Spatial-Statistical Analysis of the Relationship Between Population Density and the Distribution of Active Cooperatives in Jember Regency, Indonesia

Muhammad Nurul Huda[1,*], Azril Chairil[2], Rafi Sulthan Rizqullah[3], Solihan[4], Shalsabilla Aulia Putri[5], Denisa Aulia Pratiwi[6], I Putu Indra Pramana Putra[7]

[1,2,3,4,5,6,7] Department of Geography, Faculty of Social Sciences, Universitas Negeri Malang, Indonesia

[*)] Correspondence author's email: muhammad.nurul.2307226@students.um.ac.id

Citation:
Muhammad Nurul Huda[1], Azril Chairil[2], Rafi Sulthan Rizqullah[3], Solihan[4], Shalsabilla Aulia Putri[5], Denisa Aulia Pratiwi[6], I Putu Indra Pramana Putra[7] (2025). *Spatial-Statistical Analysis of the Relationship Between Population Density and the Distribution of Active Cooperatives in Jember Regency, Indonesia.* Jurnal Sains Geografi. Vol. 4, No. 1.

Article History:
Received: 15 Maret 2026
Revised: 30 April 2026
Accepted: 20 Mei 2026
Online: 14 Juni 2026
Published: 31 Mei 2026

Abstract

This study examines the spatial and statistical relationship between population density and the distribution of active cooperatives across 31 sub-districts in Jember Regency, Indonesia. Using secondary data from 2024, the research applies a quantitative approach that integrates spatial mapping with statistical analysis. The Shapiro–Wilk normality test indicates that both population density and the number of active cooperatives are not normally distributed ($p < 0.05$). Therefore, Spearman Rank correlation analysis is employed, revealing a statistically significant but weak positive relationship ($r = 0.391$, $p = 0.030$). Spatial patterns show that urban sub-districts such as Kaliwates and Sumbersari exhibit high concentrations of both population density and cooperative activity. However, several agrarian districts with relatively low population density, including Ambulu and Puger, also demonstrate a high number of active cooperatives. These findings indicate that while population density provides an important market base, the spatial distribution of cooperatives in Jember Regency is also strongly shaped by local economic structures and agrarian production systems rather than demographic factors alone.

Keywords: Population density, active cooperatives, spatial analysis, Spearman correlation, Jember Regency.

Abstrak

Penelitian ini bertujuan untuk menganalisis hubungan spasial dan statistik antara kepadatan penduduk dan distribusi koperasi aktif pada 31 kecamatan di Kabupaten Jember. Penelitian menggunakan data sekunder tahun 2024 dengan pendekatan kuantitatif yang mengintegrasikan pemetaan spasial dan analisis statistik. Hasil uji normalitas Shapiro–Wilk menunjukkan bahwa variabel kepadatan penduduk dan jumlah koperasi aktif tidak berdistribusi normal ($p < 0,05$). Oleh karena itu, analisis korelasi Rank Spearman digunakan untuk menguji hubungan antar variabel. Hasil analisis

menunjukkan adanya hubungan positif yang signifikan namun lemah antara kepadatan penduduk dan jumlah koperasi aktif (r = 0,391; p = 0,030). Pola spasial menunjukkan bahwa kecamatan perkotaan seperti Kaliwates dan Sumbersari memiliki konsentrasi tinggi pada kedua variabel. Namun demikian, beberapa kecamatan agraris dengan kepadatan penduduk relatif rendah, seperti Ambulu dan Puger, juga menunjukkan jumlah koperasi yang cukup tinggi. Temuan ini menunjukkan bahwa meskipun kepadatan penduduk memberikan basis pasar bagi perkembangan koperasi, distribusi koperasi di Kabupaten Jember juga dipengaruhi secara kuat oleh struktur ekonomi lokal dan kebutuhan sektor agraris, bukan semata-mata oleh faktor demografis.

Kata kunci: kepadatan penduduk, koperasi aktif, analisis spasial, korelasi Spearman, Kabupaten Jember.

1. INTRODUCTION

Cooperatives have long been positioned as one of the pillars of the people's economy that supports community business activities across various territorial levels. Conceptually, a cooperative is a business entity founded on the principles of kinship and economic democracy and oriented toward improving member welfare rather than merely pursuing profit (Nopitasari & Handayani, 2020). Its role is not limited to savings and loan functions but also includes the provision of economic services for community groups that often remain outside the reach of formal financial institutions. Another study emphasizes that cooperatives operate as membership-based organizations that place members' economic needs as the primary priority, thereby holding an important position within community-based economic systems (Trisniarti et al., 2022). The sustainability of cooperative organizations is closely related to the strength of social capital among their members. Shared norms, trust, and collective participation enable more effective governance structures and reduce opportunistic behavior within cooperative systems.

