

Research article

Analysis of Regional Potential and Suitability for Medium and Small Industrial Development in Karanganyar Regency

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Abstract

One indicator of economic growth is the emergence of industrial zones within a region. While industrial growth can positively impact economic metrics such as regional GDP (PDRB) and local income, it can also pose negative consequences if not aligned with spatial planning regulations. Karanganyar Regency is one area with potential for industrial development across several of its sub-districts. This study aims to analyze the potential and suitability of areas within Karanganyar Regency for medium and small industrial zones. The research employs secondary data analysis, which reveals varying levels of potential and suitability across the region. Areas with high potential include six sub-districts: Karanganyar, Jaten, Colomadu, Gondangrejo, Kebakkramat, and Mojogedang. Medium potential areas cover five sub-districts: Jumapolo, Jumantono, Matesih, Tasikmadu, and Kerjo. Areas with low potential include six sub-districts: Jatipuro, Jatiyoso, Tangwangmangu, Ngargoyoso, Karangpandan, and Jenawi. The high-potential areas generally feature flat topography, moderate to high aquifer productivity, well-developed road and communication infrastructure, low building density, and a large population of productive working-age residents. Areas classified as highly suitable for industrial development cover 1,397.36 km², spread across parts of Colomadu, Gondangrejo, Jaten, Karanganyar, Kebakkramat, and Mojogedang sub-districts. Areas with moderate suitability cover 235.87 km², located in Jumantono, Jumapolo, Kerjo, Matesih, and Tasikmadu sub-districts. Areas with low suitability span 64.99 km² across several sub-districts, while areas classified as unsuitable cover 78,736.98 km², extending through nearly all sub-districts in Karanganyar Regency

Keywords: regional potential; suitability; spatial planning; industry; Karanganyar Regency.

1. Introduction

Population growth in a region is expected to drive economic growth. An increase in population expands the market, and this market expansion enhances the level of specialization in the economy. As a result of this specialization, economic activity tends to increase (Arsyad, 2010). One indicator of economic growth in a region is the increase in per capita income.

Per capita income is a crucial variable in macroeconomic discussions. It not only serves as an indicator of a nation's prosperity but is also used to measure the economic performance of a country over time, assess its economic structure, and compare its performance with other nations (Arsyad, 2010).

Globally, economies can be categorized into two major groups: developed countries (industrialized nations) and developing or emerging economies. Typically, developed countries obtain raw materials for their industries from developing countries, which export these as finished or semi-finished goods that are essential for their own economic activities and development (Sri Haryani, 2002). Indonesia, as a developing country, relies on the industrial sector to boost its per capita income.

The economic crisis that once affected Indonesia brought both negative and positive impacts. Negatively, many formal industrial sectors laid off workers, increasing unemployment. On the positive side, this crisis stimulated the growth of small-scale

businesses in society (Partomo et al., 2004). The faster growth of small and medium industries (IKM) compared to large industries has helped improve the overall business structure and income distribution (Ikhsan, 2004).



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The development of the industrial sector in Indonesia still faces several challenges, particularly in terms of economic and environmental impacts. Industrial growth has often disregarded spatial planning concepts, leading to environmental impacts that outweigh economic benefits. Key factors in industrial development include physical conditions (slope, proximity to major roads, infrastructure, distance to rivers, soil conditions, land use, population), and adherence to spatial planning policies. Daldjoeni (1998), in his book *Spatial Organization and Practice*, presents various theories on industrial location that serve as a foundation for assessing potential industrial areas.

Karanganyar Regency is one area with significant potential for industrial development. The presence of industries here is essential for boosting economic growth and creating employment. The industrial sector is a cornerstone for Karanganyar Regency in driving economic growth and employment. Industrial development in Karanganyar aims to strengthen a competitive industrial base. A visual representation of employment absorption in the medium and small industries sector in Karanganyar Regency can be seen in Table 1.

