Jurnal Manajemen & Agribisnis, Vol. 22 No. 1, March 2025
Permalink/DOI: http://dx.doi.org/10.17358/jma.22.1.1

Available online at
http://journal.ipb.ac.id/index.php/jmagr

SPATIAL ANALYSIS OF INCLUSIVE GROWTH IN CENTRAL JAVA PROVINCE

Farid Adam Rahmadi[*)1], Ernan Rustiadi[**)], Dedi Budiman Hakim[***)]

[*)] IPB University
Jl. Raya Dramaga, IPB Dramaga Campus Bogor, 16680, Indonesia
[**)]Department of Soil Science and Land Resources, Faculty of Agriculture, IPB University
Jl. Ulin IPB Dramaga Campus Bogor, 16680, Indonesia
[***)]Department of Economics, Faculty of Economics and Management, IPB University
Jl. Agatis IPB Dramaga Campus Bogor, 16680, Indonesia

Article history:

Received
22 August 2024

Revised
11 November 2024

Accepted
26 November 2024

Available online
31 March 2025

Abstract

Background: Economic growth, while often viewed as a sign of development success, may not guarantee equitable income distribution, particularly in developing nations. The Inclusive Economic Development Index (IPEI) by the National Development Agency (Bappenas) gauges inclusivity in Indonesian development. In Central Java Province, regency/city-level IPEI varies, indicating uneven growth.
Purpose: This study has two objectives: (1) to analyze the spatial distribution patterns of inclusive growth in regencies/cities within Central Java Province; and (2) to assess the relevance of the regional development system by considering the spatial interrelations of inclusive growth.
Design/methodology/approach: The research utilizes secondary data. The same analytical methods are applied for both objectives with different data points Moran's Index Analysis, Moran's Scatterplot, and Local Indicator of Spatial Autocorrelation (LISA).
Findings/Results: The research findings indicate that (1) the spatial distribution pattern of the IPEI in the regencies/cities of Central Java Province from 2012 to 2021 tends to form spatial clusters, with three regencies/cities showing significant and consistent local IPEI spatial influence namely Surakarta City (High-High quadrant) and Banjarnegara and Wonosobo (Low-Low quadrant), and (2) alternative Regional Development (WP) spatial analysis reveals a high IPEI spatial correlation within each WP, with Surakarta City and Salatiga City consistently appearing in the High-High quadrant, while Pekalongan City is significantly positioned in the Low-Low quadrant.
Conclusion: The spatial distribution pattern of the IPEI in Central Java Province tends to form spatial clusters with three regencies/cities showing significant and consistent local IPEI spatial influence namely Surakarta City, Banjarnegara, and Wonosobo. The spatial analysis of alternative WPs reveals a strong spatial correlation of IPEI values with Surakarta City and Salatiga City identified as significant local spatial influencers.
Originality/value (State of the art): This study enables the identification of regencies, cities, and/or WP with lagging IPEI values, thereby allowing policymakers to design targeted interventions. Based on the findings, Banjarnegara and Wonosobo are identified as such areas. The alternative WPs proposed in this study can serve as important considerations for regional development planning in Central Java Province.

Keywords: IPEI, inclusive growth, spatial analysis, Moran's Analysis, Central Java Province

How to Cite: Rahmadi F. A., Rustiadi E., & Hakim D. B. (2025). Spatial Analysis of Inclusive Growth in Central Java Province. Jurnal Manajemen & Agribisnis, 22(1), 1. https://doi.org/10.17358/jma.22.1.1

[1] Corresponding author:
Email: adam.rahmadi@gmail.com

INTRODUCTION

High economic growth is often considered an indicator of development success because of its potential to enhance societal well-being through trickle-down effects. However, in reality, high economic growth is not always accompanied by equitable income distribution, especially in developing countries where social disparities persist despite significant economic growth. Therefore, it is essential to pay attention to income distribution to ensure that development outcomes are enjoyed evenly across all segments of society. The use of Gross Domestic Product (GDP) and Gross Regional Domestic Product (GRDP) as measures of economic growth is often regarded as inadequate for reflecting comprehensive development achievements, as they do not account for income distribution.

Birdsall (2007) argues that inclusive growth facilitates the expansion of the size and economic capacity of the middle class. Inclusive economic growth is a manifestation of sustainable growth, as defined in the Sustainable Development Goals (SDGs) number 8, which are determined by the extent to which economic growth addresses poverty, inequality, and unemployment. To achieve the country's economic growth that supports inclusive growth and aligns with SDG 8 goals, it is essential to guarantee employment opportunities and decent work (Pratiwi et al. in Anindyntha, 2023). In other words, development and growth in a region are considered inclusive if they involve active participation from all members of society and if their benefits are felt by all layers of society. Ramos et al. (2013) also introduced the concept of inclusive growth, which integrates the pro-poor approach within the dimension of Benefit Sharing, measured through indicators of poverty and inequality, and the dimension of Participation, which is assessed using the Employment to Population Ratio (EPR).

Disparities between regions are common, where investments and resources are absorbed and concentrated in urban areas and growth centers, while hinterland areas experience excessive resource backwash, resulting in macro-level disparities between rural and urban areas, eastern and western Indonesia, Java and non-Java regions, and so forth (Rustiadi, 2009). Government intervention is necessary to balance growth and ensure sustainable development, including through the design of Regional Developments (Wilayah Pengembangan/ WP), such as those implemented in Central Java Province, which includes eight WPs as shown in Table 1.

However, there is a gap between targets and achievements, with disparities in inclusive growth still evident even within the same development region. To enhance competitiveness in the global economy and achieve inclusive development, regional cooperation and strong fiscal capacity from local governments are crucial. Several studies addressing inclusive growth issues, such as the one conducted by Fauzia and Suseno (2017), state that significant income disparities still exist in economic growth within the development region (WP) of Purwomanggung in Central Java Province. This contradicts the goals of establishing development regions, which should reduce economic disparities between regencies/cities within the region. Fauzia and Suseno (2017) also emphasize that economic growth does not always reduce poverty and inequality, and reducing poverty does not always mean reducing disparities. One underutilized measure of inclusive growth worth considering is the Inclusive Economic Development Index (IPEI) formulated by the National Development Planning Agency (Bappenas), which measures and monitors the inclusiveness of development in Indonesia at the national, provincial, and regency/city levels.

Table 1. Regional Developments (WP)

WP	Regencies/cities
Kedungsepur	Kendal, Demak, Semarang, Salatiga, Semarang City, Grobogan
Barlingmascakeb	Banjarnegara, Purbalingga, Banyumas, Cilacap, Kebumen
Purwomanggung	Purworejo, Wonosobo, Magelang, Magelang City, Temanggung
Subosukawonosraten	Surakarta City, Boyolali, Sukoharjo, Karanganyar, Wonogiri, Sragen, Klaten
Banglor	Rembang, Blora
Wanarakuti	Jepara, Kudus, Pati
Petanglong	Pekalongan, Batang, Pekalongan City
Bregasmalang	Brebes, Tegal City, Tegal, Pemalang

Based on IPEI data, it is known that regencies and cities in Central Java Province have varied IPEI values ranging from 5,68 to 6,74 for the year 2021 for each regency/city. If this information is presented in the form of a distribution map, it can be seen that the IPEI of each regency/city in Central Java Province tends to cluster into several adjacent clusters, as shown in Figure 1.

