Modelling and mapping the poverty levels with applied spatial regression model in South Sulawesi province of Indonesia

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ABSTRACT

The focus of this study is to model the poverty rate using a statistical approach and then carry out a spatial mapping of the poverty rate in regencies and cities in South Sulawesi Province. This study is important to research so that it becomes a reference for the government in formulating policy analysis on poverty alleviation and its sustainability. The method used is the spatial regression model with cross-sectional data, using R software as a tool for analyzing research data. The findings show that the poverty levels in the regencies and cities of South Sulawesi province are randomly distributed and have a dispersed pattern. The significance of the response variable under analysis has an impact on this. In addition, the best model was obtained, namely the Spatial Error Model (SEM) model with the smallest p-value and a confidence level of 86%. The results of the hot-spot and cold-spot analysis show that the concentration of poverty levels is still focused on the southern region in the hot-spot area (red color), namely Bantaeng Regency, Jeneponto Regency, Takalar Regency, Gowa Regency, Makassar City, Maros Regency, Sinjai Regency, and Barru Regency. The implications for the community in the hot-spot category area are that special attention is needed from the government and stakeholders to be directly involved in improving the poverty level that occurs in the community through sustainable poverty alleviation programs.

Contribution/Originality: This study explains the existence of spatial linkages and is a new approach that integrates spatial influences in poverty studies so that the solution to poverty alleviation is not homogeneous but pays attention to spatial heterogeneity. Another novelty is to use real data for each variable obtained in the study.

1. INTRODUCTION

The problem of poverty is one of the fundamental issues that has been the focus of the government's attention since long ago. The Indonesian Central Statistics Agency (CSA) uses the concept of ability to meet basic needs in measuring poverty levels. Through this approach, poverty is seen as an economic inability to meet basic needs, both food and non-food needs, which are measured from the expenditure side or interpreted as residents who have an average monthly per capita expenditure below the poverty line (Hikmah, 2017). Several government policy programs have been implemented to suppress and reduce poverty, including reducing inequality. However, the number of poor people in Indonesia is still quite high, including in South Sulawesi province.

According to data from CSA, the percentage of poverty levels in South Sulawesi province from March 2016 to September 2022 has experienced a decreasing trend from year to year, with a percentage of 9.40% in March 2016 decreasing to 8.63% in March 2022 (BPS, 2022). To maintain the trend of poverty reduction, serious efforts are needed to reduce poverty in various sectors. Even though the poverty levels in South Sulawesi province are 8.63%, which is categorized as low compared to the national poverty levels of 9.57%, this figure is still far from the target of the work plan in the South Sulawesi province apparatus in 2022, which is expected to be in the range of 5.98 to 7.60% (Provincial Government, 2022). Thus, the government needs to work optimally in poverty alleviation, and the government's target can be achieved to realize people's welfare. This target can be achieved with seriousness in analyzing the various factors that cause poverty (Laurens & Putra, 2020) as well as equitable distribution of development according to the needs of the people of each region (Wang, Jiang, Yin, Liang, & Duan, 2021).

Research on the topic of modelling and mapping poverty levels has been carried out by many researchers, but research using spatial aspects is still in the small category. The existence of different characteristics in each geographical area can affect the poverty levels in each region (Dewi, Majid, Aliasuddin, & Kassim, 2018; Nurdiana, Hasan, Arisah, Riesso, & Hasanah, 2020). The differences in the factors that influence each topography indicate that there is an influence of local conditions in a particular area in determining significant factors in poverty modeling and mapping (Zewdie, Aidi, & Sartono, 2015). The factors that affect poverty levels can be changed in the form of variables that are analyzed and modeled mathematically so that a solution to the problem is obtained. This study uses the analysis of the spatial regression model, which is the development of a linear model based on the influence of geographic or spatial areas on the data being analyzed (Asrol & Ahmad, 2018; Hikmah, 2017; Rizki & Taqiyyuddin, 2021). The spatial regression model is applied in the regencies and cities of South Sulawesi Province so that the resulting error values are heterogeneous due to inter-regional linkages. The problem of poverty is basically not just an economic problem; it is complex and multidimensional. Poverty is also closely related to social, cultural, and political issues, including geographical or spatial issues. Because there are spatial links in the analysis, we need a new way of looking at poverty and inequality that takes these effects into account. This way, the solution to reducing poverty won't be the same everywhere, but will take into account the differences between places. Thus, a study is needed that models and maps poverty levels based on regencies and cities in South Sulawesi province.

