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SPATIAL ANALYSIS OF LOCAL SUSTAINABLE DEVELOPMENT INDEX BASED ON SOCIAL, ECONOMIC, AND ENVIRONMENTAL DIMENSIONS IN SURABAYA CITY

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Abstract

Sustainable development at the level local need capable evaluation integrate dimensions social , economic and environmental in a way spatial as base compilation policy proper development target . Surabaya City as center growth economy Still face gap development potential inter- district hinder achievement *Sustainable Development Goals* (SDGs). Study This aim analyze conditions and patterns distribution spatial Sustainable Development Index Local (IPBL) in Surabaya City. Research use approach *mixed methods* with utilizing secondary data from various agency government . Analysis done through compilation index composite , *Moran's Index* , and *Local Indicators of Spatial Autocorrelation* (LISA). The results of the study show that dimensions social dominated category medium (61%), dimensions economy category medium (58%), and dimensions environment category tall and while each is 42%. Analysis spatial show existence autocorrelation spatial positive with pattern clustered , where *the* dimensions social and environmental significant , whereas dimensions economy No significant . Findings This indicates the need policy further development directed through subtraction poverty , strengthening MSMEs and industry , increasing room open green , management garbage , and strengthening mitigation disaster in accordance characteristics spatial of each sub-district .

Keywords: *Analysis Spatial ; Sustainable Development Index Local ; Local Indicators of Spatial Association (LISA); Moran's Index; Surabaya City*

INTRODUCTION

The city of Surabaya has an area of 33,593 hectares, divided into 31 districts and 153 sub-districts or villages. The total population in 2025 according to BPS statistics is 3,003,860 people with a population density of 133 people per hectare. East Java Provincial Regulation Number 10 of 2023 concerning the 2023-2043 Spatial Planning establishes the city of Surabaya as a National Activity Center (PKN), a National Strategic Area (KSN) within the Surabaya Urban Area, a provincial strategic area (KSP) for the Economic Corridor-Super Corridor, and part of the Surabaya-Malang Metropolitan Corridor. The Human Development Index (HDI) consists of three fundamental aspects of human development: age and health, education, and adequate living conditions. The Human Development Index (HDI) of Surabaya City in 2025 is projected at 85.65%, which includes a life expectancy at birth of 76.34 years, an estimated length of schooling of 14.88 years, an average length of schooling of 11.15 years, and annual per capita expenditure of 20.679 million rupiah. The Human Development Index of Surabaya City in 2025 is the highest among regencies or cities in East Java province. In 2020, the poor population in Surabaya was 145.67 thousand people, which then decreased by 1.46% to 105.09 thousand in 2025. The poverty line of Surabaya City in 2025 was Rp 775,597, this figure is still above the poverty line of East Java Province of Rp 585,020. The open unemployment rate in Surabaya City in 2020 was 154,896 people and then decreased by 4.95% to 79,432 people in 2025. The open unemployment rate significantly increases poverty while the average years of schooling significantly reduces it (Alfin & Boedirochminarni, 2025) ; (Monica & Susilowati, 2025) . This condition reflects the failure to achieve the first SDG goal, which is to end all forms of poverty everywhere. The economic growth rate in 2023 is 5.70%, then increasing by 17% to reach 5.87% in 2025. This statistic exceeds other regencies in East Java, with the average economic growth of the region at 5.33%. This situation is contrary to Sustainable Development Goal 8, namely inclusive and sustainable economic development, productive and comprehensive employment prospects, and

dignified labor for all. In 2025, the economic sector of Surabaya City as measured by Gross Regional Domestic Product at current prices by Business Sector is mainly led by the wholesale and retail trade sector, including car and motorcycle repairs at 26.97%, the manufacturing industry at 19.59%, and the accommodation and food services sector at 16.71%.

In 2024, the city of Surabaya won the highest award in the SDGs Action Award (City Government category) Indonesia for its commitment to the Sustainable Development Goals. (BPKAD, 2024) . Assessment Sustainable Development Index Local is very important For formulate strategies for achieving Development Goals (Lubis et al., 2021) . Considering issues mentioned above , it is important For investigate status and allocation index development sustainable local in Surabaya, because city This projected face a number of challenges , including underpopulated lucky as many as 106.09 thousand soul or 3.56%. Although the percentage relatively more low from number poverty Indonesia's national population is 24,054 thousand soul or 8.57%, the situation This show that Surabaya as a metropolitan area with progress significant economic Keep going meet enough obstacles big in achieve the Sustainable Development Goals , especially SDG 1 (No Poverty). Initiatives aimed at For achieve the Sustainable Development Goals (SDGs) as arranged in Regulation Presidential Decree No. Article 59 of 2017 requires assessment and development of appropriate strategies , especially at the level area , for overcome problem poverty in Surabaya.

In Indonesia, particularly in the metropolitan area of Surabaya (Gerbangkertosusila), the assessment regional sustainability shows that metropolitan areas are often show condition better economic , social and environmental superior compared to with other regions on the island of Java (Pravitasari et al., 2018) . Government Surabaya city , together with United Cities and Local Governments Asia Pacific (UCLG ASPAC), launched the Global Public Space Programme featuring three main strategies : (1) establishing partnership in governance urban , (2) using Minecraft for design planning city , and (3) implement project room public in three forms location main areas , especially Ketandan Village , Keputih Village , and Tanah Kali Kedinding Village (Trifita & Amaliyah, 2022) .

METHOD

Study This located in the city of Surabaya, which is located in the province of East Java. The city of Surabaya is administrative divided into 31 districts and 154 villages with area of 33,857.31 hectares . Research This using method strategies mixture based on findings survey institutions and documentation . Sustainable development own three dimensions main : dimensions social dimension economy , and dimensions environment (Rodrigues & Franco, 2020) . Aspects social covering quantity institutions education , quantity facility health , population poor individuals , and prevalence malnutrition (Merino-Saum et al., 2020) . Aspects economy covering proximity subdistrict with the market, quantity of MSMEs, number industry , and number of hotels (Malay & Mashur, 2023) **.** Aspects environment covering green open area , changes in land use from agriculture to non- agricultural , quantity location disposal waste , and frequency occurrence disaster hydrometeorology (Afandi & Muftiadi, 2023) .