Valentinov and Iliopoulos (2022) emphasize that strong social capital significantly contributes to the long-term stability and performance of cooperative institutions. Recent studies highlight that cooperative governance has evolved significantly in response to global economic changes. Social capital among cooperative members also plays a crucial role in facilitating access to financial resources. Yu et al. (2023) show that strong interpersonal trust and network ties within agricultural cooperatives significantly improve members' access to credit, as financial institutions tend to perceive cooperative networks as mechanisms that reduce lending risks. Bijman et al. (2013) explain that modern cooperatives increasingly adopt more professional management structures while maintaining democratic member participation, allowing them to remain competitive in increasingly complex market environments. Within the framework of regional development, equitable access to community economic institutions continues to receive attention because it relates to the expansion of financial inclusion as well as the reduction of interregional disparities. Patel and Tirthani (2025) state that cooperatives are able to expand access to affordable financial services while also supporting income growth and employment opportunities at the local level. Cooperatives have long been recognized as effective institutional mechanisms for strengthening community-based economic systems.

According to Wanyama (2024), cooperative organizations play a crucial role in improving rural livelihoods by facilitating collective resource management, expanding access to markets, and strengthening local economic resilience in developing regions. Despite these benefits, the distribution of cooperatives in Indonesia remains plagued by spatial inequality, implying that many households still encounter barriers in accessing cooperative financing.

Changes in population structure across regions have also generated variations in the demand for economic services. Increasing density in urban areas is often associated with larger market potential for cooperative activities, whereas sparsely populated areas tend to show higher dependence on community-based collective economic institutions, particularly in regions still dominated by agrarian activities. In addition, cooperatives currently face pressures to adapt to global changes and digitalization in order to remain relevant to members' needs (Hakim & Supriyadi, 2025). Digital transformation is increasingly recognized as a critical factor in improving the adaptability of cooperative institutions. The integration of digital platforms enables cooperatives to expand market access, streamline financial management, and improve communication with members. Zhao et al. (2023) demonstrate that digital adoption enhances operational efficiency and institutional competitiveness, while Hidayat et al. (2023) highlight that digital transformation also strengthens information management and service responsiveness within cooperative organizations.

Population density is frequently used as a spatial indicator associated with the intensity of socio-economic activities within a region. Conceptually, an increase in population per unit area is often linked to rising demand for economic services, including membership-based institutions such as cooperatives. In regional economic studies, cooperatives are viewed as collective economic organizations that support rural economic reorganization and strengthen local community economies (Liu et al., 2024; Geskus et al., 2024). The concentration of population within a relatively limited space is typically followed by increased economic interaction, expansion of production and distribution networks, and growing financing needs at both household and small enterprise levels. In many rural contexts, the presence of cooperatives is also related to the need for market access, resources, and more affordable financial services for members (Sarsale, 2026; Lestari et al., 2024). Based on this framework, densely populated areas are often assumed to have a higher tendency in the number of cooperatives compared to sparsely populated regions.

Nevertheless, empirical findings indicate that the spatial pattern of cooperatives does not always follow population distribution in a simple manner, as it is influenced by resource endowment, levels of socio-economic development, and market dependence in each region (Liu et al., 2024). Even in several developing regions, cooperatives exhibit particular spatial clustering patterns that form core areas and emerging growth points that do not always coincide with the most densely populated zones (Xu & Mai, 2024). This condition is also in line with findings that cooperatives often grow strongly in agrarian regions that possess an established community base and local institutional networks (Cai et al., 2021). Several previous studies have examined the relationship between demographic factors and cooperative development through various approaches, including statistical methods and spatial distribution analysis. Research on Savings and Loan Cooperatives in Indonesia indicates that cooperative business performance is influenced by a range of internal economic factors, including the volume of credit disbursement and member participation, which statistically relate to cooperative income performance (Juswadi & Sumarna, 2023).

In the demographic context, increases in population size or regional density are often associated with the growth in the number of cooperatives due to the expansion of the membership base and the rising demand for community economic services. However, other findings show that cooperative development is not determined solely by demographic factors but is also shaped by the quality of human resources, governance practices, and the level of

public trust in cooperatives (Muniroh et al., 2025). In several regions where the economic structure remains dominated by the agrarian sector or where community institutions are strongly established, cooperatives continue to persist even when population density is not dominant. In addition, studies that specifically examine the spatial distribution of cooperatives remain relatively limited, as most previous research tends to rely on descriptive or non-spatial statistical approaches without explicitly testing interregional relationships.

These differences in findings and approaches indicate the need for further examination of the relationship between population density and cooperative distribution through the integration of statistical and spatial analysis. This need becomes increasingly relevant when linked to the characteristics of Jember Regency, which exhibits variation in population density across sub-districts, diverse economic structures, and an uneven distribution of cooperatives. Understanding this spatial inequality is particularly urgent given the Indonesian government's ongoing commitment to strengthening cooperative institutions as instruments of inclusive economic development, where misalignment between policy targeting and actual cooperative distribution may result in ineffective resource allocation at the sub-district level. Therefore, an evidence-based spatial and statistical examination of cooperative distribution in Jember Regency is necessary to provide empirical grounding for more equitable and context-sensitive cooperative development policies. Consequently, this study aims to analyze the statistical relationship between population density and the number of active cooperatives, identify the spatial distribution patterns at the sub-district level, and examine spatial autocorrelation as part of testing the emerging spatial patterns.