The Central Java Provincial Government has developed a regional system that emphasizes functional connectivity between cities and hinterlands in efforts to achieve equitable regional development, the Regional Regulation of Central Java Province No. 6 of 2010 on the Regional Spatial Plan of Central Java Province for 2009–2029 designates areas to serve as inter-regional strategic zones between regencies/cities. Based on these strategic zones, each area within the designated zone will strive to promote economic growth while simultaneously ensuring equitable development (Waluyaningsih and Setiawan, 2020). Despite being divided into eight development regions, there are still lagging areas where certain areas with high IPEI values are adjacent to areas with low IPEI categories, such as Magelang City, Pekalongan City, and Tegal City, making the analysis of the distribution pattern of IPEI in regencies/cities and its dynamic growth in the region from 2012 to 2021 important to consider.

Most studies on inclusive growth focus on determinant factors influencing the increase or decrease of inclusive growth itself, while the understanding of the simultaneous relationship between inclusive growth components, namely economic growth, poverty, and inequality, and their spatial interaction has not been widely discussed. Spatial factors are essential considerations, as highlighted by Sameti and Farahmand (2009) and Long and Pasaribu (2019), emphasizing the importance of considering spatial factors in achieving inclusive economic growth. The results of both studies indicate a relationship between economic growth, poverty, and inequality simultaneously, as well as being spatially related to other regions.

Additionally, Purnami et al (2023) state that there is a clustered spatial distribution and pattern of poverty in the Tegal Regency based on Moran's Index and LISA analysis results. Dewi et al (2021), employing a similar research methodology, using Moran's Index and Local Moran's analysis, identified no spatial correlation in economic growth in South Sumatra. The divergent findings regarding the spatial relationship between components of inclusive growth (poverty and economic growth) in various studies suggest that research on inclusive growth remains inconclusive. On the contrary, Figure 1 indicates that there is a presumption that the distribution of IPEI in regencies and cities exhibits a clustered pattern, with regencies and cities showing a similar range of IPEI values.

Spatial factors in inclusive growth economic development are closely related to economic growth, defined as a process that causes the real income per capita of a community to increase in the long term (Sukirno, 2006). Economic activities in an area involve not only capital and labor within that area but also spatial interactions due to the movement (mobility) of goods and people that stimulate economic growth between its surrounding regions. Given the differences in economic potential between regions in terms of human resources and natural resources, as well as the availability of labor, the spatial interaction of capital and labor is inevitable. It can be said that with the spatial interaction of natural resources and human resources between regions, the economic growth of one region (as one component of inclusive growth) also contributes to or influences the economic growth of other regions. Oktareni (2020) concluded that growth in the regency areas studied has been interrelated with growth in urban areas, thereby affecting the success of each other's development with markedly increased economic growth. These descriptions illustrate to what extent spatial elements influence economic growth between regions according to the economic activities in each area.

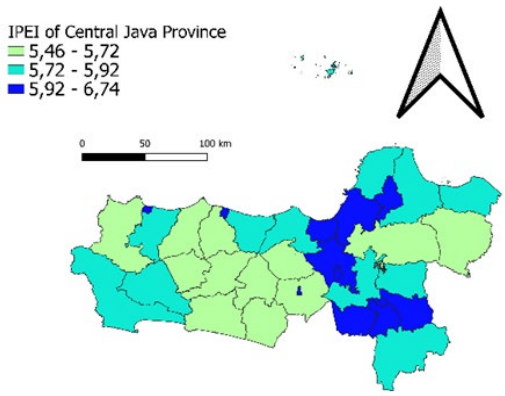

Figure 1. Map of IPEI Distribution Quantiles of Regencies and Cities in 2021

Research on the role of local governments in development has gained importance, especially with the implementation of broader regional autonomy. The persistent disparities in inclusive growth among development regions, as illustrated in Figure 1, are inconsistent with the concept of regional autonomy. This autonomy aims to optimize local development by encouraging each regency/city to engage in regional cooperation to enhance their competitiveness in the global economy (Larasati and Wijaya, 2022). This has positioned the promotion of inclusive growth as a significant responsibility for local governments. As a result, integrating spatial analysis has become a key element in understanding and addressing the challenges of inclusive economic development at the regional level.

Previous research linking spatial aspects to inclusive growth in regencies/cities within one province includes a study conducted by Long and Pasaribu (2019) on the spatial analysis of determinants of inclusive growth in regencies/cities in Central Java Province in 2017, using inclusive growth variables based on the Inclusive Growth Composite Index compiled by Mckinley (2010) but the study was limited only to the 2017 data. As a novelty element, this study attempts to explain the spatial aspect of the IPEI of regencies and cities in Central Java Province using time series data from 2012 to 2021. The spatial analysis of IPEI offers a comprehensive overview of disparities across regencies, cities, and WPs within Central Java Province. By visualizing and quantifying spatial inequalities, this study enables the identification of regencies, cities, and/or WP with a lagging IPEI, thereby allowing policymakers to design targeted interventions, including improvements to WP planning.

METHODS

The data used in this study are quantitative panel data such as the IPEI value index ranging from 0 to 10 and coordinates of 35 regencies/cities of Central Java Province from 2012 to 2021. The data was sourced primarily from secondary sources, including the government index of inclusiveness and regencies/cities's coordinates in longitude and latitude format.

The data used for this research are the IPEI values of regencies/cities, obtained from the National Development Planning Agency (Bappenas) website. Geospatial data such as coordinates (latitude and longitude) and map layer used in this research were sourced from the Central Java Geoportal website. The research was conducted over a period of six months, from January to June 2024.

The analysis methods used to achieve those goals were Moran and LISA analysis. Moran and LISA tests were used to determine whether there is a spatial dependency among locations with the null hypothesis for both tests having no spatial dependencies (Sinaga et al., 2021). The first analysis method used in this study is Moran's index analysis which is used to determine the presence of spatial autocorrelation. Autocorrelation refers to the estimation of observed values related to spatial locations of the same variable. The Moran's index method is frequently utilized in various studies due to its ability to detect the onset of spatial randomness, which indicates the presence of clustering patterns or trends across space (Kosfeld, 2006).

Weighting is required in the calculation of the Moran's Index, based on the spatial relationships between regions. This study employs the Gaussian kernel method as spatial weighting to measure the proximity between regencies/cities. Furthermore, spatial relationships between non-adjacent regions are also calculated. The test is conducted using the standardized W_{ij} matrix based on the centroid values of each regency/city concerning the activity center of their respective development regions. The formulation of the Moran's Index, as defined by Arlinghaus (1996) in Santi et al (2020), is as follows:

$$I = \frac{n}{\sum i \sum j W_{ij}} \frac{\sum i \sum j W_{ij} (x_i - \bar{x})(x_j - \bar{x})}{\sum i (x_i - \bar{x})^2} \quad \text{(i)}$$

Where: I (Moran's Index); n (Number of regencies/cities); xi (Observed value of regency/city i); xj (Observed value of regency/city j); $\bar{x}$ (Mean value of all observed variables); Wij (Matrix element between regency/city i and regency/city j)

Moran's Scatterplot is used to identify clustering/dispersal patterns between locations, indicated by the observed value of a location with standard provisions to test with an average of assessments taken based on locations neighboring the location concerned (Anggani et al., 2023). According to Zhukov (2010) in Munibah et al. (2018), the interpretation of the quadrants produced

by Moran's Scatterplot is as follows:

- Quadrant I (High-High, HH): Represents areas with high observed values surrounded by areas with high observed values. These are commonly referred to as hot spots due to the presence of regions with high characteristics.
- Quadrant II (Low-High, LH): Represents areas with low observed values surrounded by areas with high observed values.
- Quadrant III (Low-Low, LL): Represents areas with low observed values surrounded by areas with low observed values. These are often referred to as cold spots due to the low characteristics of the region.
- Quadrant IV (High-Low, HL): Represents areas with high observed values surrounded by areas with low observed values.

