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Availability of Infrastructure for Poverty in Indonesia: Spatial Panel Data Analysis

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Abstract

Poverty is a key issue in various developing countries, including Indonesia. One of the efforts to reduce poverty is building the infrastructure. Therefore, this study aims to determine the effect of infrastructure on the level of poverty by considering the spatial effect in the period 2011–2015. This study applies spatial panel data analysis with Spatial Autoregressive (SAR) model with fixed effect. The findings show that the infrastructure of electricity, health, sanitation, and building of senior high school has a significant negative impact on the percentage of the underprivileged people. Meanwhile, the building of elementary school has a significant positive impact on the percentage of the underprivileged people.
Keywords: poverty; infrastructure; spatial panel data analysis; SAR

Abstrak

Kemiskinan merupakan salah satu masalah yang dihadapi oleh banyak negara berkembang, termasuk Indonesia. Salah satu upaya untuk mengatasi kemiskinan adalah dengan membangun infrastruktur. Dalam penelitian ini akan dilihat pengaruh infrastruktur terhadap tingkat kemiskinan di Indonesia dengan mempertimbangkan pengaruh spasial pada periode 2011–2015. Penelitian ini menggunakan metode analisis spasial data panel, yaitu model Spatial Autoregressive (SAR) dengan fixed effect. Hasil penelitian menunjukkan bahwa infrastruktur listrik, kesehatan, sanitasi, dan gedung SMA/SMK/MA berpengaruh signifikan dan negatif terhadap persentase penduduk miskin. Adapun gedung SD/MI berpengaruh signifikan dan positif terhadap persentase penduduk miskin.
Kata kunci: *kemiskinan; infrastruktur; analisis spasial data panel; SAR*

JEL classifications: C31; C33; I32; O18

1. Introduction

Poverty reduction is one of the main development targets of many developing countries, including Indonesia. Poverty in a country is a reflection of the level of the welfare of its population. The programs, policies and plans that have been carried out essentially aim to reduce the number of underprivileged people. In Indonesia, poverty reduction has been mandated in the Constitution, stipulating the obligation of the country to minister to the underprivileged and neglected children. The government continues to strive to alleviate poverty by implementing the SDGs (Sustainable Development Goals), one of which is to end all forms of poverty in all regions from 2015 to 2030.

In developing countries, economic growth is the most essential factor to reduce poverty (Adams 2003). The finding of a study by Dollar & Kraay (2002) signifies that an increase of one percent per capita income shall increase the income of the underprivileged by one percent. Correspondingly, economic growth in Indonesia can reduce poverty.

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In the period of high economic growth prior to the 1997 economic crisis, poverty rate declined rapidly. Conversely, when the economic crisis reached its peak in 1998–1999, poverty rate increased rapidly. It is strong evidence that economic growth is the main requirement to reduce poverty. The fundamental issue of economic growth is not how high and rapid the growth is, but rather who enjoys it. The greater the number of the underprivileged people enjoying the growth, the stronger the ability of the economic growth to reduce poverty. Contrarily, the smaller the share of the economic growth enjoyed by the underprivileged people, the weaker the ability of economic growth to reduce poverty, leading to the increase in poverty and income inequality.

In the current era of President Joko Widodo, the government keeps paying great attention to the issue of poverty. The level of poverty in Indonesia is expected to decline until it reaches a target of approximately 5–6 percent by the end of 2019 (RPJMN 2014–2019). One of the policies to reduce poverty is to increase the availability and coverage of basic services for the underprivileged such as education, health, sanitation, housing, electricity, etc. (Bappenas 2014). It is carried out to facilitate access to basic services for the underprivileged and reduce development gaps.

The poverty rate in Indonesia in recent years tends to decline from 11.13 percent in 2015 to 10.12 percent in 2017. However, in reality, there are many provinces whose poverty rate is higher than national poverty rate. In Figure 2, it is apparent that the level of poverty in Indonesia has a tendency to cluster in adjacent regions. The highest percentage of underprivileged people in 2015 is concentrated in the eastern regions of Indonesia, such as Papua, West Papua, East Nusa Tenggara, Maluku, and Gorontalo whose poverty rate is higher than the national poverty rate of 11.13 percent. Meanwhile, the lowest percentage of underprivileged people in 2015 tends to cluster in the western regions of Indonesia, namely DKI Jakarta, Bali, South Kalimantan, Bangka Belitung Islands, and Banten whose poverty rate is lower than the national poverty rate.

The infrastructure sector is considered to have an important role in reducing income disparity in addition to long-term impacts on GDP per capita (Maryaningsih, Hermansyah & Savitri 2014). Infrastructure in Indonesia remains an issue on a national scale, thus the government issues a law on regional autonomy (*UU Otonomi Daerah*) providing new space for regions in the development of the infrastructure sector. The enactment of the law is expected to provide autonomous regional governments with full authority to develop and implement infrastructure services in their regions. To ensure that infrastructure development in each region on target, it is necessary to know the illustration of the distribution of infrastructure in Indonesia.

The high level of poverty is frequently associated with a lack of distribution of infrastructure in several regions of Indonesia. Infrastructure plays an important role in socio-economic activities by providing household and industrial services. The ease of access to basic infrastructure such as roads, electricity, drinking water and sanitation as well as other important facilities such as schools and hospitals has a significant impact on improving the quality of life of households, particularly the underprivileged (Haughton & Khandker 2009). Transportation affordability also provides convenience in production, transportation, and transaction, generating increase in economic growth to help increase income and reduce poverty. On the contrary, slow infrastructure development is a hindrance to overall growth and development (Asian Development Bank/ADB 2012).

According to the Organization for Economic Cooperation and Development (OECD) survey (OECD 2016), the overall quality of infrastructure in Indonesia remains the lowest compared to other develop-

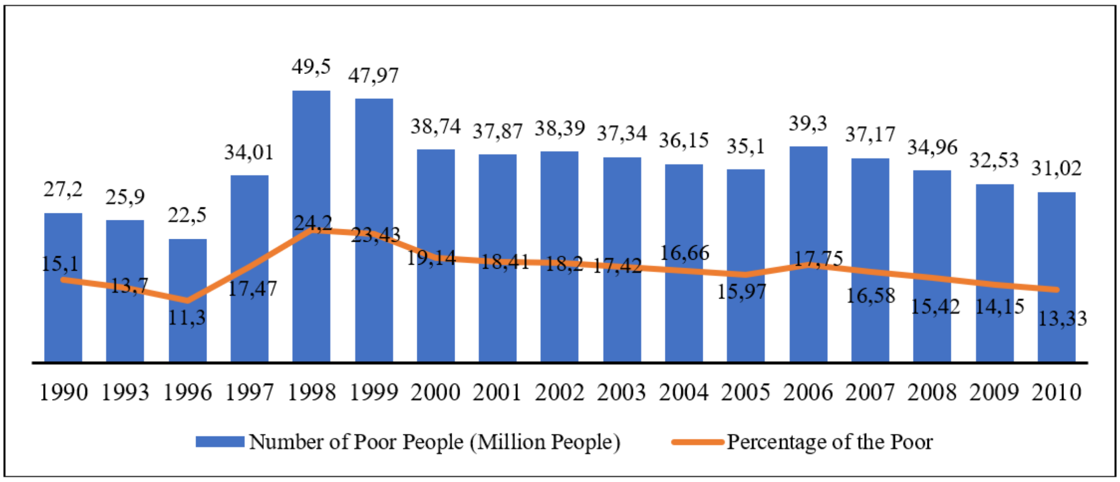

Figure 1: The Development of the Number and Percentage of Underprivileged People in Indonesia for the Period 1990–2010
Source: Central Bureau of Statistics (BPS)

