Administrative Unit Proliferation Through Spatial Interaction Approach: Case Study of Lembang City Region

Lili Somantri[1]*, Iqbal Eko Noviandi[1]*, Agil Akbar Fahrezi[1], Muhammad Arrafi[1]

Abstract. Administrative unit proliferation is a decision that needs to be taken based on several considerations based on research. The proposed Lembang City region is an area that will develop into a city in the next few years. For this reason, this research attempted to evaluate the proposed area's ability to become an administrative city using various spatial aspects. The analytical approaches used in this study were: spatial interaction analysis, which helps to determine the regional economic center; thematic overview analysis, implementing village SDGs through a spatial analysis approach; and SWOT analysis to identify Lembang City region's strengths, weaknesses, opportunities, and threats in qualitative terms. The study results show that the proposed Lembang City area has excellent potential as a city region. Through a spatial analysis approach supported by geographic information system tools, this research was conducted as a consideration in deciding to expand Lembang Regency may provide significant assistance to the government in its work related to this decision.

Keywords. City administration, GIS, Lembang City, New Autonomous Region, Proliferation, Spatial interaction analysis

Abstrak. Pemekaran unit administrasi merupakan keputusan yang perlu diambil berdasarkan beberapa pertimbangan berdasarkan penelitian. Kawasan Kota Lembang yang diusulkan merupakan kawasan yang akan berkembang menjadi kota dalam beberapa tahun ke depan. Untuk itu, penelitian ini mencoba mengevaluasi kemampuan kawasan yang diusulkan untuk menjadi kota administratif dengan menggunakan berbagai aspek keruangan. Pendekatan analitis yang digunakan dalam studi ini adalah: analisis interaksi spasial, yang membantu menentukan pusat ekonomi regional; analisis tinjauan tematik, implementasi SDGs desa melalui pendekatan analisis spasial; dan analisis SWOT untuk mengidentifikasi kekuatan, kelemahan, peluang, dan ancaman kawasan Kota Lembang secara kualitatif. Hasil kajian menunjukkan bahwa kawasan Kota Lembang yang diusulkan memiliki potensi yang sangat baik sebagai kawasan kota. Melalui pendekatan analisis spasial yang didukung perangkat sistem informasi geografis, penelitian ini dilakukan sebagai pertimbangan dalam memutuskan pemekaran Kabupaten Lembang dapat memberikan bantuan yang signifikan kepada pemerintah dalam pekerjaannya terkait keputusan tersebut.

Kata kunci. Daerah Otonom Baru, Kota Lembang, GIS, Analisis Interaksi Spasial, Pemkot, Proliferasi

---

[1] Geographic Information Science, Faculty of Social Science Education, Indonesia University of Education, Jl. Dr. Setiabudhi No.207 Bandung 40154, Indonesia. *(Corresponding author). E-mail: lilisomantri@upi.edu*, iqbal.en14@upi.edu*

Introduction

Administrative unit proliferation divides an area of a province, district, or city into more than one region. According to official law, administrative unit proliferation is defined as the formation of a new area and can be in the form of merging several regencies/cities side by side in different regencies/cities. In the context of administrative unit proliferation, several aspects need to be considered. These include regional functions, physical/environmental, economic, and social criteria. These considerations are used to avoid disparities in the expanded area and the resulting expansion area (Khairullah & Cahyadin, 2006).

West Bandung Regency is a regency in West Java Province, Indonesia, with an area of 3.69% of the total area of West Java Province (BPS, 2021b). This regency is bordered by Cianjur Regency to the west, Purwakarta Regency and Subang Regency to the north, Bandung Regency, Bandung City, Cimahi City to the east, and Bandung Regency and Cianjur Regency to the south. The administrative center of West Bandung Regency is located in Ngamprah District, which defines its economic and regional government center. West Bandung Regency consists of sixteen sub-districts and 165 villages, with a population of 1,814,230 people (BPS, 2021a). The huge potential of the West Bandung Regency area encourages researchers and the government to expand the area in West Bandung Regency.

One of the areas in West Bandung Regency that is planned for expansion is Lembang Regency, which consists of three districts, namely Cisarua District, Lembang District, and Parongpong District, with Lembang District as the capital. Lembang Subdistrict is in the northern highlands of the Bandung Basin and is part of the West Bandung Regency, West Java Province, Indonesia. Lembang Subdistrict is about 22 kilometers from the capital of West Bandung Regency to the northeast through Cisarua. According to the Deputy Chairman of the Regional Planning Design Coordination Forum (*Forkodetada*), Lembang has high potential for expansion because in terms of income, Lembang is relatively higher compared to other areas in West Bandung. The geographical location of Lembang Regency, which is in a mountainous area, has caused rapid development of the tourism sector. The tourism sector and its supporting sectors are the main sources of income for the Lembang sub-district.

Lembang is one of the sub-districts in the West Bandung region with the most outstanding tourism potential in West Java (Nisaa et al., 2017). Its strategic geographical location makes Lembang a hot spot for tourist, generating considerable regional income. This factor encourages researchers and the government to propose to make the Lembang area into a new separate administrative region of West Bandung Regency. In the beginning, the proposal for Lembang to become a new city was proposed at the Regional Planning Design Communication Forum to the Deputy Governor of West Java Province. Lembang will have adequate sources of regional income from the tourism and agricultural sectors when it does become a new regency or city. Population growth will also increase rapidly because people prefer to live in a city. The main reason people move to an administrative city is because economic development grows relatively better under city administrations (Pakaya, 2016).

Although in terms of regional income, Lembang as an administrative city is feasible, it is necessary to study other aspects to produce a comprehensive policy related to the unit proliferation of Lembang. Evaluation of the Lembang New Autonomous Region can be done with the help of Geographic Information System (GIS) analysis tools. The GIS analysis may have to be integrated with qualitative research to gain specific information (Steinberg & Steinberg, 2012). GIS tools are capable of integrating various geographic and socioeconomic factors to produce information for policymaking (Holdstock, 1998). The output information is key to rational

decision making (Dangermond, 1988). The local government started implementing GIS for asset management and administrative tasks that require geographic data processing (Worral, 1994).

Tourist potential

Lembang is famous for its tourism destinations, which include nature tourism, culinary tourism, and built attractions (Effandi, 2010). There are many different tourist attractions, causing tourism market competition in the Lembang region (Bhudiharty, 2021). Based on observations and local knowledge, most of the tourists who visit Lembang come are outsider, especially from the Jakarta metropolitan area.

The number of tourist movements is extremely high on weekends or during the holiday season. Based on the data from Indonesia Statistical Agency (BPS) in 2018, the number of Lembang City tourism visits was 505,947 (local and international). Lembang subdistrict is well developed for tourism businesses, with a perfect geographical location and temperature, which is suitable for tourist vacationing (Herayanti et al., 2020). Visiting the place is popular and in high demand by people from outside the city and local communities.

