,247
Tourist Arrivals (thousand persons)	5,491	5,047	3,686	67.14	346	9,088	26.27
Accommodation Capacity (rooms)	1,988	1,152	3,755	188.92	151	29,191	193.32
Per Capita Expenditure (thousand IDR)	12,291	11,918	2,278	18.53	8,542	18,926	2.22
Tourism Budget (Billion IDR)	22.16	18.43	20.49	92.47	2.84	289.76	102.04

Source: Research data, processed

Critically, tourist arrivals distribute far more evenly than economic output. The coefficient of variation for visitor numbers (67.14%) stands substantially below that of GRDP (404.53%), with a maximum-to-minimum ratio of only 26.27 times compared to GRDP's 1,247-fold difference. This divergence carries significant economic implications: raw tourist volume does not automatically translate into proportional economic value-added. Instead, conversion efficiency varies dramatically across regions, reflecting differences in service quality, spending capture mechanisms, length of stay, and local economic linkages. Some districts attract substantial visitors but fail to monetize this traffic effectively, while others efficiently convert modest flows into significant economic contributions.

Accommodation capacity inequality (CV 188.92%, max-to-min ratio 193 times) reveals stark contrasts in tourism industry maturity. Surabaya's 29,191 hotel rooms dwarf Bangkalan's 151, demonstrating how metropolitan cores accumulate hospitality infrastructure while peripheral regions remain undercapitalized. This capacity gap both reflects and perpetuates economic disparities without adequate facilities, high-potential destinations cannot capture extended visitor stays, while oversupplied mature markets may face diminishing returns on additional infrastructure investment.

Spatial Clustering and Core-Periphery Dynamics

Spatial autocorrelation analysis confirms that East Java's tourism economy operates within a persistent core-periphery structure rather than evolving toward balanced regional development. Global Moran's I statistics ranging from 0.048 to 0.050 (p < 0.01) demonstrate consistent positive spatial autocorrelation throughout 2022-2024, indicating that regions with high sectoral GRDP tend to cluster near other high-performing areas, while low-output districts concentrate together.

Moran Scatterplot: PDRB Sektor Pariwisata 2024
Moran's I = 0.0488
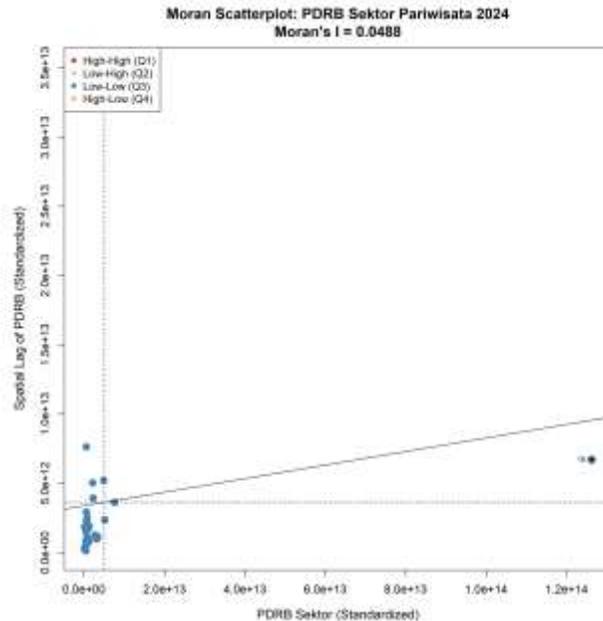
However, Local Indicators of Spatial Association (LISA) reveal that this clustering remains geographically limited. High-High clusters concentrate exclusively in the Surabaya metropolitan area, encompassing four to five contiguous regions that benefit from proximity to the provincial capital through shared infrastructure, visitor overflow, and business service spillovers. Low-Low clustering appears only in Pamekasan on Madura Island, representing an isolated pocket of persistently low tourism performance. Crucially, 84-87% of regions show no significant spatial association, indicating that most districts operate independently without meaningful spatial spillovers from neighbors.[