Areas that tend to fall within Quadrant I (HH) and Quadrant III (LL) exhibit positive spatial relationships, whereas areas within Quadrant II (LH) and Quadrant IV (HL) are considered spatial outliers due to their differing characteristics compared to surrounding areas. Regions located in Quadrants II and IV are indicative of negative spatial relationships, while a random distribution of regions across all four quadrants suggests no spatial relationship.

Local Indicators of Spatial Association (LISA) is employed to identify local autocorrelation or spatial correlation in each region. The LISA analysis provides information on whether there is partial/local spatial dependence between regencies/cities, distinguishing it from Global Moran's analysis, which only represents spatial dependence across the entire area. This distinction arises from the assumption that not all regencies/cities exhibit spatial effects or that these effects vary between regions. Lee and Wong (2001) suggest that higher local values indicate that neighboring locations have similar values or form a clustered distribution. The calculation of LISA is as follows:

$$I_i = Z_i \sum_{i=1}^{n} Wij\, Zj \qquad \text{(ii)}$$

Where: Ii (LISA index for regency/city i); Zi and Zj (Standardized data); Wij (Weighting between regency/city i and regency/city j).

The hypotheses in this study are divided into two categories: the hypothesis for the spatial analysis of IPEI at the regency/city level and the hypothesis for the spatial analysis of IPEI in the proposed alternative WP. Both sections utilize the same analytical techniques, specifically Moran's Index analysis, Moran's scatterplot, and Local Indicators of Spatial Association (LISA). Building upon the previously outlined background, problem formulation, and research objectives, the hypotheses proposed in this study are as follows:

- There are spatial patterns and dependencies of IPEI value across Central Java Province.
- There are spatial patterns and dependencies of IPEI value within each WP and the proposed alternative WPs.

The hypothesis for Moran's Index analysis are:
H_0: I = 0 (no spatial autocorrelation)
H_1: I ≠ 0 (significant spatial autocorrelation)

The null hypothesis (H_0) stated that there is no spatial autocorrelation in the point data (regencies/cities) implying that the spatial arrangement of the IPEI value is random, and the observed distribution does not significantly differ from what might be expected to occur by random chance. Conversely, the alternative hypothesis (H_1) stated that there is significant spatial autocorrelation in the point data (regencies/cities) either positive or negative spatial autocorrelation with the following interpretation (Adiputra et al., 2022) :

- $I > I_0 \rightarrow$ Positive spatial autocorrelation, indicating the formation of a clustered data pattern.
- $I < I_0 \rightarrow$ Negative spatial autocorrelation, indicating a dispersed data pattern.

In the context of Moran's I analysis, (I_0) is also referred to as the expected value of Moran's I, determined by the characteristics of the number of observations under the null hypothesis. It provides a baseline for comparison with the observed Moran's I.

This research proposes the following hypothesis from the LISA parameter:
H_0: $I_i = 0 \rightarrow$ There is no spatial autocorrelation within the local area
H_1: $I_i \neq 0 \rightarrow$ There is significant spatial autocorrelation within the local area

The null hypothesis (H_0) of LISA states that the IPEI value at a specific point (regency/city) is not significantly related to the IPEI values of the neighboring regencies/cities, meaning that any observed spatial clustering or outliers are random. The alternative hypothesis (H_1)

on the other hand, stated that there is significant local spatial autocorrelation of IPEI where the value of IPEI at a specific point data (regency/city) is systematically related to the IPEI of the neighboring regencies/cities with positive autocorrelation (specific regency/city is surrounded by neighboring regencies/cities with similar values of IPEI) and negative autocorrelation (specific regency/city is surrounded by neighboring regencies/cities with dissimilar value of IPEI). Spatial visualization is essential for the local Moran's index; therefore, it is presented in the LISA cluster map. This LISA-based cluster map reveals which districts or cities share similar characteristics regarding specific parameters based on the spatial patterns formed (Wibisono and Kuncoro, 2015).

The research framework for this research is shown in Figure 2. The research framework focuses on analyzing disparities in the Inclusive Economic Performance Index (IPEI) among regencies/cities within Central Java Province, using the province's eight Regional Development Areas (WP) as a basis for understanding functional linkages between cities and hinterlands. The study highlights the clustering of IPEI values, where regencies/cities with similar IPEI ranges tend to group together, indicating spatial disparities. To address this, the framework calls for an analysis of the spatial effects of IPEI achievements in neighboring areas on a related area's IPEI value, alongside an evaluation of the Regional Development System's relevance. This comprehensive analysis aims to provide critical insights for policy implications to achieve more inclusive growth across the province.

