

Geospatial Data Visualization with Spatio Temporal Analysis method: The Effect of Hotel Accommodation Distribution on Poverty Level in East Java Province

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Abstract— Tourism accommodation distribution influences regional poverty rates, making accurate data essential for analysis. This study aims to create a data visualization on poverty rates and tourism accommodation, especially hotels, in East Java Province to examine the relationship between the two through geospatial data visualization. By using the spatio-temporal analysis method starting from data preprocessing, data integration, data identification, and data visualization, this process allows comprehensive mapping and analysis of the available data. The resulting data visualization will be very useful for stakeholders in identifying and understanding the relationship between the availability of tourism facilities and economic welfare. Through this visual representation, stakeholders can clearly see how the distribution of tourism accommodations, such as hotels, can affect poverty levels in different regions. The statistical analysis using an F-test regression model confirms a significant relationship, with an F-value of 7.19 and a p-value of 0.003, indicating that an increase in hotel accommodations is associated with a decrease in poverty levels. This is due to the potential opening of jobs in the tourism sector for local residents in each district or city area.

Keywords—component; data visualization; geospatial; spatio temporal analysis; poverty; tourism

I. INTRODUCTION

Mapping is a crucial tool for planning and decision-making, particularly in analyzing tourism and poverty data. Statistics Indonesia (BPS) East Java provides a comprehensive statistical database that enables evidence-based analysis of hotel accommodation distribution and poverty rates. This study examines the relationship between hotel accommodation distribution and poverty levels in East Java using geospatial visualization. The findings will help stakeholders understand regional economic disparities and make informed policy decisions. Currently, data is available only in *.csv and *.xlsx formats, making it difficult for users to analyze tourism and poverty trends effectively. This study addresses this gap by providing a visual representation through spatio-temporal analysis. Economic development is a multidimensional process of change, encompassing various aspects that have an impact on improving the quality and standard of living of humans [1].

This study enhances previous research by employing spatio-temporal analysis using QGIS and StatPlanet, offering interactive and dynamic visualizations that surpass traditional mapping methods. Unlike previous research that focused solely on static GIS-based mapping, this study integrates real-time spatial and temporal components to analyze tourism's economic influence. This approach allows policymakers to

make data-driven decisions with greater accuracy and comprehensiveness.

If any influence is found, the data will be analyzed and displayed in detail. One effective method to present this data is through geospatial data visualization. These visualizations enable a deeper understanding of relationships and trends, and support better and more informed decision-making. Using QGIS can import, manage and insert geospatial data.

Organizations expect to be able to provide and serve information quickly, clearly, and accurately. However, the available data can only be accessed in *.csv and *.xlsx formats so that users are not yet able to view and analyze data on the distribution of poverty and hotel accommodation tourism quickly. For organizations and users, the distribution and influence can be important to know because it can be very important information. However, users no longer need to download data, process data, and present data. Therefore, this work aims to visualize poverty data with tourism data and analyze their influence in a spatio-temporal manner.

II. RESEARCH AND METHODOLOGY

Research on Geographic Information System Marketing Mapping of Nine Staples in West Bandung Regency resulted in an integrated system that facilitates data control. This system allows monitoring the distribution and gaps of daily staples, helping the Industry and Trade Office minimize errors in distribution and management [2].

Another study, which used a global regression model, found that variables such as the average years of schooling, school enrollment rate, and the number of people who completed bachelor's degree/diploma affect poverty in Jambi Province. Geographically Weighted Regression (GWR) analysis showed different dominant factors in each district/city. For example, average years of schooling is significant in Tebo and Bungo districts, while in Merangin, Sarolangun, and Batanghari districts, it is significant together with the number of people who have graduated from S1/D3. Several other districts were influenced by other variables outside of this study [3]. Research in Penajam Paser Utara District used the K-Means Clustering method to map Muhammadiyah members. The results showed three clusters based on the level of distribution of Muhammadiyah members: high, medium, and low. This information is useful for Muhammadiyah leaders in policy making. There are a total of 168 members spread across 25 villages, with a digital map showing the location of members in each village [4].