2. METHOD

Research Location

Jember Regency is one of the regencies in East Java Province, Indonesia. The administrative center is located in Jember City which lies in the Tapal Kuda region in the eastern part of East Java Province. The administrative area of Jember Regency is divided into 31 districts consisting of 28 districts with village status comprising 226 villages and 3 districts with urban village status covering 22 urban villages. The administrative area also includes the Nusa Barung Islands which are located in the southern part of Java Island. Geographically, Jember Regency is located at coordinates 6°27’29”–7°14’35” East Longitude and 7°59’6”–8°33’56” South Latitude. The topographic condition of the region is dominated by fertile valley plains in the central to southern parts. The surrounding areas of the regency are located on the slopes of the Iyang Mountains and Mount Argapura, while the southern part of the region borders directly with the Indian Ocean. The conservation area of Meru Betiri National Park is located on the southeastern side of the region and administratively borders Banyuwangi Regency. The northwestern part of Jember Regency which borders Probolinggo Regency is dominated by mountainous areas that are part of the Iyang Mountains. The highest peak in this area is Mount Argopuro which has an elevation of about 3,088 meters above sea level. The eastern part of the regency is included in the morphological series of the Ijen Highlands. The administrative boundaries of Jember Regency include Probolinggo Regency and Bondowoso Regency in the north, Banyuwangi Regency in the east, the Indian Ocean in the south, and Lumajang Regency in the west.

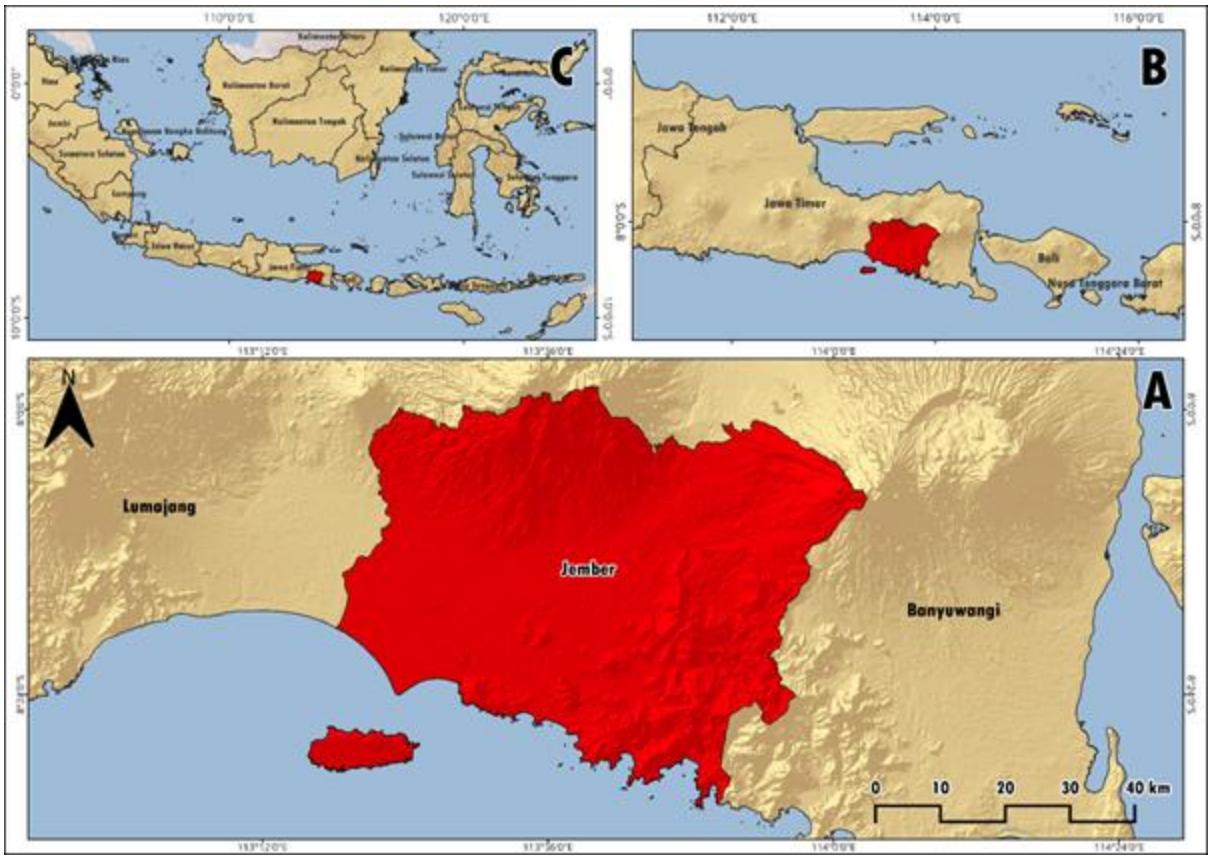


Figure 1. Research Location

Data and Data Source

This study uses secondary data obtained from several government institutions. The data used include the number of active cooperatives, population size, administrative area size, as well as subdistrict administrative boundary data. Statistical data are used for analyzing relationships between variables, while spatial data are used in mapping processes and spatial analysis. All data are organized at the subdistrict analysis unit within the Jember Regency area.