Table 1. Absorption of Medium and Small Industry Labor in Karanganyar Regency 2011-2015

Subdistrict	Medium and Small Industries				
	2011	2012	2013	2014	2015
1. Jatipuro	0	1	0	0	0
2. Jatiyoso	0	1	0	0	0
3. Jumapolo	1	0	0	0	0
4. Jumantono	1	2	3	3	4
5. Matesih	2	0	5	0	5
6. Tawangmangu	1	0	0	0	2
7. Ngargoyoso	0	1	0	2	1
8. Karangpan-dan	3	4	1	6	12
9. Karanganyar	3	13	8	2	8
10. Tasikmadu	5	4	2	4	7
11. Jaten	23	21	24	11	23
12. Colomadu	5	10	7	11	8
13. Gondangrejo	15	9	17	10	11
14. Kebakkramat	4	2	12	6	3
15. Mojogedang	2	0	2	3	2
16. Kerjo	0	0	1	1	1
17. Jenawi	1	0	0	0	0
Amount	66	68	82	59	87

Source: Karanganyar Regency Industry Service, 2016

Based on Table 1, it is found that in 2015 there were 60 medium-sized industries and 133 small industries in Karanganyar Regency. From 2011 to 2015, the number of medium and small industries in Karanganyar Regency experienced fluctuations. A summary of the data on the number of medium and small industries in Karanganyar Regency can be seen in Table 2 and Figure 1.

Table 2. Summary of the Number of Medium and Small Industries in Karanganyar Regency for 2011-2015

No.	Year	Medium Industry	Small Industry
1	2011	34	33
2	2012	44	24
3	2013	49	33

4	2014	37	24
5	2015	60	23
Amount		224	133

Source: Karanganyar Trade and Industry Office, 2016

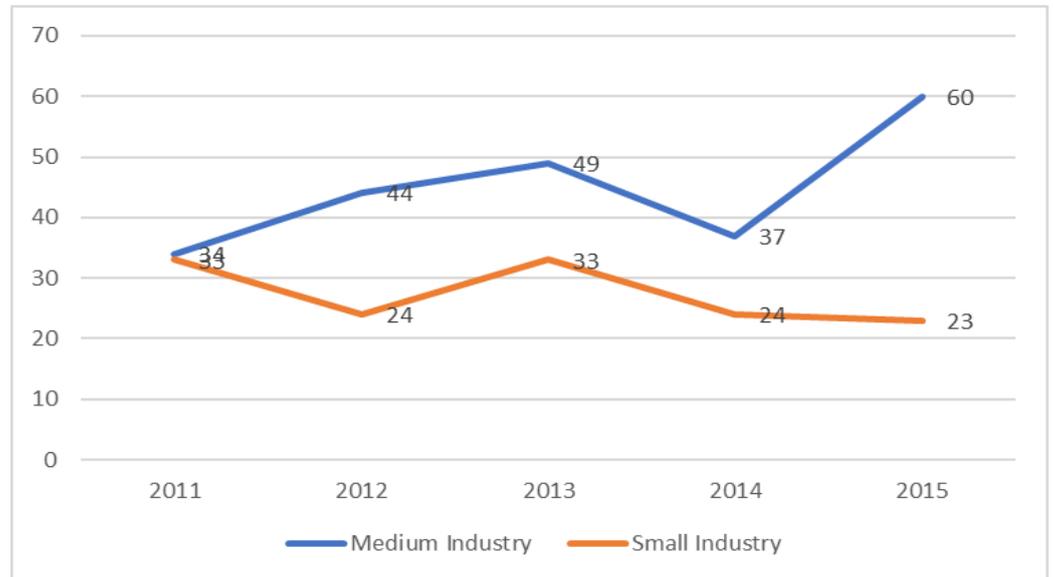


Figure 1. Graph of Fluctuations in the Number of Large and Small Industries in Karanganyar Regency 2011-2015

Based on Table 2 and Figure 1, it can be observed that the number of industries in Karanganyar Regency has fluctuated. The increase in industry numbers in 2015 suggests that Karanganyar Regency has the potential to serve as a location for the growth of new medium-sized industries. Meanwhile, the decline in small industries is likely due to competition among small enterprises, causing many to struggle with growth. To better direct, integrate, and optimize the growth of the industrial sector, a study on industrial area development is necessary

Several previous studies have also examined the potential of areas for medium and small industrial development. Yoni Setiawan (2005), in a study titled "Analysis of Regional Potential for Industrial Zones in Cirebon Regency," aimed to assess the suitability of current industrial distribution in Cirebon Regency with its potential and to identify districts suitable for industrial zones. The study used secondary data analysis by documenting and studying available data, both physical and socio-economic. Results indicated that large, medium, and small industries were appropriately located, with Ciledug, Babakan, Astanajapura, Mundu, Palimanan, and North Cirebon identified as high-potential districts for industrial development.