In another study, a spatio-temporal analysis method was used to identify and analyze the dynamics of land cover and use in the buffer zone and industrial zone using NDVI and NDWI. The NDVI model revealed landscape change and vegetation index, while the NDWI showed water bodies and waterlogging in the industrial zone. These results are important for stakeholders in policy-making and disaster risk mitigation due to changes in the earth's surface. Agricultural and plantation activities in the buffer zone, especially in Gulo Village and

Dowongimaiti Village, were recorded in Landsat 8 OLI satellite image data in 2018, 2019 and 2021 [5]. Research mapping grain distribution and overlap using QGIS 3.12.2 revealed potential areas for agricultural expansion. The analyzed spatial data provides insights into the distribution of these crops and provides a basis for decision-making regarding agricultural modernization, resource allocation, and regional development strategies. The maps from this research can be accessed online based on QGIS2 web and are expected to be further developed using Google Maps for access on Android and IOS smartphones [6].

Previous studies provide a strong basis for the importance of geospatial data visualization and spatio-temporal analysis in social and economic contexts. The spatio-temporal analysis method used to identify land cover change and agricultural commodity distribution provides an in-depth view of environmental and social dynamics. In the context of this research, the spatio-temporal analysis method is applied to understand the effect of the distribution of hotel accommodation on poverty levels in East Java Province. Given the relevance of the previous research results, this approach is expected to provide significant insights for policy makers in formulating geospatial data-based poverty alleviation strategies.

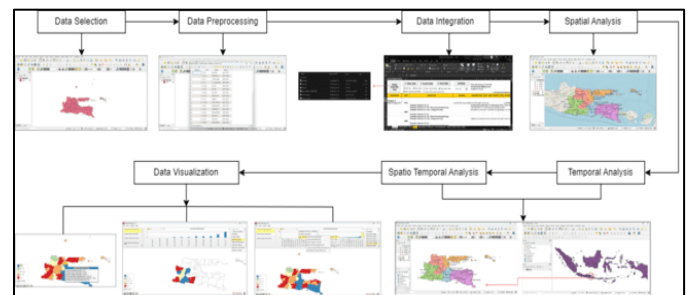


Fig. 1. Spatio-Temporal Analysis Method

This study applies Spatio-Temporal Analysis to visualize the relationship between hotel accommodation distribution and poverty rates in East Java. The methodology consists of seven stages: (1) Data Selection, (2) Data Preprocessing, (3) Data Integration, (4) Spatial Analysis, (5) Temporal Analysis, (6) Spatio-Temporal Analysis, and (7) Data Visualization.

First, based on the application of the spatio-temporal analysis method [7][8], data selection is carried out for the selection of map data used in accordance with the district and city map data in East Java province, which amounts to 38 districts / cities on the Qgis screen followed by preprocessing to standardize region codes and integrate missing data. Then, poverty and tourism data were integrated using a unique regional identifier. Spatial and temporal patterns were identified, allowing categorization of regional trends. Finally, a visual representation was created, enabling users to explore data based on different administrative divisions, such as the Bakorwil (regional coordinating body).

QGIS was selected due to its comprehensive GIS capabilities, open-source nature, and integration with spatial data management tools. StatPlanet was chosen for its ability to generate interactive, web-based geospatial visualizations,

making it superior to alternative visualization platforms. QGIS offers extensive customization options and supports various data formats, while StatPlanet provides advanced data storytelling features suitable for policy analysis. The combination of these tools enables a more detailed and accessible visualization of the relationship between hotel accommodation distribution and poverty levels. The study integrates poverty and tourism data from multiple sources, ensuring data consistency and eliminating potential biases through thorough data cleaning. Missing data points were addressed using interpolation techniques to maintain dataset completeness.

Additionally, data normalization was performed to maintain statistical integrity and comparability between regions. To further validate the accuracy of the dataset, cross-referencing with official government records from Statistics Indonesia (BPS) was conducted. This approach minimizes discrepancies and enhances the reliability of the analysis. The study employs an F-test regression model to examine the relationship between hotel accommodations and poverty rates. The model assumes homoscedasticity and normal distribution of residuals, ensuring reliability in determining the statistical significance of tourism's economic impact. A preliminary Shapiro-Wilk test was conducted to verify normality, and variance inflation factors (VIF) were assessed to rule out multicollinearity. These steps ensure that the regression model is robust and that the conclusions drawn from the statistical analysis are valid.