2. LITERATURE REVIEW

Poverty is a major problem that must be solved so that all citizens are able to enjoy a prosperous and dignified life (Laurens & Putra, 2020). Poverty is a situation of deprivation that occurs not because the poor person wants it but because of a condition that exists and cannot be avoided. Poverty also indicates the inability of people to meet basic needs, which in turn has an impact on the various problems they face. Poverty will leave generations who are malnourished, stunted, susceptible to disease, and unable to obtain quality education (Narayan, John, & Ramadas, 2019). In the end, poverty will be left to generations that suffer from social problems and even become a source of social problems that have an impact on the breakdown of social interaction (Manshor, Abdullah, & Hamed, 2020). Because of this, the state and society have assumed responsibility for the issue of poverty, and various parties will continue to make serious efforts to fulfill the constitution's mandate of bringing prosperity to all people. Causes of poverty can occur due to natural and economic conditions, structural and social conditions, as well as cultural conditions (Yulianti, Widyanigsih, & Nurrohmah, 2021). Poverty with natural and economic conditions arises due to limited natural, human, and other resources, so that production opportunities are relatively small and cannot play a role in sustainable development. Uneven development results, institutional arrangements, and development policies that have not benefited the general public are the causes of poverty with structural and social conditions. Whereas poverty with cultural conditions is caused by attitudes or life habits that feel sufficient and do not try to find a decent job, so that it traps someone in the poverty chain. In addition, other causes of poverty also come from internal and external source of the poor population (Tang, Liu, Chao, & Han, 2021). Internal causes include the low quality of

human resources and the attitude of individuals who do not want to adapt to progress due to a lack of knowledge. Meanwhile, external causes are limited natural resources, social and institutional arrangements in society, development policies, limited job opportunities, intense competition, and unemployment (Didiharyono & Syukri, 2020). Based on various sources of reference (Yulianti et al., 2021), there are several types of poverty which are differentiated based on the time pattern, namely: (1) persistent poverty is interpreted as poverty that has been chronic or hereditary from parents which, among them are critical areas of natural resources or isolated; (2) cyclical poverty is interpreted as conditions of poverty that follow the pattern of the economic cycle that is happening as a whole; (3) seasonal poverty is interpreted as seasonal poverty as is often found in cases of fishermen and food crop farmers, while; (4) accidental poverty is interpreted as poverty due to natural disasters or the impact of an policies that are not pro-poor. Thus, various sustainable poverty alleviation policy strategies are needed.

The poverty alleviation strategy put forward by the World Bank (2020) says that every decade, the poverty alleviation strategy has developed, starting from job creation, increasing income, health and education development, protection, and community empowerment. In supporting the World Bank's strategy, the government formulates a poverty alleviation strategy that can be divided into two major parts, namely, firstly protecting families and community groups who experience temporary poverty, and secondly helping people who experience chronic poverty by empowering and preventing new poverty (Yulianti et al., 2021). This strategy is then outlined in three programs that are directly directed at the poor, namely providing basic needs of the community with direct cash assistance from the government, subvention/subsidy assistance, developing a social security system, and developing a business culture through product innovations for micro, small, and medium enterprises (MSMEs). In addition, the poor have their own strategies for overcoming poverty, namely borrowing from informal institutions, increasing working hours, having family members look for work, and saving money.

Poverty alleviation is one of the main goals of development, which is a measuring tool to assess the effectiveness of the implementation of various types of government programs in realizing the welfare of a just and prosperous society. To achieve the target of poverty alleviation, one can start by knowing and analyzing the factors that influence poverty with various existing mathematical approaches.

Several supporting studies on the problem of poverty have been carried out in Zanganeh and Akbari (2019), Breunig and Majeed (2020), and Wang et al. (2021). Furthermore, in Hutapea and Utomo (2020), an analysis of the factors that influence poverty includes the percentage of poor people, the poverty line, the number of poor people, the poverty severity index, and the poverty depth index (Song, Geng, Fahad, & Liu, 2022). Research on the analysis of the factors that influence poverty has also been carried out a lot before using various statistical and mathematical methods (Rizki & Taqiyyuddin, 2021; Wang et al., 2021). Including several studies using spatial aspects to analyze poverty levels in several places with different response variables (Hutapea & Utomo, 2020; Zanganeh & Akbari, 2019). Analysis of the influence of this spatial aspect is important to study in research on the number of poor people because there are differences in characteristics in determining the level of poverty in each region (Cao, Ouyang, & Xu, 2022; Do et al., 2021). The differences in the influencing factors in each topography indicate the influence of local conditions in a particular area of determining significant factors in poverty modeling (Tu, Ha, Wang, & Liu, 2020; Yulianto, 2021). Thus, the existence of spatial linkages is a new approach to integrating spatial influences in the analysis of poverty, including socio-economic inequality. This is one of the novelties in this research. Apart from that, the development of models and methods is also an important factor in the novelty and depth of the economic poverty mapping analysis in the regencies and cities of South Sulawesi province.