Table 1. Data and Data Source

No	Data	Tahun	Sumber
1	Number of active cooperatives by sub-district	2024	Department of Cooperatives and Micro Enterprises of Jember Regency
2	Population by sub-district	2024	Statistics Indonesia (BPS) Jember Regency
3	Administrative area of sub-districts	2024	Statistics Indonesia (BPS) Jember Regency
4	Administrative boundary shapefile of sub-districts	2024	Geospatial Information Agency (BIG)

Table 2. Software Used in Study

No	Software	Function
1	ArcGIS Pro	Spatial data processing, thematic map creation, and Moran's I spatial autocorrelation analysis
2	Microsoft Excel	Data compilation, tabulation, and preliminary data processing
3	R	Statistical analysis including normality test and Spearman correlation

Data Analysis Method

Population Density Calculation

The initial stage of the analysis involves calculating population density for each sub-district in Jember Regency. Population density values were obtained by comparing the total population with the administrative area of each sub-district. The formula used is as follows:

$$Density = \frac{Population}{Area}$$

Population density values are expressed in persons per square kilometer (persons/km²). Population data and administrative area data were obtained from the 2024 publication of Statistics Indonesia (BPS) Jember Regency. All data were first organized in tabular form using Microsoft Excel before being used in the subsequent analysis stages.

Data Normality Test

A normality test was conducted for the population density and the number of active cooperatives at the sub-district level. The test was carried out to determine the appropriate statistical analysis method for the following stage. The Shapiro–Wilk test was applied due to the relatively small number of observational units. The testing criteria based on significance values are as follows:

$p > 0.05$ indicates normally distributed data
$p < 0.05$ indicates non-normally distributed data

Statistical testing was conducted using the R software environment. The results of the test serve as the basis for selecting the correlation analysis method used in examining the relationship between variables.

Spearman Correlation Analysis

Spearman correlation analysis was used to measure the relationship between population density and the number of active cooperatives at the sub-district level. Population density was used as variable X, while the number of active cooperatives was used as variable Y. This method was selected because it does not require normally distributed data. The Spearman correlation coefficient is calculated using the following formula:

$$r_s = 1 - \frac{6\sum d^2}{n(n^2 - 1)}$$

Where:
r_s = Spearman correlation coefficient
d^2 = difference in rank between variables
n^2 = number of observational units
The correlation coefficient ranges from −1 to 1. Values approaching 1 indicate a positive relationship, while values approaching −1 indicate a negative relationship. Statistical calculations were conducted using the R software environment.

3. RESULTS AND DISCUSSION
3.1. RESULTS

Distribution of Population Density and Active Cooperatives

Table 1 presents the distribution of population density and the number of active cooperatives in each district of Jember Regency in 2024, while Figure 1 and Figure 2 display the spatial distribution of these two variables. The population density values show considerable variation among districts. The highest density value is recorded in Kaliwates District at 3,850.23 people/km², followed by Sumbersari District at 2,907.99 people/km², and Patrang District at 1,914.24 people/km², which are located in the central part of the regency. Several other districts show moderate density levels ranging from around 1,000 to 1,500 people/km², including Ajung, Balung, Jenggawah, Rambipuji, and Arjasa. Lower density values are observed in several peripheral areas such as Ledokombo with 485.14 people/km², Jelbuk with 497.87 people/km², Sumberjambe with 506.88 people/km², and Silo with 399.4 people/km², while the lowest density value is recorded in Tempurejo District at 144.08 people/km².

The number of active cooperatives also shows differences among districts. The largest number is recorded in Sumbersari District with 64 units, followed by Patrang District with 52 units and Kaliwates District with 51 units. Several other districts have a moderate number of cooperatives, including Ambulu with 34 units, Umbulsari with 28 units, Wuluhan with 23 units, Puger with 22 units, Bangsalsari with 21 units, and Silo with 21 units. A number of areas show a smaller number of cooperatives such as Arjasa, Jelbuk, and Pakusari, each of which has 6 cooperative units, while several other districts are in the range of around 8 to 14 units.