III. RESULT AND DISCUSSION

A. QGIS

QGIS is a widely used free geospatial software recognized globally. It is developed and maintained under the Open-Source Geospatial Foundation (OSGeo) [9]. Quantum GIS (QGIS) is a free and open source Geographic Information System (GIS) software for geospatial data processing. QGIS operates under the GNU General Public License and can be downloaded from <https://www.qgis.org> [10]. QGIS aims to be a comprehensive Geographic Information System (GIS) software, capable of displaying geospatial data and providing various functions and features commonly used in the analysis and management of geospatial data. QGIS is designed to meet the needs of users who require a powerful tool for visualization, manipulation and analysis of geographic data [11]. With features such as digitizing, georeferencing, and various spatial analysis tools, QGIS provides a complete and efficient solution for users in various fields [12].

The following are the steps of this research in mapping with QGIS:

1. Map Digitization

Map digitization has a polygon type by adding objects to represent cities or districts in the province of East Java. In this digitization stage, the data selection stage is also carried out, which selects the map data used as many as 38 districts / cities.

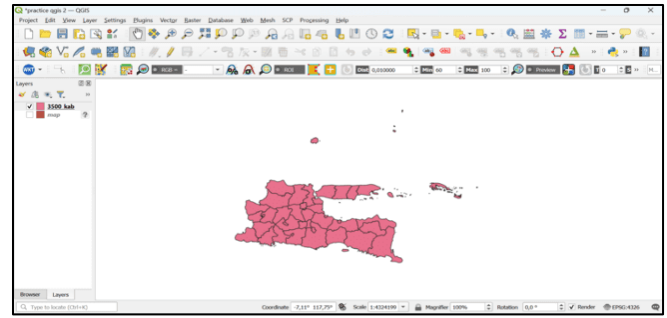


Fig. 2. Map Data Selection

2. Base Map Georeferencing

This process is used to determine the actual position on the earth's surface using a coordinate system. In this research, QGIS is used for spatial data processing.

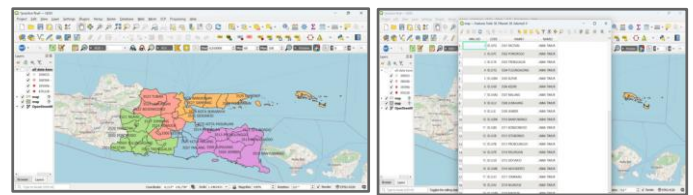


Fig. 3. Data Preprocessing

Figure 3 shows the results of analyzing the distribution of districts and cities in East Java Province by performing data preprocessing. This step involves filling in the appropriate region codes to facilitate data mapping in the next stage. The categorization of these regions is important to ensure that the data to be analyzed has an accurate and consistent basis. After the regions have been categorized, data related to poverty and tourism in East Java Province can be entered based on the region codes that have been determined for each district and city. For further visualization, other tools such as Statplanet can be used. Thus, a more in-depth analysis of the social and economic conditions in each region can be conducted, enabling more targeted and effective policy formulation [13].

B. StatPlanet

According to Ilmawan & Santosa, 2021 StatPlanet is software for creating interactive maps and data visualization which has several features, namely [14]:

- Visualization:** provides various forms of data visualization, including maps, tables, charts, and graphs. The platform can generate choropleth maps, which display thematic data through color variations, as well as proportional symbol maps, which use symbols of a certain size to present thematic data.
- Area Selection:** used to select spatial objects on the map to display related data. Selected objects can be grouped separately, allowing comparison of data between objects.
- Zooming and Panning:** to clarify the display of certain areas, users can zoom and pan the map.
- Customization:** to adjust the color and appearance of the map.

To manage the data that you want to visualize, on statplanet it can be done through an excel file as shown at figure 4.

