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Spatial Clustering of Housing Backlog and Socioeconomic Inequality: Evidence from the Special Region of Yogyakarta

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Abstract

Housing backlog remains a critical challenge in Indonesia, particularly for low-income communities. However, existing mitigation policies often rely on aggregate data, overlooking the spatial concentration of poverty and housing needs. This study investigates the spatial clustering of housing backlogs and its correlation with socioeconomic status in the Special Region of Yogyakarta. Utilizing a quantitative spatial approach, the study employs Global Moran's I and Local Indicators of Spatial Association (LISA) to diagnose geographic disparities. The analysis reveals a significant positive spatial autocorrelation (Moran's I = 0.643), identifying distinct "hotspots" where high housing deficits significantly overlap with low socioeconomic clusters. Unlike conventional descriptive studies, these findings demonstrate that housing vulnerability is not randomly distributed but structurally trapped in specific zones. The study concludes that "one-size-fits-all" subsidies are insufficient and advocates for spatially targeted interventions to address these entrenched inequalities effectively.

Keywords: Housing Backlog, spatial clustering, LISA, socioeconomic inequality, Yogyakarta.

Abstrak

Backlog perumahan tetap menjadi tantangan kritis di Indonesia, khususnya bagi Masyarakat Berpenghasilan Rendah (MBR). Namun, kebijakan mitigasi yang ada saat ini sering kali bergantung pada data agregat, sehingga mengabaikan konsentrasi spasial kemiskinan dan kebutuhan perumahan. Penelitian ini menyelidiki pengelompokan spasial backlog perumahan dan korelasinya dengan status sosial ekonomi di Daerah Istimewa Yogyakarta. Dengan menggunakan pendekatan spasial kuantitatif, penelitian ini menerapkan Global Moran's I dan Local Indicators of Spatial Association (LISA) untuk mendiagnosis disparitas geografis. Analisis tersebut mengungkapkan adanya autokorelasi spasial positif yang signifikan (Moran's I = 0,643), serta mengidentifikasi "hotspot" yang jelas, di mana defisit perumahan yang tinggi secara signifikan tumpang tindih dengan klaster sosial ekonomi rendah. Berbeda dengan studi deskriptif konvensional, temuan ini menunjukkan bahwa kerentanan perumahan tidak terdistribusi secara acak, melainkan terjebak secara struktural pada zona-zona tertentu. Studi ini menyimpulkan bahwa kebijakan subsidi yang bersifat umum (one-size-fits-all) tidaklah memadai dan merekomendasikan adanya intervensi berbasis spasial yang tertarget untuk mengatasi ketimpangan yang mendalam ini secara efektif.

Kata Kunci: *Backlog perumahan, pengelompokan spasial, LISA, ketimpangan sosial ekonomi, Yogyakarta.*

INTRODUCTION

Despite various government interventions, the gap between housing demand and supply remains a persistent challenge in Indonesia. Recent data from the National Socioeconomic Survey (Susenas) indicates that the housing backlog for home ownership stood at 9.9 million households in 2023 (Central Bureau of Statistics, 2023).

While the government's strategic 'One Million Houses Program' (Program Sejuta Rumah) successfully delivered approximately 1.21 million units in the same year (Ministry of Public Works and Housing, 2024), this supply barely keeps pace with the annual formation of 700,000 to 800,000 new families. This disparity is disproportionately felt by low-income communities, where affordability constraints exacerbate the shortage. The government is constitutionally mandated to provide housing for low-income communities, but faces significant resource limitations, with its financing capacity estimated to cover only 20-30% of the required Rp780 trillion for the housing sector between 2020-2024 (Ministry of Public Works and Housing, 2019).

The Special Region of Yogyakarta , a province with high population density and rapid urbanization, presents a compelling case for examining this issue. Its unique socio-economic landscape, characterized by a dense urban core surrounded by extensive rural areas, creates complex and spatially varied housing market dynamics. While the provincial government has established a strategic plan for housing and settlement development (RP3KP), the on-the-ground impact of these policies appears uneven.