Peta 4.3: LISA Cluster Analysis 2024
PDRB Sektor Pariwisata - Jawa Timur
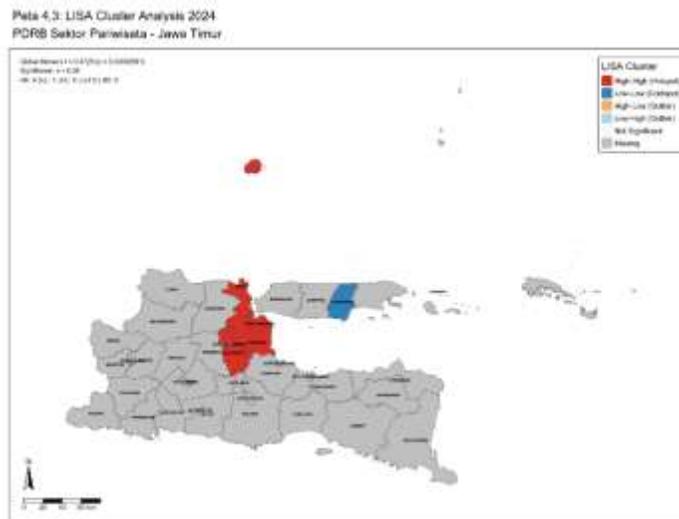
The combination of extreme inequality (Gini coefficient 0.82) with limited clustering (only 13-16% of regions significantly associated) carries important policy implications. Spatial inequality stems primarily from Surabaya's dominance as a single growth pole rather than from multiple competing regional centers. This monocentric

structure means peripheral regions cannot rely on automatic diffusion effects or spatial spillovers to stimulate local tourism development. Instead, effective interventions must be deliberately place-based, building endogenous capacity tailored to local characteristics rather than expecting trickle-down benefits from distant urban cores.

The stability of cluster patterns across three years demonstrates entrenched structural differences rather than temporary fluctuations. High-performing regions maintain advantages while peripheral areas remain trapped in low-tourism equilibria, suggesting that without targeted policy intervention, natural market forces will perpetuate rather than diminish regional disparities.

Global Panel Regression: Average Effects Mask Spatial Variation

Estimating global panel models reveals how averaging across diverse regions obscures critical spatial heterogeneity. The Common Effect Model (pooled OLS) achieves $R^2 = 0.828$, explaining approximately 83% of variation through four determinants. Tourist arrivals show elasticity of 0.91, suggesting that a 10% increase in visitor numbers associates with roughly 9% higher sectoral GRDP on average. Per capita expenditure demonstrates even stronger effects (elasticity 2.80), indicating that local purchasing power independent of tourist flows substantially drives hospitality sector performance. However, this specification assumes complete homogeneity across districts, ignoring unobserved regional characteristics.

The Fixed Effect Model substantially improves fit ($R^2 = 0.947$) by incorporating region-specific intercepts that capture time-invariant differences. Notably, tourist arrivals elasticity collapses from 0.91 to merely 0.04, revealing that most apparent visitor effects in pooled data reflect between-region differences rather than within-region temporal changes. Districts with historically high tourism maintain high sectoral output, but increasing visitors within a given region over short periods produces minimal economic impact at the provincial average. Per capita expenditure remains robust (elasticity 2.83), while accommodation capacity and tourism budget lose statistical significance entirely when controlling for fixed effects.

The Random Effect Model, selected as the preferred global specification via Hausman test ($\chi^2 = 6.131$; p = 0.190), produces intermediate results with $R^2 = 0.866$. Per capita expenditure emerges as the most consistent determinant (elasticity 2.90), dominating other factors in explaining sectoral performance. Tourist arrivals shows small but significant effects (0.06), whereas accommodation capacity and tourism budget remain statistically insignificant. The estimated theta parameter near unity (0.97) confirms that cross-sectional variation dwarfs temporal changes, indicating that fundamental regional characteristics determine outcomes more than year-to-year dynamics.[

These global results demonstrate a critical limitation: variables that appear weak or insignificant at the provincial average particularly accommodation capacity and tourism budgets may exert strong localized effects that cancel out when averaged across heterogeneous regions. This motivates the geographically weighted approach to uncover location-specific mechanisms obscured by global averaging.

Geographically Weighted Panel Regression: Revealing Local Economic Dynamics

The GWPR model, employing a Gaussian kernel with adaptive bandwidth optimized via corrected Akaike Information Criterion, dramatically outperforms global specifications by allowing coefficients to vary geographically. Table 2 quantifies this improvement: residual sum of squares plummets 91.6% from 30,696 to 2,565, capturing previously unexplained variation. R^2 surges from 0.828 to 0.986, while Adjusted R^2 reaches 0.981, confirming genuine explanatory gains rather than mere overfitting. The AICc decreases 54% despite increased complexity (18.45 effective parameters versus 5 in the global model), demonstrating superior model parsimony.