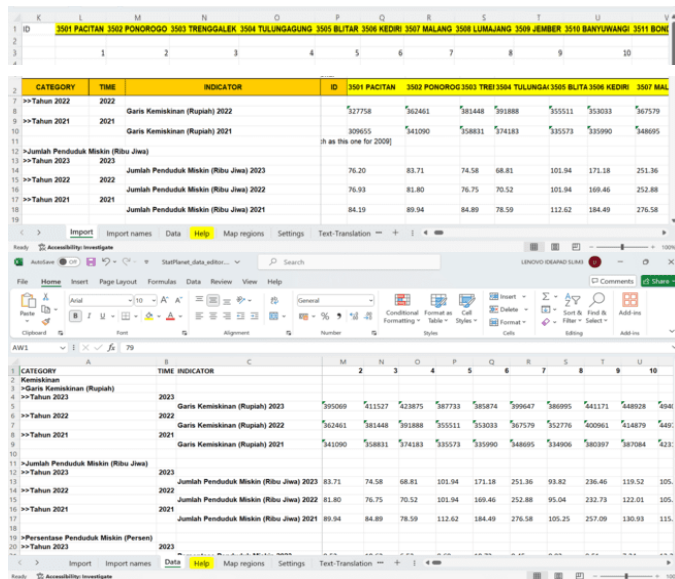


Fig. 4. Data Integration

A data integration process was carried out to combine and harmonize all data from districts/cities in East Java Province. This process includes combining poverty and tourism data by adjusting the ID or code of each region. Each district and city in East Java province was identified by identifying the regional pattern of the district and city and then categorized by using the code of each region adjusted so that the data could be integrated perfectly. This step is important to ensure the accuracy and consistency of the data used. Through data integration, the resulting information becomes more comprehensive and reliable. This integrated poverty and tourism data can then be analyzed to generate in-depth insights. This data integration also makes it possible to map patterns and trends across the province. That way, policy makers can make more informed decisions based on well-processed data. This process is an important foundation in spatio-temporal analysis and data visualization.

C. Data Visualization

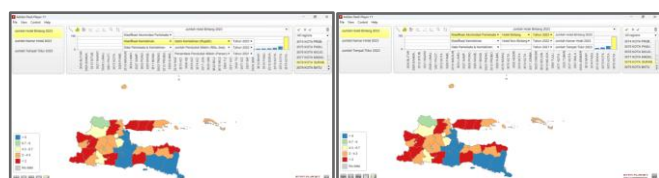


Fig. 5. Data Integration

In the data visualization process using a map view, several categories are created that will be displayed as needed. These categories cover various important aspects such as tourism accommodation classification, poverty classification, tourism and poverty data, poverty line, number of poor people, percentage of poor people, and number of star hotels and their

year categories. Each category is designed to provide comprehensive and easy-to-understand information.

For example, the tourism accommodation classification category will display the various types of accommodation available in an area, such as star hotels, the number of hotel rooms, and beds, as well as the classification based on star hotels and non-star hotels provided. The poverty classification will provide an overview of the level of poverty in various regions, helping to understand the distribution and intensity of poverty in the area [15].

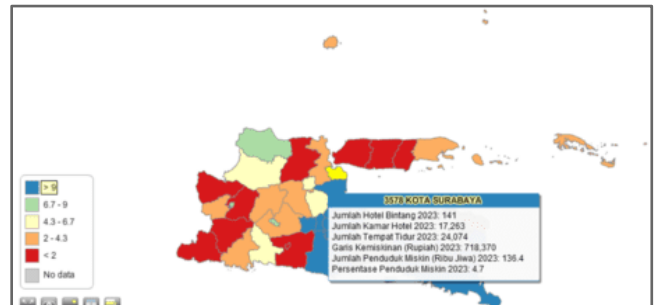


Fig. 6. Data Visualization Results

The tourism and poverty data category integrates information on tourism infrastructure and poverty levels, enabling a comprehensive analysis of their relationship. By overlaying tourism data with poverty statistics, users can identify regions where tourism contributes significantly to economic improvement and areas where its impact remains minimal. Regions such as Malang Regency and Banyuwangi Regency, which have a high concentration of star-rated hotels and well-developed tourism facilities, exhibit lower poverty rates due to increased employment opportunities and business growth in the hospitality sector. Conversely, rural areas like Bondowoso Regency, Sampang Regency, and Situbondo Regency, where hotel accommodations are scarce, continue to experience higher poverty rates. This disparity highlights the uneven distribution of tourism benefits and underscores the need for targeted development policies in underdeveloped regions. The visualization also incorporates the poverty line as a benchmark, allowing users to assess economic disparities across districts. The number of poor people and the percentage of poor people provide essential quantitative insights for further economic evaluation. Additionally, the historical distribution of star-rated hotels is displayed alongside annual tourism data, revealing long-term trends in accommodation development and its correlation with regional economic changes.