Table 3. Population Density and Active Cooperatives Data by District in Jember Regency

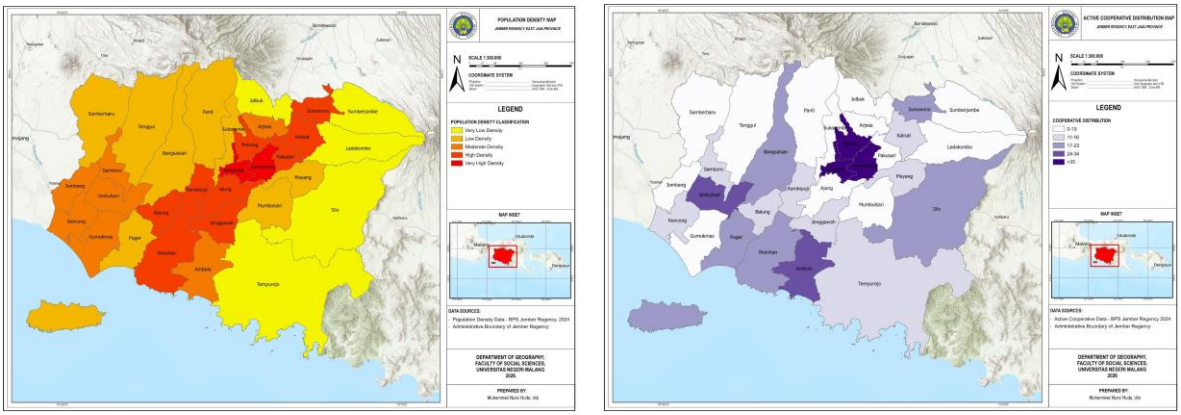
Sub-District	Population Density (people/km²)	Active Cooperatives
Ajung	1480.7	10
Ambulu	990.09	34
Arjasa	1149.81	6
Balung	1496.47	13
Bangsalsari	839.65	21
Gumuk Mas	1007.83	10

Jelbuk	497.87	6
Jenggawah	1407.69	14
Jombang	989.7	9
Kalisat	1488.51	13
Kaliwates	3850.23	51
Kencong	971.88	16
Ledokombo	485.14	9
Mayang	883.38	14
Mumbulsari	718.97	8
Pakusari	1454.78	6
Panti	813.47	8
Patrang	1914.24	52
Puger	740.23	22
Rambipuji	1557.35	12
Semboro	1025.35	12
Silo	399.4	21
Sukorambi	878.7	10
Sukowono	1331.12	18
Sumberbaru	630.84	9
Sumberjambe	506.88	10
Sumbersari	2907.99	64
Tanggul	722.12	9
Tempurejo	144.08	13
Umbulsari	1142.23	28
Wuluhan	1433.24	23

Source: BPS–Statistics Indonesia, Jember Regency (2024)

The population density map shows that areas classified in the high and very high-density categories are concentrated in the central urban zone of the regency, particularly in Kaliwates, Sumbersari, Patrang, and Pakusari. Areas with moderate density are visible in several districts

in the western and southern parts such as Balung, Rambipuji, and Wuluhan. Lower density categories dominate several eastern and southeastern areas such as Ledokombo, Sumberjambe, Silo, and Tempurejo. The cooperative distribution map shows a higher concentration of cooperatives in the central urban districts, while moderate numbers appear in several southern and western areas such as Ambulu, Umbulsari, Wuluhan, and Puger. Lower numbers of cooperatives are observed in several northern and eastern districts such as Arjasa, Jelbuk, Ledokombo, and Sumberjambe.



(a) (b)

Figure 2. (a) Population Density Map; (b) Distribution of Active Cooperatives Map
Source: research analysis

Normality Test of Population Density and Cooperative Data

The normality test was conducted on the population density data and the number of active cooperatives at the district level listed in Table 3 to assess the distribution pattern of the two variables before proceeding to the next stage of statistical analysis. The table contains variations in population density values and the number of active cooperatives across 31 districts in Jember Regency in 2024. The population density values show a fairly wide range among districts, ranging from 144.08 people/km² in Tempurejo District to 3,850.23 people/km² in Kaliwates District. Relatively high-density values are also recorded in Sumbersari District at 2,907.99 people/km² and Patrang District at 1,914.24 people/km². Several other districts fall within a moderate density range of around 1,000 to 1,500 people/km², such as Ajung, Balung, Rambipuji, and Jenggawah.

Lower density values are observed in several districts such as Ledokombo at 485.14 people/km², Jelbuk at 497.87 people/km², and Sumberjambe at 506.88 people/km². Variation is also observed in the number of active cooperatives among districts. The highest value is recorded in Sumbersari District with 64 cooperative units, followed by Patrang District with 52 units and Kaliwates District with 51 units. Several other districts have a moderate number of cooperatives, such as Ambulu with 34 units, Umbulsari with 28 units, Wuluhan with 23 units, Puger with 22 units, and Bangsalsari and Silo with 21 units each. The variation in population density values and the number of active cooperatives at the district level was then tested using the Shapiro–Wilk normality test to examine the data distribution of both variables. The results of the Shapiro–Wilk test show a statistical value (W) of 0.811 for the population density variable and 0.726 for the number of active cooperatives variable. The significance values obtained are 0.0001 for population density and 0.0000 for the number of active cooperatives with a sample size of 31 districts. The significance values for both variables are below the significance threshold of 0.05, indicating that the null hypothesis stating that the data

are normally distributed is not accepted. The results of this test indicate that the distribution of population density data and the number of active cooperatives at the district level does not follow a normal distribution based on the Shapiro–Wilk test conducted on the data presented in Table 3.