Secondary data collection conducted at the Surabaya City Social Service , Surabaya City Health Service, Surabaya City Land and Housing Service, Surabaya City Environmental Service, Surabaya City Small and Medium Enterprises Cooperative Service , Surabaya City Trade Service , and Surabaya City Disaster Management Service. Surabaya City Regional Disaster . Analysis techniques used in study This covering Analysis Index Composite , Analysis Moran's Index , and Indicators Local Spatial Autocorrelation (LISA).

a. Composite index analysis was used to determine the condition of the Local Sustainable Development Index (IPBL) in Surabaya City . The IPBL value was standardized using the maximum-minimum standardization method (Lubis et al., 2021) ; Andriatia & Yusuf, 2021) .

$$IPBL(std) = \frac{(IPBL\ ki - IPBL\ min)}{IPBL\ ki(maks) - IPBL\ ki(min)}\ x\ 100$$

Where :
IPBL ki = IPBL for the kth dimension in the ith District
k = Social Dimension, Economic Dimension, Environmental Dimension
i = 1, 2, 3, 4,..... n
Min = Minimum value of sub-district indicator
Max = Maximum value of sub-district indicator

b. *Moran's Index* and *Local Indicator of Spatial Autocorrelation (LISA)* analysis were used to determine the distribution of the Local Sustainable Development Index (LDIP). The Moran's Index is calculated as follows (Hadisti et al., 2024) :

$$I = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij}\,(x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

Information :
I = Moran's Index
n = number of observation locations
x_i = observation value at the ith location
x_j = observation value at the jth location
$\bar{x}$ = average of the observed values
W_{ij} = weighting value of the ith row and jth column

The Moran index value with a standard spatial weighting matrix varies from -1 to 1. If the Moran index value is $-1 \leq I < 0$, it indicates negative spatial autocorrelation; if $0 < I \leq 1$, it indicates positive spatial autocorrelation; and if $I = 0$, it indicates no spatial autocorrelation in the region. Evaluation of the parameter I :

$$Z_{hitung}(I) = \frac{I - E(I)}{\sqrt{Var(I)}}$$

with

$$E(I) = I_0 = \frac{I}{(n-1)}$$

$$Var(I) = \frac{(n^2 S_1 - nS_2) + 3(\sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij})^2}{(\sum_{i=1}^{n}\sum_{j=1}^{n} W_{ij})^2 (n^2-1)} - [E(I)]^2$$

Where

$$S_1 = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n}(W_{ij} + W_{ji})^2}{2}$$

$$S_2 = \sum_{i=1}^{n}\left(\sum_{i=1}^{n} W_{ij} + \sum_{i=1}^{n} W_{ji}\right)$$

If the value of $|Z_{hitung}(I)| > Z_{\alpha/2}$ then H_0 is rejected where $Z_{\alpha/2}$ is the critical region of the Z test with an error level of α. In accordance Anselin (1993), Moran's scatterplot works as tool For analyze information Moran Index . Moran's scatterplot works For study correlation between measurement data in a locations that have been normalized with the average value of location other.in adjacent the intended location . Moran 's distribution can show correlation between observed values and local mean values standards shown in Figure 1.

Quadrant 2 (Low-High)	Quadrant 1 (High-High)
Quadrant 3 (Low-Low)	Quadrant 4 (High-Low)

Figure 1 . *Morans Scatterplot Quadrants*

LISA is used to detect local autocorrelation or spatial correlation in each area. LISA is an extension of the Moran Index. An increasing local Moran Index indicates that neighboring areas exhibit similar values or indicate a clustered distribution. LISA is represented by the formula (Rachmadsyah, 2024) :

$$I_i = Z_i \sum_{i=1}^{n} W_{ij} Z_j$$

$$Z_i = \frac{x_i - \underline{x}}{\sigma} \quad dan \quad Z_j = \frac{x_j - \underline{x}}{\sigma}$$

σ is the standard deviation value of the change in x. Testing of parameter I can be done as follows:
Hypothesis:
$H\,0 : Ii = 0$ (No autocorrelation)
$H\,1 : Ii \neq 0$ (There is autocorrelation)

RESULTS AND DISCUSSION

Condition of the Local Sustainable Development Index of Surabaya City

The Local Sustainable Development Index of Surabaya City is assessed based on 3 dimensions, namely the social dimension, the economic dimension and the environmental dimension.

1. Social Dimension

Realization sustainability social is one of the indicator important achievement of the SDGs by 2030 , in which aspects social become vital indicators in measure achievement development sustainable with approach man as subject (Faruk, 2020) . The social dimension of IPBL is divided into high, medium, and low as shown in Chart 1 showing

that the social dimension of IPBL increased, with scores ranging from 73.19 to 92.78 in five sub-districts: Sukolilo, Mulyorejo, Gubeng, Wonokromo, and Laksantri. The medium social dimension of IPBL, with scores ranging from 53.59 to 73.18, covers 19 districts, including Jambangan, Gayungan, Wonocolo, Tenggilis Mejoyo, Rungkut, Dukuh Pakis, Wiyung, Sambikerep, Tandes, Sukomanunggal, Sawahan, Tegalsari, Genteng, Tambaksari, Simokerto, Kepabeanan Cantian, Bubutan, Krembangan, and Pakal. The social dimension of IPBL experienced a decline, with scores ranging from 33.99 to 53.58 in seven districts: Karangpilang, Gunung Anyar, Kenjeran, Bulak, Semampir, Asemrowo, and Benowo.