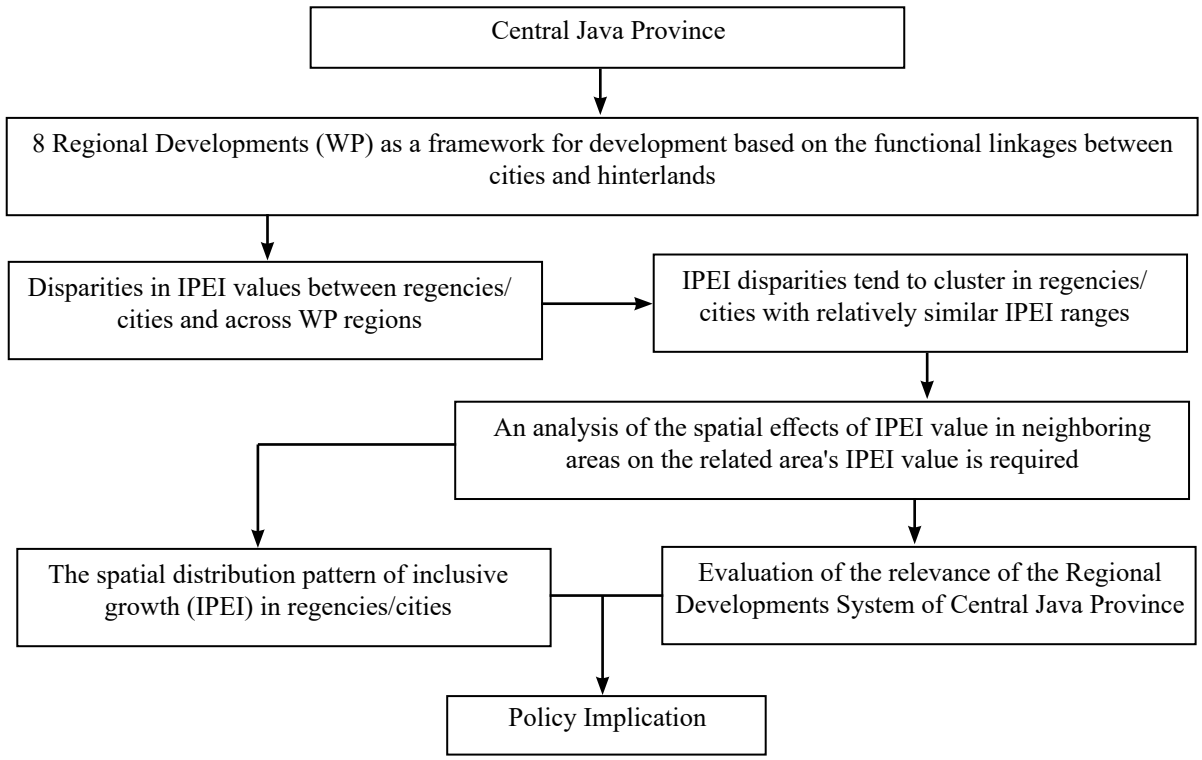

Figure 2. Research framework

RESULTS

Analysis of the Distribution Pattern of IPEI

The Moran's Index of IPEI was calculated using the formula described in the methodology section (Equation 1). The result indicates a positive spatial autocorrelation of inclusive growth and tends to decline over time. In 2012, the Moran's index value was 0,407 and in 2021, it declined to 0,350, as shown in Table 2. The p-values for the analysis from 2012 to 2021 are significant at the 5% level, indicating the rejection of the null hypothesis of Moran's I (H_0: there is no spatial autocorrelation) and the acceptance of the alternative hypothesis (H_1: there is spatial autocorrelation). The positive value of Moran's I demonstrates the presence of clustering in IPEI, where regencies/cities exhibit similar IPEI values. This result is consistent with Long and Pasaribu (2019), who stated that there is a spatial correlation in the inclusive growth of regencies/cities in Central Java Province. This result is also consistent with Pamungkas (2009), who stated there was a spatial dependency on poverty in East Java. On the contrary, this result differs from Hidayah and Gunanto (2023), who concluded that there is a negative spatial autocorrelation in economic growth (using Gross Regional Domestic Product values) in the WP Kedungsepur. The decreasing Moran's index value from 2012 to 2021 indicates that the observation values of regencies/cities are increasingly dissimilar (varied) to those of neighboring regencies/cities, and the spatial dependence on the IPEI also decreases.

Moran's scatterplot analysis result of IPEI in regencies/cities from 2012 to 2021 shows a clustered tendency of IPEI in regencies/cities in Quadrant I and Quadrant III as shown in Figure 3. For 10 years from 2012 to 2021, some regencies and cities were consistently categorized in Quadrants I and III, while no regencies/cities were consistently categorized into Quadrants II and IV. These regencies/cities are:

1. In Quadrant I (High-High), there are nine regencies/cities: Karanganyar Regency, Klaten Regency, Kudus Regency, Semarang Regency, Sukoharjo Regency, Magelang City, Salatiga City, Semarang City, and Surakarta City.
2. In Quadrant III (Low-Low), there are 14 regencies/cities: Banjarnegara Regency, Banyumas Regency, Batang Regency, Blora Regency, Brebes Regency, Grobogan Regency, Kebumen Regency, Pekalongan Regency, Pemalang Regency, Purbalingga Regency, Purworejo Regency, Rembang Regency, Wonogiri Regency, and Wonosobo Regency.

Based on the distribution map, the regencies/cities adjacent to each other in the central-southeastern part of Central Java Province consistently in Quadrant I (High-High). The same applies to the regencies/cities consistently being in Quadrant III (Low-Low), which are neighboring regencies/cities in the central-western part, as shown in Figure 3.

The calculation of LISA for the IPEI value of regencies and cities was performed using the formula explained in the methodology section (Equation 2). The result indicates from 2012 to 2021, the regencies/cities consistently being in Quadrant I (High-High) are Surakarta City, and the regencies/cities consistently being in Quadrant III (Low-Low) are Banjarnegara Regency and Wonosobo Regency. Regencies/cities with High-High cluster distribution patterns, such as Surakarta City, have high IPEI values and are surrounded by regencies/cities with similarly high IPEI values, such as Klaten Regency, Sukoharjo Regency, Karanganyar Regency, Boyolali Regency, and Sragen Regency. Conversely, this also applies to Banjarnegara Regency and Wonosobo Regency, which have been consistently in Quadrant III (Low-Low) from 2013 to 2021.

Table 2. Moran's Index of IPEI Distribution of Central Java 2012-2021

WP/Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Moran's Index	0.407	0.385	0.413	0.388	0.360	0.359	0.367	0.360	0.338	0.350
P-value	<0.00	<0.00	<0.00	<0.00	<0.00	<0.00	<0.00	<0.00	<0.00	<0.00

The values of IPEI in these two regencies are spatially influenced by and also influence the surrounding regencies/cities that also being in the range of relatively low IPEI distribution, namely Purbalingga Regency, Kebumen Regency, Purworejo Regency, Magelang Regency, Temanggung Regency, Batang Regency, and Pekalongan Regency. The significant quadrant distribution of LISA IPEI regencies/cities consistently from 2012-2021 is shown in Figure 4.

In addition to Moran's analysis's result, the LISA analysis identifies three regencies/cities with significant local Moran's Index values: Surakarta City (High-High quadrant) with p-value: 0,026 (<5%) and I_i=1,320 (positive autocorrelation), Banjarnegara (p-value= 0,015 and I_i=1,366) and Wonosobo (p-value= 0,021 and I_i=1,235) (Low-Low quadrant), proving that there is a strong spatial interaction within the WPs. Conversely, this result shows that there are consistently 30 regencies/cities from 2012 to 2021 that do not have significant spatial autocorrelation (at significance levels of 0,01 and 0,05). This indicates that not all IPEI achievements of regencies/cities are significantly related to those of neighboring regencies/cities.

The correlation only occurs in regencies/cities with nearly identical observation values, indicating the need for varied efforts to improve IPEI according to the characteristics of each region, as Harmes et al. (2017) stated that standardizing policies without considering spatial effects can result in policy impacts that negate one another across different regions. This, in turn, could moderately hinder efforts to achieve poverty alleviation goals (as part of inclusive growth).

Alternative regional development systems (WP) based on the distribution pattern of IPEI

Caroline et al (2019) in spatial economic growth analysis of Central Java reveal significant spatial spillover effects: when a district's economy grows, neighboring regions experience correlated productivity growth, hence understanding these spatial relationships is crucial for regional planning. The disparities among Regional Developments (WP), as indicated by the spatial distribution pattern analysis of IPEI and the tendency for geographically proximate regencies/cities to be in the same quadrant (Moran's Scatterplot Quadrants), necessitate a more detailed analysis and adjustment of analytical parameters to achieve more accurate results or at least provide an alternative perspective on the WP system. This will offer insights into the relevance of the current WP system in Central Java Province using the IPEI values of regencies/cities as a reference.