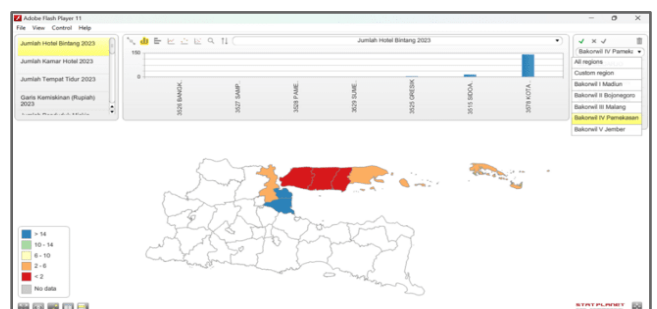


Fig. 7. Bakorwil Data Visualization

In this data visualization, users can view data grouped by Regional Coordinating Body (Bakorwil). If one of the Bakorwil is selected, the visualization will display data with special coloring for that Bakorwil. This makes it easier for users to identify different Bakorwil regions. Tourism and poverty levels in each Bakorwil are visualized through the use of different colors. For example, if the number of star hotels is more than 14, the region will be displayed in blue; if the number is less than 2, it will be marked in red; and for other numbers, other colors will be used.

This coloring indicates the availability of hotel accommodation in the Bakorwil. The lack of hotel accommodation also has an impact on the poverty rate, due to the lack of jobs available due to the lack of accommodation facilities. Thus, this visualization not only shows statistical data, but also assists users in understanding the relationship between the availability of tourism facilities and the level of economic welfare in each Bakorwil. The visualizations presented facilitate data-based analysis and decision-making, especially in regional development planning [16].

TABLE I. POVERTY DATA FOR EAST JAVA PROVINCE

Districts/Cities in East Java	Number of Poor People (Thousand People)		
	2021	2022	2023
Pacitan Regency	84.19	76.93	76.20
Ponorogo Regency	89.94	81.80	83.71
Trenggalek Regency	84.89	76.75	74.58
Tulungagung Regency	78.59	70.52	68.81
Blitar Regency	112.62	101.94	101.94
Kediri Regency	184.49	169.46	171.18
Malang Regency	276.58	252.88	251.36
Lumajang Regency	105.25	95.04	93.82
Jember Regency	257.09	232.73	236.46
Banyuwangi Regency	130.93	122.01	119.52
Bondowoso Regency	115.18	105.69	105.13
Situbondo Regency	86.95	81.46	82.62
Probolinggo Regency	223.32	203.23	205.02
Pasuruan Regency	159.78	148.62	154.09
Sidoarjo Regency	137.15	125.69	119.15
Mojokerto Regency	120.54	111.03	112.86
Jombang Regency	127.30	115.48	117.36
Nganjuk Regency	125.53	113.63	115.86
Madiun Regency	81.61	74.07	75.87
Magetan Regency	67.75	62.65	62.49
Ngawi Regency	130.81	119.02	121.30
Bojonegoro Regency	166.52	153.40	153.25
Tuban Regency	192.58	178.05	177.25

Districts/Cities in East Java	Number of Poor People (Thousand People)		
	2021	2022	2023
Lamongan Regency	166.82	151.08	149.94
Gresik Regency	166.35	149.64	149.75
Bangkalan Regency	215.97	196.11	196.66
Sampang Regency	237.23	217.97	221.71
Pamekasan Regency	137.12	126.02	126.43
Sumenep Regency	224.73	206.20	206.10
Kediri City	22.55	21.15	21.03
Blitar City	11.33	10.65	10.61
Malang City	40.62	38.56	37.78
Probolinggo City	17.91	16.16	15.86
Pasuruan City	13.97	13.02	13.56
Mojokerto City	8.37	7.88	7.65
Madiun City	9.06	8.49	8.46
Surabaya City	152.49	138.21	136.37
Batu City	8.63	8.05	7.10

Table 1 presents data on the number of poor people in thousands in various districts/cities in East Java for the last three years (2021-2023) [17]. In general, most regions show a decrease in the number of poor people from 2021 to 2023. For example, Pacitan District experienced a decrease from 84.19 thousand people in 2021 to 76.20 thousand people in 2023. A similar decline also occurred in Ponorogo Regency, where the number of poor people decreased from 89.94 thousand in 2021 to 83.71 thousand in 2023.