Table 4. Results of the Shapiro–Wilk Normality Test

Variable	Statistic (W)	df	Significance (p-value)	Conclusion
Population Density (X)	0,811	31	0,0001	Not Normally Distributed (H_1 accepted)
Actives Cooperative (Y)	0,726	31	0,0000	Not Normally Distributed (H_1 accepted)

Spearman Correlation Between Population Density and Active Cooperatives

The Spearman Rank correlation test table presents the relationship between the variables of population density and the number of active cooperatives at the district level in Jember Regency in 2024. The test was conducted on both variables that had been presented in the previous table to examine the direction and strength of the relationship between the variables. The calculation results show a correlation coefficient (r) value of 0.391. This value indicates that the relationship between population density and the number of active cooperatives is at a weak level of strength. The significance value (p-value) obtained is 0.030 at the 0.05 significance level. This significance value is below the significance threshold of 0.05, indicating that the relationship between the two variables is statistically significant. The correlation coefficient has a positive value, indicating that the direction of the relationship between population density and the number of active cooperatives is positive. This value indicates that districts with higher levels of population density tend to be associated with a greater number of active cooperatives within the analyzed regional units.

Tabel 5. Results of the Spearman Rank Correlation Test

Variable	Correlation Coefficient (r)	Significance (p-value)	Conclusion
Population Density & Active Cooperatives	0,391	0,030	Positive correlation, weak strength

3.2. DISCUSSION

The results in Table 3 show that the highest population density is found in districts located in the central part of the region such as Kaliwates, Sumbersari, and Patrang, which also appear on the population density map as zones categorized as high to very high density. These areas simultaneously show a relatively large number of cooperatives such as Sumbersari with 64 units, Patrang with 52 units, and Kaliwates with 51 units in the cooperative distribution table. The presence of a high number of cooperatives in these centers of population activity is related to the function of cooperatives as community economic institutions that serve as a means of economic activities for society across various business sectors. Research by Wu et al. (2021)

states that cooperatives often function as important socio-economic institutions in society because they become spaces for economic interaction as well as collective organizations for households in production and distribution activities. This contrast suggests that while urban areas like Kaliwates have the highest population density, their economy is dominated by large-scale retail and services which may not rely as heavily on the cooperative model. In contrast, sub-districts with lower density but strong agrarian roots, such as Ambulu and Puger, show a higher concentration of cooperatives because the community relies on these institutions for agricultural inputs and collective marketing. However, the results in the table and cooperative distribution map also show that the number of cooperatives is not only concentrated in high-density areas. Several districts with relatively lower population density such as Ambulu which has a density of around 990.09 people/km² still record a fairly large number of cooperatives, namely 34 units, while Umbulsari which has a density of around 1,142.23 people/km² has 28 cooperative units, and Puger with a density of around 740.23 people/km² has 22 cooperative units. This condition is related to the regional characteristics that are still dominated by agrarian activities so that the existence of cooperatives becomes a means of economic organization for rural communities.

Community-based economic institutions play an important role in strengthening rural economic resilience. Research by Lemmi et al. (2023) shows that agricultural cooperatives are widely formed in rural communities that depend on the agricultural sector because these institutions are used by households to support production activities and food security. This pattern is also visible in other areas such as Bangsalsari and Silo which have a relatively large number of cooperatives even though their population density is not in the highest category. A distribution that does not fully follow population density can also be seen on the cooperative distribution map which shows several cooperative concentration areas in certain regions outside the main density centers. The discrepancy between population density and cooperative distribution indicates that spatial and economic factors also influence the emergence of cooperative institutions. Mapping studies using Geographic Information Systems show that cooperative development is often associated with local production clusters and regional economic potential rather than simply population concentration. This phenomenon is consistent with the findings of Bin et al. (2024) which explain that the distribution of cooperatives often shows a spatial pattern in the form of one main center followed by surrounding circular areas as well as several other growth points that do not always correlate directly with the level of population density.

In rural areas, the existence of cooperatives is often related to the needs of rural communities to organize local economic potential through collective institutions so that cooperative growth remains visible in areas where population density is not dominant, as explained in studies on the development of cooperatives in rural communities that position cooperatives as a means of developing local economic potential in village communities (Masyhuri, 2024).The results of the Shapiro–Wilk normality test show that the population density data and the number of active cooperatives at the district level do not follow a normal distribution. The statistical value (W) for the population density variable is recorded at 0.811 with a significance value of 0.0001, while the variable for the number of active cooperatives has a statistical value of 0.726 with a significance value of 0.0000 with a sample size of 31 districts. The significance values below the 0.05 threshold indicate that the distribution of both variables is not normal; therefore, the test of the relationship between variables is conducted using Spearman Rank correlation. The results of the Spearman correlation test show a correlation coefficient value of 0.391 with a significance value of 0.030. This value indicates a positive relationship at a weak level of strength between population density and the number of active cooperatives. The relationship at this weak level indicates that the variation in the number of cooperatives among districts does not fully follow the variation in population density

observed in the previous distribution data. This condition indicates that the development of cooperatives is not only related to demographic factors such as population density but is also influenced by other factors in community economic activities.