In addition to the spatial distribution pattern of IPEI, it is essential to understand the characteristics of the IPEI of regencies/cities within each WP, as the impact of a high Moran's I value depends on the context of the IPEI values within the WP. In WPs with high IPEI value clusters, such as Kedungsepur, where three regencies/cities are in the High-High cluster, a high Moran's I value can be considered beneficial for the regencies/cities within the WP, as they can support and reinforce each other's IPEI. In contrast, WPs like Barlingmascakeb and Petanglong, where most regencies/cities are in the Low-Low cluster, indicate inequality and suggest potential issues in the distribution of IPEI among the regencies/cities.

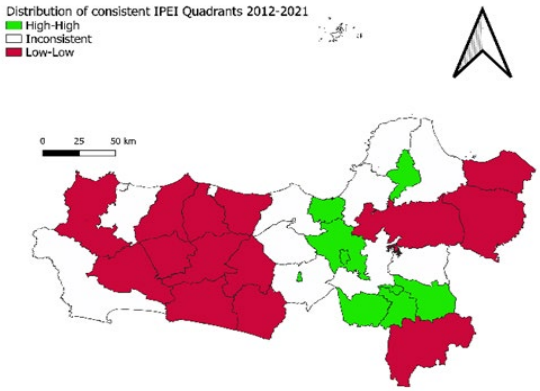

Figure 3. Distribution of Consistent IPEI Quadrants 2012–2021

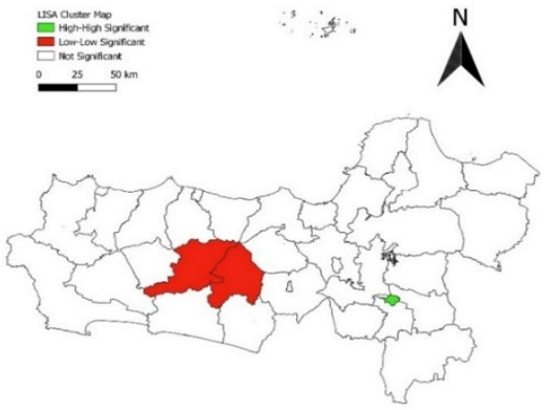

Figure 4. LISA Cluster Map of Consistent IPEI Regencies/Cities 2012-2021

The IPEI spatial analysis of alternative WP is conducted using different data points that consider the spatial correlation of a WP independently, between WPs, and the availability of certain infrastructure in the regencies/cities of Central Java Province, such as direct access to the Trans Java Toll Road.

Purwomanggung-Subosukawonosraten

Qibti and Hendarto (2020) stated that there is a high level of economic interdependence among the regencies/cities in the WP Purwomanggung, meaning that economic growth in one regency/city can influence the economic growth of other regencies/cities, and likewise, it can be affected by the economic growth in other areas within the WP Purwomanggung. Based on the results of Qibti and Hendarto (2020), it has been proven that the economic activities among the WP Purwomanggung regencies reveal spillover and backwash effects, with Magelang Regency contributing positively to Magelang City's growth but exerting a backwash effect on Purworejo. Over time, its impact on the neighboring regency/city shifts from a backwash effect to a spread effect, driven by the expansion of tourism-related activities such as hotels and culinary hubs. Magelang's proximity and trade links play a critical role in fostering economic flows and spreading growth to neighboring areas, highlighting the interconnected and interdependent nature of regional economic dynamics.

While Qibti and Hendarto (2020) focused their analysis exclusively on regencies and cities within WP Purwomanggung as point data, it is plausible that the economy of Magelang Regency in WP Purwomanggung also contributes to the economic activities of other regencies or cities outside WP Purwomanggung, such as Boyolali Regency within WP Subosukawonosraten, due to their geographic proximity. This suggests the potential for economic interdependence between WP Purwomanggung and WP Subosukawonosraten, facilitated by the spatial and economic linkages between these neighboring regions. With this economic interdependence, it is possible to have an impact on inclusive growth between the WPs. Moran's Index of IPEI for the alternative WP of Purwomanggung-Subosukawonosraten was calculated using the formula explained in the methodology section (Equation 1). The result indicates a positive spatial autocorrelation of inclusive growth and higher Moran's index IPEI values compared to the Moran's index IPEI values of each respective WP, as shown in Table 3.

The p-values for the WP Purwomanggung-Subosukawonosraten analysis from 2012-2021 are significant at the 5% level, indicating the rejection of the null hypothesis of Moran's I (H_0: there is no spatial autocorrelation) and the acceptance of the alternative hypothesis (H_1: there is spatial autocorrelation). The positive value of Moran's I demonstrates the presence of clustering of IPEI, where regencies/cities exhibit similar IPEI values.

Figure 5 illustrates the relationship patterns of the IPEI of regencies and cities within the Purwomanggung and Subosukawonosraten regions in 2012 and 2021. In 2012, there were seven regencies in Quadrant III namely: Magelang, Purworejo, Temanggung, Wonosobo, Boyolali, Sragen, and Wonogiri; four regencies/cities in Quadrant I, namely: Magelang City, Karanganyar, Sukoharjo, and Surakarta City; and Klaten in Quadrant IV. From 2012 to 2021, there were changes in regencies and cities that were in those quadrants, where in 2021 there were eight regencies and cities that were in the same quadrant consistently from 2012, namely: Karanganyar, Sukoharjo, and Surakarta City (Quadrant I); and Magelang Purworejo, Temanggung, Wonosobo, and Wonogiri (Quadrant III) as shown in Figure 5. The consistent regencies/cities in quadrant I such as Karanganyar, Sukoharjo, and Surakarta City emphasize their sustained roles as economic hubs, likely due to strong spatial linkages with neighboring areas and inclusive development policies that also benefit surrounding regencies/cities. In contrast, the consistent regency/city in quadrant III such as Magelang, Purworejo, Temanggung, and Wonosobo, highlighting persistent challenges that hinder progress in achieving inclusive growth.

Table 3. Moran's I Purwo-Subo

WP/Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Purwomanggung	0.264	0.276	0.262	0.252	0.251	0.258	0.259	0.239	0.229	0.227
Subosukawonosraten	0.344	0.359	0.346	0.337	0.316	0.287	0.291	0.293	0.309	0.287
Purwo-Subo	0.346	0.396	0.366	0.330	0.325	0.328	0.348	0.331	0.302	0.310

The calculation of LISA of WP Purwomanggung-Subosukawonosraten was performed using the formula explained in the methodology section (Equation 2). The result indicates that Surakarta City consistently occupies Quadrant I (High-High) with p-value: 0,025 and I_i= 0,738 . This outcome aligns with the LISA analysis of Central Java Province. Surakarta City's consistent presence in Quadrant I is attributed to its high IPEI value, as well as being surrounded by other regencies/cities with similarly high IPEI values, such as Sukoharjo and Karanganyar Regencies as shown in Figure 6.