Decentralization

The implementation of local government in Indonesia has experienced a significant trend from centralization to decentralization following the enactment of UU No. 22 Tahun 1999 concerning Regional Government (Simanjuntak, 2015). Decentralization gives local governments the flexibility to regulate the wheels of government in their administrative areas (Pandie, 2018). In the context of this research, the central government is held by the West Java provincial government, which gives authority to new autonomous regions in managing their territory in an effort to provide optimal services to the residents. Decentralization is a concept that can be understood universally, while regional autonomy is a decentralized concept applied in Indonesia (Smith, 1985). The term new autonomous region is contextually related to the concept of decentralization in Indonesia.

Administrative unit proliferation

Administrative unit proliferation, which is then referred to as the formation of new regions, is the division of administrative authority accompanied by the delegation of financing, the division of the area along with the potential of natural resources contained therein and the number of residents. The government has set the terms and criteria for the division, abolition, and merging of regions as stipulated in Government Regulation No. 129 of 2000 concerning Requirements for Establishment and Criteria for Regional Expansion, Abolition, and Merger. In PP No. 129 of 2000 it is explained that the establishment, expansion, abolition, and merging of regions are aimed at improving the welfare of the community. Some of the targets for this goal include improving democratic life, improving management of regional potential, and improving security and order (Khairullah & Cahyadin, 2006).

Materials and Method

This study examined the spatial aspects of the Lembang City area, which is being proposed to become a new autonomous region. We identified some existing characteristics, such as physical and social characteristics, and some existing assets, such as the distribution of schools. This aimed to evaluate the prospect of Lembang region to become an administrative city. The spatial analysis

process was carried out through a geographic information system as well as various other geographical scientific analysis approaches. Most of the visual maps were analyzed and visualized using processing tools in ArcGIS Pro software involving geographical models for calculation.

Data

The data used in this study had various forms and sources. We used news media and local knowledge to understand the social characteristics, while remote sensing data was used to identify the physical characteristics of the study area. We used spatial data in Shapefile format from various sources, such as the road network from *OpenStreetMap* and also for district and sub-district administrative data, we used official data from the Geospatial Information Agency (BIG). The last form of data that we used was secondary data in tabular format. This form of data was used in several mathematical analysis sessions, including the analysis of spatial interactions and population density. Some details of the data used in this study are listed in Table 1.

Table 1. Details of the data used in this study

Data	Source	Details
Spatial Data		
Administrative	Indonesia Geospatial Agency (BIG)	Official administrative data covering sub-district boundaries.
Road network	OpenStreetMap (OSM)	Road network data from the internet is open source and can be used in service area analysis.
Landuse	Indonesia Geospatial Agency (BIG)	Spatial data is used in understanding land use variations through map visualization.
School distribution	Indonesia Geospatial Agency (BIG)	The distribution of educational facilities in the study area includes elementary schools, junior high schools, senior high schools, and vocational high schools.
Remote Sensing Data		
SRTM 1 Arc Second	USGS EarthExplorer	Remote sensing data contains surface elevation information that is used to understand the physical condition of the study area.
Tabular Data		
Population	Bandung Barat Statistics Agency (BPS)	Population data per sub-district is used in understanding population density conditions and is defined as the mass in the spatial interaction analysis.

Spatial interaction

Spatial interaction modeling is an approach used in simulating the virtual movement of people, goods, and information through mathematical models. The model can be used as a support system for making policies (Wu et al., 2021). One of the capabilities of the spatial interaction model used in this study was to show and visualize areas with a large probability of population movement, which provides a perspective on identifying points where human activity is likely to be dense (Jia et al., 2022). The result is useful as a consideration by policymakers in determining the economic center of a region.

The spatial interaction modeling aproach used in this study was the unconstrained approach, which is the most convenient and is fairly representative (Oshan, 2021). The unconstrained approach is generally a pure form of the gravity model applied to geographic topics. Unconstrained models can be written as follows:

$$T_{ij} = KW_iW_jf(c_{ij}) \qquad (1)$$

where

K : constant

W_i : mass term at zone i

W_j : mass term at zone j

$f(c_{ij}) : \frac{1}{c_{ij}^n}$

The distance decay effect is represented as $f(c_{ij})$ in this model, which reduces interaction strength as distance increases (Gao et al., 2021). The effect of distance decay is essential in understanding and predicting travel demand geographically (Zhu et al., 2020). The mass term in the gravity model defines opportunity, where a higher value means it has huge interaction potential, while a constant is sometimes used as a balancing factor (Wilson, 1971).

The implementation of spatial interaction for ArcGIS aimed to visualize the interaction network that defines the probability of people on the move. The input was the number of people from each sub-district that defined mass/weight, while the distance function was measured from the straight line of each sub-district point. The network line was constructed from ArcGIS analysis tools and later was classified into several classes based on their interaction value. The ArcGIS software can also implement city center accessibility analysis using the Isomap approach, meaning that affordability is influenced by the road network. It can be used in conducting mileage analysis and affordability visualization.

Result

Physical condition of Lembang City

Lembang is located north of Bandung City at 638 to 2201 meters above sea level. This high altitude makes Lembang City provide essential ecosystem services such as water supply and recreational opportunities offered by geographical conditions that support natural tourism (Kurniasih & Yusup, 2016). These opportunities bring the advantage of Lembang City being visited by tourists from various regions. On the other hand, the Lembang area has a serious natural disaster threat, which is realized by the local community (Akbar et al., 2020). The potential threat of natural disasters exists within the administrative area of the proposed City of Lembang, so this threat is internal.

The two threats of natural disasters referred to in the case study of the Lembang area are earthquakes and volcanic disasters. The potential for earthquakes in the Lembang area comes from the Lembang fault, which stretches over 29 km. This area is prone to geological disasters (Abdulharis et al., 2022). There were thirteen earthquakes with a magnitude of 0.4 3.3 Mw in this area from 2010 to 2017 with an annual fault movement of 6 mm (Handayani et al., 2021; Meilano et al., 2012). Then another disaster threat is volcanic disaster originating from the active volcano Tangkuban Perahu, which is located in the northern part of the Karyawangi subdistrict (Bury, 2002).
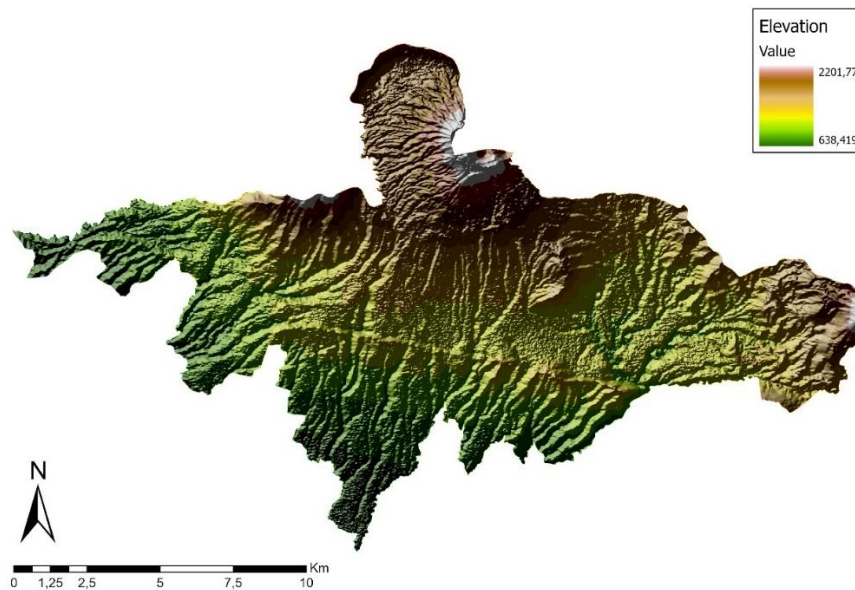
**Figure 1.** Terrain model of the proposed area.