3. METHODOLOGY

3.1. Research Approach

This study is applied research with a quantitative approach to analyzing poverty mapping using the spatial regression model and using R software as a tool for analyzing research data. The research variables and data sources

analyzed in this study are shown in Table 1. These variables aim to increase the accuracy of the analyzed research results so as to obtain the objectivity of the research results.

Table 1. Research variables and data sources for 2022.

No	Variable	Description	Data source
1	Poverty level (Y)	Percentage of poor people in regencies and cities in South Sulawesi province	Central statistics agency (CSA) of South Sulawesi, 2022
2	Gross regional domestic product (GRDP) (X_1)	Total gross regional domestic product contribution based on constant prices in regencies and cities of South Sulawesi province	Central Statistics Agency (CSA) of South Sulawesi, 2022
3	Economic growth (X_2)	Percentage of economic growth rate in regencies and cities of South Sulawesi province	Central statistics agency (CSA) of South Sulawesi, 2022
4	Investment (X_3)	Total foreign investment and domestic investment in regencies and cities of South Sulawesi province	Annual manufacturing survey Central Statistics Agency (CSA) of South Sulawesi, 2022
5	Access to health facilities (X_4)	Total number of health access facilities in regencies and cities of South Sulawesi province	Health office of South Sulawesi Province, 2022
6	Open unemployed (X_5)	The total number of unemployed in regencies and cities of South Sulawesi province	Labor force survey Central Statistics Agency (CSA) of South Sulawesi, 2022
7	Industrial sector contribution (X_6)	The percentage of the industrial sector's contribution to GRDP in regencies and cities of South Sulawesi province	Industry office of South Sulawesi province, 2022
8	Households with non-own ownership (X_7)	Percentage of households with non-own ownership status in regencies and cities of South Sulawesi province	Central Statistics Agency (CSA) of South Sulawesi, 2022

3.2. Data

The data used in this research is cross-sectional data obtained from 21 regencies and 3 cities in South Sulawesi province in 2022, as shown in Table 2. The data is real data obtained in the research process and analyzed by equating the units in percentage (%). Modeling the poverty rate by adding spatial factors provides a better model than the usual panel data model. Several studies have selected the model used in the analysis of poverty levels, as in Hutapea and Utomo (2020), which uses the model analyzed using the Geographically Weighted Regression (GWR); (Rinaldi, Susianto, Santoso, & Kusumaningtyas, 2021; Rizki & Taqiyuddin, 2021) uses the Spatial Autoregressive Fixed Effect model (SAR-FEM) in analyzing research data; then (Yulianti et al., 2021) uses two methods in data analysis, namely the spatial autoregressive model (SAR) and the Spatial error model (SEM). Thus, the analysis of research data uses five different methods, namely Spatial Cross Regressive (SCR), spatial autoregressive model (SAR), Spatial Durbin Model (SDM), Spatial error model (SEM), and Spatial Durbin Error Model (SDEM), and then the five models will be selected as the best models used in estimating research data.

Table 2. Regencies and cities in South Sulawesi provinces.

No	Regencies and cities	No	Regencies and cities	No	Regencies and cities
1	Selayar	9	Pangkep	17	Luwu
2	Bulukumba	10	Barru	18	Tana Toraja
3	Bantaeng	11	Bone	19	Luwu Utara
4	Jeneponto	12	Soppeng	20	Luwu Timur
5	Takalar	13	Wajo	21	Toraja Utara
6	Gowa	14	Sidenreng Rappang	22	Makassar city
7	Sinjai	15	Pinrang	23	Pare-pare city
8	Maros	16	Enrekang	24	Palopo city