While foundational studies have extensively examined housing affordability and distribution dynamics (Gilbert, 2004; Malpezzi & Green, 1996), a critical methodological gap persists in the context of Indonesian housing research. Existing studies predominantly rely on aspatial, aggregate statistics or descriptive urban planning approaches (Bramley & Karley N K, 2007). These conventional methods often treat administrative regions as homogeneous units, failing to capture the spatial dependency and 'neighborhood effects' where socioeconomic disadvantages cluster geographically. Consequently, current literature lacks a rigorous quantitative spatial analysis that explicitly links housing backlogs with localized socioeconomic inequalities.

This study advances the existing body of knowledge by integrating Local Indicators of Spatial Association (LISA) with Socioeconomic Status (SES) profiling. Unlike previous descriptive studies, this research moves beyond identifying how much housing is needed to statistically diagnosing where the need is structurally concentrated. By quantifying the spatial autocorrelation of low-income households, this study offers a novel diagnostic framework that challenges uniform policy interventions, providing the empirical basis for spatially targeted housing strategies in the Special Region of Yogyakarta."

Recent scholarship has increasingly adopted spatial econometrics to dissect socioeconomic disparities and housing inequalities. For instance, (Anwar, 2022) utilized LISA and Spatial Autoregressive Models (SAR) to map poverty concentrations in Central Java, demonstrating that poverty is not spatially random but significantly influenced by neighboring regions. Similarly, (Sholihin et al., 2025) confirmed the persistence of spatial dependence in poverty distribution, highlighting the necessity of cluster-based policy interventions rather than uniform approaches. Furthermore, spatial analysis has proven critical in identifying multidimensional deprivation zones, as shown by (Noviyanti et al., 2023), who applied spatial regression to determinant factors of poverty across Indonesian provinces. These studies collectively underscore the urgency of moving beyond aspatial aggregate data to understand the localized dynamics of housing and socioeconomic needs.

METHOD

This study employs a quantitative spatial analysis approach to assess the housing conditions for low-income communities in the Special Region of Yogyakarta. The research design integrates SES classification with spatial autocorrelation analysis to identify and interpret the geographical distribution of housing needs.

The research utilizes both primary and secondary data:

- Primary Data: Obtained from questionnaire responses from communities regarding the criteria for low-income households and field observations concerning their distribution.
- Secondary Data: Sourced from literature studies on housing, low-income communities criteria, and institutional data from Statistics Indonesia (BPS), including population counts, socioeconomic indicators (SUSENAS 2020), and regional minimum wage regulations.

To classify households based on their economic capacity, the Socioeconomic Status (SES) theory is applied. The SES categorization is determined by several key variables as indicators of a household's economic standing: (a) monthly household routine expenditure; (b) number of household members; (c)

primary source of drinking water; and (d) primary source of cooking fuel. Based on these indicators, households are classified into categories ranging from Upper (A, B) to Middle (C1, C2) and Lower (D, E). The criteria for low-income communities are defined based on government regulations, specifically the income and expenditure thresholds stipulated in Regulation of the Minister of Public Works and Housing No. 10/2019 Concerning Criteria for Low-Income Communities.

To identify local spatial clusters and spatial outliers, this study employs the Local Indicators of Spatial Association (LISA) statistic, originally developed by (Anselin, 1995). This method decomposes the global Moran's I into local contributions, allowing for the detection of significant spatial patterns at the district level. The LISA statistic for each observation i is defined as:

$$I_i = \frac{x_i - \bar{x}}{\sum(x_j - \bar{x})} \sum_j w_{ij}(x_j - \bar{x}) \qquad (1)$$

where x_i is the attribute for feature i, $\bar{x}$ is the mean of the corresponding attribute, and w_{ij} is the spatial weight between feature i and j. The core of the spatial analysis is the use of Local Indicators of Spatial Association (LISA). This method was chosen to identify local clusters of districts with similar values for the proportion of low-income communities households.

First, a global Moran's I statistic was calculated to test for the presence of overall spatial autocorrelation across the study area. Moran's I measures the degree to which districts with high (or low) low-income communities populations are located near other districts with similarly high (or low) values. A positive and significant Moran's I value indicates spatial clustering, while a negative value suggests spatial dispersion.