Dyah Arumastuti Wibowo (2007), in her research titled "Regional Potential Analysis for Small Industrial Development in Nogosari, Boyolali Regency," aimed to (1) identify the potential distribution for small industrial zones and (2) determine suitable types of small industries. Using secondary data analysis and a scoring method to assess industrial zone potential, the study found varying levels of potential, from low to high, and prioritized wood and bamboo industries for small industrial zones.

This research differs from previous studies by incorporating spatial planning data to assess the suitability of areas for medium and small industrial development. The objectives of this study are to (a) analyze the potential of areas for industrial development in Karanganyar Regency and (b) assess the suitability of these areas for medium and small industrial growth.

2. Research Methods

The research method used is secondary data analysis with a quantitative approach, specifically using the nearest neighbour analysis. Potential is determined through a scoring data analysis method. The analysis unit for this study is per district.

This chapter should contain sufficient technical information so that the method can be repeated by others well. Describe conclusively that the method used is a new method and if necessary use a table or a flowchart like Figure 1 to support the description.

This research relies on secondary data. Data is not collected directly from the subjects or objects under study but is obtained from other sources, such as relevant institutions, libraries, personal archives, etc. Secondary data from institutions is often pre-tabulated according to their organizational needs. Thus, researchers must process and adjust this data to meet the information requirements of the study (Pabundu Tika, 2005).

The data analysis methods used in this study include: a. Industrial Sector Regional Potential Analysis: Scoring is used to obtain composite scores for the study area, identifying regions suitable for industrial zone development. The variables used are: (a) basic physical conditions (slope gradient and groundwater availability), (b) accessibility (road infrastructure, phone network), (c) built environment conditions (health facilities, building density), and (d) human resources. b. Suitability Analysis for Potential Industries: To identify suitable industries in Karanganyar Regency, potential area data is compared with the Karanganyar Regency spatial plan (RTRW). A regional suitability matrix is used to analyze the compatibility of areas for industrial development.

3. Results and Discussion

3.1. Location, Area, and Boundaries

Karanganyar Regency, located in Central Java Province, has astronomical coordinates at 110°43'38"-111°11'24" East Longitude and 7°6'17"-7°46'07" South Latitude. Geographically, it is situated to the west of Mount Lawu. The total area of Karanganyar Regency is 77,337.64 hectares, with an average altitude of 511 meters above sea level, varying between 105-2,000 meters above sea level. The administrative boundaries are as follows: (a) North: Sragen Regency, (b) East: East Java Province, (c) South: Wonogiri and Sukoharjo Regencies, and (d) West: Surakarta City and Boyolali Regency.

3.2. Location, Area, and Boundaries

The analysis of the region's industrial potential in Karanganyar Regency is divided into three classes: high, medium, and low. The classification is based on scoring across parameters, including slope gradient, groundwater availability, road infrastructure, road condition, communication facilities, healthcare facilities, building density, and the working-age population. The scoring is used to identify locations suitable for industrial zones, and compatibility with the Regional Spatial Plan (RTRW) of Karanganyar Regency is assessed to classify regions as suitable, moderately suitable, or unsuitable for industrial development.

3.3. Regional Potential Classification and Scoring for Industry

The topography of Karanganyar Regency varies from flat to hilly and mountainous, affecting the suitability of different areas for industrial zones. Flatter areas are more suitable for industrial development, while steeper, higher areas are less ideal. The slope gradient in Karanganyar ranges from gentle to steep, with the majority being gently sloped, covering 601.6 km². This indicates a high potential for industrial development due to the predominantly flat terrain.