3.3. Data Analysis

This study uses descriptive and inferential analysis methods as an answer to the research objectives. Descriptive analysis includes data visualization, which aims to determine the development and spatial distribution of regencies and cities as research variables in South Sulawesi province. Then do statistical modeling with multiple regression

equations to determine the determinants of variables that affect poverty levels. Then carry out a spatial effect test using Moran's I test on each variable with each cluster and perform a Lagrange Multiplier (LM) test in analyzing using several equations as follows:

a. Spatial Cross Regressive (SCR) with the general equation.
$$Y = \beta_0 + \beta_1 X_1 + \cdots + \beta_p X_p + \gamma_1 W X_1 + \cdots + \gamma_p W X_p + \varepsilon \tag{1}$$

b. Spatial Autoregressive Model (SAR) with the general equation.
$$Y = \rho W y + X\beta + \varepsilon, \text{ with } \varepsilon \sim N(0, \sigma_\varepsilon^2 I_n) \tag{2}$$

c. Spatial Durbin Model (SDM) with the general equation.
$$Y = \rho W y + \alpha 1_n + X\beta + W X\theta + \epsilon, \text{ with } \varepsilon \sim N(0, \sigma_\varepsilon^2 I_n) \tag{3}$$

d. Spatial Error Model (SEM) with the general equation
$$Y = X\beta + \varepsilon, \text{ with } \varepsilon = \lambda W \varepsilon + v \tag{4}$$

e. Spatial Durbin Error Model (SDEM) with the general equation.
$$Y = \alpha 1_n + X\beta + W X\theta + \varepsilon, \text{ with } \varepsilon = \lambda W \varepsilon + v \tag{5}$$

The next step is to determine the best model, do mapping with hot-spots and cold-spot analysis, then make interpretations and recommendations for poverty alleviation policies in South Sulawesi province.

4. RESULTS

4.1. Descriptive Statistics

Descriptive statistical analysis aims to see the distribution of the average value, variance, standard deviation, maximum, and minimum value of each variable. Descriptive statistics for each research variable are presented in Table 3.

Table 3. Descriptive statistical of variables.

| No	Variable	Average	Variance	Standard deviation	Maximum	Minimum
1	Y	9.318	8.011	2.830	13.92	4.58
2	X_1	15,097.09	657,941,299.81	25,650.36	133,132.60	3,903.80
3	X_2	5.277	6.570	2.563	15.45	1.99
4	X_3	27,928,836.54	7.237e+15	85,074,068.84	390,779,246	0
5	X_4	110.083	3,196.68	56.539	299	47
6	X_5	8,571.87	283,480,231.21	16,836.87	86,267	641
7	X_6	9.006	77.982	8.830	42.44	2.06
8	X_7	18.542	157.606	12.554	44.22	3.04