Second, a LISA analysis was performed. LISA is a decomposition of the global Moran's I statistic, which allows for the identification of the significant contribution of each individual observation to the global value (Anselin, 1995). It assesses the similarity of a specific location (e.g., district A) to its neighboring locations based on a chosen variable (e.g., percentage of low-income communities). The analysis classifies each district into one of four significant cluster types:

- High-High: A district with a high low-income communities proportion surrounded by neighboring districts with high low-income communities proportions (a "hotspot").
- Low-Low: A district with a low low-income communities proportion surrounded by neighboring districts with low low-income communities proportions (a "coldspot").
- High-Low: A district with a high low-income communities proportion surrounded by neighbors with low values (a spatial outlier).
- Low-High: A district with a low low-income communities proportion surrounded by neighbors with high values (a spatial outlier).

The analytical process involved defining a spatial weights matrix (queen contiguity) to establish neighborhood relationships between districts. The LISA results were then visualized using a cluster map generated in GeoDa software to illustrate the spatial distribution of hotspots, coldspots, and spatial outliers.

RESULTS AND DISCUSSION

Socioeconomic Profile of the Special Region of Yogyakarta

In 2020, the population of the Special Region of Yogyakarta was 3,671,189, distributed across five regencies/cities. Sleman Regency had the highest population (29.49%), while Kulon Progo Regency had the lowest (12.07%). Population density varies dramatically, from 12,803 individuals/km^2 in the highly urbanized Yogyakarta City to 521 individuals/km^2 in the predominantly rural Gunungkidul Regency (Table 1). Based on national survey data (SUSENAS 2020) and local regulations, the average low-income communities population in the Special Region of Yogyakarta is estimated to be 2,421,113 individuals (Table 2).

Global Spatial Autocorrelation and Clustering Tendencies

Housing accessibility is closely linked to economic capacity and social stratification. According to Bramley & Karley N K (2007), housing affordability varies based on income distribution, government subsidies, and land-use policies. The affordability crisis is exacerbated by urban expansion and rising property values, particularly in densely populated areas such as Yogyakarta City. Economic factors such as inflation, mortgage rates, and household income influence housing affordability, creating disparities that disproportionately affect low-income communities.

Previous studies have highlighted that low-income households often experience limited access to adequate housing due to financial constraints and discriminatory lending practices (Mukhija, 2004).

Economic theories suggest that housing affordability is primarily determined by income elasticity and housing supply constraints, both of which have been found to be significant factors in Indonesian urban areas (Malpezzi & Green, 1996).

Table 1 Area, Population, and Population Density by Regency/City in the Special Region of Yogyakarta (2020). (Source: BPS DIY, 2021)

No.	Regency/City	Area (km²)	Population	%	Households	%	Density (p/km²)
1	Kulon Progo	586,28	443.003	12,07	152.251	12,21	755,6
2	Bantul	506,85	954.706	26,01	329.616	26,42	1.883,6
3	Gunungkidul	1.485,36	774.609	21,10	256.786	20,59	521,5
4	Sleman	574,82	1.082.754	29,49	368.213	29,52	1883,6
5	Yogyakarta	32,50	416.117	11,33	140.527	11,27	12.803,6
Special Region of Yogyakarta		3.185,81	3.671.189	100,00	1.247.393	100,00	1.152,4

Table 2 Average Estimated Population of Low-Income Communities by Regency/City.

No	Regency/City	Population of Low-Income Communities (Expenditure Category)	Population of Low-Income Communities (Decile Aggregation)	Average Population of Low-Income Communities
1	Kulon Progo	579,186	480,258	529,722
2	Bantul	286,182	274,662	280,422
3	Gunungkidul	727,262	591,918	659,590
4	Sleman	727,083	671,307	699,195
5	Yogyakarta	282,615	257,993	270,304
Special Region of Yogyakarta		2,566,089	2,276,137	2,421,113

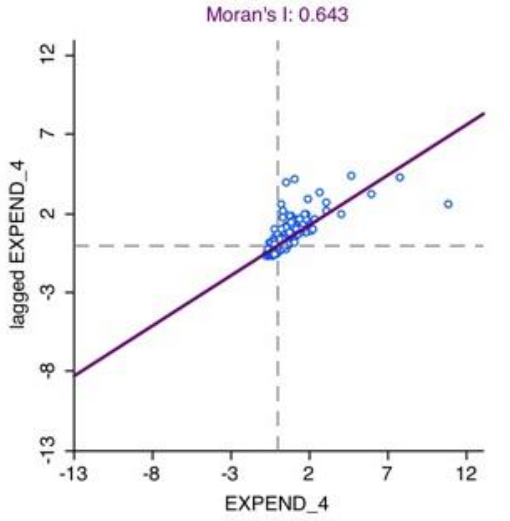

Figure 1 Moran Scatterplot of Proportions of Low-Income Communities in the Special Region of Yogyakarta.