Table 1. Analysis of the Results of the Social Dimension of the Local Sustainable Development Index in 2025

No.	Subdistrict	IPBL Social Dimension	Classification	Directions
1	Sukolilo	92.76	Tall	Reducing the poverty rate
2	Mulyorejo	89.58	Tall	1. Increasing the number of health facilities 2. Reducing the number of poor people
3	Gubeng	84.59	Tall	1. Increasing the number of educational facilities 2. Increasing the number of health facilities 3. Reducing the number of poor people
4	Wonokromo	81.27	Tall	1. Increasing the number of educational facilities 2. Reducing the number of poor people 3. Reducing the number of people suffering from malnutrition
5	Lakarsantri	75.74	Tall	1. Increasing the number of educational facilities 2. Increasing the number of health facilities 3. Reducing the number of poor people 4. Reducing the number of people suffering from malnutrition
6	Tandes	68.79	Currently	1. Increasing the number of educational facilities 2. Increasing the number of health facilities 3. Reducing the number of people suffering from malnutrition
7	Tegalsari	61.87	Currently	1. Increasing the number of educational facilities 2. Increasing the number of health facilities 3. Reducing the number of poor people
8	Customs Cantian	60.18	Currently	
9	Pakal	58.54	Currently	
10	Sukomanunggal	70.99	Currently	1. Increasing the number of educational facilities 2. Increasing the number of health facilities 3. Reducing the number of poor people 4. Reducing the number of people suffering from malnutrition
11	Wonocolo	70.6	Currently	
12	Rooftile	68.62	Currently	
13	Rungkut	66.79	Currently	
14	Wiyung	65.74	Currently	
15	Tambaksari	61.45	Currently	
16	Tenggilis Mejoyo	61.41	Currently	
17	Ladle	61.34	Currently	
18	Lathe	61.26	Currently	
19	Vase	58.23	Currently	
20	Simokerto	57.38	Currently	
21	Sambikerep	57.02	Currently	
22	Krembangan	55.22	Currently	
23	Rice fields	54.78	Currently	
24	Pakis Hamlet	53.78	Currently	
25	Asemrowo	48.81	Low	1. Increasing the number of educational facilities
26	Karangpilang	47.28	Low	

No.	Subdistrict	IPBL Social Dimension	Classification	Directions
				2. Increasing the number of health facilities 3. Reducing the number of poor people
27	Benowo	53.17	Low	1. Increasing the number of educational facilities 2. Increasing the number of health facilities 3. Reducing the number of poor people 4. Reducing the number of people suffering from malnutrition
28	Bulak	51.67	Low	
29	Mountain New	50.79	Low	
30	Kenjeran	50.48	Low	
31	Stop by	33.99	Low	

Source: Analysis Results, 2026

The results of the IPBL analysis in Table 1 show that areas with a high social dimension of IPBL require a reduction in the number of poor people. In areas with moderate social dimensions of IPBL, it is necessary to increase the number of educational facilities and health facilities, as well as reduce the number of poor people and people suffering from malnutrition. In areas with low-dimensional IPBL, it is necessary to increase the number of educational facilities and health facilities, as well as reduce the number of poor people and people suffering from malnutrition. The Human Development Index (HDI) provides influence the biggest towards the SDGs, making it the most efficient pillar (Yanto et al., 2023) . HDI is measured use three dimensions main that is aspect health , education , and standards life worthy .

2. Economic Dimension

The economic characteristics of IPBL are categorized into high, medium, and low as shown in Table 2. IPBL has a significant economic dimension, with scores ranging from 38.04 to 53.26 in nine districts: Tenggilis Mejoyo, Gunung Anyar, Rungkut, Gubeng, Wonokromo, Sawahan, Genteng, Tambaksari, and Asemrowo. The medium economic dimension of IPBL, with scores ranging from 22.81 to 38.03, covers 18 districts, including Karangpilang, Jambangan, Gayungan, Wonocolo, Sukolilo, Mulyorejo, Dukuh Pakis, Wiyung, Laksantri, Tandes, Sukomanunggal, Tegalsari, Kenjeran, Simokerto, Semampir, Bubutan, Krembangan, and Benowo. IPBL has a poor economic dimension, with scores ranging from 7.58 to 22.80 among four districts: Sambikerep, Bulak, Kepabeanan Cantian, and Pakal.

Table 2. Analysis of the Results of the Local Sustainable Development Index for the Economic Dimension in 2025

No.	Subdistrict	IPBL Economic Dimension	Classification	Directions
1	Asemrowo	50.91	Tall	1. Increasing the number of MSMEs 2. Increase in the number of hotels
2	Rooftile	46.97	Tall	1. Reducing the distance from the sub-district to the market 2. Increasing the number of MSMEs 3. Increasing number of industries
3	Gubeng	53.24	Tall	1. Reducing the distance from the sub-district to the market 2. Increasing the number of MSMEs 3. Increasing number of industries 4. Increase in the number of hotels
4	Tambaksari	49.06	Tall	
5	Rungkut	45.65	Tall	
6	Tenggilis Mejoyo	43.16	Tall	
7	Rice fields	42.68	Tall	
8	Wonokromo	41.5	Tall	
9	Mountain New	39.46	Tall	
10	Sukolilo	37.52	Currently	1. Reducing the distance from the sub-district to the market 2. Increasing the number of MSMEs 3. Increasing number of industries 4. Increase in the number of hotels
11	Simokerto	37.43	Currently	
12	Tandes	36.47	Currently	
13	Kenjeran	35.44	Currently	
14	Stop by	32.56	Currently	
15	Mulyorejo	32.13	Currently	
16	Tegalsari	30.44	Currently	
17	Wiyung	29.93	Currently	

No.	Subdistrict	IPBL Economic Dimension	Classification	Directions
18	Vase	29.55	Currently	
19	Ladle	29.03	Currently	
20	Karangpilang	28.23	Currently	
21	Lakarsantri	27.55	Currently	
22	Pakis Hamlet	27.15	Currently	
23	Benowo	26.46	Currently	
24	Krembangan	25.66	Currently	
25	Wonocolo	25.01	Currently	
26	Lathe	24.8	Currently	
27	Sukomanunggal	23.09	Currently	
28	Bulak	21.7	Low	1. Reducing the distance from the sub-district to the market 2. Increasing the number of MSMEs 3. Increasing number of industries 4. Increase in the number of hotels
29	Pakal	19.98	Low	
30	Customs Cantian	14.72	Low	
31	Sambikerep	7.58	Low	

Source: Analysis Results, 2026

Based on the results of the analysis of the local sustainable development index in Table 2, the direction for regions with a high economic dimension of IPBL is to increase the number of MSMEs, increase the number of industries, and increase the number of hotels. Regions with a medium economic dimension of IPBL require reducing the distance from the sub-district to the market, increasing the number of MSMEs, increasing the number of industries, and increasing the number of hotels. Regions that obtain a low economic dimension of IPBL require reducing the distance from the sub-district to the market, increasing the number of MSMEs, increasing the number of industries, and increasing the number of hotels. The economic dimension indicates a weak sustainability status if economic stability is not well maintained, because economic stability significantly affects the preservation of local culture and area management (Geria et al., 2025) . *Urban farming* in urban areas proven become contributor significant economic impact . Studies in Kendari City show that urban farming is contributor highest third to the city's GRDP , contributing 10.66% of total economic output , emphasizing its significant role in support economy local and resilience food (Astuti et al., 2025) .

