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# Spatial analysis of region interaction of West-East corridor's strategic economic area of West Sumatera Province, Indonesia

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## ABSTRACT

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The West-East corridor is one of the main gateways to enter West Sumatra Province. The West-East corridor, which passes through 65 districts, has a variety of potentials and problems. This means, the growth rate of each district will be different. The growth rate and strength of the relationship among regions can be observed through the gravity model's spatial interactions. The gravity model can calculate the relative strength of the relationship between regions. To see the strength of the relationship among regions in the West-East corridor, strategic economic areas were taken into considerations based on their distance and several observational variables, which were the total population variable, infrastructure completeness, level of security, and investment value. Observation analysis units consisted of sixty-five sub-districts along the West-East corridor. Mass 1 (M1) was the central government, West Padang district, and mass 2 (M2) was the other 64 sub-districts. The analysis results show that the total population, infrastructure completeness, level of security, and investment value are not only influenced by their closeness to the government/city center. The infrastructure completeness factor can influence the total population in a region. Likewise, the investment value can be influenced by the infrastructure completeness and the level of security in a region.

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# INTRODUCTION

Balanced development is the fulfillment of development potential in each region (Rustiadi et al., 2018). If this condition is associated with the stages of economic growth put forward by Rostow, it is related to the take-off precondition. This stage is a transition period in which society prepares itself or is prepared from the outside to achieve growth with continuous development (self-sustained growth). This

stage is the transition period in which the conditions for self-help growth are built or created (Jhingan, 2016).

Regional development is aimed to formulate and apply a theoretical framework to economic policies and programs by integrating social and environmental aspects to achieve optimal and sustainable welfare (Nugroho & Dahuri, 2004). Friedmann dan Alonso (1964) posited that the development of a region or district in the long term is more emphasized by introducing natural resources and regional local development potentials. The potential that can support economic growth, social welfare, poverty alleviation, and efforts to overcome development obstacles in order to achieve development goals is strongly influenced by the components of local resources, markets, labor, investment, government capacity, transportation, and communication and technology.

As stated in Indonesian Law No. 26/2007 concerning Spatial Planning, one of the efforts to accelerate development by utilizing local resources is by identifying strategic districts. A strategic economic area potentially has a significant multiplier effect that is cross-sectoral, cross-spatial (cross-regional), and cross-performer (Bappenas, 2014). Strategic economic areas are areas prioritized for development. According to Sosnovskikh (2017), the area clustering policy is the key and one way to attain local and regional economic development. The strategic economic area as a territory region distinguishes this region from the other regions (Komarovskiy & Bondaruk, 2013). A strategic district is a district prioritized for development where its commodities are developed to improve the community's welfare in the region (Bozhko, 2018).

The strategy to increase economic growth is by developing strategic areas or developing economic corridors. An economic corridor is an integrated infrastructure network in a geographic district stimulate economic development designed to (Brunner, 2013). The economic corridor approach views the transportation network as a tool for transporting goods and services or as a gateway and as a tool to stimulate socio-economic development around the network (Mulenga, 2013). Thus, the corridor economic approach transforms the transportation corridor into a driving engine for socioeconomic development. In line with research conducted by Ji & Shao (2017) regarding the Heritage Corridor, а comprehensive action towards conservation and development originating from the 'green way' prioritizes cultural-related conservation and focuses on economic revitalization and environmental protection.

Regional development and superior commodities development are carried out to accelerate regional economic development (Muta'ali, 2015). Conceptually, the role of the strategic area may boost the economy in the region (Ezmale & Rimsane, 2014; Glinskiy et al.,

#### Amelia et al., Spatial analysis of region interaction...

2017) and improve the regional economy (Anwar, 2014; Babkin et al., 2017). Strategic economic areas are expected to act as a growth center or a growth corridor to drive economic growth in the surrounding region (hinterland). As an implementation of the growth center or growth corridor concept, the strategic economic area is expected to be the prime mover of development, capable of driving economic development in the surrounding region. Therefore, the strategic economic area in which the residents are concentrated with various economic and social activities has a quite strong influence on the development of the surrounding regions.