Table 2. Model Comparison: Global Panel vs GWPR

Model	RSS	AICc	R^2	Adjusted R^2	Effective Parameters	Improvement
Global OLS (Pooled)	30,696	186.05	0.828	0.822	5	–
GWPR (Local Model)	2,565	86.31	0.986	0.981	18.45	−91.6% RSS

Source: Research data, processed

Local coefficient estimates, summarized in Table 3, reveal substantial spatial non-stationarity in how tourism determinants shape sectoral GRDP. Tourist arrivals elasticity ranges from -0.089 to 1.501 across regions, with 60.5% showing statistically significant positive effects. This variation reflects fundamentally different tourism-economy relationships: in dedicated destination regions like Banyuwangi (elasticity 0.94), Probolinggo (0.87), and Pasuruan (0.82), visitor arrivals efficiently convert into local economic activity through extended stays, attraction entrance fees,

and hospitality spending. Conversely, transit-oriented metropolitan areas and low-tourism peripheral regions exhibit minimal or negative coefficients, indicating that marginal visitor increases produce little additional economic value

Table 3. Descriptive Statistics of Local GWPR Coefficients (N = 38 Districts/Municipalities)

Variable	Mean	Median	Std. Dev.	Minimum	Maximum	CV (%)	Significant Coefficients ($\|t\| > 1.96$)
β_1 – Tourist Arrivals (WIS)	0.584	0.588	0.394	−0.089	1.501	67.5	23 (60.5%)
β_2 – Accommodation Capacity (KAP_AKO)	0.564	0.48	0.421	0.139	1.531	74.7	34 (89.5%)
β_3 – Tourism Budget (ANG_PAR)	0.198	0.199	0.316	−0.650	1.3	159.7	11 (28.9%)
β_4 – Per Capita Expenditure (PENG_PK)	1.823	1.885	1.379	−0.868	4.018	75.7	22 (57.9%)

Source: Research data, processed

Accommodation capacity demonstrates even higher significance rates (89.5% of regions), with elasticities spanning 0.139 to 1.531. Metropolitan cores Surabaya (1.23), Sidoarjo (0.98), and Malang City (0.91) exhibit the strongest infrastructure effects, reflecting how high-capacity hospitality sectors enable these urban centers to capture and monetize large visitor flows. In contrast, rural and destination-oriented regions show weaker capacity effects, suggesting either infrastructure oversupply relative to demand or insufficient scale to achieve operational efficiencies.

Tourism budget effects prove highly variable, with only 28.9% of regions demonstrating significant impacts and coefficients ranging from -0.650 to 1.300. Mid-tier cities like Batu (0.58), Malang City (0.52), and Jember (0.47) show strongest fiscal multipliers, while most districts derive negligible or even negative returns from public tourism spending. This pattern underscores that budget allocation quality, institutional capacity, and strategic alignment with local competitive advantages determine effectiveness far more than expenditure volume.

Per capita expenditure shows significance in 57.9% of regions, with particularly strong effects in peri-urban areas like Gresik (0.76), Mojokerto (0.68), and Lamongan (0.61). This highlights how local household consumption independently drives hospitality sector performance beyond tourist-dependent mechanisms, especially in transitional zones where resident dining and accommodation demand sustains businesses regardless of visitor cycles.

Regional Typologies: Differentiated Economic Structures Demand Tailored Strategies

Local coefficient patterns reveal four distinct regional economic archetypes operating within East Java's tourism sector, each requiring fundamentally different development strategies. High-efficiency regions (seven districts: Surabaya, Malang City, Batu, Banyuwangi, Sidoarjo, Pasuruan, Gresik) demonstrate significant positive effects across multiple determinants, efficiently converting tourism inputs into economic output. These mature markets possess synergistic advantages strong visitor flows, adequate infrastructure, effective public investment, and robust local demand creating virtuous cycles where each element reinforces others. Development priorities here should emphasize innovation, quality differentiation, and sustainability rather than capacity expansion, as these regions already operate near optimal efficiency.

Supply-driven regions (nine districts: Mojokerto, Jombang, Ponorogo, Blitar, Tulungagung, Nganjuk, Madiun, Magetan, Bojonegoro) exhibit significant accommodation capacity effects (elasticities 0.6-0.8) but weak visitor responsiveness. These areas have built hospitality infrastructure often through public investment or private speculation but struggle to attract sufficient tourist traffic to utilize capacity fully. Infrastructure represents stranded assets yielding suboptimal returns, indicating that the binding constraint lies in demand generation rather than supply provision. Effective interventions require bridging this demand gap through targeted destination marketing, product development, and experience quality enhancement to convert existing capacity into economic productivity.