However, there are several regions that show fluctuations or a slight increase. For example, Probolinggo Regency, where the number of poor people rose from 203.23 thousand in 2022 to 205.02 thousand in 2023. In addition, several regency with a relatively high number of poor people, such as Malang Regency and Jember Regency, continue to show significant numbers despite a decrease in numbers from year to year. In Malang Regency, the number of poor people fell from 276.58 thousand in 2021 to 251.36 thousand in 2023, while in Jember Regency, the number fell from 257.09 thousand in 2021 to 236.46 thousand in 2023. This data is important for monitoring poverty trends and identifying areas that require further intervention in poverty alleviation efforts.

TABLE II. TOURISM DATA OF EAST JAVA PROVINCE

Districts/Cities in East Java	Number of Star Hotels			Number of Non-Star Hotels		
	2021	2022	2023	2021	2022	2023
Pacitan Regency	-	-	-	61	73	58
Ponorogo Regency	1	1	1	53	53	50

Districts/Cities in East Java	Number of Star Hotels			Number of Non-Star Hotels		
	2021	2022	2023	2021	2022	2023
Trenggalek Regency	2	2	2	58	82	88
Tulungagung Regency	2	3	5	25	22	24
Blitar Regency	2	-	-	12	14	14
Kediri Regency	2	3	3	14	17	18
Malang Regency	8	9	10	280	264	233
Lumajang Regency	-	-	-	25	20	23
Jember Regency	10	10	11	50	58	58
Banyuwangi Regency	12	12	12	61	65	60
Bondowoso Regency	2	2	2	16	13	17
Situbondo Regency	-	-	-	36	43	41
Probolinggo Regency	-	2	2	170	203	196
Pasuruan Regency	11	15	14	669	633	579
Sidoarjo Regency	15	15	15	123	142	117
Mojokerto Regency	1	2	5	146	152	155
Jombang Regency	3	4	4	23	23	23
Nganjuk Regency	1	2	2	15	15	16
Madiun Regency	1	1	1	8	8	8
Magetan Regency	2	2	2	197	192	191
Ngawi Regency	-	-	-	17	17	23
Bojonegoro Regency	5	5	5	17	16	17
Tuban Regency	6	7	8	20	20	18
Lamongan Regency	1	1	1	16	18	14
Gresik Regency	4	4	4	30	31	27
Bangkalan Regency	-	-	-	6	6	8
Sampang Regency	1	1	1	5	5	6
Pamekasan Regency	1	1	1	14	15	13
Sumenep Regency	2	2	2	15	28	15
Kediri City	7	7	7	22	21	20
Blitar City	-	1	1	17	16	16
Malang City	34	36	36	144	145	142
Probolinggo City	2	3	3	25	34	32
Pasuruan City	2	2	2	7	7	16
Mojokerto City	2	3	3	10	9	9

Districts/Cities in East Java	Number of Star Hotels			Number of Non-Star Hotels		
	2021	2022	2023	2021	2022	2023
Madiun City	9	9	9	26	33	28
Surabaya City	114	135	141	144	156	141
Batu City	18	19	21	955	980	1025

The table 2 provides information on the number of star and non-star hotels in various districts/cities in East Java over the past three years (2021-2023) [17]. In the category of star hotels, there is growth in several regions. For example, the number of star hotels in Malang Regency increased from 8 hotels in 2021 to 10 hotels in 2023. A significant increase was also seen in Surabaya City, from 114 star hotels in 2021 to 141 star hotels in 2023. Batu City recorded growth from 18 star hotels in 2021 to 21 star hotels in 2023.

However, some districts had no star hotels at all during the period, such as Lumajang and Situbondo. Meanwhile, the number of non-star hotels shows a more mixed trend. In Pasuruan Regency, the number of non-star hotels decreased from 669 hotels in 2021 to 579 hotels in 2023, while in Batu City there was an increase from 955 non-star hotels in 2021 to 1025 hotels in 2023. Some areas with a low number of non-star hotels have also experienced changes. For example, in Bangkalan Regency, the number of non-star hotels increased from 6 hotels in 2021 to 8 hotels in 2023. Similarly, in Sampang Regency, the number increased from 5 hotels in 2021 to 6 hotels in 2023. This data reflects the varied development of tourism infrastructure among districts/municipalities in East Java, which may affect tourism attraction and the local economy. This information is important to understand the potential and challenges in developing the tourism sector in the region [18] .