Figure 1 is a map of the topographical condition of the Lembang area, which is visualized using SRTM remote sensing data. The elevation value displayed in the map legend is the height in meters above sea level. The lowest value in this area is 638 meters above sea level, so this area is high. The geography of the disaster threat can be seen on the topographic map above. The Lembang Fault is seen stretching in length around the middle of the visualized area, while the volcanic threat of Mount Tangkuban Perahu is in the north of the Lembang area with the highest altitude. Information on physical conditions extracted from remote sensing data is given in Table 2, which contains information on the average height and average slope of each sub-district.

Land use is an attempt to manage and modify the natural environment by humans as a means of fulfilling the necessities of life (Martina, 2021). The land-use map in Figure 2 was sourced from official spatial data from the Indonesian Geospatial Information Agency (BIG), however, some of the spatial data are rather old. The study looked at the improvability of land use in understanding the characteristics of land management and modification at the location of the proposed administrative city of Lembang. The visual is useful in reviewing the conditions in supporting the sustainability of the city. Over time, land-use experiences some dynamic changes, especially in the use of built-up land. This is due to the high demand, as the population continues to increase every year.

The results of the visualization show that the use of built-up lands such as settlements and buildings does not dominate the city that is being proposed. This may be an early form of an elevated city less dominated by built-up land, but the concept can also be more towards to a unique green city. Another possibility is that the status may not be administrative city but rather administrative district. Considering its physical conditions and land use patterns, built-up land will likely dominate in the central to the southern part of Lembang City while the northern part will be left to have a natural environment.

Table 2. Details of sub district area width and its physical information

District	Area Width (Hectares)	Average Elevation	Average Slope (Degree)
Parongpong			
Cigugur Girang	412.7	1118.46	10.43
Cihanjuang	261.12	942.38	9.49
Cihanjuang Rahayu	457.57	1206.44	13.34
Cihideung	519.29	1214.62	9.02
Ciwaruga	312.8	894.26	8.15
Karyawangi	2047.76	1602.27	14.72
Sariwangi	227.87	872.63	7.51
Lembang Timur			
Cibodas	592.5	1205.09	12.62
Cibogo	309.95	1227.27	13.09
Cikidang	807.82	1282.01	15.46
Cikole	797.68	1356.62	12.52
Langensari	385.68	1186.27	13.29
Mekarwangi	415.52	1075.47	20.17
Suntenjaya	1593.58	1462.67	19.44
Wangunharja	791.42	1233.71	15.72
Lembang			
Cikahuripan	743.08	1493.54	13.7
Gudangkahuripan	346.8	1160.28	14.04
Jayagiri	920.44	1514.93	13.43
Kayuambon	220.42	1208.91	6.49
Lembang	196.76	1241.73	6.48
Pagerwangi	465.01	1144.47	14.45
Sukajaya	603.11	1519.02	11.97
Wangunsari	359.83	1067.24	13.19
Cisarua			
Cipada	559.4	1095.12	12.74
Jambudipa	466.62	1144.35	9.59
Kertawangi	648.59	1375.57	15.15
Padaasih	472.7	1027.54	11.97
Pasirhalang	366	1047.86	11.48
Pasirlangu	1270.39	1225.22	17.08
Sadangmekar	764.09	910.69	16.29
Tugumukti	742.67	1301.55	18.91
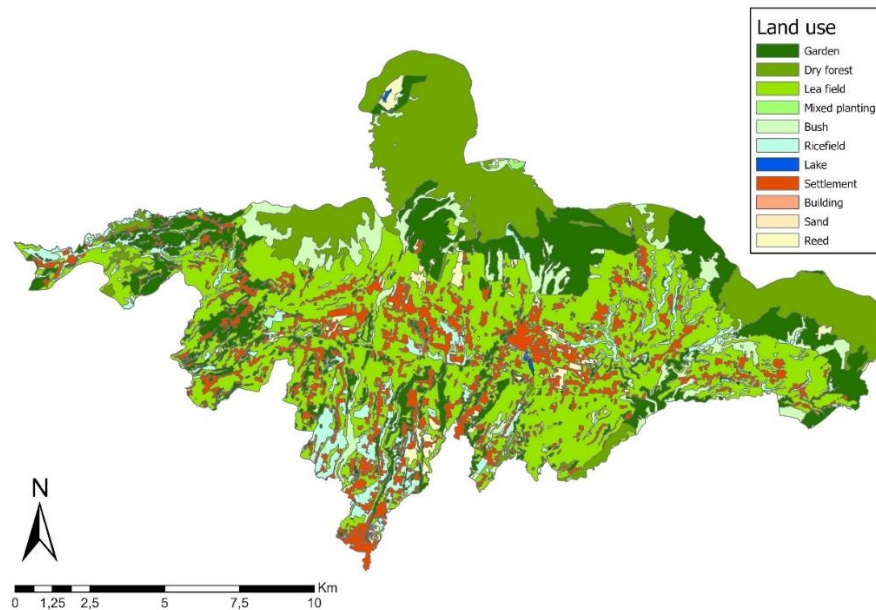
Figure 2. Land use map of the proposed Lembang city area.

Table 3. Details of land use width and its percentage

Landuse	Area width km²	Percentage of the entire study area (%)
Built-up	**22.63**	**9.07**
Settlement	22.37	8.97
Building	0.26	0.1
Natural	**226.85**	**90.93**
Garden	35.29	14.15
Dry forest	36.03	14.44
Lea field	69.84	27.99
Mixed planting	0.2	0.08
Bush	11.86	4.75
Ricefield	69.84	28
Lake	0.2	0.08
Sand	0.07	0.03
Reed	3.52	1.41

Based on the details of land use in Table 3, land use in the Lembang City area is currently dominated by natural environments such as lea fields, dry forests, and gardens. The use of built-up land, which includes settlements and buildings, has currently a percentage of 9% of the entire administrative area of Lembang City. Although this is relatively low, the category of built-up land is the one that often increases every year and may dominate when Lembang is officially has the status of a city.