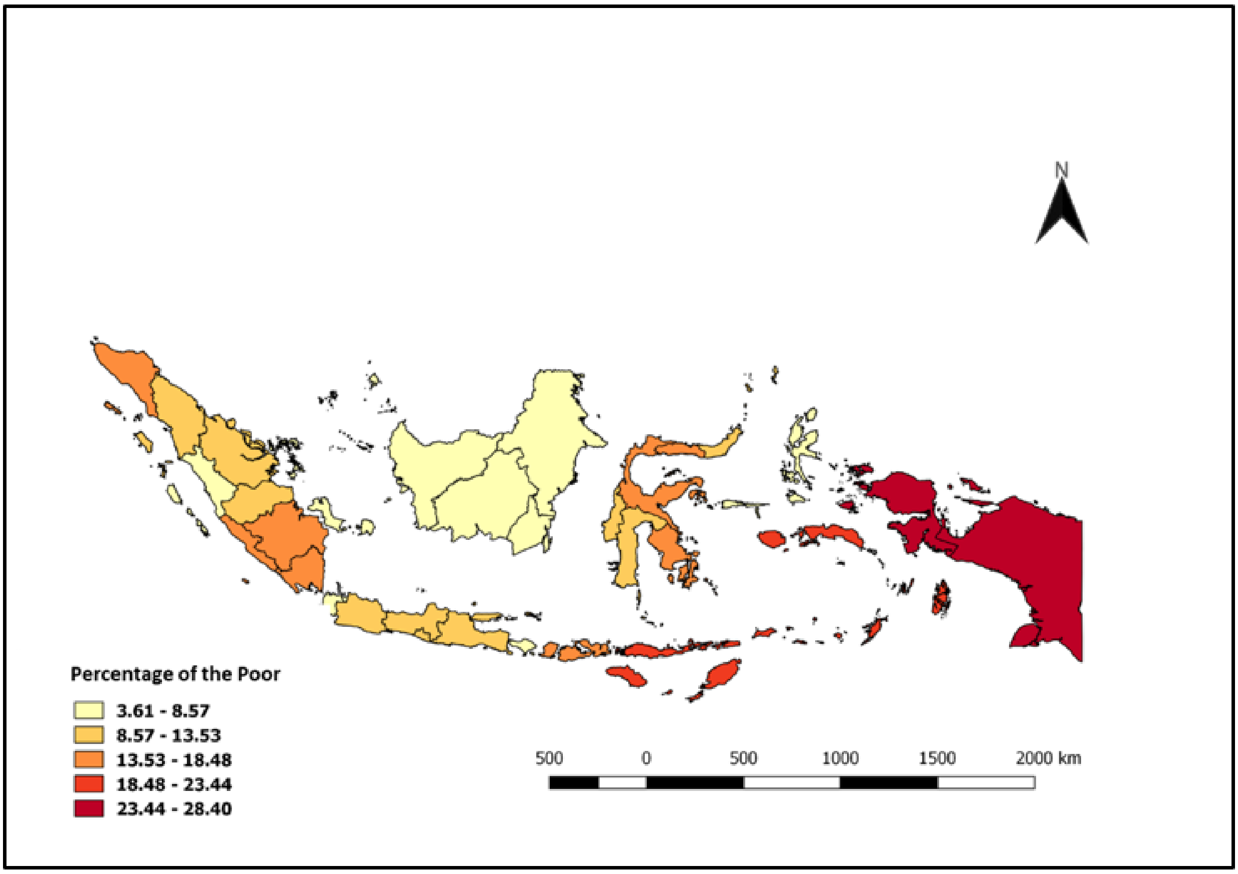

Figure 2: Percentage of Underprivileged People in Indonesia in 2015
Source: Central Bureau of Statistics (BPS)

ing countries such as India, Thailand, China, and Malaysia. Indonesia is also ranked 62 of 138 countries in terms of infrastructure according to Global Competitiveness Index (2015–2016) of the World Economic Forum (WEF) from previously ranked 52 from 137 countries. The decline indicates that there has not been any progress in Indonesia's infrastructure over the past few years.

Further investigation reveals the poor condition of infrastructure in Indonesia. Based on the WEF's report 2015, the quality of electricity supply in Indonesia is ranked 86^{th} in the world. In reference to the quality of health and basic education, Indonesia is ranked 80^{th} in the world. Based on the 2015 WHO/UNICEF, the quality of water supply and sanitation in Indonesia is ranked 133^{th} in the world. The low quality of infrastructure development in Indonesia is a challenge for the current government.

Humantito (2009) in his study evaluates the contribution of infrastructure consisting of education, health, clean water, electricity, and land transportation to the level of poverty in Indonesia. The findings show that education, health, clean water, electricity, and land transportation can significantly reduce the poverty rate. It signifies that the increase in infrastructure availability in Indonesia can lower the poverty level.

Based on the aforementioned description, it is evident that infrastructure has an important role in reducing poverty. There is a phenomenon where the western regions of Indonesia tend to have low poverty, while the eastern regions of Indonesia tend to have high poverty. The First Law of Geography or Tobler Law I is "everything is related to everything else, but near things are more related than distant things." This first law is the foundation of the fundamental concepts of spatial dependence and spatial autocorrelation. According to the law, spatial effects are important to consider in analyzing poverty level in Indonesia. The existence of a cluster of neighbor regions with nearly similar characteristics of poverty indicates a spatial influence on the level of poverty in Indonesia.

This study was carried out in order to: (1) Discover general illustration of infrastructure and the level of poverty in Indonesia; (2) Analyze the influence of infrastructure on the level of poverty in Indonesia spatially.

2. Literature Review

2.1. Poverty

Based on the publication of the Human Development Report (United Nations Development Program/UNDP 1997), the United Nations defines poverty as "The denial of most basic choices and opportunities to human development to a long, healthy, creative life and enjoy a decent standard of living, freedom, self-esteem, and respect from others". In other word, poverty is a condition where an individual cannot enjoy all the choices and opportunities to fulfill their basic needs, such as proper health, a decent standard of living, freedom, self-esteem, and a sense of respect from others.

According to BPS (2008), there are two types of poverty to measure, namely relative poverty and absolute poverty. Poverty is relatively underprivileged due to government policies that do not touch all levels of society, causing inequality in income distribution. Standards of poverty are determined based on standard living conditions in a country. For example, the lowest 20 percent of the population sorted by income/expenditure can be said to be underprivileged should the country determines the limitation to be approximately 20 percent. Thus, poverty is relatively dependent on the distribution of income/expenditure of the population, ensuring that there will always be underprivileged people in a country. Relative poverty lines cannot be used to compare poverty rates between countries and period since they do not reflect the equal level of poverty or welfare (BPS 2008).

Absolute poverty is determined based on the inability of individuals to meet minimum basic needs such as food, clothing, health, housing, and education. Minimum basic needs are a financial measure in the form of money. The value of minimum basic needs is known as the poverty line. Therefore, absolute poverty in measuring poverty refers to the poverty line. People whose income is lower than the poverty line are categorized as underprivileged. Thus, the poverty rate can be used to compare poverty rates between countries and period should the absolute poverty line used is equivalent. In general, the World Bank uses two measures in determining the poverty line, namely US$1 per capita per day and US$2 per capita per day.

In measuring poverty, BPS uses the concept of the ability to meet basic needs (basic needs approach). In this approach, poverty is calculated based on the inability to meet basic food and non-food needs from the expenditure side. The method used consists of the sum of the components of the Food Poverty Line (GKM) and Non-Food Poverty Line (GKNM), written as follows:

$$\mathrm{GK} = \mathrm{GKM} + \mathrm{GKNM} \tag{1}$$

GKM is the value of minimum food requirements, equal to 2,100 kilocalories per capita per day. GKNM is the value of minimum requirement for housing, clothing, education and health.

The poverty indicator used in this study is based on the basic need approach, namely Head Count Index $(\mathrm{HCI} - \mathrm{P_0})$ or the percentage of underprivileged people below the poverty line. The following formula $\mathrm{P_0}$:

$$\mathrm{P_0} = \frac{1}{\mathrm{n}} \sum_{\mathrm{i}=1}^{\mathrm{q}} \left[\frac{\mathrm{z} - \mathrm{y_i}}{\mathrm{z}} \right] \tag{2}$$

z is the poverty line, n is the population, y is the average per capita expenditure per month of the population below the poverty line, q is the number of population below the poverty line, and n is the population.

According to Haughton & Khandker (2009), the main causes of poverty can be observed from three perspectives: regional characteristics, community characteristics, and household and individual characteristics. Regional characteristics include remoteness, quality of government, vulnerability to floods or typhoons, and ownership rights to property. Community characteristics include the availability of basic infrastructure and services. The quality of road, clean water, access to markets, availability of electricity, as well as availability of health and education services have an influence on the development and poverty of a region. Household and individual characteristics are observed from demographic aspects (total household members, age structure, dependency ratio, and gender of the head of household), economic aspects (employment status, working hours, and possessions), and social aspects (health status and nutrition, education, and shelter).

2.2. Poverty and Infrastructure

Infrastructure can provide great benefits in economic growth, poverty alleviation, and environmental sustainability, should the infrastructure development is excellent, effective and efficient (World Bank 1994). According to the World Bank (1994), infrastructure consists of three types, namely economic, social, and administrative/institutional infrastructure. Economic infrastructure is physical capital providing services and used in final production and consumption, including public utilities (telecommunications, drinking water, sanitation, and gas), public works (roads, dams and irrigation channels, and drainage) and transportation factors (railroad, port, and airport transportation). Social infrastructure is an asset supporting the health and expertise of the community, including education (schools and libraries), health (hospitals and health centers), as well as recreation (parks, museums, etc.). Administrative/institutional infrastructure includes law enforcement, administrative control and coordination and culture.

Unbalanced infrastructure development results in the development gap in Indonesia (TNP2K 2011). This gap causes the welfare of the population of each province to vary. Figure 2 shows that low poverty rate tends to be concentrated in the western regions of Indonesia. It has become a major development challenge for the government to balance overall economic and social disparities between regions.

Infrastructure development in various countries focuses on basic access and human connectivity, such as sanitation, electricity, water, energy, and transportation (World Bank 1994). Quality infrastructure shall effectively and efficiently drive economic activities while increasing economic growth and reducing poverty. Regions with sufficient infrastructure availability shall have low poverty level and higher economic growth.

Nugraheni and Priyarsono (2012) in their study reveal that regional financial performance and infrastructure availability has a correlation with poverty level. The study used multiple regression analysis with panel data, observing 200 municipalities/districts in Indonesia in the period 2006–2009. The findings conclude that electricity, clean water, and roads have a significant effect on poverty reduction in the regions of Indonesia. However, the impact of infrastructure availability on reducing poverty requires a certain period of time.

Bosch et al. (2001) on his study finds a correlation between water infrastructure and sanitation and poverty level in several Asian, African and Latin American countries. Inadequate water and sanitation facilities for the underprivileged shall increase their living costs, reduce their income potential, thereby reducing their welfare and making their life riskier.