3. Environmental Dimension

IPBL environmental dimension is divided into high, medium, low as in Table 3. IPBL high environmental dimension with a score of 66.28–79.68 is spread across 13 sub-districts, namely Karangpilang Sub-district, Jambangan Sub-district, Gayungan Sub-district, Gunung Anyar Sub-district, Rungkut Sub-district, Sukolilo Sub-district, Mulyorejo Sub-district, Wiyung Sub-district, Lakarsantri Sub-district, Tandes Sub-district, Simokerto Sub-district, Asemrowo Sub-district, and Benowo Sub-district. IPBL with medium environmental dimension with score 52.88–66.27 is spread across 15 sub-districts, namely Wonocolo Sub-district, Tenggilis Mejoyo Sub-district, Gubeng Sub-district, Dukuh Pakis Sub-district, Sambikerep Sub-district, Sukomanunggal Sub-district, Tegalsari Sub-district, Genteng Sub-district, Kenjeran Sub-district, Bulak Sub-district, Semampir Sub-district, Pabean Cantian Sub-district, Bubutan Sub-district, Krembangan Sub-district, and Pakal Sub-district. IPBL with low environmental dimension with score 39.47–52.87 is spread across 3 sub-districts, namely Wonokromo Sub-district, Sawahan Sub-district, and Tambaksari Sub-district.

Table 3. Analysis of the Results of the Local Sustainable Development Index for the Environmental Dimension in 2025

No.	Subdistrict	IPBL Environmental Dimension	Classification	Directions
1	Simokerto	68.52	Tall	1. Increasing the area of green open space 2. Reduction of waste accumulation
2	Sukolilo	75.56	Tall	1. Reduction of waste accumulation 2. Increasing mitigation and resilience to hydrometeorological disasters

No.	Subdistrict	IPBL Environmental Dimension	Classification	Directions
3	Ladle	67.91	Tall	1. Increasing the area of green open space 2. Increasing mitigation and resilience to hydrometeorological disasters
4	Mulyorejo	79.66	Tall	1. Increasing the area of green open space 2. Reduction in the amount of stockpiles 3. Increasing mitigation and resilience to hydrometeorological disasters
5	Lakarsantri	79.46	Tall	
6	Benowo	78.81	Tall	
7	Asemrowo	77.58	Tall	
8	Wiyung	77.26	Tall	
9	Mountain New	73.63	Tall	
10	Karangpilang	72.87	Tall	
11	Tandes	70.01	Tall	
12	Rungkut	69.45	Tall	
13	Vase	68.98	Tall	
14	Tegalsari	62.22	Currently	1. Increasing the area of green open space 2. Reduction in the amount of stockpiles 3. Increasing mitigation and resilience to hydrometeorological disasters
15	Lathe	61.76	Currently	
16	Pakal	66.72	Currently	1. Increasing the area of green open space 2. Reduction of waste accumulation 3. Increasing mitigation and resilience to hydrometeorological disasters
17	Bulak	63.76	Currently	
18	Krembangan	62.98	Currently	
19	Customs Cantian	62.72	Currently	
20	Tenggilis Mejoyo	62.35	Currently	
21	Pakis Hamlet	62.33	Currently	
22	Sambikerep	62.13	Currently	
23	Sukomanunggal	59.36	Currently	
24	Rooftile	59.24	Currently	
25	Wonocolo	58.45	Currently	
26	Stop by	56.2	Currently	
27	Kenjeran	54.75	Currently	
28	Gubeng	53.85	Currently	
29	Rice fields	49.32	Low	1. Increasing the area of green open space 2. Reduction of waste accumulation 3. Increasing mitigation and resilience to hydrometeorological disasters 4. Reduction of land cover changes from agricultural to non-agricultural
30	Tambaksari	45.01	Low	
31	Wonokromo	39.47	Low	

Source: Analysis Results, 2026

The results of the IPBL analysis in Table 3 indicate that areas with a high environmental dimension of IPBL require an increase in green space and a reduction in the amount of waste dumped. Areas with a moderate environmental dimension of IPBL require an increase in green space, a reduction in the amount of dumped waste, and increased mitigation and resilience to hydrometeorological disasters. Areas with a low environmental dimension of IPBL require an increase in green space, a reduction in land cover changes from agricultural to non-agricultural, a reduction in the amount of dumped waste, and increased mitigation and resilience to hydrometeorological disasters . environment covers aspect conversion land agriculture to non- agriculture , support government in spatial planning , and regional protection (Geria et al ., 2025). In the context of change climate and urban heat island research projection show that Surabaya has potential experience decline *Universal Thermal Climate Index* (UTCI) of 0.84°C in the period 2018-2042 due to the greening program city , different with Medan and Denpasar which are actually experience increase in UTCI up to 3.1°C (Setiawati et al., 2021) . Garbage Bank Surabaya parent company realizes principle the next maqashid sharia realized through economy green (Masduqie et al., 2021) . Findings the demonstrate implementation principle maqashid Sharia in framework waste bank operations Surabaya parent company through

provisions that have been determined , procurement activities , and regulations , so actualize principle draft economy green at a time advance three initiative in SDGS. In Bulak Regency , Surabaya, the management of rubbish House ladder disclose only 19.5% of respondents did management waste , while 80.5% do not (Pratiwi & Santosa, 2018) .

Candirejo Village in Surabaya can serve as a model of urban sustainability aligned with SDG 11, using the urban resilience approach of the Brundtland sustainability concept. Key initiatives identified include household wastewater recycling for catfish farming, hydroponic systems, and herbal plant cultivation. These practices not only demonstrate environmental sustainability but also produce marketable products, contributing to household income in the village (Zahra & Ramadhani, 2024) .