Regions with high potential based on slope gradient include nine sub-districts: Jatipuro, Jumantono, Karanganyar, Tasikmadu, Jaten, Colomadu, Gondangrejo, Kebakkramat, and Mojogedang. Sub-districts with low potential, based on slope gradient, include Tawangmangu, Ngargoyoso, and Jenawi. Sub-districts with moderate potential, such as Jatiyoso, Jumapolo, Matesih, Karangpandan, and Kerjo, may still be considered for industrial development depending on additional factors.

Groundwater availability is crucial for industrial development, as water is essential for both production and consumption within industrial zones. The study considers aquifer conditions as an indicator of groundwater availability, where regions with extensive aquifers are more suitable for industry.

The highest class of groundwater availability, characterized by aquifers with moderate productivity and wide distribution, spans 300.3 km² in Karanganyar. This high availability indicates that Karanganyar has a strong potential for industrial development. Most sub-districts in Karanganyar Regency fall within the high groundwater availability category.

Sub-districts with high groundwater availability include Jatipuro, Jumapolo, Jumantono, Matesih, Karangpandan, Karanganyar, Tasikmadu, Jaten, Colomadu, Kebakkramat, Mojogedang, and Kerjo. Sub-districts with medium groundwater availability are Jatiyoso, Tawangmangu, and Jenawi, while those with low availability include Ngargoyoso and Gondangrejo. The dominant aquifer type in Karanganyar consists of aquifers with flow through fractures and intergranular spaces, with moderate productivity and extensive distribution, making these areas highly suitable for industrial development.

Road infrastructure is a critical factor in determining the suitability of a location for industrial development. Main roads are preferred by investors when establishing industries, although many industries also utilize collector roads. Based on field surveys, the width of arterial roads ranges from >8 meters to 12 meters, while collector roads average between 7-8 meters. Both road types are suitable for industrial zones as they allow for two-way traffic, which is crucial for the distribution of goods and labor.

In Karanganyar Regency, most roads are collector roads with widths ranging from 6-8 meters, found across all sub-districts. Arterial roads, with widths greater than 8-12 meters, are only found in three sub-districts: Colomadu, Jaten, and Kebakkramat. Areas with good arterial road conditions are highly suitable for industrial zones, as they support faster transportation of goods and raw materials. The overall condition of roads in Karanganyar is mostly good, with 593.91 km of roads in excellent condition, 230.84 km in fair condition, and 172.7 km in poor condition.

The communication network is essential for industrial development, supporting both operational communications and external interactions. This network includes telephone lines, mobile networks, and internet services. However, communication signal reception varies across different areas due to geographic conditions.

The availability of communication infrastructure in Karanganyar Regency is categorized into three levels: low, medium, and high. Higher levels of availability, with more diverse communication facilities, support the growth of industrial areas. Comprehensive communication services are crucial for industrial development and improving regional connectivity.

Healthcare facilities are a key supporting factor for any industrial zone, ensuring the health and well-being of workers and nearby communities. The most common healthcare facilities in Karanganyar are Posyandu (integrated health posts), while hospitals are fewer, with only eight in total. The largest number of hospitals are located in Tasikmadu and Jaten, with two each. The areas with the most healthcare services, particularly hospitals, are better suited for industrial development due to the availability of health services for industrial workers.

Karanganyar's healthcare facility suitability is categorized into three levels: high, medium, and low. The majority of sub-districts fall into the medium category, with three sub-districts having high suitability and five with low suitability. The greater the variety and number of healthcare facilities, the more suitable the region is for industrial development.

The building density coefficient, or Building Coverage Ratio (BCR), is used to assess the impact of urbanization on groundwater availability. The higher the BCR, the less rainwater will infiltrate the ground, which affects groundwater levels. In Karanganyar, all BCR values are less than 1, indicating that the region has low building density, which is favorable for industrial development as it helps maintain groundwater supply.

Karanganyar's building density is categorized into high, medium, and low levels. Colomadu has high density, while the majority of other sub-districts such as Jatipuro, Jumapolo, Jumantono, Matesih, Karangpandan, Karanganyar, Tasikmadu, Jaten, Gondangrejo, and Mojogedang fall into the medium category. Low-density areas, which are ideal for industrial zones due to their positive impact on groundwater retention, are found in Jatiyoso, Tawangmangu, Ngargoyoso, Kerjo, and Jenawi.