Using panel data regression analysis, Ali & Pernia (2003) in their study in India state that infrastructure variables affect poverty reduction. However, the selection of locations for infrastructure investment is highly essential. Poverty reduction can be accelerated supposing that roads, irrigation and electricity in rural areas are established in a highly essential location in terms of distribution and multiplier effects benefiting the underprivileged.

Estache, Foster & Wodon (2002) explore the correlation between infrastructure reform (private sector participation) and poverty alleviation in Latin America. In the study, both macroeconomic and microeconomic correlations between infrastructure reform and poverty reduction are analyzed. The findings conclude that the expansion of services allowed by privatization shall lead to poverty reduction supposing that the infrastructure development is affordable by the underprivileged.

In addition, there is also a spatial influence on poverty in Indonesia. According to Rahmawati, Safitri & Fairuzdhiya (2015), there are spatial dependency and spatial heterogeneity influencing poverty in Indonesia, hence the need to involve weighting data by region.

Based on the aforementioned description, infrastructure has an important role in reducing poverty. A great number of previous studies have not paid attention to spatial effects. Therefore, this study is expected to be able to explain the in-depth correlation between infrastructure and poverty by considering spatial effects. The study used spatial regression panel data analysis with reference to previous studies mostly using panel data without considering spatial effects.

3. Method

3.1. The Scope of Study

This study consists of two variables, namely dependent and independent variables. The dependent variable is the level of poverty in Indonesia, while the independent variables are the ratio of total hospitals and health centers per 1000 population, the ratio of total elementary schools per total elementary school students, the ratio of total senior high school buildings per total senior high school students, electricity distributed, and the percentage of access to proper sanitation.

This study used secondary data obtained from the Central Bureau of Statistics (BPS), namely data on the percentage of underprivileged people, the ratio of total hospitals and health centers per 1000 population, the ratio of total elementary school buildings per total elementary school students, the ratio of total senior high school buildings per total senior high school students, electricity distributed, and the percentage of access to proper sanitation. The data merely cover the period 2011–2015.

3.2. The Method of Data Collection

The data used in this study are secondary data obtained from BPS, namely the percentage of underprivileged people, total education infrastructure includes total elementary school and senior high school students, total health infrastructure includes health centers and hospitals, electricity distributed, and the percentage of access to proper sanitation. The data were obtained during observations in the period 2011–2015.

This study was carried out in all provincial levels of Indonesia as the units of observation during the period 2011–2015. North Kalimantan is an exception since the province was inaugurated in 2012, resulting in limited data. Thus, the units of observation in this study cover 33 provinces with a five-year observation during the period 2011–2015.

3.3. Spatial Econometrics

According to Elhorst (2014), spatial econometrics is part of econometrics handling the effects of spatial interactions between geographical units. Spatial econometrics is related to spatial autocorrelation and spatial heterogeneity (Anselin 1988). Thus, spatial econometrics is a method for modeling and analyzing panel data by considering spatial effects. The spatial effect can be spatial autocorrelation and spatial heterogeneity.

Spatial autocorrelation causes linkages between regions since the value of observation in a region shall be influenced by the value of observation in the surrounding area. Meanwhile, spatial heterogeneity causes instability of correlation behavior, resulting in a variance of inconstant error, leading to differences in the function of correlation between regions (BPS 2011).

3.4. Spatial Weighing Matrix

Spatial weighing matrix is a weighing matrix describing the correlation between regional units. According to BPS (2011), spatial weighing matrix is a measure of connectivity describing spatial processes, spatial structures, or spatial interactions. The matrix measures "$\mathrm{N} \times \mathrm{N}$" as follows:

$$\mathrm{W} = \begin{bmatrix} \mathrm{w}_{11} & \mathrm{w}_{12} & \cdots & \mathrm{w}_{1\mathrm{N}} \\ \mathrm{w}_{21} & \mathrm{w}_{22} & \cdots & \mathrm{w}_{2\mathrm{N}} \\ \vdots & \vdots & \ddots & \vdots \\ \mathrm{w}_{\mathrm{N}1} & \mathrm{w}_{\mathrm{N}2} & \cdots & \mathrm{w}_{\mathrm{NN}} \end{bmatrix} \quad (3)$$

w_{ij} is a weighed describing the correlation of region i with region j, where $\mathrm{w}_{\mathrm{ij}} \geq 0$, $\mathrm{w}_{\mathrm{ij}} = \mathrm{w}_{\mathrm{ji}}$, and $\mathrm{w}_{\mathrm{ii}} = 0$.

To facilitate interpretation, the row and column elements in the spatial weighing matrix are frequently normalized (Elhorst 2014). Normalization gives the value of one in each element of each row in the spatial weighing matrix. The value of w_{ij} is confirmed to have a weight of 0 and 1 since the nature of w_{ij} is non negative and the weighing operation used is the average value of the neighbor. The normalization formula is as follows:

$$\widetilde{w_{ij}} = \frac{w_{ij}}{\sum_{j=1}^{N} w_{ij}} \tag{4}$$

Following the normalization, a weighing matrix is formulated as follows with $\sum_{j=1}^{N} \tilde{w}_{ij} = 1$:

$$\tilde{W} = \begin{bmatrix} 0 & \tilde{w}_{12} & \cdots & \tilde{w}_{1N} \\ \tilde{w}_{21} & 0 & \cdots & \tilde{w}_{2N} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{w}_{N1} & \tilde{w}_{N2} & \cdots & 0 \end{bmatrix} \tag{5}$$

The correlation between regions in the weighing matrix can vary depending on the criteria used. The criteria for compliance consist of two types, namely border intersection and distance contact (BPS 2013).

3.5. Analysis Method

The analytical method used in this study is descriptive analysis with tables, graphs and thematic maps, as well as spatial regression analysis with panel data as inferential analysis. An analysis using thematic maps was carried out to describe the pattern of poverty and the inequality of interprovincial infrastructure development considered to affect poverty in Indonesia, while spatial regression analysis with panel data was carried out to determine the factors influencing poverty level in all provinces in Indonesia.

In carrying out spatial regression modeling, a weighing matrix is required. Observation on the effects on physical bordering provinces in Indonesia is not easy. Adjustments are required since not all regions in an archipelagic country like Indonesia directly border each other physically (by land). Therefore, the approach with 'closest distance' is used instead. The weighing matrix used in this study is k-nearest neighbor. According to BPS research (2011), each province in general has links with the three closest provinces. The determination of the three closest provinces is based on the fact that the provinces in Indonesia in general merely have direct and indirect borders with three other provinces. Thus, this study uses a k-nearest neighbor weighing matrix with $k = 3$.

This study considers spatial effects of infrastructure availability on poverty level in Indonesia. The spatial model of panel data formed is as follows:

$$\begin{aligned} POV_{it} = \mu_i + \lambda \sum_{j=1}^{N} w_{ij} POV_{jt} + \beta_1 HLTH_{it} \\ + \beta_2 \ln(ELECT)_{it} + \beta_3 SANIT_{it} \\ + \beta_4 ES_{it} + \beta_5 HS_{it} + \rho \sum_{j=1}^{N} w_{ij}\varepsilon_{jt} + V_{it} \end{aligned} \tag{6}$$

where:

- POV_{it} : provincial poverty i year t;
- POV_{jt} : provincial poverty j year t;
- λ : spatial lag coefficient;
- ρ : spatial coefficient error;
- w_{ij} : weighting matrices of province-i and province-j;
- μ_i : spatial specific effects;
- V_{it} : vector error;
- $HLTH$: ratio of total health infrastructure per 1,000 population;
- $LN(ELECT)$: natural logarithms of electricity distributed;
- $SANIT$: the percentage of access to proper sanitation;

ES : ratio of total elementary school buildings per total elementary school students;

HS : ratio of total high school buildings per total high school students.

4. Findings and Analysis

4.1. An Overview of Infrastructure and Poverty in Indonesia

4.1.1. Poverty

Indonesia is the largest archipelagic country in the world consisting of 17,504 islands (BPS 2015) with the fourth largest population in the world of 258,162 million people. It makes Indonesia have great potential for economic growth and community prosperity, particularly in the availability of abundant natural resources and labor.

During the period of 1970 to the end of 1996, Indonesia's poverty level shows a downward trend. In 1996, the lowest poverty rate recorded is 11.30 percent, a difficult achievement to recover after the reform era. However, during the New Order (*Orba*) period, the infrastructure development was merely centered in Java Island. Thus, the development outside Java was less noticed. As a result, there is a development gap between regions in Indonesia, particularly in infrastructure development.

Based on Figure 3, the level of poverty in Indonesia in 2011 to 2015 experiences a decline. Low poverty rates tend to cluster in western regions of Indonesia while eastern regions of Indonesia tends to have high poverty rates (Figure 2). This study shows a negative correlation between poverty and infrastructure. Provinces having good infrastructure usually have low poverty rates while provinces with low infrastructure tend to have high poverty rates.

4.1.2. Electricity Distributed

Electricity is one of the basic needs to fulfill since each activity depends on electric power. The development of electric power certainly requires large funds, the application of sophisticated technology, and a lot of time. The advantages and disadvantages of electricity supply shall cause the similar amount of losses. An excess of electricity creates a futile investment since it requires a large amount of money to operate. However, a shortage of electricity results in blackouts, causing losses in various social and economic activities.