Social Condition of Lembang City

Population density is one social aspect that can be used in understanding areas where people concentrate. The ratio of population to land area is the most common way to define population density, which explains the number of people per specific area width. The definition of land area in this section of population density is the total area of the entire sub-district, which in some cases can be replaced with settlement area or built-up land area in the sub-district. However, the analysis will go up to the slum area level.

Based on West Bandung Regency Statistics Agency (BPS) data in 2020, Lembang City had a population of 389,231 or 63% of the total population of Cimahi City. The factor that makes the proposed Lembang City administrative area have a smaller population than Cimahi City, which has a smaller administrative area, is because Cimahi City's administrative area consists mostly of built-up land and only a small amount of green open space. On the other hand, the proposed Lembang city area consists of various green open spaces, which include plantations, rice fields, dry forests, and vacant land.

Due to the greater area of Lembang City and its great economic potential, this may increase the population growth when Lembang becomes a new autonomous region. A high population number is good for its productive potential but also brings with it higher poverty potential. According to (Amati, 2018), the ideal population number for a city is 50 people per hectare, while according to (Litman, 2017) is between 20 and 40 residents per hectare. If the proposed Lembang City administration area has a population of 389,231 people and an area of 190.79 hectares, then the total population per hectare will be 20 people.

Figure 3 is a visualization of the population density map of the proposed region of Lembang City. The map has five classes of population density, making it easier to read and identify areas with unsuitable characteristics. The classification was done using a natural break, which was carried out in the ArcGIS application. The natural break classification method, also called the Jenks optimization method, is a data classification method designed to determine the best order of values into different classes. This is done by minimizing the deviation of the mean of each class from the class mean, while maximizing the deviation of each class from the mean of the other groups (Chen et al., 2013).

After we obtained the results of the natural break classification on the map, we highlighted the class with the highest and the lowest value categories. In this study, both the highest and the lowest class categories did not have good marks. This is because ideal population density in a city is 20 to 40 residents per hectare, or under 50 residents per hectare, meaning that the sub-districts that have a good population density category are at the 18 to 30 population per hectare class, or at the middle class shown in the legend of Figure 3. Sub-districts with ideal population density already exist in the sub-districts of Kertawangi, Jambudipa, Padaasih, Sukajaya, Jayagiri, Pagerwangi, and Cibodas. Meanwhile, sub-districts with high population density, such as the sub-districts of Lembang, Cihanjuang, and Ciwaruga, can be considered to stabilize their population density by relocating some of the residents to sub-districts that have low population density, as depicted in light colors area in Figure 3.
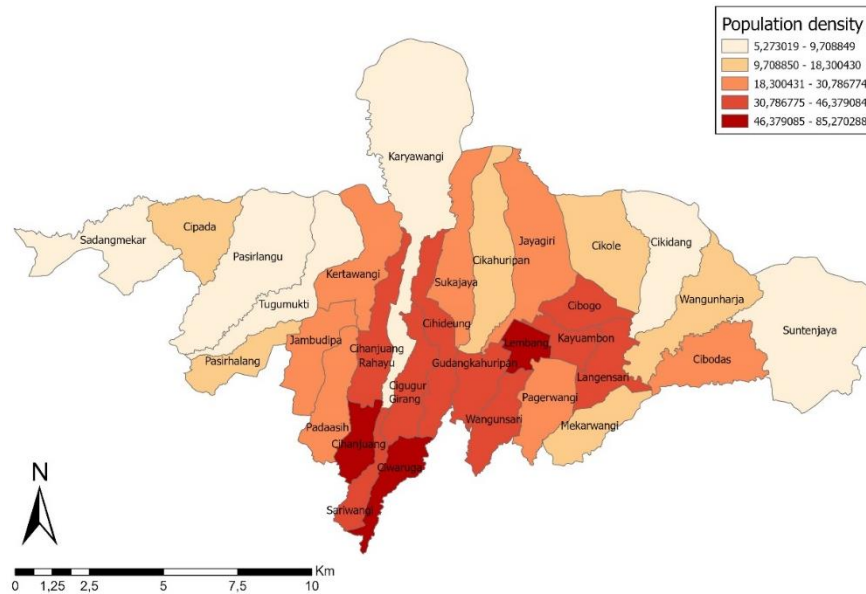
Figure 3. Population density map of Lembang City region.

The city center of Lembang is the centroid of regional economic activities. The city center in Lembang City is defined as Lembang Square in this study. This is because the square is relatively in the middle of the center of activity. Another factor is that around the square there are strategic places such as the Grand Mosque, markets, bank offices, police offices, government offices, tourist attractions, and other important aspects, causing the community to interact with the city center more often. Another factor that supports the choice of this point as the city center is the result of the analysis of regional interactions between sub-districts in Figure 4, which shows the Lembang square area having the highest interaction density in the entire administrative scope of Lembang City.

Based on the results of the analysis of the overall affordability of points in Lembang City, the shortest time to get to the city center point is 4 seconds while the longest is 2,620 seconds (43.6 minutes) and the average trvael time is 983 seconds (16.38 minutes). This travel time is stable if the vehicle travels at 33 km/h. Traffic and congestion factors are not considered in this form of visualization. However, heavy traffic can be concentrated at some specific points considering that the road network in Lembang does not have many branches and always relies on main roads.