The data in the tables show that more hotel accommodation, both star and non-star, can create jobs and increase local income. This has a positive impact on reducing the number of poor people in the area. The development of tourism infrastructure such as hotels not only attracts tourists but also provides employment opportunities for local residents, both directly in the hospitality industry and indirectly through other supporting sectors such as transportation, food and beverages, and handicrafts. This, an increase in the number of hotel accommodations plays an important role in improving local economic welfare and reducing poverty levels.

D. Data Visualization

The overall variable test is carried out with the F-test. Partial hypothesis testing (F test) is used to see how much each independent variable influences and is influenced by the dependent variable [19]. Can be seen in the following table 3.

TABLE III. Simultaneous Test Results (F-Test)

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	167.34	2	83.67	7.19	0.003

Residual	317.13	31	10.23	-	-
Total	484.47	33	-	-	-

Based on the results of this F test, it can be concluded that the regression model that uses the number of star and non-star hotels as predictors significantly affects the number of poor people in districts/cities in East Java. The high F value (7.19) and the low significance value (0.003). This means that if the statistical test results show that the p-value associated with the regression coefficient is 0.003, which is at the 0.05 level of significance, it can be concluded that an increase in the number of hotels (both star and non-star) will be associated with a decrease in the number of poor people in the East Java Province.

IV. CONCLUSION AND SUGGESTION

This research highlights the importance of geospatial data visualization and spatio-temporal analysis in social and economic contexts [20], particularly to understand the influence of hotel accommodation distribution on poverty rates in East Java Province. The spatio-temporal analysis method was used to analyze data from 38 districts/cities in the province with the help of QGIS software. The research process involved several stages, namely data selection to select suitable district/city maps, data preprocessing to adjust and update region codes, data integration to combine poverty and tourism data, pattern identification to identify regional distribution patterns, and data visualization to display poverty and hotel accommodation data in the form of maps. This visualization allows stakeholders to see the relationship between the availability of tourism facilities and economic welfare, and facilitates the exploration of data based on regional categories such as Bakorwil.

The special coloring helps in identifying areas with different amounts of hotel accommodation, showing how tourism levels and poverty are interlinked. The data shows that an increase in the number of hotels, both star and non-star, contributes to job creation and increased local income, which has a positive impact on poverty reduction. The development of tourism infrastructure not only attracts tourists but also provides employment opportunities for the local population through various supporting sectors. Therefore, increasing the number of hotel accommodations is crucial to improving local economic welfare and reducing poverty levels.

REFERENCES

- [1] N. E. Mumu, T. O. Rotinsulu, And D. S. M. Engka, "The Influence of the Tourism Sector on Economic Growth and Labor Absorption in North Sulawesi Province," *J. Pembangunan Ekon. Dan Keuang. Drh.*, Vol. 21, No. 2, Pp. 1–16, 2020.
- [2] A. Kurniawan, F. Renaldi, And F. R. Umbara, "Geographic Information System for Marketing Mapping of Nine Basic Commodities in West Bandung Regency," In *Seminar Nasional Teknologi Komputer & Sains (Sainteks)*, 2019, Pp. 877–880.
- [3] N. Lutfiani, Sugiman, And S. Mariani, "Geographically Weighted Regression (GWR) Modeling With Gaussian Kernel And Bi-Square Weighting Functions," 2019.
- [4] E. J. Ramadhan And Rudiman, "Mapping the Distribution of Muhammadiyah Members Based on Density Level Using the K-Means