Distribution of the Local Sustainable Development Index in Surabaya City

After identifying spatial patterns using the Moran index, the next step involves examining the Local Spatial Association Indicators (LISA). The purpose of the LISA analysis is to determine the significance of spatial relationships within each sub-district, thereby revealing the sub-districts that form the cluster. This assessment is conducted on the social, economic, and environmental aspects of IPBL. The assumptions used in the LISA examination are as follows:

H_0: $I = 0$, meaning there is no spatial autocorrelation in the i-th sub-district or there is no relationship between the social dimension, economic dimension and environmental dimension in the i-th sub-district with the sub-districts that are located nearby.

H_1: $I \neq 0$, namely there is spatial autocorrelation in the i-th sub-district or there is a relationship between the social dimension, economic dimension and environmental dimension in the i-th sub-district with the sub-districts that are located nearby.

The significance level used in this research is $\alpha = 0.05$. The testing decision is made by rejecting H_0 if the p-value is <0.05.

1. Social Dimension

The Moran's Index value for the social dimension is 0.254, indicating positive spatial autocorrelation. Districts with high IPBL values for the social dimension tend to be adjacent to districts with high IPBL values for the social dimension, while districts with low IPBL values for the social dimension tend to be adjacent to districts with low IPBL values for the social dimension. Hypothesis testing using a significance level of 5% shows a p-value of 0.007 (<0.05). Spatial autocorrelation for the social dimension is significant, so the distribution pattern of IPBL for the social dimension in Surabaya City tends to be clustered, *as* shown in Table 4 and Figure 1 .

Table 4. IPBL Moran Index Social Dimension

Moran's Index	*z-score*	*p-value*	**Spatial Patterns**	**Information**
0.254	2,691	0.007	*Clustered*	Spatial autocorrelation positive (significant)

Source: Analysis Results, 2026

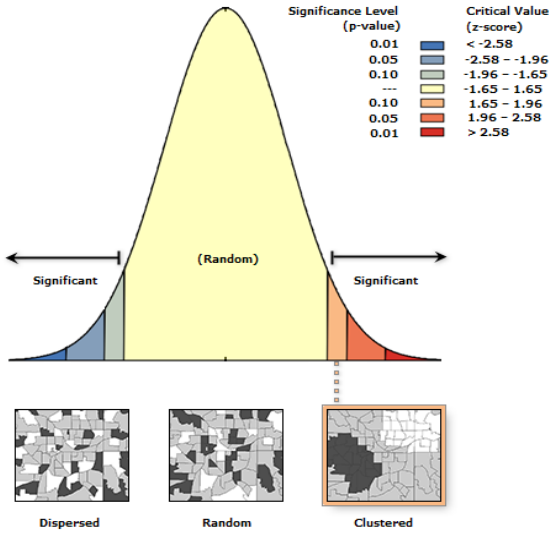

Figure 1. *Moran's Index* **Pattern** of Social Dimension

There are 4 clusters of social dimension IPBL which are divided into High-High (HH) cluster, High-Low (HL) cluster, Low-Low (LL) cluster, and Not Significant cluster (Figure 2). The High-High (HH) cluster is spread across 3 sub-districts, namely Sukolilo Sub-district, Mulyorejo Sub-district, and Gubeng Sub-district. It is indicated by a high social dimension index value and is adjacent to sub-districts that also have high social dimension IPBL values such as Sukolilo Sub-district at 92.76, Mulyorejo Sub-district at 89.58, Gubeng Sub-district at 84.59 and Wonokromo Sub-district at 81.27. The Low-High (LH) cluster is only found in Tenggilis Mejoyo District, indicated by the existence of regional inequality with low social dimension index values adjacent to districts with high social dimension IPBL values, namely Sukolilo District of 92.76. The Low-Low (LL) cluster is only found in Kenjeran District, indicated by the existence of low social index values adjacent to districts with low social dimension IPBL values, such as Bulak District of 51.67, Kenjeran District of 50.48, and Semampir District of 33.99. The Not Significant Cluster is spread across 26 other Districts .