Inter-sub-district interactions in this study identified which areas in Lembang City have the highest potential of high mobility activities. City center interactions in this visualization can be seen through the thickness of the straight line. The thicker the straight line, the thicker the interaction of the city. City interaction strength in this study is influenced by distance and the population of the area. Each point in this visualization represents a village in the Lembang City area. Based on the analysis of the strength of the spatial interaction unconstrained approach, the strongest relationship to the City Center in this study was the interaction that came from Jayagiri Sub-district, Lembang Sub-district, and Cikahuripan Sub-district.
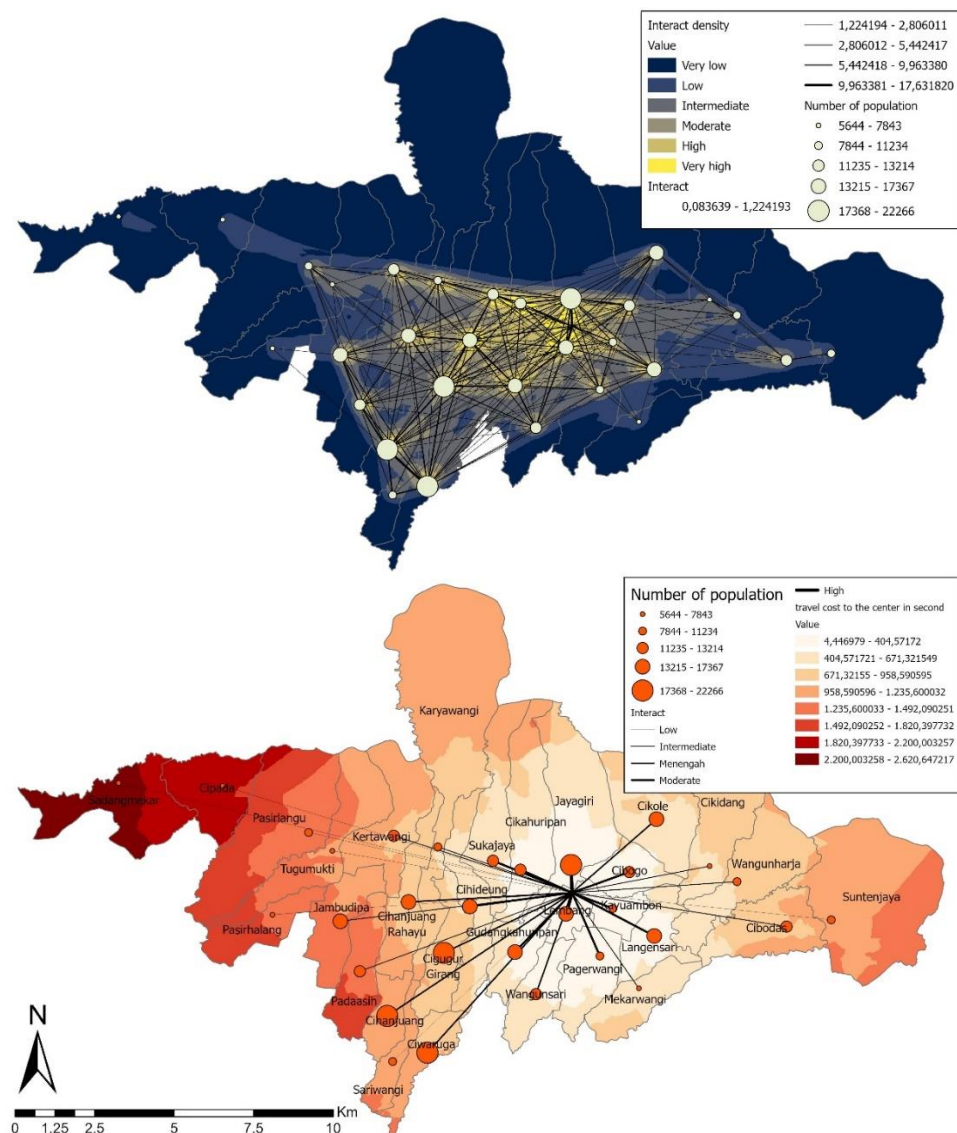
Figure 4. (upper image) Spatial interaction between sub-districts using population as a mass. (bottom image) Interaction with the center of Lembang City and the travel time cost from various points.

Among the approaches used in evaluating the dominant parameter influencing the spatial interaction model are the alpha lambda effect and the beta effect. The beta effect refers to evaluating the effect of the exponential of the distance parameter on the value of the spatial interaction. In the beta effect, the closer the distance, the higher the likelihood of spatial interaction. Meanwhile, the alpha lambda effect is the exponential effect of the mass variable on the value of the spatial interaction, where the higher the mass, the higher the likelihood of spatial interaction that will be obtained.

Table 4. Details of the average value of spatial interaction in each sub-district along with the average distance to the city center.

| District	Average spatial interaction value	Average distance to city center (in seconds)
Parongpong		
Cigugur Girang	6794.81	813.34
Cihanjuang	4297.62	1136.76
Cihanjuang Rahayu	4707.32	896.97
Cihideung	5575.33	650.28
Ciwaruga	3402	989.31
Karyawangi	700.1	1041.7
Sariwangi	2350.88	1133.72
Lembang Timur		
Cibodas	1911.74	868.95
Cibogo	5693.86	334.63
Cikidang	733.96	771.04
Cikole	944.63	640.24
Langensari	3313.69	379.21
Mekarwangi	467.4	581.27
Suntenjaya	55.06	1184.44
Wangunharja	990.43	756.79
Lembang		
Cikahuripan	3005.32	566.5
Gudangkahuripan	7260.16	391.82
Jayagiri	2131.82	464.15
Kayuambon	7443.31	176.49
Lembang	11284.13	122.55
Pagerwangi	3046.27	307.17
Sukajaya	2934.81	706.42
Wangunsari	3119.34	405.89
Cisarua		
Cipada	541.27	1958.3
Jambudipa	2243.29	1276.35
Kertawangi	2060.56	1040.91
Padaasih	2854.32	1422.34
Pasirhalang	631.67	1528.24
Pasirlangu	624.71	1566.02
Sadangmekar	258.73	2297.67
Tugumukti	833.47	1279.8
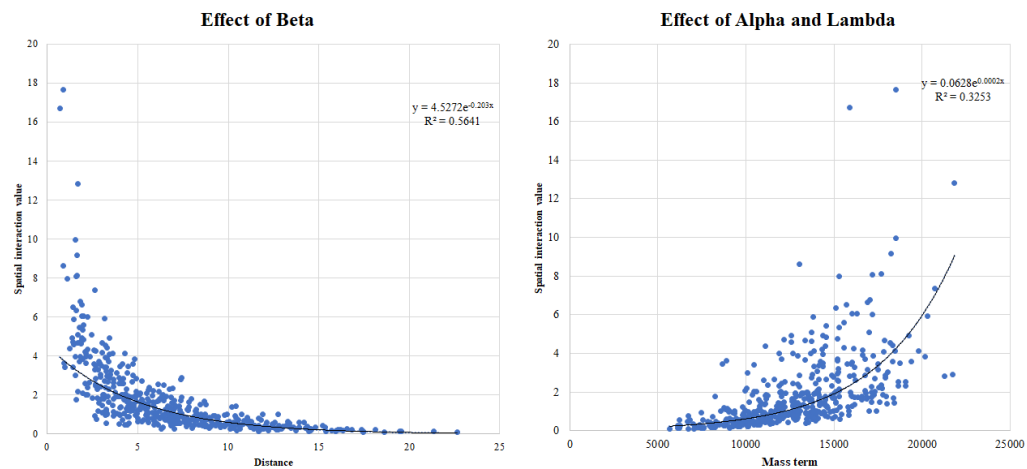
Figure 5. Exponential analysis of beta, alpha and lambda effects in spatial interaction modeling in the form of regression.

Figure 5 shows the exponential effects of beta and alpha lambda through regression analysis. The The beta effect in this case produced an exponential value of 0.816 with an R^2 value of 0.5641. Meanwhile, for the alpha lambda effect, the exponential value of 1 with R^2 was 0.3253. An exponent value of 1 means that there is a linear relationship between the interaction value with mass or distance. A value exceeding 1 implies exponential growth of the value of the spatial interaction at the level of increasing mass or distance.

SDG implementation

One of the SDG topics implemented in this research is education quality. Education is the fourth-ranking priority for sustainable development designated by the United Nation. This research is about the spatial perspective to overview and evaluate what may help the government to implement a policy that is sustainable for education quality. Some spatial perspective research about education quality focused on infographics of teacher and student qualifications, visualized through a map (Binot et al., 2020). This approach seems very helpful for the government in policy making so that all schools/regions can obtain a decent and equitable quality of education. Unfortunately, data from the qualifications of teaching staff and data on quality indicators from students are very difficult to obtain at the local level. Obtaining data associated with education quality indicators may sound challenging to obtain, but we can still apply GIS analysis to this topic of SDGs on education quality. The topic of the application is the affordability of schools for residents in the Lembang city area.