Total scoring is applied to all parameters determining the potential for industrial development in Karanganyar Regency. The classification of regions for industrial development in this study is divided into three categories: high, medium, and low. Detailed scoring results are presented in Table 2.

Table 2. Total Score Value and Class of Regional Potential for Industrial Development

No	Subdistrict	Parameter							Total Score	Class
		A	B	C	D	E	F	G		
1	Jatipuro	3	3	2	1	2	2	1	14	Low
2	Jatiyoso	2	2	2	2	2	3	1	14	Low
3	Jumapolo	2	3	2	3	3	2	1	16	Medium
4	Jumantono	3	3	2	3	2	2	1	16	Medium
5	Matesih	2	3	2	3	2	2	1	15	Medium
6	Tawangmangu	1	2	2	2	1	3	1	12	Low
7	Ngargoyoso	1	1	2	2	1	3	1	11	Low
8	Karangpandan	2	3	2	3	1	2	1	14	Low
9	Karanganyar	3	3	2	3	2	2	3	18	high
10	Tasikmadu	3	3	2	3	2	2	2	17	Medium
11	Jaten	3	3	3	3	2	2	3	19	High
12	Colomadu	3	3	3	3	2	1	3	18	High
13	Gondangrejo	3	1	3	3	3	2	3	18	High
14	Kebakkramat	3	3	3	3	2	2	2	18	High
15	Mojogedang	3	3	2	3	3	2	2	18	High
16	Kerjo	2	3	2	3	1	3	1	15	Medium
17	Jenawi	1	2	2	2	1	3	1	12	Low

Source: Calculation Results, 2024

Information: (A): Slope Gradient, (B): Geohydrological Conditions, (C): Availability of Road Infrastructure, (D): Availability of Communication Facilities, (E): Availability of Health Facilities, (F): Building Density, and (G): Number of Productive Population.

Based on Table 2, it can be concluded that the potential for industrial development areas in Karanganyar Regency is divided into three categories: high, moderate, and low potential. High potential areas are distributed across six subdistricts, namely Karanganyar, Jaten, Colomadu, Gondangrejo, Kebakkramat, and Mojogedang. Moderate potential areas are found in five subdistricts, including Jumapolo, Jumantono, Matesih, Tasikmadu, and Kerjo. Meanwhile, low potential areas are spread across six subdistricts, namely Jatipuro, Jatiyoso, Tawangmangu, Ngargoyoso, Karangpandan, and Jenawi.

The potential for industrial development in Karanganyar Regency varies. From the analysis results through scoring and classification, it can be seen that most of the high-potential areas are characterized by flat topography, moderate to high aquifer productivity, good road infrastructure, well-established communication facilities, low building density, and a high number of productive populations (working-age). The spatial distribution of potential areas for industrial development can be seen in Figure 2.

Based on Table 1, it is found that in 2015 there were 60 medium-sized industries and 133 small industries in Karanganyar Regency. From 2011 to 2015, the number of medium and small industries in Karanganyar Regency experienced fluctuations. A summary of the data on the number of medium and small industries in Karanganyar Regency can be seen in Table 2 and Figure 2.