Ramadhan and Ardiansyah (2025) explain that the development of cooperatives in various regions is more often related to economic policy, organizational innovation, and community economic needs than demographic factors such as population density. The weak level of correlation is also visible in several districts that have relatively low population density but have a fairly large number of cooperatives such as Ambulu, Umbulsari, and Puger in the cooperative distribution table. This condition indicates that the presence of cooperatives is also related to the structure of local economic activities that develop in certain regions. Rizkian et al. (2024) explain that the development of cooperatives in Indonesia is more often related to community economic activities as well as support from local government policies rather than population distribution alone. The distribution of cooperatives in several agrarian areas also shows that the number of cooperatives is relatively high in districts that have agricultural activity bases and businesses based on local resources. Rachmadi et al. (2024) state that the development of agricultural cooperatives is related to the availability of resources and local raw materials so that many develop in agrarian regions even though population density is relatively low. Another condition is also seen in areas with high population density that are not always followed by a greater number of cooperatives.

Research by Wintergalen and Molina (2025) shows that cooperatives located near urban areas actually have a higher risk of becoming inactive due to changes in community economic orientation and shifts in the structure of business activities. Qorri and Felfoldi (2024) state that the development of cooperatives is more often related to government policy, agricultural value chains, and the institutional structure of community economies than to regional demographic factors. Internal organizational factors are also related to cooperative development as seen in the differences in the number of cooperatives among districts. Winata et al. (2023) explain that cooperative development is often related to business scale, profitability, and organizational growth within the cooperative institutions themselves.

4. CONCLUSION

This study analyzed the spatial and statistical relationship between population density and the distribution of active cooperatives across 31 sub-districts in Jember Regency using 2024 secondary data through a quantitative approach that integrates spatial mapping and statistical analysis. The distribution of population density in Jember Regency shows considerable spatial variation among sub-districts, where high-density zones are concentrated in the central urban sub-districts of Kaliwates, Sumbersari, and Patrang, while sub-districts in peripheral and rural areas such as Tempurejo, Silo, and Ledokombo record significantly lower density values.

The Shapiro–Wilk normality test confirmed that both variables are not normally distributed ($W = 0.811$; $p = 0.0001$ for population density and $W = 0.726$; $p = 0.0000$ for the number of active cooperatives), and the analysis was therefore continued using a non-parametric method. The Spearman Rank correlation test yielded a correlation coefficient of $r = 0.391$ with a significance value of $p = 0.030$, indicating a statistically significant yet weak positive relationship between population density and the number of active cooperatives. This result confirms that sub-districts with higher population density tend to have a greater number of active cooperatives, but the strength of this relationship is limited and a substantial portion of the variation in cooperative distribution cannot be explained by demographic factors alone. This condition is reinforced by the spatial findings, which show that cooperative clustering does not strictly follow population density gradients. The presence of a relatively high number of active cooperatives in low-density agrarian sub-districts illustrates the role of local economic

structures, particularly agricultural production systems and community-based institutional networks, in driving the formation and sustainability of cooperatives in those areas. Overall, the spatial distribution of cooperatives in Jember Regency is shaped by a combination of demographic and non-demographic factors, including the sectoral composition of local economies, the dependence of rural communities on collective economic institutions, and the availability of local resources that sustain cooperative activity.

Population density is a relevant yet insufficient predictor for explaining the distribution of cooperatives in Jember Regency comprehensively. Future research is encouraged to incorporate additional variables such as agricultural land use, local government policy support, household income levels, and social capital indicators in order to obtain a more complete explanation of the spatial dynamics of cooperative development. For policymakers, the heterogeneous economic characteristics of each sub-district need to be considered when designing cooperative development programs, so that support is directed not only toward densely populated urban areas but also reaches agrarian sub-districts that demonstrably rely on cooperative institutions to sustain the economic lives of their rural communities.

REFERENCES

Badan Pusat Statistik Kabupaten Jember. (2025). *Kabupaten Jember dalam angka 2025 (Jember Regency in Figures 2025)*. BPS Kabupaten Jember.

Bijman, J., Hendrikse, G., & van Oijen, A. (2013). Accommodating two worlds in one organisation: Changing board models in agricultural cooperatives. *Managerial and Decision Economics*, 34(3–5), 204–217. https://doi.org/10.1002/mde.2584

Cai, S., Wang, H., & Zhou, X. (2021). Do city size and population density influence regional innovation output? Evidence from China. *Wireless Communications and Mobile Computing*, 2021, Article 3582053. https://doi.org/10.1155/2021/3582053

Geskus, S., Punt, M. B., Bauwens, T., Corten, R., & Frenken, K. (2024). Does social capital foster renewable energy cooperatives? *Journal of Economic Geography, 24*(6), 887–905. https://doi.org/10.1093/jeg/lbae031

Hakim, L., & Supriyadi, T. (2025). Cooperatives and inclusive economy in the era of world change: A case study of community cooperatives. In *Proceeding Book: The 1st International Student Conference on Earth and Environmental Science 2025*. Universitas Komputer Indonesia.