Similar research related to the analysis of regional affordability as an effort to improve the quality of education has been carried out by (Sakti et al., 2022). The previous research mentioned covers the province of West Java and the fact that the Lembang area in this study is part of the province of West Java. Figure 6 is a map of school accessibility that contains information on travel times at each different point and the distribution points of schools. The results of the visualization of the map show that the distribution of schools is associated with the distribution of settlements, and it can also be seen that most of the residential locations are in the green zone of the accessibility of the nearest school, which means that the location is affordable in terms of access to education.
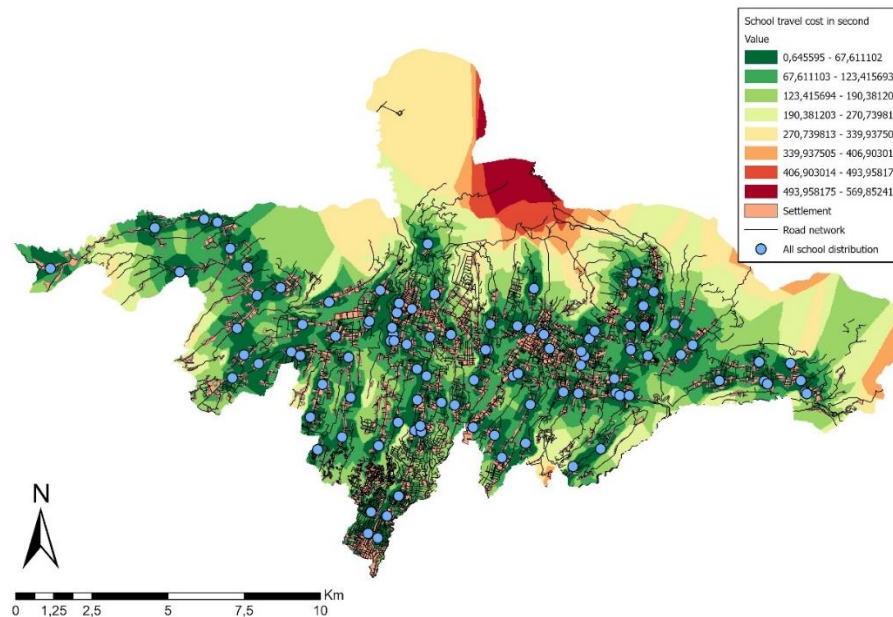
Figure 6. Travel time to the nearest school and its distribution.

The results of this travel time were obtained by defining a travel speed of 33 km/hour. This is the average value of the speed of private vehicles traveling at the location in this study. Students usually bring their own vehicles or are picked up by their parents using a private vehicle. Settlements are where most students live, so we took this into account when calculating the average distance traveled to the nearest school. There is a significant difference between the average distance traveled from the settlement and the distance traveled at any point where the distance from the settlement looks more affordable and takes less time.

Table 5. Details of average travel time to the nearest school

District	Number of Schools	Average Travel cost (seconds)	
		from any point within the district	From the settlement
Parongpong			
Cigugur Girang	6	77.96	50.56
Cihanjuang	1	105.13	98.88
Cihanjuang Rahayu	6	105.35	81.82
Cihideung	4	93.22	72.6
Ciwaruga	3	97.54	83.49
Karyawangi	5	264.35	41.11
Sariwangi	2	86.32	78.14
Lembang Timur			
Cibodas	4	102.85	63.32
Cibogo	3	84.16	62.36
Cikidang	1	191.21	61.47
Cikole	5	165.23	56.43
Langensari	7	69.81	48.58
Mekarwangi	2	138.71	115.64
Suntenjaya	4	204.65	88.14
Wangunharja	2	164.32	53.69
Lembang			
Cikahuripan	4	234.82	60

Gudangkahuripan	4	76.23	64.66
Jayagiri	4	285.21	68.26
Kayuambon	3	72.94	59.76
Lembang	1	68.69	59.77
Pagerwangi	2	145.09	86.51
Sukajaya	0	258.48	146.15
Wangunsari	4	72.63	59.18
Cisarua			
Cipada	4	80.31	67.3
Jambudipa	5	81.44	67.14
Kertawangi	4	155.58	66.98
Padaasih	3	86.33	74.58
Pasirhalang	3	78.19	75.77
Pasirlangu	4	119.88	86.27
Sadangmekar	2	140.57	90.57
Tugumukti	2	171.17	69.27

SWOT Analysis

SWOT analysis is a strategic planning technique used to assist in identifying the strengths, weaknesses, opportunities, and threats associated with project planning. A SWOT analysis is conducted as a strategic consideration in making decisions on a topic that is being studied (Caves, 2005). This is the last discussion of this research and contains identification of the non-spatial analysis. The strategy obtained from this research is a recommendation given by the author.

Table 6. The SWOT analysis

|	Identification	Strategy
Strengths	Lembang has a strong potential for economic resources. Lembang is also known by the public for its tourism and food products. Thus, economic activity will grow faster if Lembang is made into a New Autonomous Region (City).	Implementation of optimal management of economic resource assets as an effort to maintain the success of economic resources.
Opportunities	Opportunities for increasing economic growth do not only come from within Lembang itself but can also be influenced by the surrounding environment. Lembang City is surrounded by two cities that excel in their GRDP, which will directly affect Lembang itself.	Improve access to the road network and widen the road because access to Lembang City mainly depends on Jl. Setiabudi and Jl. Sergeant Bajuri.
Weaknesses	The weakness that needs to be considered is that Lembang City has the lowest GRDP value between Cimahi City and Bandung City.	Improving the quality of economic resources and optimal and regular use of land.
Threats	The threat that affects the feasibility of Lembang City is that most of the economic income of the Lembang area comes from outside Lembang. Thus, the constraints of mobilization from outside will have a direct impact on the economic income of Lembang City.	Economic resources do not only depend on the tourism sector. Develop other economic sources that are exporting goods such as agriculture, plantations, as well as goods and services.

Discussion

There are many challenges that need to be considered in planning the administration of a city. This research was very limited in understanding the overall spatial aspects of Lembang City, but it provides a multifaceted identification of several aspects. This study aimed to examine the area of a candidate new city, namely Lembang City, by considering the spatial analysis of the Lembang City area, both physically and socially. From the research results, we obtained several findings that can be considered and some challenges in determining the administration of the city of Lembang.