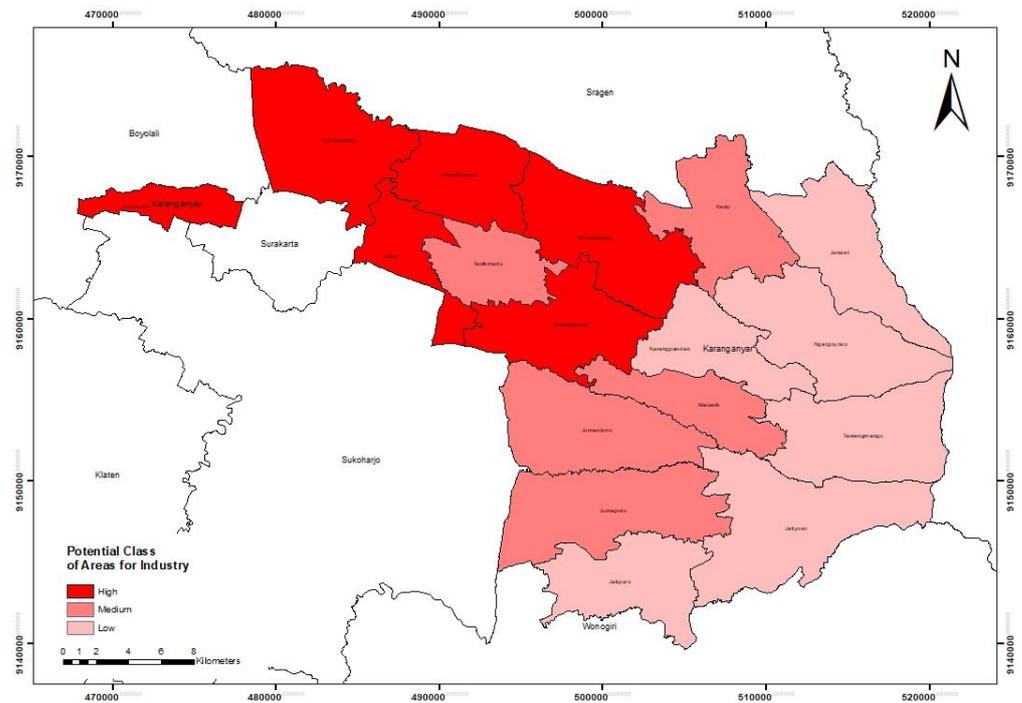


Figure 2. Map of Regional Potential for Industrial Development

3.4. Regional Potential Classification and Scoring for Industry

The suitability of areas for industrial development in this study is based on the results of regional potential assessments combined with the spatial planning map of Karanganyar Regency. The analysis of area suitability for industrial development was conducted using GIS software (ArcGIS 10.3) by overlaying the regional potential map with the regional spatial plan map. The analysis was performed using a matrix as follows:

Regional Potential Map	Spatial plans	
	Industry	Non-Industrial
High	Very Suitable	It is not in accordance with
Medium	In accordance	It is not in accordance with
Low	Less Suitable	It is not in accordance with

Figure 3. Area Suitability for Matrix Industry

The suitability levels for industrial area development are categorized into four classes: highly suitable, suitable, less suitable, and not suitable. The highly suitable areas cover an area of 1,397.36 km², spread across parts of Colomadu, Gondangrejo, Jaten, Karanganyar, Kebakkramat, and Mojogedang subdistricts. Suitable areas cover 235.87 km², found in parts of Jumantono, Jumapolo, Kerjo, Matesih, and Tasikmadu subdistricts. Less suitable areas cover 64.99 km², dispersed across portions of Jatipuro, Jatiyoso, Jenawi, Karangpandan, Ngargoyoso, Tawangmangu, Colomadu, Gondangrejo, Jaten, Jumantono, Jumapolo, Karanganyar, Kebakkramat, Kerjo, Matesih, and Mojogedang. Finally, areas deemed not suitable cover 78,736.98 km², spanning nearly all subdistricts in Karanganyar Regency.

Highly suitable areas for industrial zone development align with the regional spatial plan, which designates these areas for industrial use and possess high regional potential. According to the analysis, subdistricts categorized as highly suitable are located along main roads, have flat topography, and offer good accessibility. The spatial distribution of area suitability levels for industrial development is shown in Figure 4.