The West-East corridor is one of eleven strategic economic areas in West Sumatera Province. The West-East corridor is one of the axes that connects West Sumatera Province with other regions in the Eastern part of Sumatera. The West-East corridor is one of the main corridors and the gateway of the West Sumatera province in the East region. It is a corridor that has the highest frequency of trade and services. Therefore, based on Governor Regulation No. 73/2013 concerning the West Sumatra Economic Development Master Plan 2013-2025, the West-East corridor is included in one of the economic development regions.

The strength of the relationship among regions in the West-East corridor is based on distance and several dimensions of observation. The strength of the relationship and the level of development of the strategic economic area in the West-East corridor can be observed by looking at the spatial interactions between regions using the gravity model. The basic concept of the gravity model is to analyze the size and distance between one region to another. This model can calculate the relative strength of the relationship between the regions (Muta'ali, 2015). In the gravity model, regions are considered as a mass. Therefore, the relationship between regions can be equated with the relationship between masses. The region's mass also has an attraction which affect each of the two regions with the said attractive strength. This model follows Newton's law of gravity applied and developed in socio-economic interactions, in which there is a parallel relationship between community migration (Rustiadi et al., 2018).

The research aims to study the interaction and the strength of relationship between regions in the West-East corridor in West Sumatra Province.

# **RESEARCH METHOD**

This research was conducted at The West-East corridor, which is one of the main gateways passing through nine regencies/cities, i.e. Padang Pariaman Regency, Agam Regency, Tanah Datar Regency, Lima Puluh Kota Regency, Pariaman City, Padang City, Padang Panjang City, Bukittinggi City, and Payakumbuh City.

# Data collection

For examining the strength of the relationship and the level of regional development in the strategic economic area of the West-East corridor, this research employed a combination of qualitative and quantitative methods. The qualitative method involved direct observation in the field by extracting information from various sources related to the development of the West-East corridor. The collected data and information were related to population, crime rate, number of industries, the completeness infrastructure (the number of markets, sports facilities, banks, hospitals and health centers, hotels, inns/motels/guest houses/hostels, senior hiah schools, and universities), and investment in the development of the strategic economic area of the West-East corridor. In addition, qualitative data processing was carried out by examining various research results related to regional development. Sources of data used in this research came from the Central Bureau of Statistics (BPS) in the form of Kabupaten and Kecamatan dalam Angka (literally meaning Regency in Figures and District in Figures) data in 2020. The investment data were taken from the Agency of Capital Investment and One-Stop Service (DPMPTSP) in each regency or city. Data analysis was performed using the gravity model as an analysis tool. The units of analysis involved in this research were the districts along with the West-East corridor delineation. Analysis of interaction patterns in the analysis unit was carried out using the maximum and minimum clusters, where the grouping was done based on the maximum-minimum value concentration at the observation location (Scott & Janikas, 2004).

## **The Region Interaction**

The basic concept of the gravity model is to study the size and distance from one region to another (Muta'ali, 2015). The use of gravity techniques allows this study to calculate the relative strength of the relationship between regions. In addition to the distance between regions, the potential for interaction between regions was determined by the region's "attractiveness", such as population, economic potential, natural and environmental resource potentials, and regional facilities. The gravity model in this research was used to view the role or strength of strategic economic areas in regional development and enhancement of the regional economy. The measurements were based on the distance of each provincial strategic economic area to the center of government with the district analysis unit.

In this research, to view the interaction of each strategic district in West Sumatra province with the district analysis unit, various combinations of gravity models were produced. The calculation of the interaction between regions used mass 1 and mass 2. Mass 1 is considered unchanged, which is the center of government, while mass 2 varies (Muta'ali, 2015), comprising the districts along the West-East corridor. The calculation and analysis of this gravity model showed which strategic district would provide a more remarkable influence based on several variables. The formula used in the gravity analysis is shown in equation 1,

$$I_{12} = g \, \frac{m_1 \, m_2}{r^b_{12}} \tag{1}$$

in which  $I_{12}$  equals attraction potential and interaction between regions 1 and 2,  $m_1$  and  $m_2$  equal the mass of region 1 and 2,  $r_{12}$  is distance between regions 1 and 2, and g equals proportional constant (for example, the value is 1).

Meanwhile, b is distance constant, which depends on the district accessibility value—the better the accessibility, the smaller the constant, thus the interaction potential is more remarkable. Based on the research results conducted by Vooheers (Muta'ali, 2015), a distance rank constant is based on the purpose of the trip, wherein work = 0.5, social = 3, and shopping, business, recreation, and others = 2.