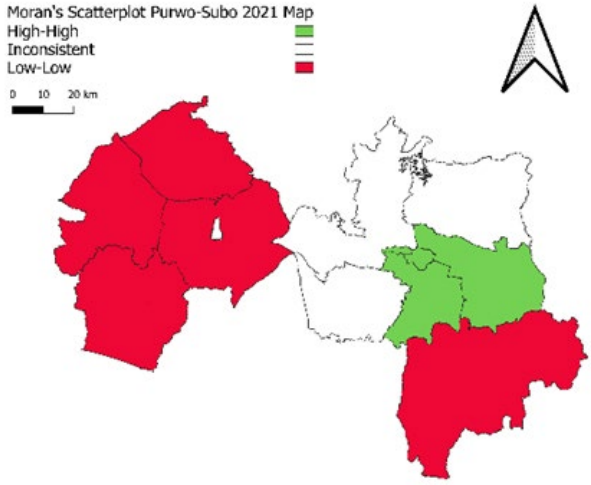

Figure 5. WP Purwomanggung-Subosukawonosraten's distribution of Quadrants I and III IPEI 2021

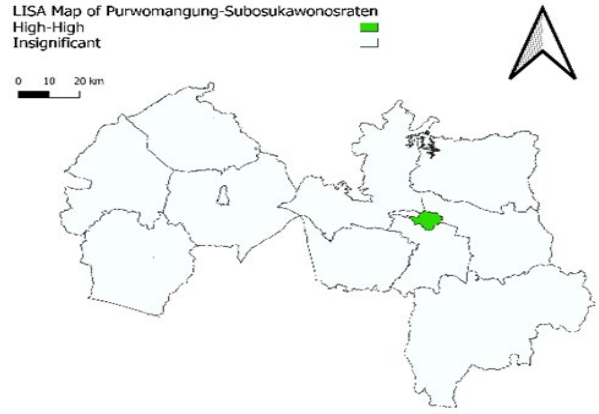

Figure 6. LISA Cluster Map of Purwomangung-Subosukawonosraten 2012-2021

Kedungsepur-Petanglong

The Moran's Index of IPEI for the alternative WP of Kedungsepur-Petanglong was calculated using the formula described in the methodology section (Equation 1). The result indicates a positive spatial autocorrelation of inclusive growth between the two regions is relatively higher compared to the overall spatial correlation of IPEI in Central Java Province as shown in Table 4. The p-values for the WP Kedungsepur-Petanglong analysis from 2012-2021 are significant at the 5% level, indicating the rejection of the null hypothesis of Moran's I (H_0: there is no spatial autocorrelation) and the acceptance of the alternative hypothesis (H_1: there is spatial autocorrelation). The positive value of Moran's I demonstrates the presence of clustering of IPEI, where regencies/cities exhibit similar IPEI values.

Figure 7 illustrates the IPEI relationship patterns of regencies/cities in the Kedungsepur and Petanglong regions in 2012 and 2021. In 2012, there were three regencies and cities in Quadrant I (High-High), namely: Semarang, Salatiga City, and Semarang City; in Quadrant III (Low-Low), namely: Demak, Grobogan, Batang, and Pekalongan; in Quadrant II (Low-High) and Quadrant IV (High-Low) were Kendal and Pekalongan City. From 2012 to 2021 six regencies and cities were in the same quadrant consistently, namely: Salatiga City and Semarang City in Quadrant I (High-High), also Demak, Grobogan, Batang, and Pekalongan, in Quadrant III (Low-Low) as shown in Figure 7. According to these results, it is shown that regencies/cities in Quadrant I (Salatiga City and Semarang City) managed to sustain and/or improve their inclusive economic growth with strong economic networks and policies while regencies/cities in Quadrant III (Demak, Grobogan, Batang, and Pekalongan) might be facing issues such as high poverty levels and limited infrastructure that hinder the broader population from benefiting from inclusive economic growth.

The calculation of LISA for WP Kedungsepur-Petanglong was conducted using the formula described in the methodology section (Equation 2). The result indicates that Salatiga City consistently occupies Quadrant I (High-High) with p-value = 0,017 and I_i = 1,175. Salatiga City's consistent presence in Quadrant I is attributed to its high IPEI value, as well as being surrounded by other regencies/cities with similarly high IPEI values, such as Semarang

and Semarang City, as shown in Figure 8. This result shows Salatiga's strong and sustained performance in fostering inclusive economic growth within the city itself and its neighboring regencies/cities. Salatiga's consistent presence in Quadrant I can be attributed to its economic development and its proximity to high-IPEI-value neighbors such as Semarang and Semarang City. The spatial interactions between those regions make Salatiga increase inclusive economic growth as its development becomes more integrated into a broader regional economic system.

Toll-based region of Central Java

The Javanese North Coast National Road Corridor (Pantura) in Central Java Province, has long served as the primary access route in the northern part of Central Java. The connectivity within Central Java Province has been further enhanced by the Trans Java Toll Road, which extends from Brebes Regency in the west to Sragen Regency in the east of Central Java, thereby boosting economic growth in the regencies and cities along its path (Ahmad, 2022).

This economic growth has the potential to reduce social indicators such as poverty, inequality, and unemployment through the trickle-down effect of toll road infrastructure. Consequently, a Moran analysis for IPEI of the regencies and cities traversed by the Trans Java Toll Road was conducted. The regencies and cities where the analysis was carried out, namely: Brebes Regency, Pemalang Regency, Tegal Regency, Tegal City, Batang Regency, Pekalongan Regency, Pekalongan City, Kendal Regency, Semarang Regency, Salatiga City, Semarang City, Boyolali Regency, Surakarta City, Karanganyar Regency, Sukoharjo Regency, and Sragen Regency.

Moran's Index of IPEI for the alternative WP of the Toll-based region was calculated using the formula described in the methodology section (Equation 1). The result indicates a positive spatial autocorrelation of inclusive growth and higher spatial correlation of IPEI compared to the overall IPEI of Central Java Province during the same period with a declining trend in Moran values as shown in Table 5. The p-values for the WP Toll-based region analysis from 2012-2021 are significant at the 5% level, indicating the rejection of the null hypothesis of Moran's I (H_0: there is no spatial autocorrelation) and the acceptance of the alternative hypothesis (H_1: there is spatial autocorrelation). The positive value of Moran's I demonstrates the presence of clustering of IPEI, where regencies/cities exhibit similar IPEI values. The declining trend in Moran values indicates that the IPEI achievements among the regencies and cities along the Trans Java Toll Road are interrelated, but the spatial correlation is weakening, leading to a more dispersed or non-clustered distribution of IPEI.

Figure 9 illustrates the IPEI relationship patterns of the regencies and cities along the Trans Java Toll Road from 2012 to 2021, with most being in Quadrants I and III, as follows: Salatiga City, Semarang City, Surakarta City, Karanganyar, and Sukoharjo in Quadrant I (High-High); Brebes, Pemalang, Tegal, Batang, Pekalongan, and Sragen in Quadrant III (Low-Low); Kendal and Tegal City in Quadrant II (Low-High) and IV (High-Low). Regencies/cities that consistently appear in Quadrant I suggest that these regions clustered are likely facilitated by their strong economic linkages and access to toll road infrastructure, which enhances integration and promotes inclusive growth. This result is in line with Ahmad (2022) who stated that the economic growth with the presence of toll roads is higher compared to before (without toll roads) and shows that toll road objectives have been achieved by improving the efficiency of distribution services to support the increase in economic growth.