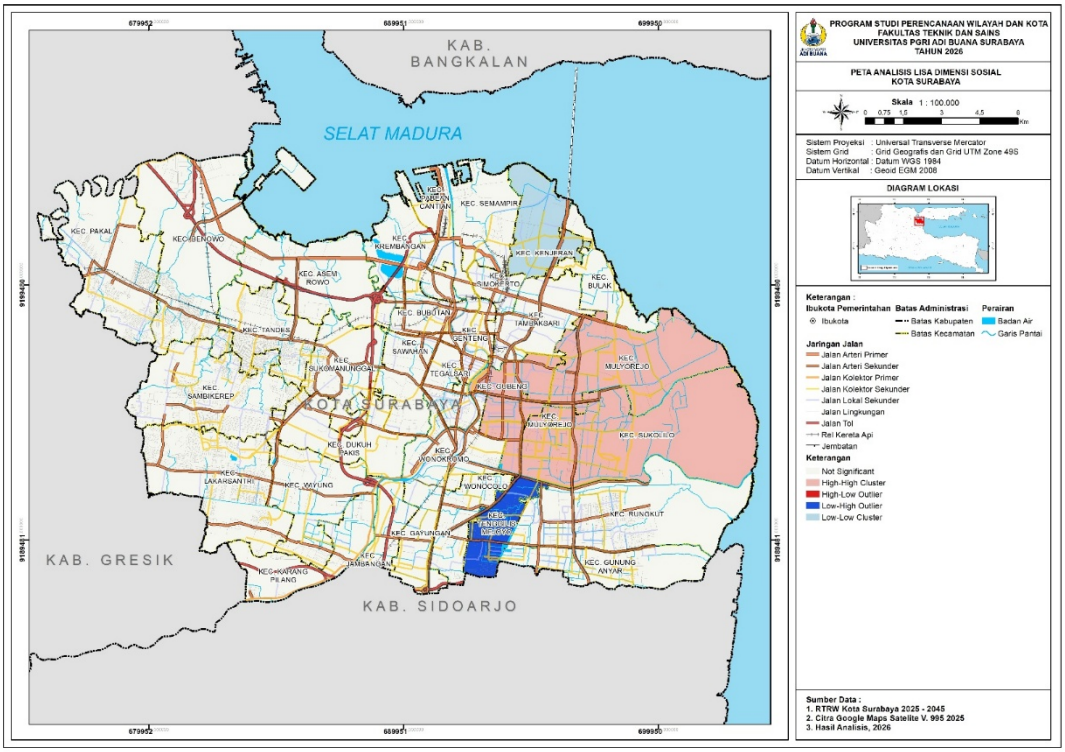

Figure 2. IPBL Distribution Map Social Dimension

The findings from the LISA social dimension analysis indicate the presence of clusters that fail to reject hī (p-value >0.05) and those that reject hī (p-value <0.05). Failure to reject hī indicates that the area does not have substantial spatial autocorrelation with its surroundings, while rejection of hī indicates that the area shows prominent spatial autocorrelation with its neighbors. The null hypothesis of HN is not rejected in 26 districts (84%), which include Karang Pilang, Jambangan, Gayungan, Wonocolo, Gunung Anyar, Rungkut, Wonokromo, Dukuh Pakis, Wiyung, Lakarsantri, Sambikerep, Tandes, Sukomanunggal, Sawahan, Tegalsari, Genteng, Tambaksari, Bulak, Simokerto, Semampir, Kepabeanan Cantian, Bubutan, Kecamatan Kecamatan Krembangan, Kecamatan ASEM Rowo, Benowo, and Pakal. Cluster rejection of H1 is spread across five districts (16%), including Tenggilis Mejoyo, Sukolilo, Mulyorejo, Gubeng, and Kenjeran.

2. Economic Dimension

The Moran's Index value for the economic dimension is 0.176, indicating positive spatial autocorrelation. Districts with high IPBL values for the economic dimension tend to be adjacent to districts with high IPBL values for the economic dimension, while districts with low IPBL values for the economic dimension tend to be adjacent to districts with low IPBL values for the economic dimension. Hypothesis testing using a significance level of 5% shows a p-value of 0.055 (<0.05). Spatial autocorrelation for the social dimension is insignificant, so the distribution pattern of IPBL for the social dimension in Surabaya City tends to be clustered , as shown in Table 5 and Figure 3 .

Table 5. IPBL Moran Index Economic Dimension

Moran's Index	*z-score*	*p-value*	Spatial Patterns	Information
0.176	1,914	0.055	*Clustered*	Positive spatial autocorrelation (not significant)

Source: Analysis Results, 2026

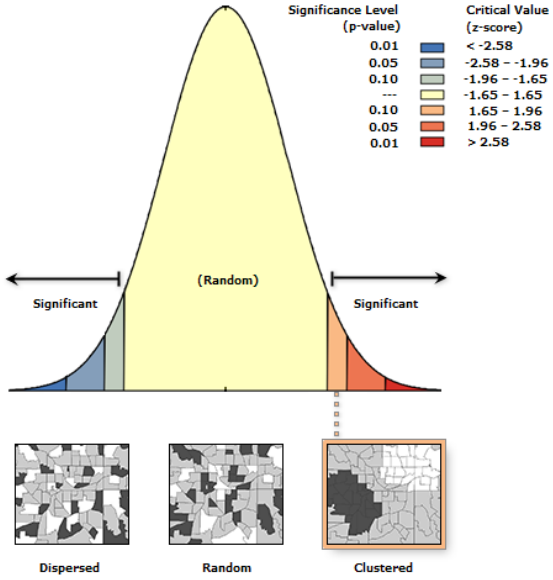

Figure 3. *Moran's Index* **Pattern** of Economic Dimension

There are 4 clusters of IPBL economic dimensions divided into High-High (HH) cluster, High-Low (HL) cluster, Low-Low (LL) cluster, and Not Significant cluster (Figure 4). The High-High (HH) cluster is spread across 3 sub-districts, namely Tenggilis Mejoyo Sub-district, Sukolilo Sub-district, and Gubeng Sub-district. It is indicated by the high economic dimension index value and is adjacent to sub-districts that also have high IPBL economic dimension values such as Genteng Sub-district at 46.97, Gubeng Sub-district at 53.24, Tambaksari Sub-district at 49.06, Rungkut Sub-district at 49.06, Tenggilis Mejoyo Sub-district at 43.16, Wonokromo Sub-district at 39.46, and Gunung Anyar Sub-district at 39.46. The Low-High (LH) cluster is only found in Tegalsari District, indicated by the existence of regional inequality with low economic dimension index values adjacent to districts with high economic dimension IPBL values, namely Gubeng District of 53.24, Sawahan District of 42.68, Genteng District of 46.97, and Wonokromo District of 41.5. The Low-Low (LL) cluster is found in Lakarsantri District and Wiyung District, indicated by the existence of low economic index values adjacent to districts with low economic dimension IPBL values, namely Sambikerep District of 7.58. The Not Significant Cluster is spread across 25 other districts.