The spatial analysis commences by testing for global spatial autocorrelation. The calculated Moran's I statistic for the proportion of low-income households per district is 0.643 (pseudo p-value <0.001). This strong, positive, and statistically significant value unequivocally rejects the null hypothesis of spatial randomness. It indicates a powerful tendency for districts with similar proportions of low-income community populations to cluster together geographically. This finding is consistent with broader patterns of socio-spatial segregation observed in other major Indonesian urban regions, where economic development often exacerbates spatial inequality (Winarso et al., 2015). The Moran scatterplot (Figure 1) visually corroborates this, with a majority of observations falling within the High-High and Low-Low quadrants, confirming the dominance of positive spatial autocorrelation over spatial heterogeneity.

Local Patterns of Spatial Association: Hotspots, Coldspots, and Policy Mismatches

While the global Moran's I confirms that clustering exists, the LISA analysis reveals where it occurs, providing granular insights crucial for policy formulation. The resulting cluster map (Figure 2) uncovers a stark spatial dichotomy in the distribution of the housing backlog, which we interpret through the lens of urban economic theory and policy analysis.

- High-High (HH) Clusters: Urban Poverty Pockets
  The analysis identifies statistically significant High-High clusters (hotspots) concentrated in the urban core and the suburbanizing fringe of Yogyakarta City, Sleman, and Bantul regencies. These hotspots represent what can be termed "urban poverty pockets," where a high concentration of low-income households is reinforced by surrounding districts with similar characteristics. This phenomenon aligns with classic theories of residential segregation and spatial sorting, where low-income groups are concentrated in specific areas due to market forces, such as high land values in central locations, and social stratification (Brueckner, 2000; Glaeser & Gyourko J, 2005). More recent studies in Southeast Asian cities suggest that rapid urbanization without adequate affordable housing provision often leads to such concentrated disadvantages (Kidokoro et al., 2022). In these hotspots, the challenge for housing provision is immense, constrained by land scarcity and soaring property prices,

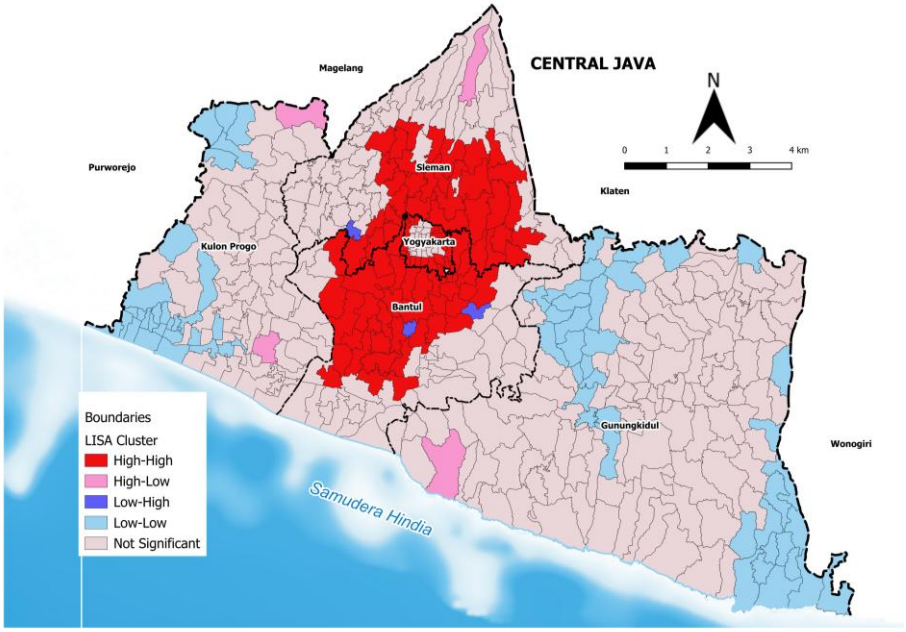

Figure 2 LISA Cluster Map of the Distribution of Low-Income Communities in the Special Region of Yogyakarta.

rendering conventional landed housing programs for low-income communities economically unfeasible.