Table 4. Moran's I Kedung-Petang

WP/Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Prov. Jawa Tengah	0.407	0.385	0.413	0.388	0.360	0.359	0.367	0.360	0.338	0.350
Kedung-Petang	0.549	0.479	0.590	0.545	0.560	0.610	0.579	0.535	0.568	0.507

Table 5. Moran's I Trans Jawa Toll

WP/Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Prov. Jawa Tengah	0.407	0.385	0.413	0.388	0.360	0.359	0.367	0.360	0.338	0.350
Reg/Cit Trans Jawa	0.583	0.520	0.606	0.508	0.469	0.445	0.448	0.407	0.379	0.397

The calculation of LISA for the WP Toll-based region was conducted using the formula described in the methodology section (Equation 2). The result indicates that from 2012 to 2021 there is no regency or city consistently located in any quadrant. However, Pekalongan consistently occupied Quadrant III (Low-Low) from 2014 to 2021 (p-value= 0,034 and I_i= 1,977), as depicted in Figure 10. Pekalongan's significant presence in Quadrant III (Low-Low) is due to its location within a region of high concentration of regencies and cities in Quadrant III (Low-Low), such as Brebes, Pemalang, Tegal, and Batang. The absence of regencies or cities significantly occupying Quadrant I (High-High) may be attributed to the dispersion of regencies and cities with IPEI in Quadrant I (High-High) or their lack of concentration compared to those in Quadrant III (Low-Low). The LISA analysis results for the regencies and cities with access to the Trans Java Toll Road suggest that the local spatial influence of IPEI has not yet been uniformly distributed across all regencies and cities with access to the Trans Java Toll Road.

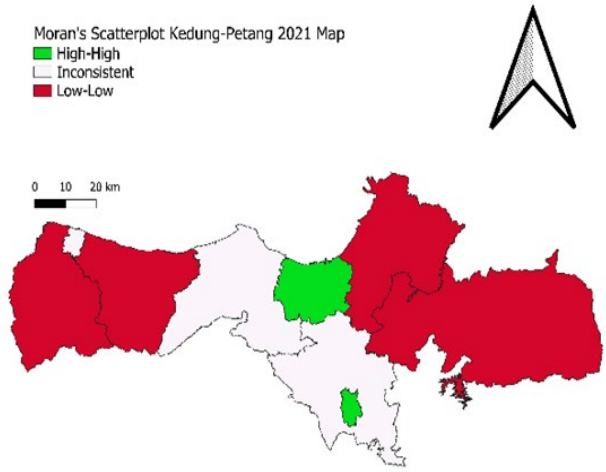

Figure 7. WP Kedungsepur-Petanglong's distribution of Quadrants I and III IPEI 2021

Figure 8. LISA Cluster Map of Kedungsepur-Petanglong 2012-2021

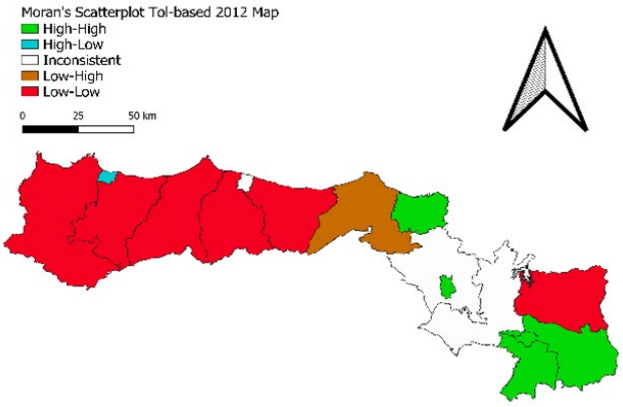

Figure 9. WP Toll-based region's distribution of Quadrants I and III IPEI 2012

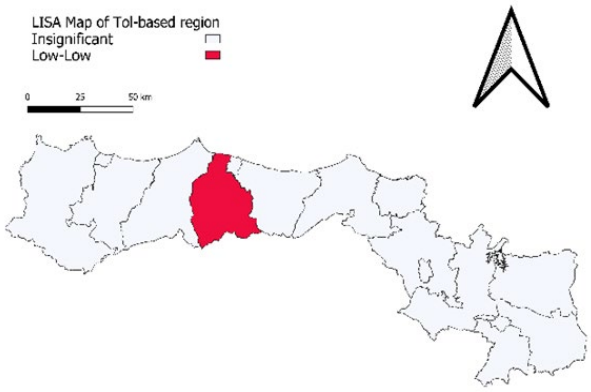

Figure 10. LISA Cluster Map of Toll-based region 2012-2021

Managerial Implications

The spatial analysis of the Inclusive Economic Development Index (IPEI), conducted using administrative boundaries of the WP, offers an alternative perspective on the relationship between one regency/city and neighboring regencies/cities. This perspective not only considers their functional ties but also emphasizes the interconnectedness of inclusive growth achievements (IPEI) between these areas. The results of the IPEI spatial distribution analysis across regencies/cities in Central Java indicate a clustering of areas with relatively high IPEI and others with relatively lower IPEI, as shown in Figure 3. With a significantly high Moran's index, which reflects the correlation between the IPEI of a regency/city and those surrounding it, there is a need for comprehensive efforts to improve IPEI across Central Java to achieve more equitable distribution among regencies/cities.

Further analysis of the existing WP system reveals several regencies/cities with strong spatial IPEI connections, both within their respective WPs and across neighboring WPs. This is particularly evident in Purwomanggung-Subosukawonosraten WP and Kedungsepur-Petanglong WP. These findings could serve as an alternative consideration for future regional development planning in Central Java, given that inclusive growth is the desired outcome of regional development. By understanding the inclusive growth interrelations between neighboring regencies/cities, development planning is expected to become more synergistic and integrated, fostering more inclusive growth across the region.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The conclusion drawn from this research is the spatial distribution patterns of IPEI values of regencies/ cities in Central Java Province from 2012 to 2021 have a clustered/positive spatial correlation and tend to decline over time. This result is in line with Long and Pasaribu (2019) that there is a spatial correlation in inclusive growth in Central Java Province, while it differs from Hidayah and Gunanto (2023) which show that there is negative spatial autocorrelation in economic growth in WP Kedungsepur. Some regencies and cities consistently remained in the same quadrant on Moran's Scatterplot from 2012 to 2021, specifically 9 regencies/cities in Quadrant I (High-High) and 14 regencies/cities in Quadrant III (Low-Low). There are three regencies/ cities with significant and consistent local IPEI spatial influence from 2012 to 2021, namely the City of Surakarta, Banjarnegara Regency, and Wonosobo Regency.

Alternative WP analysis that combines several geographically adjacent WPs, indicates that there is a higher IPEI spatial correlation than that observed in the regencies/cities of Central Java Province. Specifically, the Purwomanggung-Subosukawonosraten WP shows Surakarta City in the High-High quadrant and the Kedungsepur-Petanglong WP shows Salatiga City in the High-High quadrant, both of which are significant and consistent. IPEI spatial analysis of regencies/cities with Trans-Java toll access showed that there was no dismantling of IPEI in Pekalongan, which is located in Quadrant III (Low-Low).

Recommendations

Given the significant spatial influence on IPEI values among regencies/cities, it is expected that neighboring regions, particularly those within the same Regional Development (WP), will enhance inter-regional cooperation by leveraging local economic potential and fostering regional development synergy. This approach aims to ensure that development in one region positively impacts surrounding areas. Specifically, Banjarnegara and Wonosobo regencies, which are located in Quadrant III (Low-Low), should be the focus of efforts to improve IPEI due to the significant spatial characteristics of the surrounding regencies/cities.