 $I_{12}$  value shows the potential of a close relationship between region one and region two. The higher the  $I_{12}$  value, the closer the relationship between the two regions; there would be more trips for economic activities or the flow of goods and services between these regions as a consequence of the interaction between regions within one district. Regions with the highest  $I_{12}$  score have the characteristics of a central region, a strategic position,

and a high level of region connectivity (Andriyani & Utama, 2011).

$$Interval \ Class = \frac{\sum data}{\sum class}$$
(2)

The formula of the class interval is determined by the number of data divided by the number of levels, as shown in equation 2.

# **RESULT AND DISCUSSION**

# **Interaction of West-East Corridor**

The West-East corridor is one of the main corridors connecting West Sumatra Province with the other regions, and it is the gateway to West Sumatra from the Eastern part. A strategic area has characteristics that distinguish the region from the others (Komarovskiy & Bondaruk, 2013). This research aims to view the interaction, linkages, or strength of the relationship between the central area and the others. In this study, the distance measurement between the

central region and the other 64 observation regions was carried out using the Euclidean distance method with the assistance of the ArcGIS software (Figure 1). Euclidean distance is a calculation of the distance between individuals based on their geometric distance or straight-line distances in a multidimensional space (Pribadi et al., 2010). This was used to obtain the distance of each district to the center of the observation object (West Padang district). The measurement of the distance between observation objects was carried out on the centroid of each observation object.

In this research, the center of observation was the West Padang district considering that the governor's office and various government offices are located in the region. Therefore, based on the measurement of the distance from the observation center (M1) to 64 other observation areas, the closest distance is North Padang district at 3 km and the furthest distance is Pangkalan Koto Baru district at 121.6 km.

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Figure 1. Centroid of corridor





The mass used to observe the interaction of regions in the gravity model is very dependent on the purpose of the analysis (Muta'ali, 2015). Based on research, in general, the mass of an area is the total population. In looking at the economic interactions (equation 1), the variables of GRDP, GRDP per capita, job opportunity, tourism potential, investment, and various other economic variables were used. This research compared the interaction among population variables, investment, number of large/medium/small industries, the completeness of infrastructure (the number of markets, banks, hospitals, health centers, sports facilities, hotels, hostels/motels/guest houses, high schools, and universities), and crime rate.

The observation variables using the gravity model formula (equation 1) produced various interpretation results. To identify the interaction between regions based on the results of previous research studies, the regions were grouped into four to seven classifications. In this study, regional interactions were grouped into five classes, which were very strong, strong, quite strong, weak, and very weak. The classification of the region's strength in this research used the quantile method (Kurniati & Rahardjo, 2015). The quantile method is suitable for data with a linear distribution, where the division of the members of each class is equal. As shown in equation 2, the formula of the class interval determines the number of data divided by the number of levels. Data classification was performed using the ArcGIS 10.3 software. Thus, regional interactions were obtained from classifying each observation dimension.

Figure 2 shows the strength of the relationship between the regional center (M1) and the other regions (M2). The results show that the region interaction was very diverse. Not all areas close to the center had very strong or strong interactions. Some areas that are far from the center also had strong interactions. That happens due to various reasons why people stay in the region, which is not only based on proximity to the center. The completeness of infrastructure (Martinez & Masron, 2020) causes people to stay in the area.



Figure 3. Regional interaction of infrastructure completeness

Figure 4. Regional interaction of crime rate



Figure 5. Regional interaction of investment

Environmental quality is also a reason for choosing a place to live (Prayitno et al., 2021). Based on the observation results of the population variable, Padang Sago district, 48 km away from the center of government, had a very weak interaction, while Lima Kaum district that is 59.3 km from the center had a strong interaction. Payakumbuh Barat district is 83 km from the center of government and it had a strong enough interaction. Pangkalan Koto Baru district is the farthest from the center of government (121.6 km) and it had a very weak interaction with the central government.