Demand-driven regions (twelve districts: Probolinggo, Lumajang, Bondowoso, Situbondo, Karanganyar, Wonogiri, Trenggalek, Pacitan, Sumenep, Sampang, Bangkalan, Pamekasan) show strong tourist arrival effects (elasticities 0.7-0.9) without corresponding infrastructure or budget impacts. High visitor volumes remain unmatched by adequate accommodation facilities, constraining economic capture as tourists transit through without staying

overnight or spending locally. These areas represent untapped potential where natural or cultural attractions generate footfall but capacity shortages prevent monetization. Development priorities demand accelerated infrastructure deployment hotels, restaurants, supporting services to convert visitor interest into sustained economic contributions.

Low-efficiency regions (ten districts, primarily Madura Island and southern periphery) show no significant positive effects for any determinant, with predominantly negative or statistically insignificant coefficients. Tourism remains economically dormant in these areas, where neither visitors, infrastructure, nor public spending generates measurable sectoral output. Fundamental structural barriers poor accessibility, absence of compelling attractions, weak institutional capacity, limited private sector presence prevent tourism from functioning as a development pathway. Effective interventions require addressing foundational prerequisites (transportation connectivity, attraction development, human capital, institutional strengthening) before tourism-specific policies become relevant.

Policy Implications: Toward Spatially Differentiated Development Strategies

The documented spatial heterogeneity fundamentally challenges uniform regional tourism policies embedded in East Java's Regional Tourism Master Plan (RIPPARDA). While RIPPARDA organizes destinations into five thematically coherent Destination Tourism Provinces such as DPP 4's Ijen-Baluran-Meru Betiri-Alas Purwo cluster covering Banyuwangi, Bondowoso, Jember, and Situbondo GWPR analysis reveals these groupings contain economically disparate regions requiring contradictory interventions. Banyuwangi operates as a high-efficiency mature destination, whereas Bondowoso functions as demand-driven with capacity constraints, yet both receive similar policy frameworks under current structures.

Effective resource allocation demands matching intervention types to regional economic realities. High-efficiency regions should receive innovation support, quality certification programs, and sustainability initiatives to maintain competitive advantages in increasingly saturated markets. Supply-driven regions need marketing budgets and product development assistance to fill existing capacity rather than additional infrastructure investment. Demand-driven regions require expedited infrastructure deployment and service quality training to capture existing visitor interest. Low-efficiency regions demand foundational interventions road connectivity, attraction development, institutional capacity building before tourism-specific strategies apply.

Spatial analysis reveals that positive spillovers from Surabaya's metropolitan cluster benefit immediate neighbors (Sidoarjo, Gresik, Mojokerto) through demand overflow, infrastructure sharing, and knowledge transfer, but these spread effects attenuate rapidly with distance. Low-Low clustering in Pamekasan and peripheral isolation confirm that backwash effects dominate long-distance relationships, where metropolitan growth concentrates resources and talent away from remote areas. True regional convergence requires building autonomous development capacity across diverse typologies rather than expecting automatic diffusion from urban cores.

The finding that tourism budgets achieve significance in only 28.9% of regions carries profound fiscal implications. Rather than distributing funds equally or based on population, effective allocation should concentrate resources where institutional absorptive capacity exists to convert spending into economic outcomes. Regions lacking prerequisites for tourism-led growth should receive foundational infrastructure and capacity building rather than tourism-specific budgets that demonstrate zero economic returns.

CONCLUSION

This research provides robust empirical evidence that accommodation and food services sector GRDP determinants in East Java exhibit strong spatial heterogeneity. GWPR analysis reveals that tourist arrivals, accommodation capacity, per capita expenditure, and tourism budget influence sectoral GRDP differently across locations, with local coefficients substantially varying from global estimates (e.g., accommodation capacity ranging 0.14-1.53 across regions versus 0.005 globally; tourism budget 28.9% significant locally vs. 0% globally).

The extreme spatial concentration (Gini coefficient 0.82) reflects core-periphery structure predicted by New Economic Geography. Limited positive spillover effects confined to metropolitan clusters indicate peripheral regions require autonomous development support rather than dependence on spatial diffusion.

Four distinct regional typologies identified high-efficiency (7), supply-driven (9), demand-driven (12), and low-efficiency (10) regions require differentiated interventions. RIPPARDA implementation should incorporate

greater flexibility for place-based approaches within DPP framework, with resource allocation guided by local absorptive capacity.

The novelty of this research lies in demonstrating that spatial heterogeneity, not just spatial dependence, fundamentally shapes tourism's economic impacts in regional contexts. Future research should extend this framework to analyze temporal dynamics of spatial relationships and evaluate specific policy interventions' effectiveness across regional typologies.

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