Until 2015, the electricity distributed in Indonesia amounts to 204,279.97 GWh, an increase of 28.72 percent compared to electricity distributed in 2011. In addition, the pattern of electricity distribution in Indonesia continues to increase annually. Based on Table 1, Maluku and Papua have the highest growth of electricity distributed by 50.29 percent compared to other regions. Meanwhile, Java and Lesser Sunda Islands have the lowest growth by 25.74 percent. However, observed from the electricity distributed, Java and Lesser Sunda Islands are the regions with the most electricity distribution compared to other regions. Maluku and Papua have the lowest electricity distribution of 2057.85 GWh, while Java and Lesser Sunda Islands have the highest electricity distribution of 154,438.53 GWh. It means that nearly 75 percent of the electricity distributed is concentrated in the regions of Java while Maluku and Papua have merely one percent of the total electricity distributed in Indonesia.

Figure 4 shows the electricity distributed between provinces in Indonesia in 2015. It is shown that electricity distributed in 2015 tends to cluster in certain regions. West Java Province has the largest total electricity distribution in Indonesia in 2015, namely 44,071.43 GWh, yet having a low poverty rate. This rate is nearly 170 times the electricity distributed in the province of West Sulawesi and

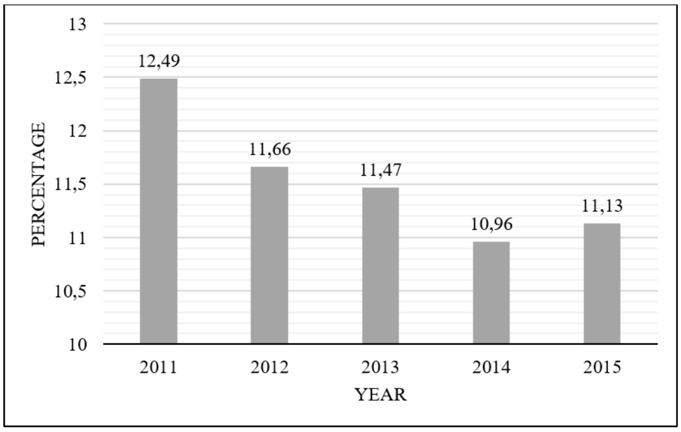

Figure 3: Percentage of Indonesia's Underprivileged Population in 2011–2015
Source: Central Bureau of Statistics (BPS)

Table 1: Electricity distributed according to the region in 2011–2015 in Indonesia

Year	Region					Total (GWh)
	Sumatra	Java-Lesser Sunda Islands	Kalimantan	Sulawesi	Maluku-Papua	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
2011	23,036.88	12,2822.89	5,829.02	5,636.87	1,369.24	158,694.9
2012	25,875.85	13,3926.49	6,546.82	6,412.08	1,580.69	174,341.93
2013	28,127.21	14,3586.41	7,356.41	7,265.34	1,826.31	188,161.68
2014	29,641.08	15,1782.26	7,740.38	7,720.13	1,944.86	198,828.71
2015	31,251.95	15,4438.53	8,233.21	8,091.93	2,057.85	204,073.47
Total (%)	15.31	75.68	4.03	3.97	1.01	100
Growth (%)	35.66	25.74	41.25	43.55	50.29	28.59

Source: BPS (processed)

nearly 134 times the electricity distributed in the province of North Maluku.

4.1.3. Health Infrastructure

Along with the increase in community welfare, health has become one of the indicators of community welfare. This is evidenced by the inclusion of health factors as one of the weighting in calculating the Human Development Index (UNDP 2016).

In this study, health infrastructure is observed from total available health infrastructure in the form of hospitals and health centers in each provinces per 1000 population. Increasing health infrastructure is expected to improve public health that shall continue to drive the economy to enhance public welfare.

Based on Table 2, Maluku and Papua have the largest growth of health infrastructure until 2015, amounting to 17.94 percent. Meanwhile, the island of Kalimantan has the lowest growth of 1.87 percent. However, observed quantitatively, Java and Lesser Sunda Islands have the highest number of health infrastructure, namely 46.35 percent. Meanwhile, Maluku and Papua have the lowest number of health infrastructure, namely 7.98 percent.

Figure 5 shows an overview of the distribution of health infrastructure between provinces in Indonesia in 2015. It is seen that most health infrastructure in 2015 is located mostly in Java. West Java Province is a reflection of the large number of health infrastructure with low poverty rate. Meanwhile, the province of Papua has a small number of health infrastructure yet a high level of poverty.

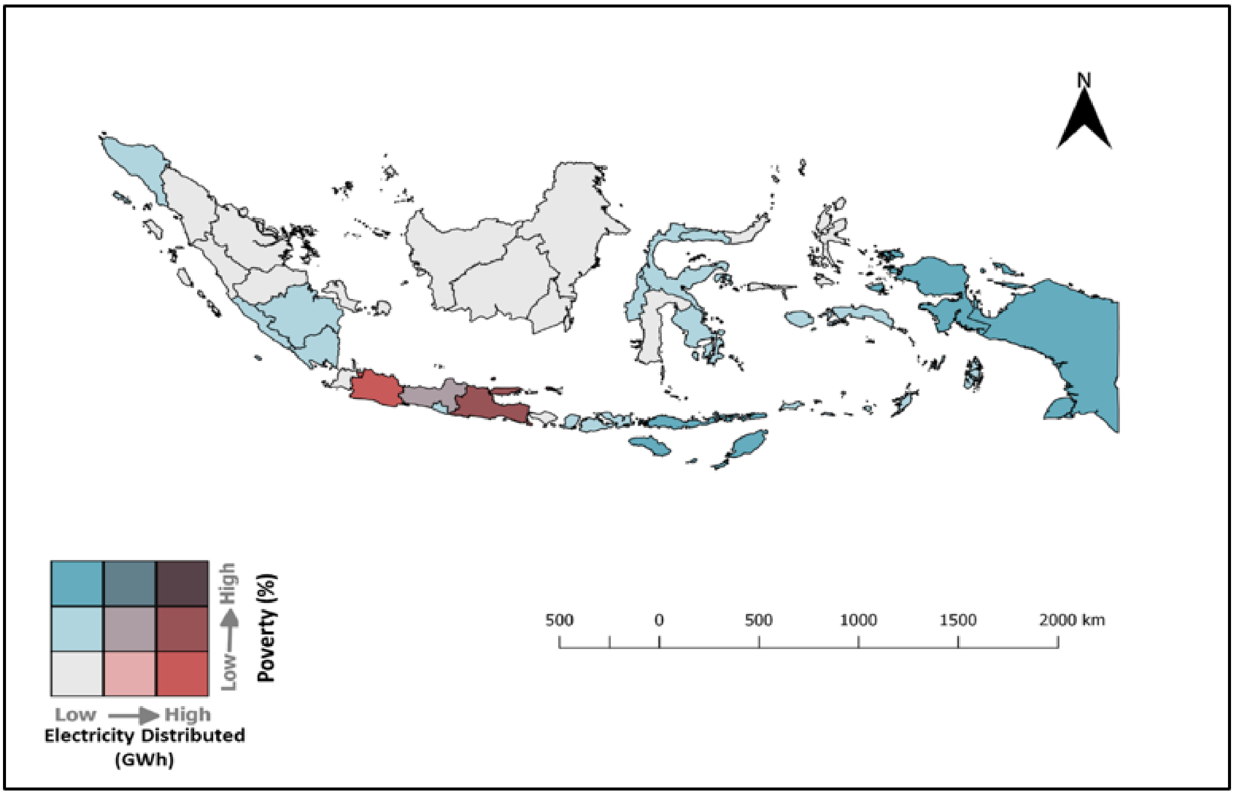

Figure 4: Electricity Distributed and Poverty in Indonesia in 2015
Source: Central Bureau of Statistics, processed

Table 2: Total Health Infrastructure by Region in 2011–2015 in Indonesia

Year	Region					Total (Unit)
	Sumatra	Java-Lesser Sunda Islands	Kalimantan	Sulawesi	Maluku-Papua	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
2011	2,809	5,097	965	1,346	825	11,042
2012	2,936	5,366	1,003	1,392	896	11,593
2013	2,969	5,499	1,023	1,447	945	11,883
2014	3,049	5,589	979	1,481	969	12,067
2015	3,092	5,649	983	1,489	973	12,186
Total (%)	25.37	46.36	8.07	12.22	7.98	100
Growth (%)	10.07	10.83	1.87	10.62	17.94	10.36

Source: BPS (processed)

4.1.4. Proper Sanitation Facilities

Sanitation is one of the supporting factors in improving human health. Sanitation is also one of MDGs (Millennium Development Goals) later continued with SDGs (Sustainable Development Goals). Considering that sanitation remains one of SDGs indicates the high level of urgency for proper sanitation access in all countries.

To improve the quality of health, facilities and infrastructure supporting public access to proper sanitation are necessary. To increase the access to proper sanitation is to take preventive actions against various types of environmental diseases and infections in order to reduce government losses due to health issues.