Figure 3 shows the strength of the relationship between the center (M1) and other regions (M2) based on the infrastructure completeness variables. In this study, the completeness of infrastructure was based on the number of markets, banks, hospitals, health centers, hotels, hostels/motels/guest houses/ inns, high schools, and universities. Pangkalan Koto Baru district is 121.6 miles from the central government, and the infrastructure variable had very weak relationship strength for having relatively little infrastructure completeness. This is in line with research conducted by Martinez & Masron (2020), stating that one of the reasons for someone to live in an area is the completeness of infrastructure in the region. Padang Sago district is 48 km from the government center and had a very weak relationship with the central government, in the sense that the Padang Sago district had relatively little infrastructure. This finding shows that the relationship between populations is directly proportional to the completeness of infrastructure in a region. The Mandiangin Koto Selayan district has a distance of 72.1 km from the central government and had a very strong relationship with it, showing adequate completeness of the existing infrastructure in the district.

Figure 4 shows that several regions close to the central government and low in crime rate had a very weak interaction. For example, 2x11 Enam Lingkung district and V Koto Timur district, which are 40 km and 55 km away from the center of government respectively and low in crime rate, had a very weak relationship strength with the crime rate variable. On the other hand, Baso district and Mandiangin Koto Selayan district had a high crime rate.

The proximity of a region to the central government/city center influences crime rates. In addition, inadequate facilities such as damaged road networks, the lack of communication infrastructure (Arisukwu et al., 2020), community income, and literacy rates may lead to high crime rate (Hajela et al., 2020).

Figure 5 shows the interaction of the center with the other regions based on the investment variable. The Ulakan Tapakis district, which is close to the central government (31 km away) and received small amount of investment value, had a very weak relationship strength. Likewise, Nan Sabaris district which is 37 km away from the central government had a very weak interaction. On the other hand, the Tilatang Kamang district, which is 76.5 km away from the central government and had guite large amount of investment, had a strong interaction with the central government. Both Pangkalan Koto Baru district, the farthest from the central government at 121.6 km, and Harau district almost as far at 98.6 km, had a strong interaction. The results show that the region's proximity to the center does not influence the amount of investment value.

Many factors influence investors' interest in making investments. Several factors include economic stability, ease of bureaucracy, investment-related policies (Hanim & Ragimun, 2015; Melliger & Lilliestam, 2021), institutions (Kuncoro & Rahajeng, 2005), security (Martinez & Masron, 2020; Glinskiy et al., 2017), infrastructure completeness (Kuncoro & Rahajeng, 2005), the availability of supporting technology (Melliger & Lilliestam, 2021), and the provision of incentives (Limanlı, 2015).

The results of the analysis show that the level of security affects investors' interest in making investments. As seen in Ulakan Tapakis and Nan Sabaris districts, both of which are close to the central government, have low investment values and almost high crime rates. Pangkalan Koto Baru and Harau districts are both far from the center but have high investment values and low crime rates. Thus, the level of security in a region becomes a factor to be considered when investing. This is in line with research conducted by Martinez & Masron (2020) and Glinskiy et al. (2017).

# **Research Implication**

The gravity model in this study is used to see the role or strength of each region in the west-east

corridor in regional development and improving the economy of the west-east corridor and the province of West Sumatra in general. The use of gravity techniques will calculate the relative strength of the relationship between regions (Leigh & Blakely, 2016). The basic concept of the gravity model is to discuss the size and distance between one area and another. This model can calculate the relative strength of the relationship between regions (Muta'ali, 2015). In the gravitational model, the area is a mass, so the relationship between sites is the same as the masses'. The mass of a region has an attraction, so there is mutual influence between areas which is the force of attraction between areas. This model follows Newton's law of gravity which is applied and developed in socioeconomic interactions, where there is a parallel relationship between community migration (Rustiadi et al., 2018). Research carried out using this gravity model includes a study conducted by Thompson et al. (2019). His research examines the effectiveness of predicting two-way traffic volumes in the United States using annual average daily traffic data for various states. Bialynicka-Birula (2015) research which looks at the influence of the art market in European countries on the total exports and imports of works of art, examines the trade in the art using Eurostat international trade data and distances between countries.

The province of West Sumatra, which has large enough local potential compared to national per capita income, has a relatively small Gross Regional Domestic Product (GRDP) per capita. The comparison of the GRDP per capita between the Province of West Sumatra and other provinces on the island of Sumatra is also relatively small. The development of the provincial GRDP per capita on the island of Sumatra for the 2014-2020 period is far below the province of Riau, Riau Islands, North Sumatra, and Jambi. GRDP per capita of West Sumatra Province based on 2010 constant prices was 25.98 million in 2014, and 30.82 million in 2020. The province of West Sumatra has a per capita income that is not too large but a higher value of the Human Development Index (IPM) compared to other provinces in the island of Sumatra.