The percentage of poverty levels in the regencies and cities of South Sulawesi province is generally not spread evenly. The same thing happened with response variables including GRDP, economic growth, total investment value, number of health facilities, number of unemployed, contribution of the industrial sector, and the percentage of households with non-own ownership in regencies and cities of South Sulawesi province, as shown in Figure 1. This description can be seen in the different colors in the regencies and cities of South Sulawesi province for each variable.
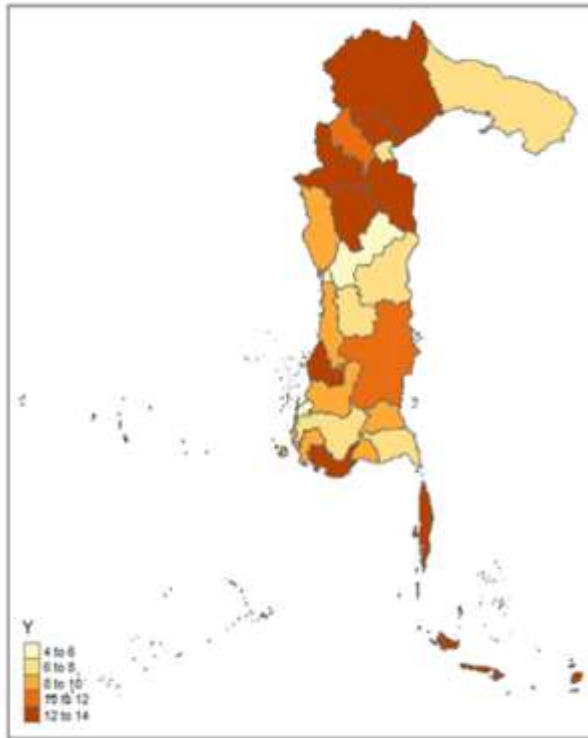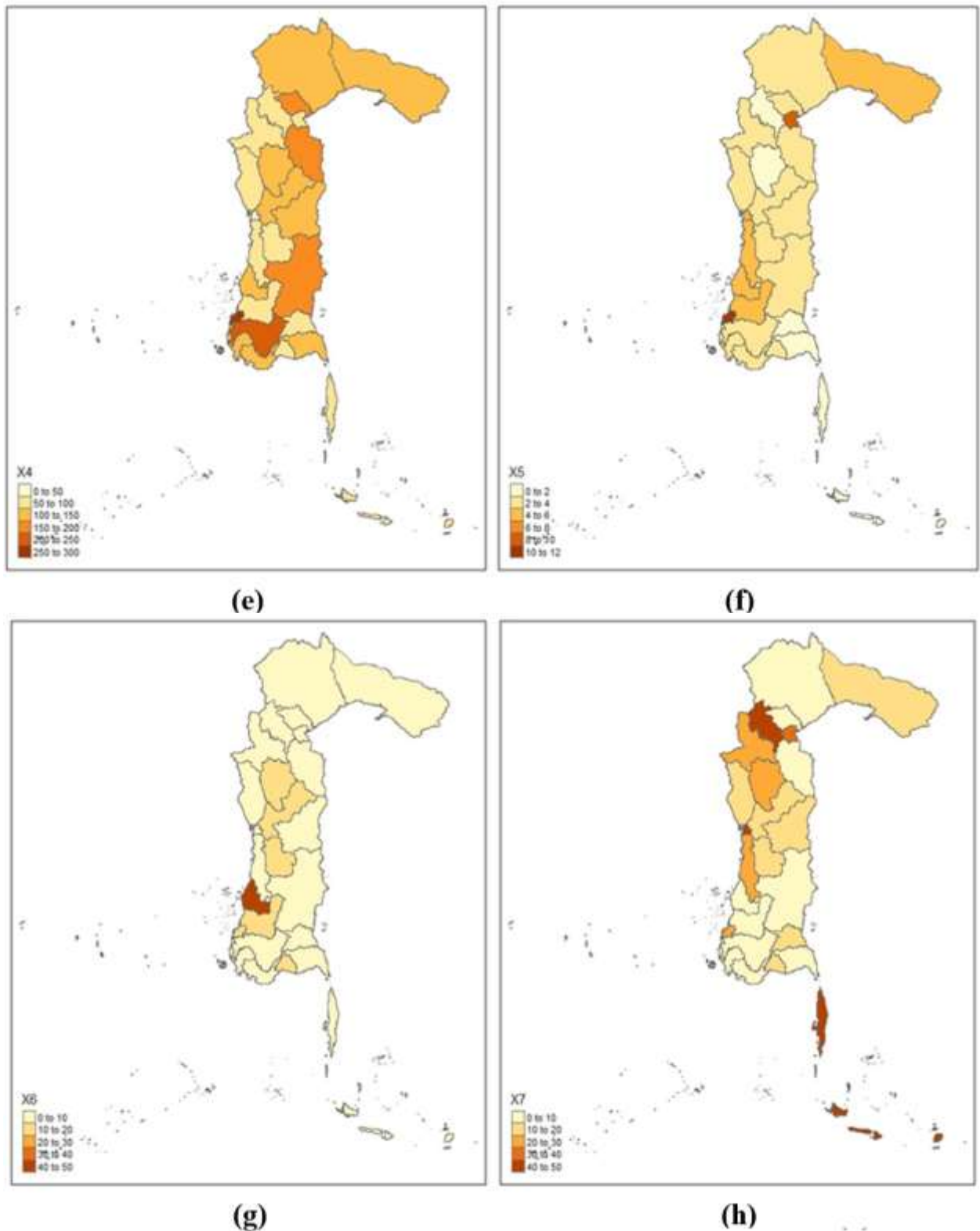
(a)
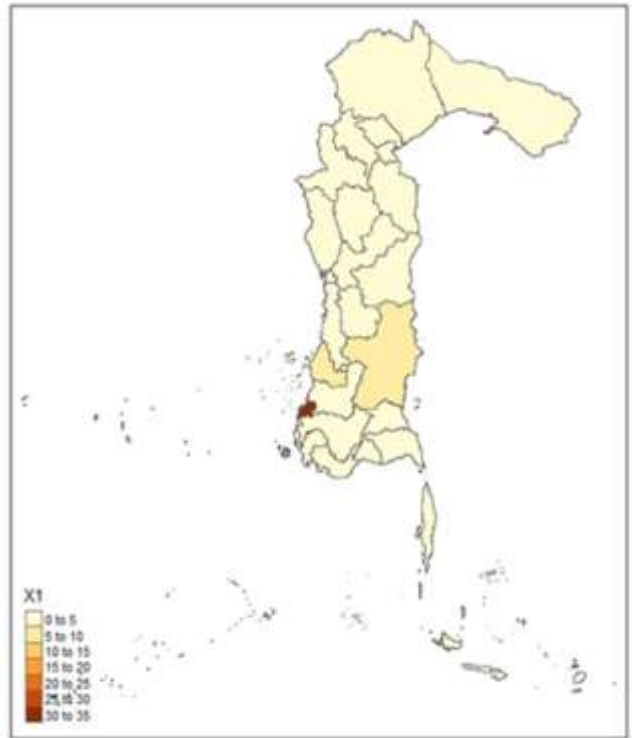
(b)
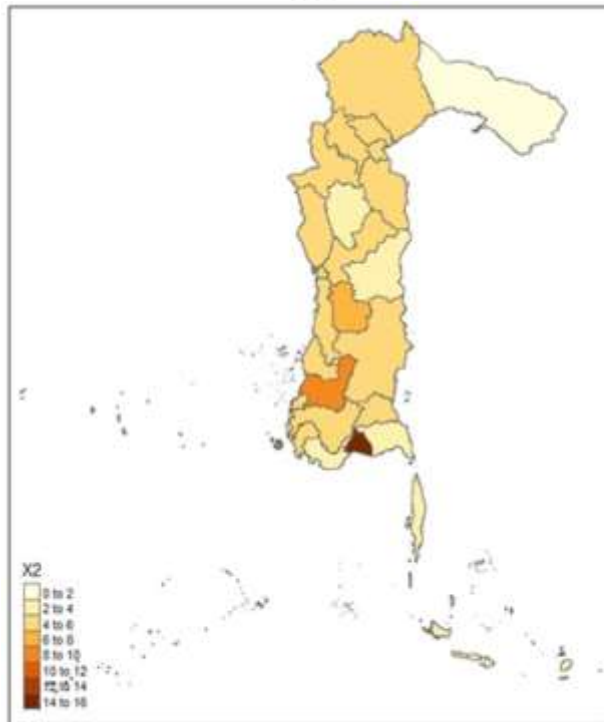
(c)