Administrative boundary

One of the challenges in managing a new administration are territorial boundaries. Sub-district boundaries are usually carried out by negotiation between sub-districts to create an official boundary (Ardianto & Alfirdaus, 2020). However, based on local knowledge of the local community, we found that boundaries are usually separated by natural objects such as rivers and boundaries of built objects such as roads, and sometimes by monuments. One of the examples regarding regional boundaries from this research area is the Cibodas sub-district. Based on research by (Noviandi et al., 2021), the boundaries of the Cibodas sub-district in the north and south are natural rivers covered by natural forest. This proves that physical conditions have an important role in providing administrative boundaries for each sub-district in an area where land cover is dominated by natural objects.
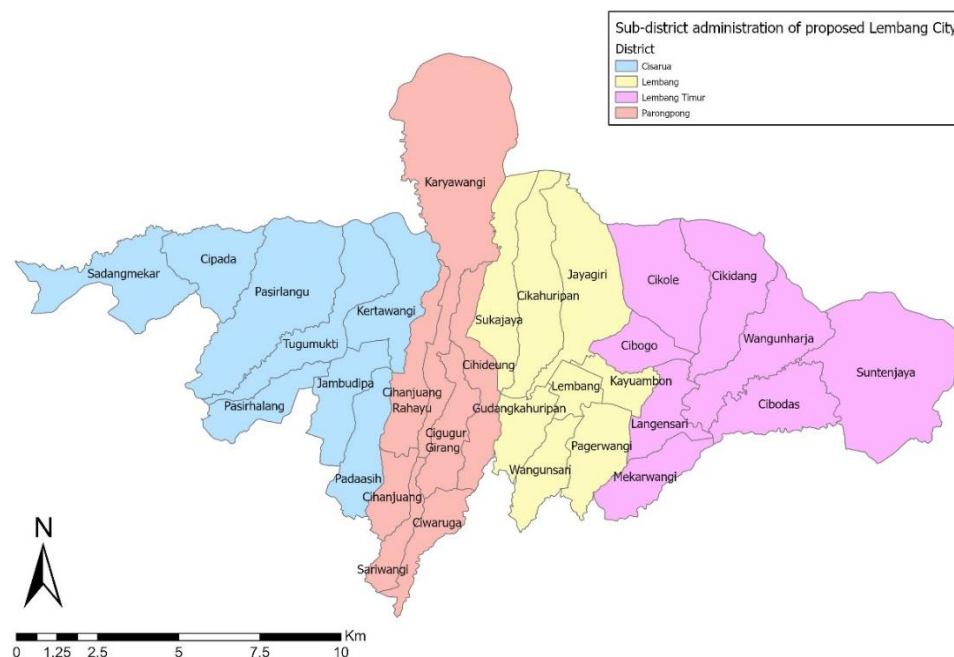
Figure 7. Division of districts and sub-districts in the proposed Lembang City administrative area.

When Lembang is separated from West Bandung Regency, Lembang City will cover three existing sub-districts, i.e., Lembang District, Cisarua District, and Parongpong District. Based on Law No. 32 of 2004, Article 5, Paragraph 5, it is necessary to have at least four sub-districts to form a city. Meanwhile, the proposed Lembang City sub-district covers only three exisiting sub-

districts. Therefore, it is necessary to divide Lembang into two sub-districts. The new sub-district is named Lembang Timur District (some sources predict the new name will be Maribaya district), which includes Cikole Sub-district, Cibogo Sub-district, Cikidang Sub-district, Lanensari Sub-district, Mekarwangi Sub-district, Cikidang Sub-district, Wangunharja Sub-district, Cibodas Sub-district, and Suntenjaya Sub-district (Burdansyah, 2021; Pradana, 2020). The total area of Lembang City is 190.79 km^2.

Interaction Opportunities

The interaction between multiple cities that are adjacent to the city of Lembang will affect the level of economic growth of the city of Lembang. In theory, this is affected by the nature of spatial interaction and the distance decay concept. The city of Bandung has a fairly high population of 1,262,479 people. Then follows Cimahi City with 614,304 people and Lembang City with 389,231 people. Short-haul trip interaction potential in this case is where people from Bandung and Cimahi go to Lembang city for tourism activities, while people from Lembang go to Bandung or Cimahi for working purposes. This interaction will be beneficial for the City of Lembang so that the administration of the City of Lembang will experience rapid economic growth. In other cases, long-haul interaction may involve inter-city trips from the Jakarta metropolitan area and other cities.

Road Network and accessibility challenge

A drawback for the establishment of Lembang City that really needs to be considered are Lembang's road network and access roads, which are not feasible. The road network is an essential aspect of a city. The challenge of this problem is that repairing the road network in Lembang City is quite difficult due to the extreme topographical and natural conditions. Meanwhile, the existing road network causes traffic flow problems. Visually, Lembang only acts as a link between the City of Bandung and Subang Regency with the road width not being very wide and there being no route choices. If Lembang is not yet worthy of being called an administrative city due to not fulfilling several criteria, Lembang as a candidate new autonomous region can still continue, but it may be that Lembang will rather aspire to the status of administrative regency.

Conclusion

This study concludes that the aspect of spatial analysis has a broad scope in reviewing and may be used as strategic material for the government in making decisions. We conclude several important points in this study to be improvable. 1) Regarding physical conditions, Lembang City has a mountainous topography, great potential as natural environment for tourism, however, it has and high potential threat of natural disasters. Extreme physical conditions also are a challenge that can lead Lembang to being separated from West Bandung Regency into an administrative city. 2) The percentage of built-up land use in the proposed coverage area is very small, around 9% of the total administration. This number is relatively very small for a city administration and is more appropriate for the regency administration type. 3) Several sub-districts in the proposed administrative area do not meet the ideal population density criteria for a city, which means that some sub-districts need more residents. This target may be achieved over time. 4) Intra-administrative interaction shows that the Lembang sub-district has the highest interaction density. Thus, it can be used as a centroid for administrative economic centers. 5) Existing schools and education are well distributed and affordable by the people of Lembang. The next focus for better education is to improve the quality of education and facilities internally. 6) The proposed

administration coverage of Lembang city is not ideal for an administrative city due to the difficulty of expanding built-up land. One example of an obstacle is that the coverage of the proposed Lembang City includes active volcanic mountains and protected forests. It is highly recommended to reconsider and adjust the coverage of the proposed region if it has to be an administrative city. If it has to maintain the proposed area coverage, it would be more appropriate to use the Lembang district, which previously has been proposed to be named Lembang City.

References

Abdulharis, R., Handayani, A. P., Isouchi, C., & Meilano, I. (2022). Developing Community Disaster Resilience in the Lembang Fault Area, Indonesia: Lessons Learned from Japanese Experience. *Applied Sciences (Switzerland)*, *12*(3). https://doi.org/10.3390/app12031271

Akbar, M. A., Rahmafitria, F., & Nurazizah, G. R. (2020). Analisis Usaha Pariwisata Dalam Menghadapi Risiko Bencana Alam Di Kecamatan Lembang. *Journal of Indonesian Tourism, Hospitality and Recreation*, *3*(2), 177–187. https://doi.org/10.17509/jithor.v3i2.26414

Amati, M. (2018). *How many people make a good city? It's not the size that matters, but how you use it*. Phy.Org. https://phys.org/news/2018-08-people-good-city-size.html

Ardianto, H. T., & Alfirdaus, L. K. (2020). Analisis Rencana Pemekaran Desa dan Kecamatan di Kabupaten Kotawaringin Barat : Sebuah Skenario Wajah umum wilayah Indonesia pasca Orde Baru adalah lahirnya provinsi , kabupaten , dan kota-kota baru . Hal ini merupakan hasil perubahan politik pasca reform. *Journal of Social Politics and Governance*, *2*(2), 99–120.