Based on the period of this study, namely in 2011–

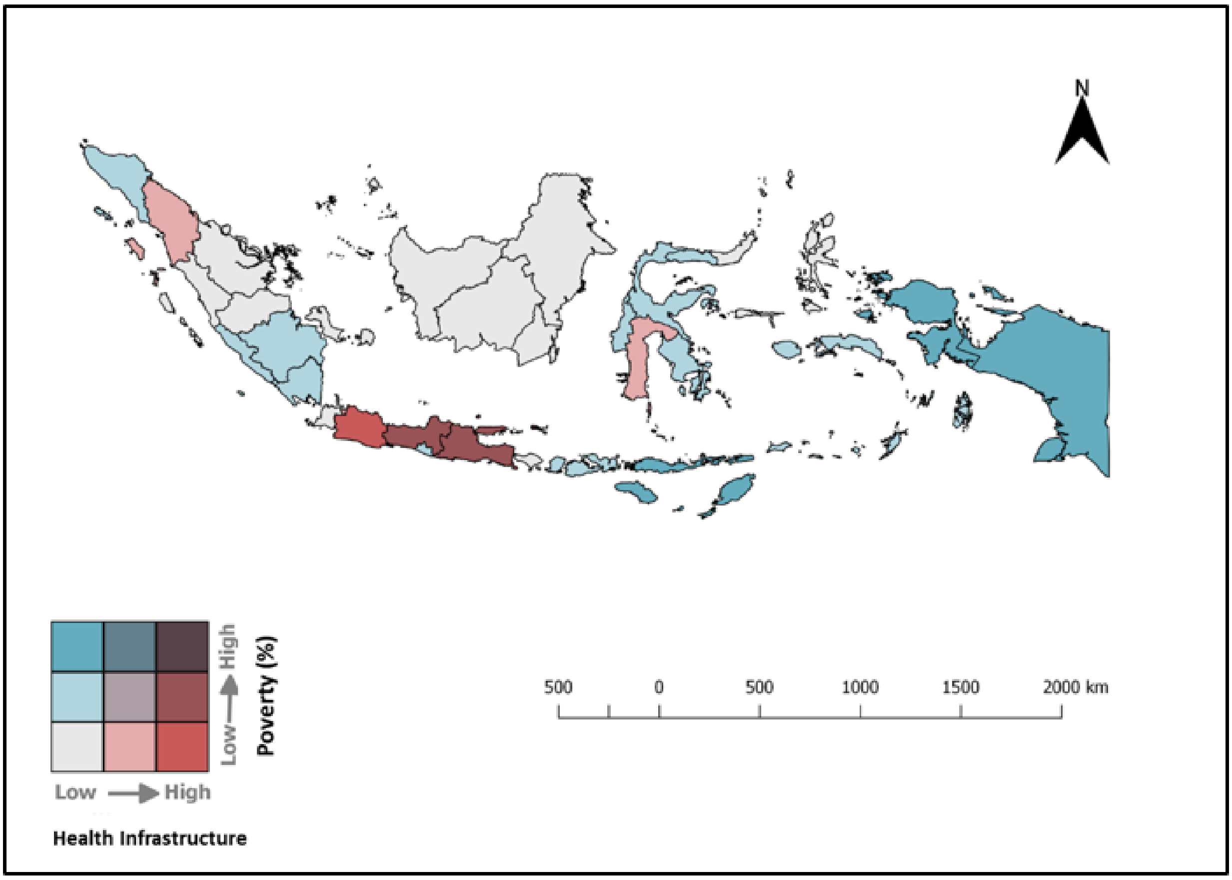

Figure 5: Distribution of Health Infrastructure and Poverty in Indonesia in 2015
Source: Central Bureau of Statistics, processed

2015, there is an improvement in access to proper sanitation in Indonesia. Until 2015, the national rate for proper sanitation access is 62.14 percent. It means that only approximately 62.14 percent of Indonesia's population can access proper sanitation. It remains the lowest number compared to other ASEAN countries such as Singapore of 100 percent, Malaysia of 96 percent, Thailand of 93 percent, Vietnam of 78 percent, and the Philippines of 74 percent. However, Indonesia is better compared to Cambodia of 42 percent and India of 40 percent (PT SMI 2017).

There are still many regions in Indonesia having sanitation rate lower than the national rate. It conveys that access to proper sanitation is still a serious issue to overcome. Figure 6 shows that DKI Jakarta, DI Yogyakarta, and Bali have the highest percentage of access to proper sanitation compared to other provinces, ranging from 85.46 percent to 89.28 percent, yet have a low poverty rate. Meanwhile, East Nusa Tenggara, Papua, and Central Kalimantan have the lowest percentage of access to decent sanitation compared to other provinces, ranging from 23.90 percent to 35.88 percent, yet have a high poverty rate.

4.1.5. Education Infrastructure

Education is one of the efforts to improve community welfare, proved by the inclusion of the education factor as one of the weighting in calculating the

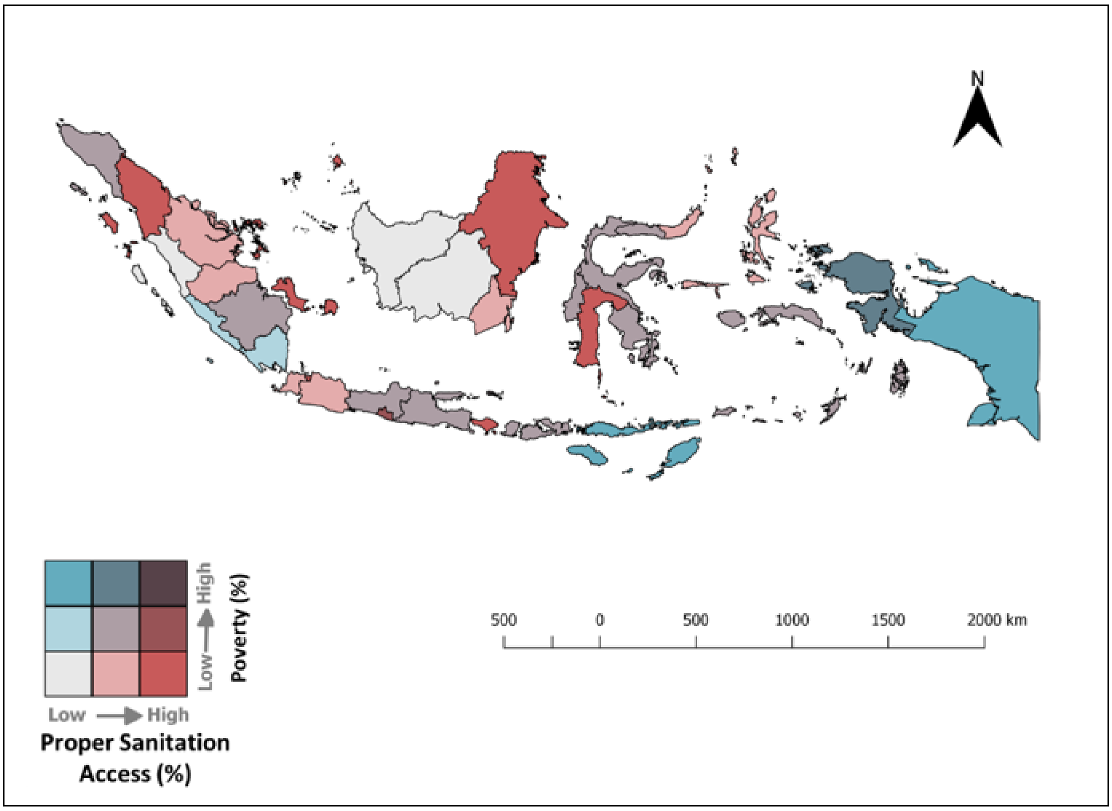

Figure 6: Distribution of the Percentage of Decent Sanitation and Poverty in Indonesia in 2015
Source: BPS

Human Development Index (UNDP 2016).

In this study, education is measured in terms of infrastructure, namely total education infrastructure in the form of total elementary school and senior high school buildings available in each region. Total school buildings is expected to increase the participation of total students towards access to better education. The increase in education infrastructure is expected to improve the skills of the people who shall continue to drive the economy to improve community welfare.

Based on Table 3, Java and Lesser Sunda Islands have the largest number of elementary school buildings in 2015, namely 95,613 units or 55.79 percent of total elementary school buildings throughout Indonesia. Meanwhile, Maluku and Papua have the lowest number of elementary school buildings, merely 6,628 units or 3.87 percent of total elementary school buildings throughout Indonesia.

Figure 7 shows an overview of the distribution of elementary school infrastructure in 2015. It is apparent that the distribution of elementary school infrastructure is mostly located in Java. West Java Province is a reflection of the large number of elementary school buildings with low poverty level. Meanwhile, the Province of Papua has a small number of elementary school buildings yet a high level of poverty.