The spatial analysis of alternative WP regions (Purwomanggung-Subosukawonosraten, Kedungsepur-Petanglong, and regencies/cities along the Trans Java Toll) can serve as a key consideration for regional development planning in Central Java Province. Understanding the interconnections of inclusive growth between regencies/cities is expected to result in synergistic and integrated development planning, ultimately achieving more inclusive growth.

FUNDING STATEMENT: This research received a special grant from National Development Planning Agency (Bappenas), Republic of Indonesia.

CONFLICTS OF INTEREST: The author declares no conflict of interest.

REFERENCES

Adiputra, M. S., Rustiadi, E., & Pravitasari, A. E. (2022). Pola sebaran permukiman kumuh di Kabupaten Tangerang dan keragaman spasial faktor yang mempengaruhinya: Distribution pattern of slums in Tangerang Regency and spatial diversity factors that affect. Journal of Regional and Rural Development Planning, 6(2), 146–164. https://doi.org/10.29244/jp2wd.2022.6.2.146-164

Ahmad, F. S. (2022). Dampak pembangunan jalan tol Trans Jawa terhadap pertumbuhan ekonomi di Jawa Tengah. Jurnal Ekonomi dan Kebijakan Pembangunan, 11(1), 1–18. https://doi.org/10.29244/jekp.11.1.2022.1-18

Anggani, N. L., Amrullah, H. M., & Gemilang, D. S. A. (2023). Moran I autocorrelation study for level spatial pattern analysis. Jurnal Indonesia Sosial Teknologi, 4(9), 1285–1291. https://doi.org/10.59141/jist.v4i9.686

Anindyntha, F. A. (2023). Analysis of inclusive growth in ASEAN countries. OPTIMUM: Jurnal Ekonomi dan Pembangunan, 12(2), 231–241. https://doi.org/10.12928/optimum.v13i2.8363

Birdsall, N. (2007). Income distribution: Effects on growth and development. Center for Global Development Working Paper No. 118. http://dx.doi.org/10.2139/ssrn.1003252

Caroline, E., Sugiyanto, F. X., Kurnia, A. S., Lestari, E. P., & Mindarti, C. S. (2019). The impact of spillover labor on the economic growth of Central Java Province with spatial econometrics model approach. International Journal of Civil Engineering and Technology (IJCIET), 10(9), 16–26.

Dewi, N. P., Novianti, T., & Hakim, D. B. (2021). Identifying spatial correlation and factors influencing regional economic growth in Southern Sumatra. Jurnal Perspektif Pembiayaan dan Pembangunan Daerah, 9(3), 184–200.

Fauzia, A. A., & Suseno, D. A. (2017). Analisis determinan disparitas pendapatan di Kawasan Purwomanggung tahun 2009–2015. Economics Development Analysis Journal, 6(4), 345–357.

Harmes, Juanda, B., Rustiadi, E., & Barus, B. (2017). Pemetaan efek spasial pada data kemiskinan Kota Bengkulu. Journal of Regional and Rural Development Planning, 1(2), 98–112.

Hidayah, N., & Gunanto, E. Y. A. (2023). Analisis interaksi spasial ekonomi di Kawasan Kedungsepur. BISECER (Business Economic Entrepreneurship), 6(2), 75–88. https://doi.org/10.61689/bisecer.v6i2.395

Kosfeld, R. (2006). Spatial econometric. University of Kassel.

Larasati, D., & Wijaya, R. S. (2022). Peran sektor basis dalam mengurangi disparitas pendapatan di Kawasan Subosukawonosraten Provinsi Jawa Tengah. e-Jurnal Perspektif Ekonomi dan Pembangunan Daerah, 11(2), 113–126.

Long, T. J., & Pasaribu, E. (2019). Analisis spasial determinan pertumbuhan inklusif Kabupaten/Kota di Provinsi Jawa Tengah tahun 2017. Seminar Nasional Official Statistics 2019, 3, 67–78.

McKinley, T. (2010). Inclusive growth criteria and indicators: An inclusive growth index for diagnosis of country progress. Asian Development Bank.

Munibah, K., Widiatmaka, & Widjaya, H. (2018). Spatial autocorrelation on public facility availability index with neighborhoods weight difference. Journal of Regional and City Planning, 29(1), 15–30. https://doi.org/10.5614/jrcp.2018.29.1.2

Oktareni, L. A. (2020). Pengaruh interaksi spasial Kota Makassar dan Kabupaten Gowa terhadap pertumbuhan Kabupaten Gowa (Disertasi). Universitas Hasanuddin.

Pamungkas, C. P. (2009). Analisis spasial keterkaitan pertumbuhan ekonomi dengan kemiskinan di Jawa Timur. Jurnal Riset Ekonomi, 1(3), 89–102.

Purnami, I., Rustiadi, E., & Pravitasari, A. E. (2023). Distribution and spatial diversity of factors affecting poverty in Tegal Regency. Journal of Economic, Business and Accounting, 6(2), 45–60.

Qibti, M. H. M., & Hendarto, R. M. (2020). Analisis spillover effect pertumbuhan ekonomi antar Kabupaten/Kota di Kawasan Purwomanggung Jawa Tengah tahun 1988–2018. Diponegoro Journal of Economics, 9(4), 207–223.

Ramos, R. A., Ranieri, R., & Lammens, J. W. (2013). Mapping inclusive growth. International Policy

Centre for Inclusive Growth (IPC-IG).

Rustiadi, E., Saefulhakim, S., & Panuju, D. R. (2009). Perencanaan dan pengembangan wilayah. Jakarta: Crestpent Press dan Yayasan Obor Indonesia.

Sameti, M., & Farahmand, S. (2009). Spatial analysis of income inequality, poverty and economic growth in the Euro-Med zone. Faculty of Administrative Sciences and Economics, University of Isfahan.

Santi, E., Pravitasari, A. E., & Lubis, I. (2020). Mapping of spatial distribution and spatial autocorrelation patterns of poverty in all regencies/cities in Indonesia. Geospatial Information, 4(1), 78–93.

Sinaga, J. P., Hendriadi, A., Firdaus, M., Fauzi, A., & Arsanti, W. (2021). Analysis of geographically weighted regression (GWR) on retail prices of medium rice and red chili in Java. Jurnal Manajemen & Agribisnis, 18(2), 144–159. https://doi.org/10.17358/jma.18.2.144

Sukirno, S. (2006). Ekonomi pembangunan: Proses, masalah dan dasar kebijakan. Jakarta: Kencana.

Waluyaningsih, V. D., & Setiawan, A. H. (2021). Analisis ketimpangan pendapatan antarwilayah di Kawasan Kedungsepur, Barlingmascakeb, dan Subosukawonosraten periode 2008–2017. Diponegoro Journal of Economics, 9(2), 123–134.

Wibisono, P., & Kuncoro, M. (2015). Efek limpahan pertumbuhan antar-kabupaten/kota di Provinsi Jawa Timur tahun 2001–2013. Jurnal Ekonomi dan Pembangunan Indonesia, 16(1), 45–63. https://doi.org/10.21002/jepi.v16i1.03