- Low-Low (LL) Clusters: Rural Disadvantage and Different Needs. Conversely, significant Low-Low clusters (coldspots) dominate the predominantly rural regencies of Kulon Progo and Gunungkidul. It is critical to interpret this finding with caution. A "coldspot" does not imply widespread prosperity; rather, it indicates a lower relative concentration of low-income communities compared to the urban core and a different socio-economic structure, often agrarian-based. The housing challenges in these areas are distinct from the urban backlog. They typically relate to the quality of the existing housing stock, access to basic services and infrastructure (clean water, sanitation), and limited economic opportunities, rather than a quantitative shortage of units (Rukmana, 2018). Applying urban-centric backlog reduction strategies in these cold spots would represent a significant policy mismatch.

Implications for Theory and Housing Policy in Indonesia

The findings challenge the efficacy of aspatial, "one-size-fits-all" housing policies prevalent in Indonesia. The clear spatial structure of the housing backlog in the Special Region of Yogyakarta provides empirical support for the application of spatially differentiated policy interventions. The concentration of HH clusters underscores the failure of existing policies, such as the *Satu Juta Rumah* (One Million Houses) program, to adequately penetrate high-density, high-cost urban markets where the need is most acute.

- Policy Recommendations for Urban Hotspots: For the identified HH clusters, policy must shift away from landed housing models. Interventions should prioritize high-density solutions such as subsidized vertical public housing (*rusunawa*), rental assistance vouchers to leverage the existing private rental market, and the implementation of inclusionary zoning policies. The latter would mandate that new private residential developments allocate a percentage of units for affordable housing, a strategy proven effective in other contexts for fostering mixed-income communities (Turok et al., 2024).
- Policy Recommendations for Rural Coldspots: In the LL clusters, the focus should be on improving the quality of the existing housing stock. Programs like *the Bantuan Stimulan Perumahan Swadaya* (BSPS), a self-help housing improvement stimulus, are far more relevant here. Furthermore, housing policy in these areas must be integrated with broader rural development strategies aimed at enhancing infrastructure, improving access to essential services, and creating local economic opportunities to prevent distress-driven migration to the already overburdened urban core.

Theoretically, this study demonstrates the utility of spatial econometrics in moving beyond simplistic measures of housing deficit. By quantifying and mapping spatial dependency, it provides a robust evidence base for policy design that is both

equitable and efficient. The primary contribution of this research is its clear demonstration that an effective housing strategy for a region as diverse as Yogyakarta and by extension, Indonesia must be explicitly spatial in its diagnosis and prescription.

CONCLUSION

This study successfully demonstrates the existence of significant spatial correlation in the distribution of the low-income housing backlog in the Special Region of Yogyakarta. The LISA analysis provides robust evidence of geographical clustering, moving beyond simple descriptive statistics to reveal a distinct spatial structure of housing inequality. The primary finding is the identification of a clear spatial pattern: significant High-High clusters (hotspots) of low-income communities are concentrated in the urban agglomeration of Yogyakarta, Sleman, and Bantul, while Low-Low clusters (coldspots) are located in the rural regencies of Kulon Progo and Gunungkidul. This confirms that the housing backlog is not randomly distributed but is a geographically embedded phenomenon.

These findings have critical policy implications. The current approach to housing provision, as outlined in regional plans, appears insufficient because it does not account for this spatial heterogeneity. A uniform policy is unlikely to succeed in a region with such diverse local conditions. Therefore, this study strongly recommends a shift towards spatially targeted interventions. For the urban hotspots (HH clusters), policies should focus on solutions suitable for dense environments, such as vertical housing, rental assistance programs, or land value capture mechanisms to fund affordable housing. In contrast, for the rural coldspots (LL clusters), interventions could prioritize self-help housing improvement programs (*"Bantuan Stimulan Perumahan Swadaya*") and infrastructure development to support local livelihoods.

This research is limited by its use of data aggregated at the district level. Future research could achieve higher granularity by using village-level or even point-data to perform a more detailed analysis of neighborhood-level dynamics. Nonetheless, this study provides a crucial spatial-analytical framework for policymakers to design more effective, equitable, and geographically informed housing policies for low-income communities.

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