Based on Table 4, senior high schools in Maluku and Papua have the highest growth of 25.95 percent while the island of Kalimantan has the lowest growth of 12.58 percent. However, Java and Lesser Sunda Islands have the highest number of senior high school buildings, namely 17,764 units or 54.83

Table 3: Number of Elementary School Buildings in 2011–2015 in Indonesia

Year	Region					Total (Unit)
	Sumatra	Java-Lesser Sunda Islands	Kalimantan	Sulawesi	Maluku-Papua	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
2011	38,054	77,307	12,950	16,838	6,398	151,547
2012	38,083	95,404	12,903	16,950	6,557	169,897
2013	38,813	96,192	13,249	17,210	6,747	172,211
2014	38,719	96,042	13,230	17,228	6,731	171,950
2015	38,941	95,613	12,936	17,274	6,628	171,392
Total (%)	22.72	55.79	7.55	10.08	3.87	100
Growth (%)	2.33	23.68	-0.11	2.59	3.59	13.09

Source: BPS (processed)

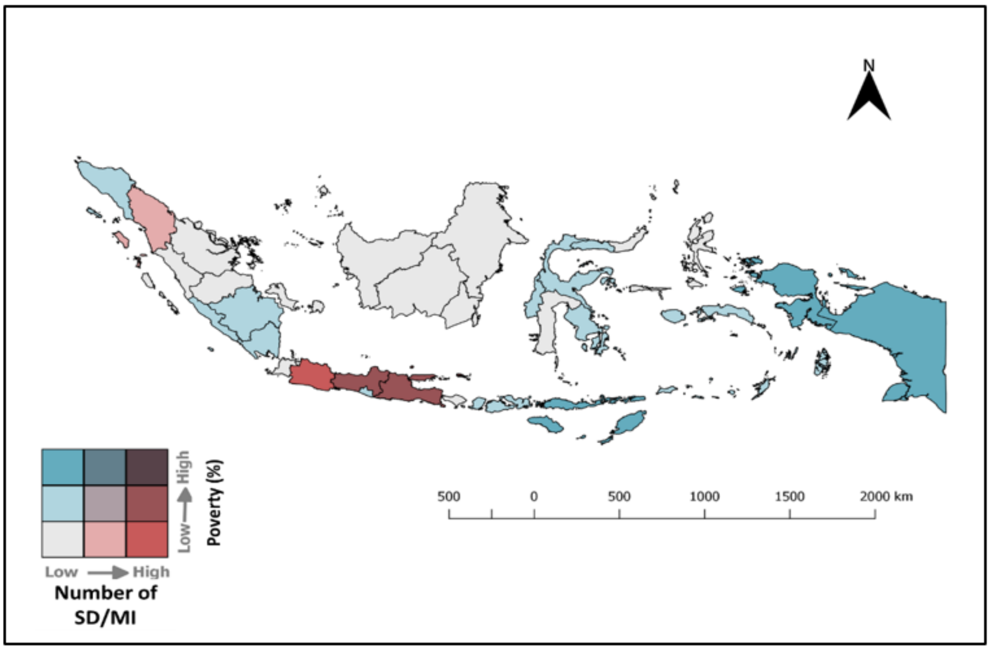

Figure 7: Distribution Elementary School Infrastructure and Poverty in Indonesia in 2015
Source: BPS, processed

percent of total senior high school buildings in Indonesia. Meanwhile, Maluku and Papua have the smallest number of senior high school buildings of 1,222 units or 3.77 percent of total senior high school buildings in Indonesia.

Figure 8 shows an overview of the distribution of senior high school infrastructure in 2015. It is apparent that the distribution of senior high school infrastructure is mostly located in Java. West Java Province is a reflection of the high number of senior high schools with a low poverty level. Meanwhile, the province of Papua has a small number of senior high school yet a high poverty rate. Total secondary education infrastructure is less than the amount of basic education infrastructure. It indicates that the government needs to provide more advanced education for all people in all regions of Indonesia.

4.2. Spatial Influence of Infrastructure on Poverty

Poor infrastructure is one of the factors affecting poverty in a region (Haughton & Khandker 2009). The variables of infrastructure used in this study are

Table 4: Total Senior High School Buildings in Indonesia in 2011–2015

Year	Region					Total (Unit)
	Sumatra	Java-Lesser Sunda Islands	Kalimantan	Sulawesi	Maluku-Papua	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
2011	7,221	14,349	1,781	2,772	973	27,096
2012	7,221	14,349	1,781	2,772	973	27,096
2013	7,729	15,734	1,947	2,948	1,135	29,493
2014	7,749	17,255	2,062	3,104	1,214	31,384
2015	8,250	17,764	2,005	3,159	1,222	32,400
Total (%)	25.46	54.83	6.19	9.75	3.77	100
Growth (%)	14.25	23.8	12.58	13.96	25.59	19.57

Source: BPS (processed)

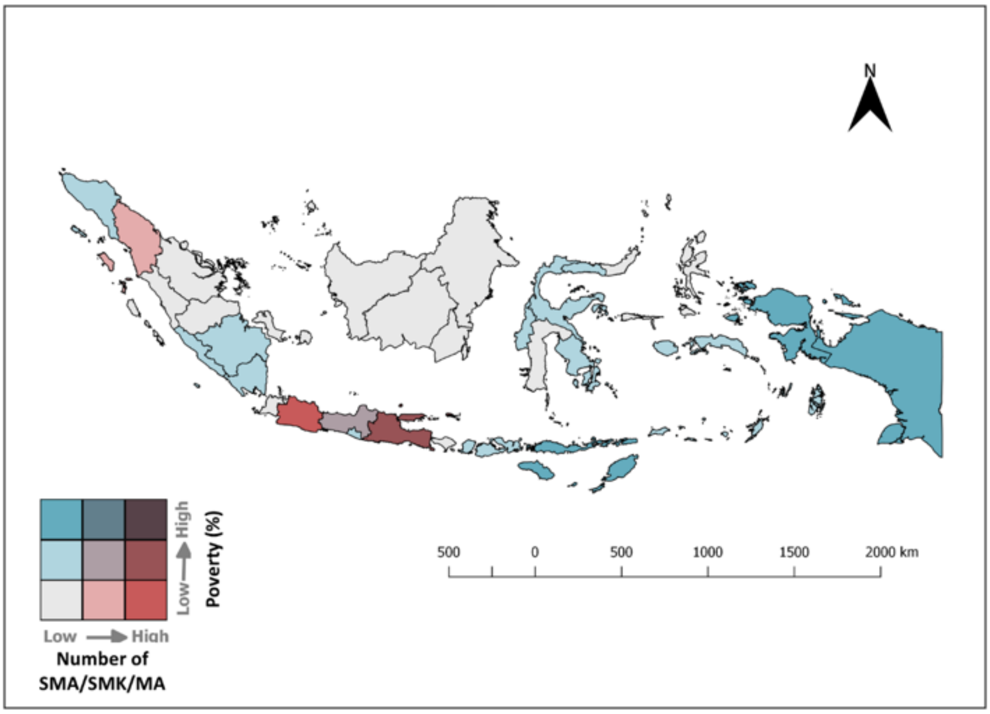

Figure 8: Distribution of Senior High School Infrastructure and Poverty in Indonesia in 2015
Source: BPS, processed

the ratio of total hospitals and health centers per 1000 population, the ratio of total elementary school buildings per total elementary school students, the ratio of total senior high school buildings per total senior high school students, electricity distributed, and the percentage of access to proper sanitation.

Furthermore, the uneven distribution of infrastructure development results in the tendency of the eastern regions in Indonesia to have a high poverty rate and a low quantity of infrastructure. Meanwhile, the western regions in Indonesia tend to have a low poverty level and a large and excellent quantity of infrastructure. It is in accordance with Tobler I's Law stating that everything is related to the others, but everything that is close together shall be more related than distant ones.

In this study, it is assumed that each province has correlation with the three closest provinces with the closest distance approach or k-nearest neighbors (BPS 2011). It refers to the fact that Indonesia is an archipelagic country, meaning that not all of its territories are physically adjacent to each other. In general, the provinces in Indonesia only have direct and indirect borders with the three closest provinces.

The LM (Lagrange Multiplier) test is carried out to determine the formation of a suitable spatial model to use. Based on Table 5, the LM test shows significant results in the LM lag test while the LM error test shows insignificant results. It indicates that there is a spatial effect in the model and the correlation is in the form of spatial lag.

The next step is to determine the best effect of the selected model. The Hausman test is carried out to determine the best effect on the selected model, namely fixed effect or random effect. The results of the Hausman test show that the p-value is less than $\alpha = 5\%$. It proves that the null hypothesis is rejected at $\alpha = 5\%$, meaning that the fixed effect approach is better used than the random effect approach. Thus, the SAR model with fixed effects is a sufficient model to illustrate the influence of infrastructure on poverty in Indonesia.

4.2.1. Spatial Linkage of Poverty in Indonesia

Poverty in Indonesia is related to the surrounding regions or neighbors. The characteristics of adjacent regions are almost identical. The characteristics used in this study are infrastructure. Therefore, to find out the infrastructure affecting the poverty of a region, the infrastructure variables used in this study include the electricity distributed, the percentage of access to proper sanitation, total education infrastructure, and total health infrastructure.

Based on the previous stages, SAR estimation model with a fixed effect is obtained. Then, model parameters are estimated using the maximum likelihood method as follows:

Based on Table 6, the equation is as follows:

$$\begin{aligned}\widehat{\mathrm{POV}_{\mathrm{it}}} &= (28.2393 + \hat{\mu}_{\mathrm{i}}) + 0.202448 \sum_{\mathrm{j}=1}^{33} \mathrm{w_{ij}POV_{jt}} \\ &\quad -8.928223\mathrm{HEALTH_{it}} \\ &\quad -1.708064\ln(\mathrm{ELECT})_{\mathrm{it}} \\ &\quad -0.027194\mathrm{SANIT_{it}} - 2.738742\mathrm{HS_{it}} \\ &\quad +0.421507\mathrm{ES_{it}} \qquad (7)\end{aligned}$$

The adjusted R^2 value in the model is 0.9903972. It means that infrastructure as an independent variable in the model can explain variations in the variable of poverty by 99 percent. The p-value of each independent variable is less than the significance level of 10 percent, meaning that the variables of ratio of total hospitals and health centers per 1,000 population, electricity distributed, the percentage of access to proper sanitation, the ratio of total elementary school buildings per total elementary school students and the ratio of total senior high school buildings per total senior high school students are significant. It means that the level of poverty in Indonesia depends on several infrastructure variables, namely health infrastructure, electricity, sanitation facilities, and education infrastructure.