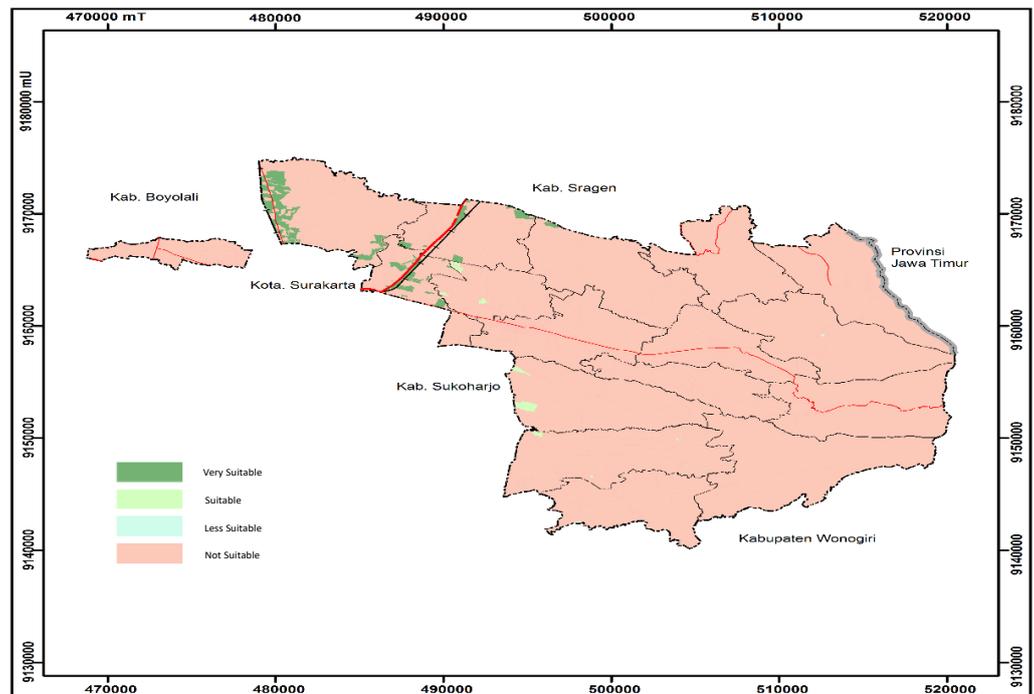


Figure 4. Map of Regional Suitability for Industrial Area Development in Karanganyar Regency

4. Conclusion

Based on the research findings and analysis, as well as the study objectives, several conclusions can be drawn:

- a. The potential of areas for industrial development in Karanganyar Regency varies and includes high, medium, and low potential. High-potential areas are spread across six subdistricts: Karanganyar, Jaten, Colomadu, Gondangrejo, Kebakkramat, and Mojogedang. Medium-potential areas are found in five subdistricts: Jumapolo, Jumantono, Matesih, Tasikmadu, and Kerjo. Low-potential areas are spread across six subdistricts: Jatipuro, Jatiyoso, Tawangmangu, Ngargoyoso, Karangpandan, and Jenawi. High-potential areas typically feature flat topography, aquifers with medium to high productivity, good road infrastructure, reliable communication networks, low building density, and a large productive-age population.
- b. The suitability of areas for industrial development is categorized as highly suitable, suitable, less suitable, and not suitable. Highly suitable areas cover 1,397.36 km², located in parts of Colomadu, Gondangrejo, Jaten, Karanganyar, Kebakkramat, and Mojogedang subdistricts. Suitable areas cover 235.87 km², found in portions of Jumantono, Jumapolo, Kerjo, Matesih, and Tasikmadu. Less suitable areas span 64.99 km² across various parts of Jatipuro, Jatiyoso, Jenawi, Karangpandan, Ngargoyoso, Tawangmangu, Colomadu,
- c. Gondangrejo, Jaten, Jumantono, Jumapolo, Karanganyar, Kebakkramat, Kerjo, Matesih, and Mojogedang. Not suitable areas cover 78,736.98 km², extending across nearly all subdistricts in Karanganyar Regency.

Environmental factors that influence industrial development in Karanganyar, such as pollution potential and environmental carrying capacity, have not been highlighted in assessing the suitability of industrial estates. In addition, this research has also not considered technological developments and industrial policies that can contribute to improving the regional economy. The socio-cultural aspects of the local community also need to be part of the analysis, especially regarding the views and acceptance of the community towards industrial development in the region. Future studies can be conducted for industries based on local leading sectors, such as agro-industry or regional handicrafts

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Author Contributions

Conceptualization: Ningrum Erlianti; **methodology:** Ningrum Erlianti, Umrotun; **investigation:** Ningrum Erlianti; **writing—original draft preparation:** Ningrum Erlianti; **writing—review and editing:** Umrotun; **visualization:** Ningrum Erlianti, Umrotun. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

All authors declare that they have no conflicts of interest.