Bhudiharty, S. (2021). Analisis Kualitas Pelayanan dan Kepuasan Pengunjung Objek Wisata Farmhouse Lembang. *Management & Accounting Expose*, *2*(1), 10–20. https://doi.org/10.36441/mae.v2i1.93

Binot, R., Debnath, T., Kar, B., Kundu, D., Milbert, A., & ... (2020). India, Germany and Europe: A Spatial Perspective at SDG 3 on Good Health and Well-being. *Federal Institute for Research on Building, Urban Affairs and Spatial Development*, *March*. https://www.ssoar.info/ssoar/handle/document/71359

Burdansyah, C. (2021). *Lembang Ingin Pisah dari Kabupaten Bandung Barat: Jadi Kota Mandiri*. Tribunnews.Com. https://www.tribunnews.com/regional/2021/06/04/lembang-ingin-pisah-dari-kabupaten-bandung-barat-jadi-kota-mandiri?page=3

Bury, J. B. (2002). Erupitve History of Tangkuban Perahu Volcano, West Java, Indonesia, Preliminary Report. *Journal of Geography*, *2*(3), 404–409. https://doi.org/https://doi.org/10.5026/jgeography.111.3_404

Caves, R. W. (2005). *Encyclopedia of the City*. Routledge.

Chen, J., Yang, S., Li, H., Zhang, B., & Lv, J. (2013). Research on geographical environment unit division based on the method of natural breaks (Jenks). *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences - ISPRS Archives*, *40*(4W3), 47–50. https://doi.org/10.5194/isprsarchives-XL-4-W3-47-2013

Effandi, F. (2010). Pola Sebaran Minimarket dengan Kinerja Usaha Toko Pengecer Tradisional di Kota Kecil (Studi Kasus: Kota Soreang, Tanjungsari, dan Lembang). *Journal of Regional and City Planning*, *21*(3), 183–196.

Handayani, A. P., Abdulharis, R., Pamumpuni, A., Meilano, I., Hendriatiningsih, S., Hernandi, A., Leksono, B. E., Saptari, A. Y., & Widyastuti, R. (2021). Assessment of Perception on Disaster Proneness of Lembang Fault in District of Cisarua, West Java Indonesia. *IOP Conference Series: Earth and Environmental Science*, *936*(1). https://doi.org/10.1088/1755-1315/936/1/012014

Khairullah, & Cahyadin, M. (2006). Evaluasi Pemekaran Wilayah di Indonesia: Studi Kasus

Kabupaten Lahat. *Jurnal Ekonomi Pembangunan*, *11*(3).

Kurniasih, N., & Yusup, P. M. (2016). Social Media Utilization To Promote Tourism Industry in Lembang: a Content Analysis Study of Social Media Used By Management of Tourism Objects in Lembang, Indonesia. *The 2016 International Conference on Media: Mass Media at Crossroads Conference 2016*, 489–500. https://plus.google.com/105720139150647986705

Litman, T. (2017). Determining Optimal Urban Expansion, Population and Vehicle Density, and Housing Types for Rapidly Growing Cities. *Transportation Research Procedia*, *00*(00), 0–0. www.elsevier.com/locate/procedia

Martina, L. (2021). Archaeological assessment reveals Earth ' s early transformation through land use. *Science.Org*, *902*, 897–902. https://doi.org/https://doi.org/10.4324%2F9780203484234

Meilano, I., Abidin, H. Z., Andreas, H., Gumilar, I., Sarsito, D., Rahma, H., Rino, Harjono, H., Kato, T., Kimata, F., & Fukuda, Y. (2012). Slip rate estimation of the lembang fault west java from geodetic observation. *Journal of Disaster Research*, *7*(1), 12–18. https://doi.org/10.20965/jdr.2012.p0012

Nurranirusmana. (2021, September 1). *Penduduk Kota Cimahi Kian Padat, Ini Sebabnya*. Retrieved from JabarEkspres.com: https://jabarekspres.com/berita/2021/09/06/penduduk-kota-cimahi-kian-padat-ini-sebabnya/

Noviandi, I. E., Garnis Pandan, W., Devi Muhamad, R., Jarry, F., Naufal Hafizhan, S., Arif, I., & Alnidi, B. (2021). Mendukung Sistem Basis Data Spasial Desa Cibodas dengan Kegiatan Pemetaan Partisipatif Menggunakan Platform Openstreetmap. *JPIG (Jurnal Pendidikan Dan Ilmu Geografi)*, *6*(2), 125–133. https://doi.org/10.21067/jpig.v6i2.5939

Oshan, T. M. (2021). The spatial structure debate in spatial interaction modeling: 50 years on. *Progress in Human Geography*, *45*(5), 925–950. https://doi.org/10.1177/0309132520968134

Pandie, P. M. R. (2018). Feasibility Study For New Local Government In East-Central-South Regency East-South East Province Prima Maryos. *Jurnal Ilmiah Administrasi Pemerintahan Daerah*, *X*(2), 101–111. http:ejournal.ipdn.ac.id/index.php/JAPD

Pradana, W. (2020). *Akankah Lembang Menjadi Kota Mandiri?* Detik News. https://news.detik.com/berita-jawa-barat/d-5254644/akankah-lembang-menjadi-kota-mandiri

Sakti, A. D., Rahadianto, M. A. E., Pradhan, B., Muhammad, H. N., Andani, I. G. A., Sarli, P. W., Abdillah, M. R., Anggraini, T. S., Purnomo, A. D., Ridwana, R., Yulianto, F., Manessa, M. D. M., Fauziyyah, A. N., Yayusman, L. F., & Wikantika, K. (2022). School location analysis by integrating the accessibility, natural and biological hazards to support equal access to education. *ISPRS International Journal of Geo-Information*, *11*(1). https://doi.org/10.3390/ijgi11010012

Simanjuntak, K. (2015). Implementasi Kebijakan Desentralisasi Pemerintahan di Indonesia. *Jurnal Bina Praja*, *07*(02), 111–130. https://doi.org/10.21787/jbp.07.2015.111-130

Smith, B. . (1985). *Decentralization the territorial dimension of the state*. London George Allen and Unwin LTD. http://opac.kaltimprov.go.id/opac/detail-opac?id=68295

Wu, C., Smith, D., & Wang, M. (2021). Simulating the urban spatial structure with spatial interaction: A case study of urban polycentricity under different scenarios. *Computers, Environment and Urban Systems*, *89*(April), 101677. https://doi.org/10.1016/j.compenvurbsys.2021.101677