(d)

Figure 1. Distribution map of each variable.

Note: (a) Distribution map of poverty levels variables; (b) Distribution map of GRDP variable; (c) Distribution map of economic growth variables; (d) Distribution map of Investment variable; (e) Distribution map of health facility variables; (f) Distribution map of the number of unemployed variables; (g) Distribution map of industrial sector contribution variables; (h) Distribution map of the percentage of non-owned households variable.

Based on Figure 1, it shows that the highest percentage of poverty levels is located in the Luwu Raya region and its surroundings, which include Luwu Regency, North Luwu Regency, Enrekang Regency, and Tana Toraja Regency. You can also see the solid color in Selayar Regency, Jeneponto Regency, and Pangkep Regency, which illustrates that the poverty levels in these areas are in the high category.

4.2. Multiple Regression Models

Statistical modeling with multiple regression in this study was carried out to be able to find out the parameters that are significant in influencing the percentage of poverty levels in the regencies and cities of South Sulawesi province.

Table 4. Estimation of parameters in the regression model.

No.	Variable	Coefficient	Error-std.	T-stat.	Prob.
1	Constant	9.488	3.211	2.953	0.009
2	X_1	-1.672	0.196	-0.830	0.041
3	X_2	2.735	0.297	0.919	0.037
4	X_3	2.867	1.544e-08	1.857	0.018
5	X_4	1.204	0.002	0.586	0.046
6	X_5	-6.979	0.035	-1.975	0.045
7	X_6	-1.181	0.147	-0.800	0.043
8	X_7	2.925	0.005	0.531	0.026

Based on Table 4, it can be shown that the test results explain that all response variables have a significant influence on the poverty levels in regencies and cities of South Sulawesi province with each $p-value < 0.05$ and the multiple regression model equation is obtained.

$$Y = 9.488 - 1.672X_1 + 2.735X_2 + 2.867X_3 + 1.204X_4 - 6.979X_5 - 1.181X_6 + 2.925X_7 + \varepsilon$$

4.3. Spatial Effect Test

4.3.1. Moran's I Test

The Moran's I test was carried out to find spatial auto-correlation between regencies and cities in South Sulawesi province with four cluster categories, including low-low, low-high, high-low, and high-high clusters. This is to determine the value of the spatial distribution of poverty levels in South Sulawesi province.

Table 5. Statistics results of Moran's I test.