Based on the aforementioned equation, there is a value of μ_{i} for each province. μ_{i} is an interception of a spatial model whose values vary for each province with fixed effects. The interpretation of the spatial or specific spatial effect model is a description of the heterogeneity of each province while reflecting the existence of other variables owned by a province but not owned by other provinces. Should the independent variable is assumed unchanged both between individuals and over time, then the poverty level variable is merely affected by spatial specific effects and the impact shall vary in each province. Therefore, fixed effects can explain differences in behavior between provinces in Indonesia.

Based on the values in Table 7, it can be interpreted

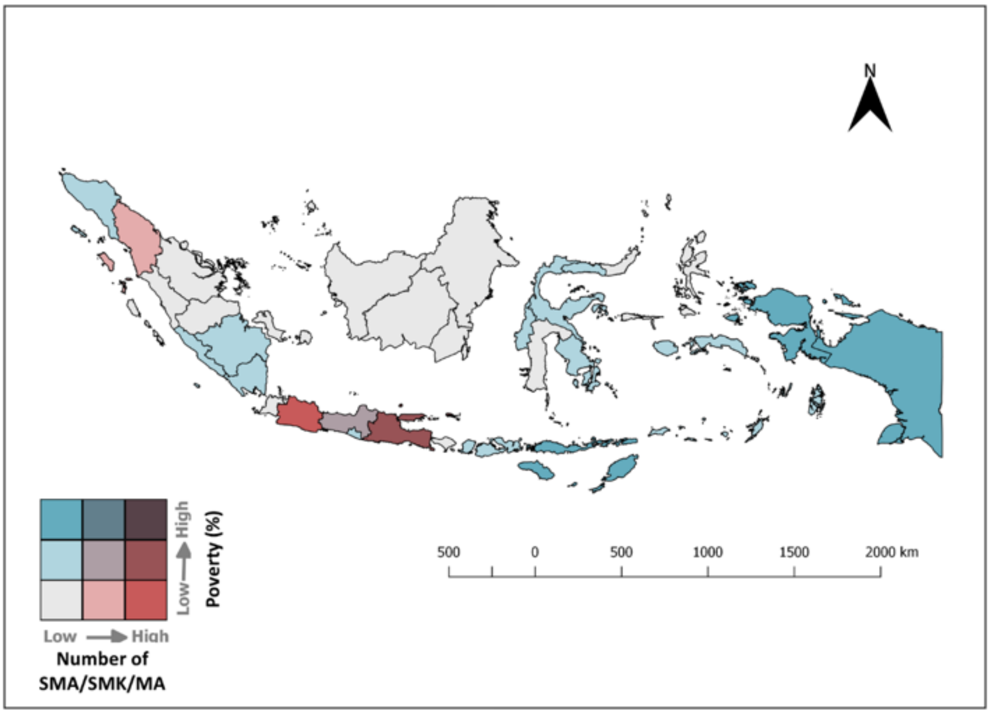

Figure 9: Map of Linkages between IndonesianPprovinces and K-nearest Neighbors
Source: Output R, processed

Table 5: LM and LM Robust test results

Test	P-value	Result
(1)	(2)	(3)
Lagrange Multiplier lag	0.07504*	SAR models can be used
Lagrange Multiplier error	0.2779	The SEM model cannot be used

Note: *Significant at a significance level of 10 percent
Source: R (processed)

Table 6: The Results of Estimation of Spatial Lag Model Parameters with Fixed Effect

Parameter	Coefficient	p-value
(1)	(2)	(3)
λ	0.202448	0.0169*
Intercept	282.393	0.0000 ***
HS	-2.738.742	0.0732645 .
ES	0.421507	0.0009594 ***
HEALTH	-8.928.223	0.0058922 **
Ln(ELECT)	-1.708.064	0.0014575 ***
SANIT	-0.027194	0.0371307 *

Note: Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Source: R (processed)

that supposing that there is no change in all independent variables both between individuals and over time, then the smallest spatial specific effect occurs in the province of West Kalimantan, equal to -10.56148, while the largest spatial specific effect occurs in DKI Jakarta, amounting to 14,20772. It signifies that the poverty level of West Kalimantan province shall be relatively smaller at 10.56148 percent while DKI Jakarta shall experience a relatively higher poverty rate of 14.20772 percent.

Spatial effects are proved to have a significant effect on the lambda coefficient or spatial autoregressive (λ). The sign of the coefficient λ shows that every increase in the level of poverty in a province is affected by an increase in the poverty rate of the surrounding province by 0.202448 percent, assuming that other variables are constant or unchanged.

Table 7: Estimation of the Intercepts of the Poverty Model for Each Province in Indonesia

Province (1)	Intercept (2)	Province (3)	Intercept (4)
Aceh	618.305	West Nusa Tenggara	375.587
North Sumatera	-825.043	East Nusa Tenggara	408.483
West Sumatera	-441.305	West Kalimantan	-105.615
Riau	167.289	Central Kalimantan	148.845
Jambi	21.562	South Kalimantan	419.387
South Sumatera	-151.868	East Kalimantan	1.413.064
Bengkulu	0.56841	North Sulawesi	1.109.098
Lampung	-501.446	Central Sulawesi	-425.408
Bangka Belitung Islands	1.169.623	South Sulawesi	-570.788
Riau Islands	1.285.409	Southeast Sulawesi	0.72898
DKI Jakarta	1.420.772	Gorontalo	-155.446
West Java	-414.312	West Sulawesi	-0.86817
Central Java	-753.489	Maluku	-661.799
DI Yogyakarta	-808.071	North Maluku	-593.143
East Java	-469.433	West Papua	337.541
Banten	-10.525	Papua	450.051
Bali	-701.793		

Source: R (processed)

The analysis can be carried out in each province based on a fixed effect spatial lag model. For example, the analysis of the province of Papua with its neighbors Maluku, North Maluku and West Papua and the individual effects of Papua amounted to 4,50051. The following is a spatial lag model of the province of Papua.

$$\begin{aligned}\widehat{\text{POV}}_{\text{Papua},2015} = {} & 32.7398 + 0.0675\text{POV}_{\text{Maluku},2015} \\ & +0.0675\text{POV}_{\text{NorthMaluku},2015} \\ & +0.0675\text{POV}_{\text{WestPapua},2015} \\ & -8.928223\text{HEALTH}_{\text{Papua},2015} \\ & -1.708064\ln(\text{ELECT})_{\text{Papua},2015} \\ & -0.027194\text{SANIT}_{\text{Papua},2015} \\ & -2.738742\text{HS}_{\text{Papua},2015} \\ & +0.421507\text{ES}_{\text{Papua},2015} \qquad (8)\end{aligned}$$

The above equation shows that when the underprivileged population in Maluku province in 2015 amounted to 19.36 percent, the underprivileged population in the province of Papua would increase by 1.3068 percent. When the underprivileged in North Maluku province in 2015 amounted to 6.22 percent, it would increase the underprivileged population by 0.41985 percent in the province of Papua. Likewise, when the underprivileged in West Papua province in 2015 amounted to 25.73 percent, the underprivileged population in the province of Papua would increase by 1.73678 percent.

The availability of health infrastructure, reflected in the ratio of total health centers and hospitals per 1,000 population of each province, has a significant negative impact on the percentage of the underprivileged. It means that every increase in total health infrastructure per 1,000 population by one unit shall reduce the percentage of underprivileged people. It shows that more convenient and inexpensive access to basic health services can reduce the percentage of underprivileged people. Coefficient value shows that each increase in the ratio of total health infrastructure per 1,000 population by one unit shall reduce the percentage of underprivileged people by 8.928223 percent, assuming that other variables are constant or unchanged. This result confirms that the 2014–2019 RPJM health development goals are appropriate. The target is to increase equity, access and quality of basic health services for the community.

The availability of electricity infrastructure, reflected in electricity distributed by each province, has a significant negative impact on the percentage of the underprivileged. It shows that the supply of electrical energy is essential for economic development in order to encourage economic activities that shall improve community welfare. Coefficient value shows that each increase in distributed electricity (GWh) by one percent shall reduce the percentage of underprivileged people by 0.01708064 percent, assuming that other variables are constant or unchanged. The result also confirms that the 2014–2019 RPJM electricity development goals are appropriate. The intended target is to provide access and energy infrastructure through the electrification ratio. Several activities and infrastructure required to drive the electrification ratio are electricity generation, electricity transmission and electricity distribution.

The availability of sanitation infrastructure, reflected through the percentage of households that have access to proper sanitation in each province, has a significant negative impact on the percentage of underprivileged people. It shows that the provision of proper sanitation shall prevent people from various diseases disrupting productivity, thereby reducing community welfare. Coefficient value indicates that each increase in access to proper sanitation by one percent shall reduce the percentage of underprivileged people by 0.027194 percent, assuming that other variables are constant or unchanged. The result also confirms that the 2014–2019 RPJM program is in the right direction, namely to improve disease control through environmental sanitation strategies such as increasing the availability of sanitation and proper drinking water as well as the arrangements of health area.