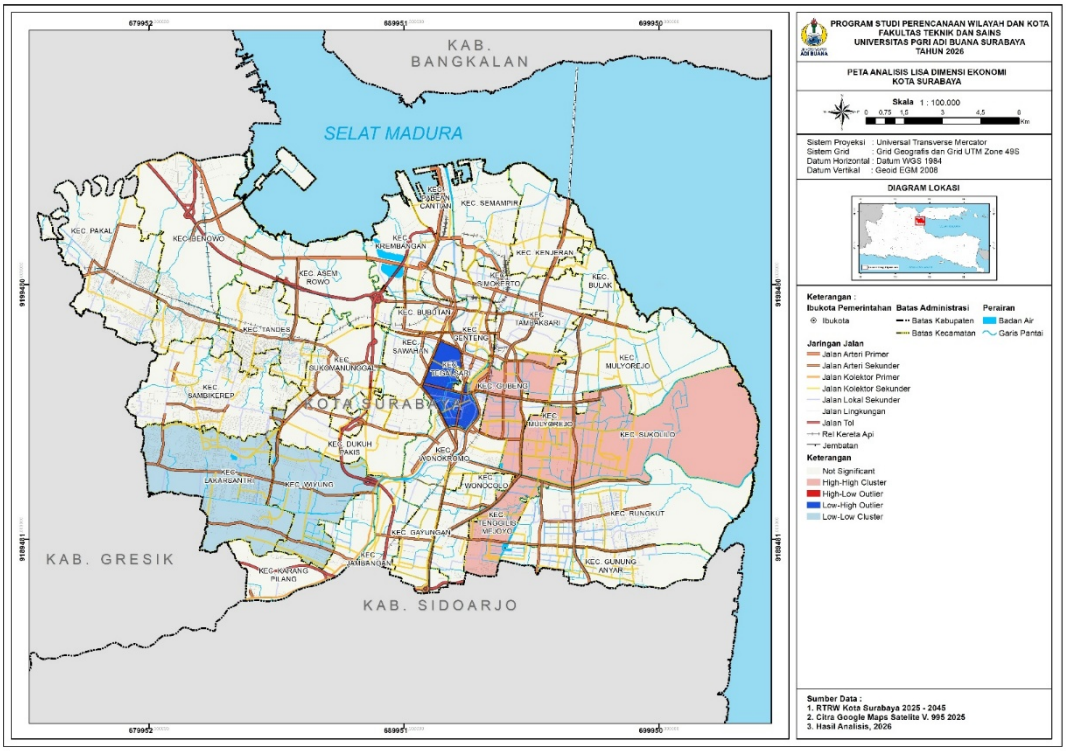

Figure 4. IPBL Distribution Map Economic Dimension

The findings of the LISA analysis regarding the economic dimension indicate a group of non-rejection of hī (p-value >0.05) and rejection of hī (p-value <0.05). The phrase "failed reject hī" indicates that the area does not have significant spatial autocorrelation with its surroundings, in contrast to "reject hī," which indicates that the location has expressed spatial autocorrelation with its surroundings. The null hypothesis of HN is not rejected in 23 sub-districts (74%), namely Karang Pilang, Jambangan, Gayungan, Rungkut, Mulyorejo, Wonokromo, Dukuh Pakis, Sambikerep, Tandes, Sukomanunggal, Sawahan, Genteng, Tambaksari, Kenjeran, Bulak, Simokerto, Semampir, Kepabeanan Cantian, Bubutan, Krembangan, Asem Rowo, Benowo, and Pakal. h. Rejected in a cluster covering 8 sub-districts (26%), namely Wonocolo Sub-district, Tenggilis Mejoyo Sub-district, Gunung Anyar Sub-district, Sukolilo Sub-district, Gubeng Sub-district, Wiyung Sub-district, Lakarsantri Sub-district, and Tegalsari Sub-district.

3. Environmental Dimension

The Moran's Index value for the environmental dimension is 0.247, indicating positive spatial autocorrelation. Districts with high IPBL values for the environmental dimension tend to be adjacent to districts with high IPBL values for the environmental dimension, while districts with low IPBL values for the environmental dimension tend to be adjacent to districts with low IPBL values for the environmental dimension. Hypothesis testing using a significance level of 5% shows a p-value of 0.009 (<0.05). Spatial autocorrelation for the environmental dimension is significant, so the distribution pattern of IPBL for the social dimension in Surabaya City tends to be clustered, *as* shown in Table 6 and Figure 5.

Table 6. IPBL Moran Index Environmental Dimension

Moran's Index	***z-score***	***p-value***	**Spatial Patterns**	**Information**
0.247	2,604	0.009	*Clustered*	Positive spatial autocorrelation (significant *)*

Source: Analysis Results, 2026

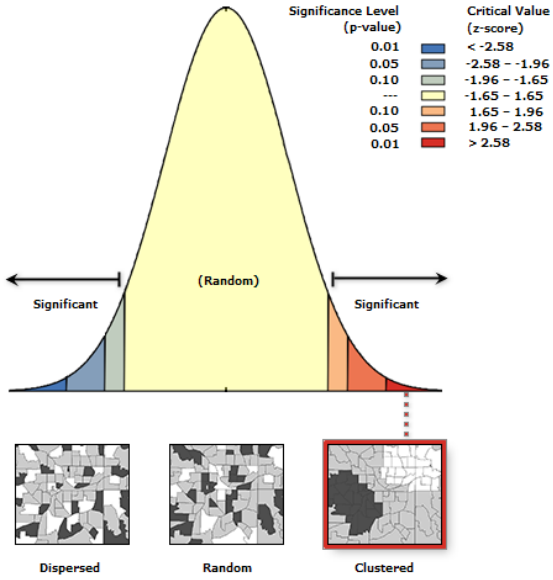

Figure 5. *Moran's Index* **Pattern** of Environmental Dimension

There are 5 clusters of social dimension IPBL which are divided into High-High (HH) cluster, High-Low (HL) cluster, Low-High (LH) cluster, Low-Low (LL) cluster, and Not Significant cluster (Figure 6). The High-High (HH) cluster is only found in Karangpilang District. It is indicated by the high environmental dimension index value and is adjacent to districts that also have high environmental dimension IPBL values such as Lakarsantri District of 79.46, Wiyung District of 77.26, Karangpilang District of 72.87, and Jambangan District of 68.98. The High-Low (HL) cluster is only found in Simokerto District, indicated by the existence of regional inequality with high environmental dimension index values adjacent to districts with low environmental dimension IPBL values, namely Tambaksari District of 45.01. The Low-High (LH) cluster is only found in Sambikerep District, indicated by the existence of regional disparities with low environmental dimension index values adjacent to districts with high environmental dimension IPBL values, namely Lakarsantri District of 79.46, Benowo District of 78.81, Wiyung District of 77.26, and Tandes District of 70.01. The Low-Low (LL) cluster is spread across 3 districts, namely Genteng District, Tegalsari District, and Wonokromo District. It is shown that there are low environmental index values adjacent to districts with low environmental dimension IPBL values, such as Sawahan District of 49.32, Tambaksari District of 45.01, and Wonokromo District of 39.47. The Not Significant Cluster is spread across 25 other districts.