No	Variable	Moran's I test	Standard deviation	P-value
1	Y	0.143	1.459	0.022
2	X_1	-0.003	0.311	0.037
3	X_2	-0.131	-0.684	0.041
4	X_3	-0.035	0.065	0.047
5	X_4	0.037	0.634	0.026
6	X_5	0.009	1.071	0.042
7	X_6	0.018	0.485	0.031
8	X_7	0.050	0.735	0.023

Furthermore, Local Moran's I calculations were carried out in order to find out each relationship between the percentage of poverty levels between districts and cities in South Sulawesi province. Based on the calculation results of Local Moran's I that have been obtained and their significance in Table 5, the Local Spatial Autocorrelation (LSA) Cluster Map is formed as shown in Figure 2.

Based on the results of the LSA cluster in Figure 2, it is shown that there is only one district that is included in the low-low cluster, namely Maros regency. This means that Maros Regency has a low poverty level, as does the surrounding area. Figure 2 also shows that there are no regions included in the low-high, high-low, and high-high clusters. This indicates that the spatial pattern of poverty levels in South Sulawesi province is spread randomly and does not have the same spatial pattern. Numerous heterogeneous or different factors in the region's distribution of poverty may be to blame for such circumstances.

Figure 2. Results of LSA cluster.

4.3.2. Lagrange Multiplier (LM) Test

In this section, testing of the spatial model is carried out using the LM test as a form of initial identification. The results of the LM test were carried out by looking at the smallest p-value of each spatial model. The results of the data analysis can be seen in Table 6.

Table 6. Spatial effect test results with the LM test.

Spatial dependency test	Value	P-Value
Moran's I	0.382	0.021
LM SEM	-	0.021*
LM SAR	-	0.031*
LM SCR	-	0.443
LM SDM	-	0.027*
LM SDEM	-	0.383

Note: * LM test results for P-Value are less than 0.05.

Based on Table 6, it shows that the P-value for the SEM, SAR, and SDM models is smaller than the significant level of 0.05. Meanwhile, the P-value for the SCR and SDEM models is greater than the significant level of 0.05. Thus, based on the process of determining the best model, the Spatial Error Model (SEM) is used as a percentage of the poverty levels in South Sulawesi province because it has the smallest P-value compared to other models. This means that the SEM model can be used to estimate the poverty levels in South Sulawesi province. The results of modeling the poverty levels based on the best model obtained can be seen in Table 7.

Table 7. Modeling results.

Variable	Constant	X_1	X_2	X_3	X_4	X_5	X_6	X_7
Coefficient value	25.355	-1.957	1.325	0.127	0.566	0.367	0.118	0.015
R-square	0.860							

By looking at Table 7, it can be seen that the spatial regression model that is formed can be seen in the following equation:

$$Y = 25.355 + 0.002 \sum_{i=1}^{n} \sum_{i=1}^{n} W_{ij} y_i - 1.957X_1 + 1.325X_2 + 0.147X_3 + 0.566X_4 + 0.367X_5 + 0.118X_6 + 0.015X_7$$

Based on Table 7, the coefficient of determination (R-Square) is 0.8601. This value explains how 86.01% of the response variable can affect the poverty levels in South Sulawesi Province, with the remaining factors not being considered. There are several supporting studies that are used as comparisons in research. Among them, Zewdie et al. (2015) explain that the Spatial Lag model, or Spatial Autoregressive Model (SAR), is the best model when compared to the usual panel model, exactly the same as the results of research in Hikmah (2017) with a different research focus. There is also research that found the Spatial Autoregressive Fixed Effect (SAR-FE) model to be the best model (Murdani, Fathurahman, & Goejantoro, 2023; Yulianti et al., 2021). Meanwhile, the best model obtained in this paper is the Spatial Error Model (SEM) model, as supported by research in Novitasari and Khikmah (2019) and Rinaldi et al. (2021) with different research areas.

Furthermore, to find out the relationship between the distribution of poverty levels in regencies and cities in South Sulawesi province, a hot-spot and cold-spot analysis was carried out. Hot-spot areas are shown in red, and cold-spot areas are shown in dark blue. The thicker the color of the area represents, the higher the level of trust. The results of the hot-spot and cold-spot analysis maps can be seen in Figure 3.
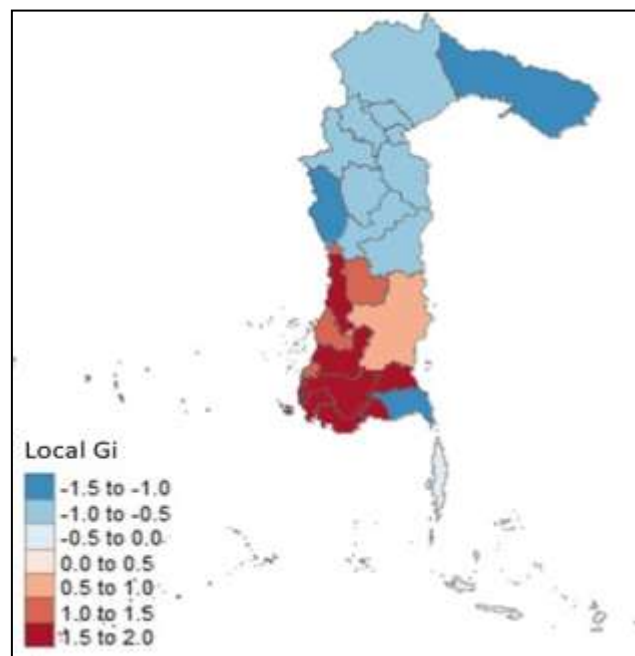