The availability of education infrastructure is reflected through the ratio of total elementary school and senior high school buildings per total elementary school and senior high school students in each province. Total elementary school buildings have a significant positive effect on the percentage of underprivileged people. It means that each increase in the ratio of total elementary school buildings per total elementary school students by one unit shall increase the percentage of underprivileged people. Coefficient value shows that each increase in the ratio of total elementary school buildings per total elementary school students by one unit shall increase the percentage of underprivileged people by 0.421507 percent, assuming that other variables are constant and unchanged. It is possible since the heads of underprivileged households in Indonesia are dominated by elementary school graduates or those who do not complete elementary school. According to BPS (2015), underprivileged households whose heads do not complete primary school and complete primary school reach 40.81 percent and 39.78 percent respectively, compared to underprivileged households whose heads are high school graduates of 8.47 percent. In addition, the School Participation Rate (APS) of elementary school in Indonesia in 2015 is 99.09 percent, of SMP/MTs level is 94.72 percent, and of senior high school is 70.61 percent. It indicates that the target of construction of elementary school infrastructure has been fulfilled. Therefore, the current needs lie on maintaining infrastructure rather than adding more elementary schools.

Total senior high school buildings have a negative and significant impact on the percentage of the underprivileged. It means that each increase in the ratio of total senior high school buildings per total senior high school students by one unit shall reduce the percentage of underprivileged people. Coefficient value indicates that each increase in the ratio of total high school infrastructure per total senior high school students by one unit shall reduce the percentage of underprivileged people by 2.738742 percent, assuming that other variables are constant and unchanged. This result provides confirmation of the need to enact compulsory education for 12 years in accordance with the 2014–2019 RPJM. The 12-year compulsory education must be supported by educational infrastructure in the form of quality education facilities and infrastructure including the construction of new school units, classrooms, libraries, and laboratories. It is expected that the addition of new school units, particularly in senior secondary education, can facilitate access to and reduce the cost of education to attract the community to go to school. Thus, higher knowledge shall improve quality and ability and produce a skilled workforce, resulting in the increase in productivity and welfare.

5. Conclusion

In general, in the period of 2011–2015, the percentage of underprivileged people in Indonesia tends to decline. Infrastructure such as electricity distributed, health infrastructure, proper sanitation facilities, and education infrastructure including elementary school and senior high school buildings has increased in each province in Indonesia. Mapping of infrastructure and poverty in Indonesia shows that high poverty rate tends to cluster in the regions with low infrastructure.

Significant factors having a negative effect on the percentage of underprivileged people with a significance level of 10 percent is distributed electricity, the ratio of total health infrastructure per 1000 population, the percentage of access to proper sanitation, and the ratio of total senior high school buildings per total senior high school students. Meanwhile the factor having a significant positive effect on the percentage of underprivileged people is the ratio of total elementary school buildings per total elementary school students.

The limitations in carrying out this study are the availability of data and limited time for further analysis.

Further study can include a lag variable from infrastructure to observe the impact of current infrastructure development on poverty in the coming year. In addition, the unit of observation can include a new province such as North Kalimantan or districts/municipalities.

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Appendix

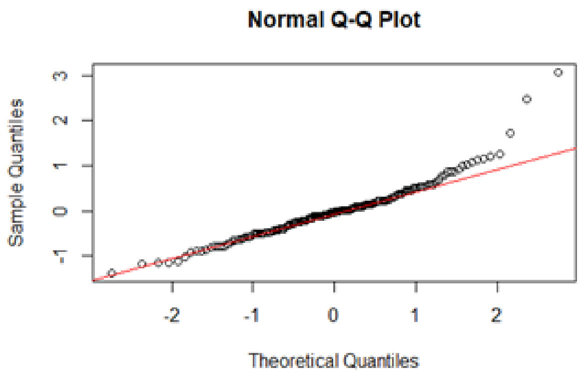
1. Standardized spatial weighing matrix

	11	12	13	14	15	16	17	18	19	21	31	32	33	34	35	36	51	52	53	61	62	63	64	71	72	73	74	75	76	81	82	91	94
11	0	0.33	0.33	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0.33	0	0.33	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0.33	0	0.33	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0.33	0.33	0	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0.33	0	0	0.33	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0.33	0.33	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0.33	0.33	0	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0.33	0	0	0	0	0.33	0	0	0	0	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0.33	0.33	0	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0.33	0	0	0	0	0.33	0	0	0	0	0	0	0	0	0	0	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0.33	0	0	0	0.33	0	0	0	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0.33	0	0.33	0	0	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0.33	0	0.33	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0.33	0.33	0	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0.33	0	0	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0.33	0	0	0.33	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0.33	0	0	0.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0	0.33	0	0	0	0	0	0	0	0	0.33	0	0	0	0	0	0	0
53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0	0	0	0	0	0	0	0.33	0.33	0	0	0	0	0	0
61	0	0	0	0	0	0	0	0	0	0.33	0	0	0	0	0	0	0	0	0	0	0.33	0.33	0	0	0	0	0	0	0	0	0	0	0
62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0	0.33	0.33	0	0	0	0	0	0	0	0	0	0
63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0	0.33	0	0	0	0	0	0.33	0	0	0	0
64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0.33	0	0	0	0	0	0	0.33	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0	0	0.33	0	0	0.33	0	0
72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0	0.33	0.33	0	0	0	0
73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0	0.33	0	0.33	0	0	0	0
74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0.33	0	0	0.33	0	0	0	0
75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0.33	0	0	0	0.33	0	0	0	0
76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0.33	0.33	0	0	0	0	0	0
81	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0	0	0	0	0	0	0.33	0.33	0
82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0	0	0	0.33	0	0.33	0	0	0
91	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0.33	0	0.33
94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33	0.33	0.33	0

2. List of Three Closest Neighbors in Indonesia

Kode	Provinsi	Tiga Tetangga Terdekat		
11	ACEH	SUMATERA UTARA	SUMATERA BARAT	RIAU
12	SUMATERA UTARA	ACEH	SUMATERA BARAT	RIAU
13	SUMATERA BARAT	SUMATERA UTARA	RIAU	JAMBI
14	RIAU	SUMATERA UTARA	SUMATERA BARAT	JAMBI
15	JAMBI	SUMATERA BARAT	SUMATERA SELATAN	BENGKULU
16	SUMATERA SELATAN	BENGKULU	LAMPUNG	KEP. BANGKA BELITUNG
17	BENGKULU	JAMBI	SUMATERA SELATAN	LAMPUNG
18	LAMPUNG	SUMATERA SELATAN	DKI JAKARTA	BANTEN
19	KEP. BANGKA BELITUNG	JAMBI	SUMATERA SELATAN	LAMPUNG
21	KEP. RIAU	RIAU	KEP. BANGKA BELITUNG	KALIMANTAN BARAT
31	DKI JAKARTA	LAMPUNG	JAWA BARAT	BANTEN
32	JAWA BARAT	DKI JAKARTA	JAWA TENGAH	BANTEN
33	JAWA TENGAH	JAWA BARAT	DI YOGYAKARTA	JAWA TIMUR
34	DI YOGYAKARTA	JAWA BARAT	JAWA TENGAH	JAWA TIMUR
35	JAWA TIMUR	JAWA TENGAH	DI YOGYAKARTA	BALI
36	BANTEN	LAMPUNG	DKI JAKARTA	JAWA BARAT
51	BALI	DI YOGYAKARTA	JAWA TIMUR	NUSA TENGGARA BARAT
52	NUSA TENGGARA BARAT	JAWA TIMUR	BALI	SULAWESI SELATAN
53	NUSA TENGGARA TIMUR	NUSA TENGGARA BARAT	SULAWESI SELATAN	SULAWESI TENGGARA
61	KALIMANTAN BARAT	KEP. RIAU	KALIMANTAN TENGAH	KALIMANTAN SELATAN
62	KALIMANTAN TENGAH	KALIMANTAN BARAT	KALIMANTAN SELATAN	KALIMANTAN TIMUR
63	KALIMANTAN SELATAN	KALIMANTAN TENGAH	KALIMANTAN TIMUR	SULAWESI BARAT
64	KALIMANTAN TIMUR	KALIMANTAN TENGAH	KALIMANTAN SELATAN	SULAWESI BARAT
71	SULAWESI UTARA	SULAWESI TENGAH	GORONTALO	MALUKU UTARA
72	SULAWESI TENGAH	SULAWESI SELATAN	GORONTALO	SULAWESI BARAT
73	SULAWESI SELATAN	SULAWESI TENGAH	SULAWESI TENGGARA	SULAWESI BARAT
74	SULAWESI TENGGARA	SULAWESI TENGAH	SULAWESI SELATAN	SULAWESI BARAT
75	GORONTALO	SULAWESI UTARA	SULAWESI TENGAH	SULAWESI BARAT
76	SULAWESI BARAT	SULAWESI TENGAH	SULAWESI SELATAN	SULAWESI TENGGARA
81	MALUKU	SULAWESI UTARA	MALUKU	PAPUA BARAT
82	MALUKU UTARA	SULAWESI UTARA	GORONTALO	MALUKU
91	PAPUA BARAT	MALUKU	MALUKU UTARA	PAPUA
94	PAPUA	MALUKU	MALUKU UTARA	PAPUA BARAT

3. Normality Test




```
One-sample Kolmogorov-Smirnov test

data:  sarfe$residuals
D = 0.092477, p-value = 0.1189
alternative hypothesis: two-sided
```

5.1. Multicollinearity Test

```
$>$ vif(f)
    ES      HS  HEALTH  lnELECT  SANIT
 1.322622  1.085035  3.186558  4.328942  1.603689
```