Hidayat, R., dkk. (2023). Digitalization of Cooperatives in the Face of Industrial Revolution 4.0: A Systematic Literature Review. *Jurnal Manajemen Terapan dan Keuangan*, 12(01), 214-225.

Juswadi, J., & Sumarna, P. (2023). Perkembangan usaha koperasi simpan pinjam Indonesia dan faktor yang mempengaruhinya periode 2013–2020. *Paspalum: Jurnal Ilmiah Pertanian*, 11(1), 74–81. https://doi.org/10.35138/paspalum.v11i1.541

Lemmi, G. A., Hirpha, H. H., & Geleta, D. W. (2023). The role of agricultural cooperatives in rural household food security in Digalu-Tijo District, Arsi Zone, Oromia, Ethiopia. *Asian Journal of Advances in Research*, 6(1), 311–323.

Lestari, D., Ambar, N., & Lathifah, L. N. (2024). The impact of population growth on housing food security and transportation. *Economic Military and Geographically Business Review, 2*(1), 41–58. https://doi.org/10.61511/emagrap.v2i1.2024.821

Liu, B., Tang, C., Zhou, G., Li, Q., & Yi, C. (2024). Spatial distribution, influencing factors and innovative development countermeasures of farmer cooperatives in Hunan Province, China. *Scientific Reports, 14*, 11308. https://doi.org/10.1038/s41598-024-56773-0

Masyhuri, M. A. (2024). The urgency of cooperative development in rural areas of Indonesia. *CITIZEN: Jurnal Ilmiah Multidisiplin Indonesia*, 4(4), 266–276. https://doi.org/10.53866/jimi.v4i4.636

Muniroh, M., Pawenary, P., & Rahmatullah, R. (2024). Permasalahan yang dihadapi koperasi di Indonesia saat ini. *Media Riset Bisnis Ekonomi Sains dan Terapan*, 2(4), 88–95.

Nopitasari, & Handayani, D. (2020). Hubungan kepadatan koperasi dan keputusan mengakses pembiayaan koperasi. *Jurnal Ekonomi & Kebijakan Publik, 11*(2), 149–162. https://doi.org/10.22212/jekp.v11i1.1674

Patel, B. N., & Tirthani, T. C. (2025). Impact of cooperatives on financial inclusion and livelihood in rural areas of Rajkot district, Gujarat. *International Journal of Humanities and Social Science Invention, 14*(9), 6–18. https://doi.org/10.35629/7722-14090618

Rachmawati, D. N., Pamungkas, T. D., Romadhon, M. L. F., & Azizah, I. J. N. (2025). Hubungan Kepadatan Penduduk dengan Sebaran Jumlah Koperasi Aktif di Kabupaten Bandung Tahun 2024. Jurnal Pendidikan Geografi Undiksha, 13(3), 345–353. https://doi.org/10.23887/jjpg.v13i3.96353

Sarsale, M. (2026). Cooperatives and rural development: A bibliometric analysis. *REVESCO. Revista de Estudios Cooperativos*, Advance online publication, 1–15. https://doi.org/10.5209/REVE.106331

Trisniarti, N., Sofyana, N. N., & Azhari. (2022). The contribution of cooperatives to the Indonesian economy. *Almana: Jurnal Manajemen dan Bisnis, 6*(3), 452–459. https://doi.org/10.36555/almana.v6i3.1927

Valentinov, V., & Iliopoulos, C. (2022). Agricultural cooperatives, social capital and sustainability. *Sustainability*, 14(3), 1892. https://doi.org/10.3390/su14031892

Wanyama, F. O. (2014). *Cooperatives and the Sustainable Development Goals: A contribution to the post-2015 development debate*. International Labour Organization (ILO) Working Paper.

Wintergalen, E. W., & Molina, R. (2025). The impact of proximity to urban areas on the dissolution of fishing cooperatives: Evidence from Mexico. *Ocean & Coastal Management*, *270*, 107858. https://doi.org/10.1016/j.ocecoaman.2025.107858

Wu, L., Li, C., & Gao, Y. (2022). Regional agricultural cooperatives and subjective wellbeing of rural households in China. *Regional Science Policy & Practice*, 14(S2), 138–158. https://doi.org/10.1111/rsp3.12502

Xu, R., & Mai, Q. (2024). Study on the spatio-temporal patterns of survival dynamic evolution of specialized farmers' cooperatives and the influencing factors of underdeveloped areas in China—Taking Yunnan Province as an example. *Sustainability, 16*, 11256. https://doi.org/10.3390/su162411256

Yu, L., Zhang, Y., & Chen, X. (2023). Social capital and credit access among members of agricultural cooperatives. *Agriculture*, 13(2), 418. https://doi.org/10.3390/agriculture13020418