Figure 3. Results of hot-spot and cold-spot analysis.

Figure 3 shows that the hot-spot areas (red color) are Bantaeng Regency, Jeneponto Regency, Takalar Regency, Gowa Regency, Makassar City, Maros Regency, Sinjai Regency, and Barru Regency. The hot-spot areas (in pink) include Pangkep Regency, Soppeng Regency, Bone Regency, and Pare-Pare City. Meanwhile, the cold-spot area (dark blue) includes East Luwu Regency, Pinrang Regency, and Bulukumba Regency. The cold-spot area (light blue) includes Selayar Regency, Wajo Regency, Sidrap Regency, Enrekang Regency, Tana Tojara Regency, North Toraja Regency, Luwu Regency, Palopo City, and North Luwu Regency.

Interpretation of the mapping from hot-spot and cold-spot analysis may involve some of the response variables analyzed in this study. Hot-spots in the south and cold-spots in the north can represent significant regional disparities in access to resources, infrastructure, employment, and economic opportunities. Conditions in the southern region are expected to face greater challenges in terms of economic development, education, health, and other related factors that contribute to high poverty levels. In addition, other conditions that cause differences in the southern region and the northern region are differences in geographical conditions and the availability of natural resources, which are

major influences, differences in infrastructure and accessibility in supporting economic growth, health services, and employment, as well as socio-economic factors and regional policies. Thus, recommendations for poverty reduction policies that can be considered based on the analysis are formulated as follows:

(a) Considering that there are clusters with high levels of poverty (hot-spot categories) that are spatially significant, it is recommended to develop and implement poverty alleviation programs that focus on hot-spot areas. This program can take into account social, economic, and demographic factors that are specific to the region and pay attention to the spatial context in allocating resources and interventions.

(b) Regions with high poverty rates and significant spatial patterns may face challenges in terms of infrastructure and access to basic services, such as clean water, sanitation, energy, and health facilities. Therefore, efforts are needed to improve infrastructure and basic services in these areas to improve the quality of life and reduce social inequality.

(c) Identify conditions that cause poverty so that it becomes a special concern in terms of economic empowerment and increasing access to education. This could include job training programs, access to business capital for MSMEs, technical assistance, and affordable and quality education programs to encourage social mobility and reduce economic disparities.

(d) Poverty alleviation is complex and related to spatial factors, requiring collaboration between the government, stakeholders, and civil society. These policy recommendations require close cooperation and coordination between local governments, social institutions, the private sector, and communities in designing, implementing, and monitoring sustainable poverty alleviation programs.

5. CONCLUSION

The results of the research analysis show that the poverty levels in the regencies and cities of the South Sulawesi province of Indonesia are randomly distributed and have a dispersed pattern. The results of multiple regression statistical modeling also show that all response variables have a significant effect on poverty levels. According to Moran's I test, a spatial auto correlation was found in the poverty levels so that it could form a spatial regression model. The Spatial Error Model (SEM) model with the smallest p-value and 86% confidence level obtained the best model selection process. Based on the hot-spot and cold-spot analysis, the concentration of poverty levels is still focused on the southern part of the hot-spot area (red color), namely Bantaeng Regency, Jeneponto Regency, Takalar Regency, Gowa Regency, Makassar City, Maros Regency, Sinjai Regency, and Baru district. Meanwhile, the cold-spot area (dark blue color) includes East Luwu Regency, Pinrang Regency, and Bulukumba Regency. Poverty alleviation programs in this area need to be maintained and enhanced with new programs that are sustainable according to the context, priorities, and available resources in South Sulawesi province. The limitation of this research is to use cross-sectional data on regencies and cities in South Sulawesi province. Thus, further research can be developed using spatial regression of panel data or time series data with adjustments for several other additional variables.

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