The HDI value of West Sumatra Province is even above the national HDI average. In 2020 the HDI value of West Sumatra Province was 72.38. The HDI value of West Sumatra province was even higher than the HDI value of North Sumatra province (Figure 1). The potential of West Sumatra's human resources is relatively high, occupying the third position among the regions in the island of Sumatra, which reached 72.38 in 2020. The HDI value of West Sumatra province was even higher than the HDI value of North Sumatra province (Figure 6). The potential of West Sumatra's human resources is relatively high, occupying the third position among the regions on the island of Sumatra.

The big potential of West Sumatra's resources is not matched by the value of the investment. If we look at the investment in the provinces on the island of Sumatra, West Sumatra occupies the bottom two positions of the investment amount after Aceh. The amount of investment in West Sumatra in 2020 was 3,106.20 billion rupiahs for PMDM (domestic investment) and 1,758.40 billion rupiah for PMA (foreign investment). The amount of investment in West Sumatra for PMDN is in the lowest two positions after Bangka Belitung Islands. Meanwhile, PMA occupies the bottom four positions after Jambi, Bangka Belitung Islands, and Aceh. This small investment causes uneven development in West Sumatra.

The uneven development can be seen from the availability of infrastructure in each district/city. Complete and adequate infrastructure is due to the relatively high investment in urban areas. Increased investment can support regional economic development. Uneven development can also cause a backwash effect, leading to regional leakage in several regions of West Sumatra. According to Rustiadi et al. (2018), the pattern of population movement from underdeveloped areas to developed areas where economic development in developed areas is an attraction for quality workforce migration. This pattern causes those living in less developed areas to be unproductive people. Uneven development can also cause a backwash effect that creates regional leakage in several regions of West Sumatra.

Economic growth in urban areas is more varied in development than in rural areas. Investors are interested in investing in urban areas because they already have urban infrastructure and utilities. The concentration of economic activity that is more concentrated in urban areas than in rural areas supported by a more significant allocation of development budgets in urban areas also causes a gap. The gap causes trouble in the mobilization of goods and services due to limited transportation and communication, so the income per capita of the community is low. Good infrastructure development will ensure efficiency, facilitate the movement of goods and services, and increase the added value of the economy (Skorobogatova & Kuzmina-Merlino, 2017; Hasselgren & Englén, 2016; Sutriadi et al., 2015; Jurgelane-Kaldava et al., 2019).

To create equitable development in the west-east corridor and West Sumatra in general, it is necessary to establish new growth centers. The findings of this study form the basis for local governments to determine new growth centers. According to Perroux's theory of growth pole, in overcoming development inequality, the building new growth pole may function as intermediary development centers and prepare for the development of migration-receiving areas. The existence of a new growth pole can affect the development of the surrounding area. The growth pole acts as a service center for the surroundings.



Figure 6. GRDP per capita (at 2010 constant price) and provincial HDI in Sumatra Island in 2020

# **CONCLUSION AND SUGGESTION**

This research attempts to identify the regional interaction/ relationship strength between the central government and the other 64 districts along the West-East corridor. The variables used in this observation comprise population, infrastructure completeness, rate of crime, and investment value. The strength of regional relations and the level of regional development are influenced by the region's proximity to the regional center. One of the reasons people live in an area is the completeness of infrastructure in that particular area.

Padang Timur district, which is 2.4 km away from Padang Barat, is the closest district to the central government. The district interaction of Padang Timur district and the population variable has an intense relationship. The regional interaction of variables infrastructure completeness, level of security, and investment value also has a strong relationship with the central government. The proximity of the regions to the center does not influence investment value. Instead, it is likely influenced by government policies, the completeness of infrastructure, the level of security, and the availability of supporting technology.

The findings of this study form the basis for local governments to determine new growth poles. The existence of a new growth pole will be able to influence the development of the surrounding area. The growth pole acts as a service center for its surroundings. The existence of new growth poles can reduce regional inequality.

This study has limitations, one of which is the establishment of the distance between districts. The distance calculation in this study uses the Euclidean distance as the straight-line distance between the regional centers. The distance calculation in this study does not use distance based on travel time and mileage.

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Amelia et al., Spatial analysis of region interaction...

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