- Clustering Method," *Jurti*, Vol. 6, No. 2, Pp. 117–123, 2022.
- [5] Y. A. Singgalen, "Application of Spatio-Temporal Analysis Method in Land Cover and Use Dynamics Analysis Based on NDTV and NDWI," *Klik Kaji. Ilm. Inform. Dan Komput.*, Vol. 4, No. 2, Pp. 1052–1061, 2023.
- [6] R. Destianto And P. Bitta, "Analysis of the Relationship between Changes in Agricultural Land and Food Security in Magelang Regency Based on the Spatio Temporal Sig Model," *Geoplanning*, Vol. 1, No. 1, Pp. 21–32, 2014.
- [7] F. F. Susanta, C. Pratama, T. Aditya, A. F. Khomaini, And H. W. K. Abdillah, "Geovisual Analytics Of Spatio-Temporal Earthquake Data In Indonesia," *Jgise J. Geospatial Inf. Sci. Eng.*, Vol. 2, No. 2, Pp. 185–194, 2019.
- [8] I. Zulfa, Fajrillah, R. Septima, M. Handri, I. Zulfida, And L. Suryati, "Mapping of Rice and Coffee Distribution Areas with Quantum Geographic Information System Version 3.12.2," *Resolusi Rekayasa Tek. Inform. Dan Inf.*, Vol. 3, No. 6, Pp. 326–335, 2023.
- [9] M. R. Chavoya, J. L. G. Salazar, P. M. L. Serrano, P. C. A. Concepcion, And A. K. L. Miranda, "Qgis A Constantly Growing Free And Open-Source Geospatial Software Contributing To Scientific Development," *Cuad. Investig. Geogr.*, Vol. 48, No. 1, Pp. 197–213, 2022.
- [10] S. Bahri, D. M. Midyanti, And R. Hidayati, "Utilization of Qgis for Mapping Public Service Facilities in Pontianak City," *Cess (Journal Comput. Eng. Syst. Sci.)*, Vol. 5, No. 1, Pp. 70–77, 2020.
- [11] E. V. Sidabutar, R. A. Rapiq, M. D. Refansyah, A. Irsyad, M. R. Ibrahim, And H. J. Setiyadi, "Utilization of Qgis for Mapping Post Office Distribution Points in Samarinda City," *Kreat. Teknol. Dan Sist. Inf.*, Vol. 1, No. 1, Pp. 32–36, 2023.
- [12] R. K. Saputra, A. Y. Purnama, And R. Perdhana, "Mapping of Health Facility Coverage in the Special Region of Yogyakarta (DIY) Province Using Software," *J. Ilmu Kesehat. Masy. (The Public Heal. Sci. Journal)*, Vol. 12, No. 6, Pp. 523–529, 2023.
- [13] N. Maymuna, R. Utomowati, R. Noviani, And H. N. Bin Isamil, "Webgis-Based Tourism Potential Mapping Using Quantum Gis (Qgis)," *J. Ilm. Ilmu Terap. Univ. Jambi*, Vol. 9, No. 1, Pp. 130–143, 2025.
- [14] H. Ilmawan And P. B. Santosa, "Visualization Of Banyumas Regency Statistical Data Using Interactive Maps," *Geoid J. Geod. Geomatics*, Vol. 16, No. 2, Pp. 150–163, 2021.
- [15] I. S. Meidodga, A. Syahrin, R. T. Putra, F. Warfandu, And A. N. Bimasena, "Utilization of Geospatial Data in Realizing a Multi-Purpose Land Information System for Multi-Parties," *J. Widya Bhumi*, Vol. 3, No. 1, Pp. 62–80, 2023.
- [16] H. S. Nasution And M. Syukri, "Geospatial Analysis to Identify Tuberculosis Case Hotspots in Sarolangun Regency in 2018-2021," *J. Ilm. Permas J. Ilm. Stikes Kendal*, Vol. 12, No. 4, Pp. 613–620, 2022.
- [17] P. Meivita, L. O. A. Arafat, A. A. Effendy, E. Susanto, A. T. Izdihar, And P. S. Wardani, *East Java Province in Figures 2024*, Vol. 47. Bps Provinsi Jawa Timur, 2024.
- [18] J. L. Rindika And F. J. Subiyanto, Sawitri Amarrohman, "Geospatial Analysis of the Development of Economic Value of the Pagar Alam City Tourism Area Using Geographic Information Systems," *J. Geod. Undip*, Vol. 9, No. 4, Pp. 22–31, 2020.
- [19] A. Balqis, H. Harmain, And Nurwani, "The Influence of Financial and Non-Financial Compensation on Employee Performance at Bank Sumut KCP Syariah Simpang Kayu Besar," *J. Maneksi*, Vol. 12, No. 2, Pp. 388–393, 2023.
- [20] Jasman, M. Ridwan, And F. Guntara, "Utilization Of Geographic Information Systems In Applying Smart Tourism In The Nona Mountain Area," *J. Kepariwisata Indonesia*, Vol. 15, No. 1, Pp. 36–48, 2021.