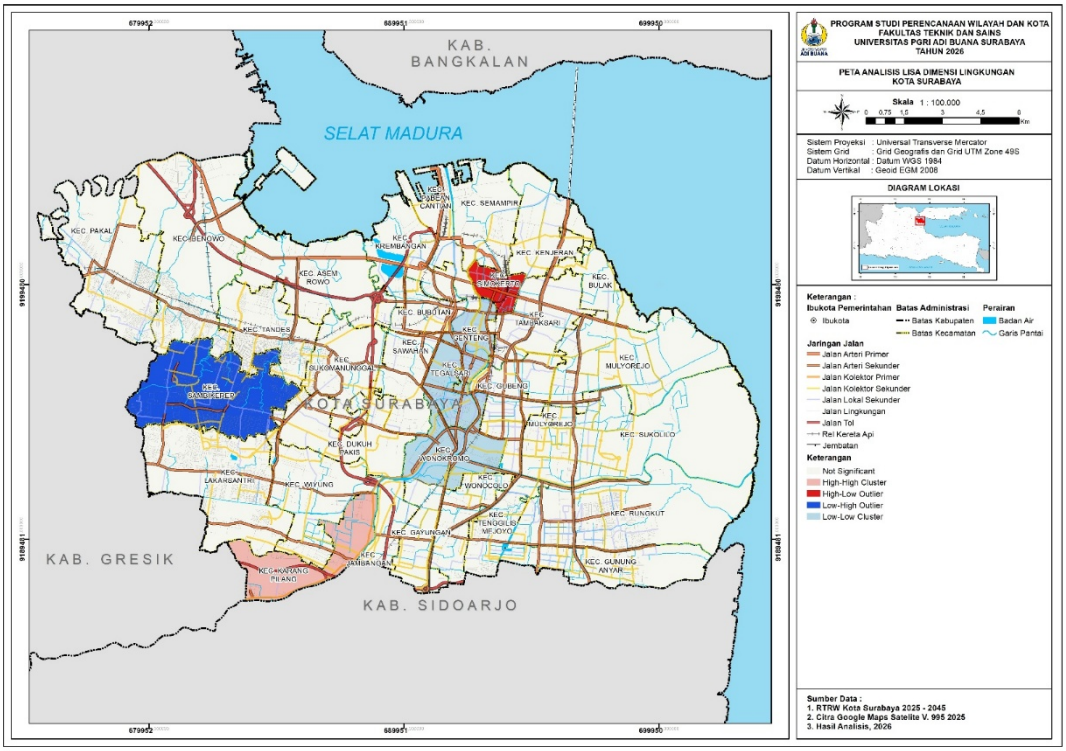

Figure 6. IPBL Distribution Map Environmental Dimension

The findings from the LISA analysis on environmental aspects indicate the existence of clusters where hī is not rejected (p-value >0.05) and where hī is rejected (p-value <0.05). The clusters that fail to reject hī indicate that the area does not have substantial spatial autocorrelation with its environment, while rejecting hī indicates that the area shows considerable spatial autocorrelation with its surrounding areas. The null hypothesis of HN is not rejected in 25 districts (81%), which include Karang Pilang, Gayungan, Tenggilis Mejoyo, Gunung Anyar, Mulyorejo, Gubeng, Wonokromo, Dukuh Pakis, Wiyung, Sambikerep, Tandes, Sukomanunggal, Sawahan, Tegalsari, Genteng, Tambaksari, Bulak, Simokerto, Semampir, Bubutan, Krembangan, Asem Rowo, Benowo, and Pakal District. The cluster that rejected HG includes 6 sub-districts (19%), namely Jambangan Sub-district, Wonocolo Sub-district, Rungkut Sub-district, Sukolilo Sub-district, Laksantri Sub-district, Kenjeran Sub-district, and Kepabeanan Cantian Sub-district. In the realm of sustainable urban development, the Green Village of the East Tegal Islands serves as a significant case study. This community achieves nearly all aspects of the SDG indicators, including environmental issues related to cities. However, several parameters remain unmet, particularly those of "no poverty" and "life on land," requiring further action to build a more optimal Green Village. (Tasya et al., 2020) .

CONCLUSION

The social dimension with a high category is spread across 5 sub-districts (16%), the medium category is spread across 19 sub-districts (61%), and the low category is spread across 7 sub-districts (23%). The economic dimension with a high category is spread across 9 sub-districts (29%), the medium category is spread across 18 sub-districts (58%), and the low category is spread across 4 sub-districts (13%). The environmental dimension with a high category is spread across 13 sub-districts (42%), the medium category is spread across 15 sub-districts (42%), and the low category is spread across 3 sub-districts (16%). The direction for increasing the IPBL value for the social dimension is to reduce the poor population and reduce the number of people suffering from malnutrition. The direction for increasing the IPBL value for the economic dimension is to increase the number of MSMEs and industries. The direction for increasing the IPBL value for the environmental dimension is to reduce waste accumulation, increase mitigation and resilience to hydrometeorological disasters. The results of the Moran's Index analysis show a clustered distribution pattern with positive spatial autocorrelation in all three dimensions, but only the social and environmental dimensions are significant. The failed H_0 cluster is spread across 26 sub-districts (84%). The rejected H_0 cluster is spread across 5 sub-districts (16%). The economic dimension with the High-High (HH) cluster is spread across 3 sub-districts (10%), the Low-High (LH) cluster is only found in 1 sub-district (3%), the Low-Low (LL) cluster is spread across 2 sub-districts (6%), and the Not Significant cluster is spread across 25 sub-

districts (81%). The failed H_0 cluster is spread across 23 sub-districts (74%). The rejected H_0 cluster is spread across 8 sub-districts (26%). Environmental dimensions with High-High (HH) clusters spread across 1 sub-district (3%), High-Low (HL) clusters are only found in 1 sub-district (3%), Low-High (LH) clusters are only found in 1 sub-district (3%), Low-Low (LL) clusters are spread across 3 sub-districts (10%), Not Significant clusters are spread across 25 sub-districts (81%). Failed to reject H_0 clusters are spread across 25 sub-districts (81%). Rejected H_0 clusters are spread across 6 sub-districts (19%).

The contribution of this research to the development of Urban and Regional Planning science lies in strengthening the spatial approach in measuring sustainable development at the local scale. The integration of the composite index, Moran's Index, and LISA provides an analytical framework for identifying social, economic, and environmental disparities between sub-districts in a more measurable manner. The research findings enrich urban planning studies by demonstrating that development achievements need not only be assessed in aggregate but also based on patterns of distribution and inter-regional linkages. These results can form the basis for developing evidence-based planning models, determining regional intervention priorities, and formulating more inclusive, adaptive, and sustainable urban development policies.

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