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Original Article

Geospatial Perspective in the Distribution and Zoning Model of Senior High Schools in Bandar Lampung City

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ABSTRACT
The school zoning system aims to improve equitable access to education, but its effectiveness is highly dependent on spatial distribution and the availability of educational facilities. This study analyzes the spatial distribution and evaluation of zoning for 17 public high schools in Bandar Lampung City based on the 2024 Technical Guidelines (Juknis) for Student Admission (PPDB). The study uses a quantitative approach with Geographic Information System (GIS) methods, including geoprocessing and buffering techniques for service zone mapping. Data were collected through documentation and field observations, then analyzed using: (1) Nearest Neighbor Analysis (NNA) for distribution patterns, and (2) GIS geoprocessing with buffering for delineating service zones. The results of the study show: (1) The distribution pattern of public high schools is random (NNA value = 1 km), indicating an uneven distribution; (2) The delineation of the 0-3000 meter buffering zone results in the identification of served and unserved areas, especially in suburban areas such as Panjang, Telukbetung Barat, and Sukabumi. The conclusion of the study reveals that the implementation of 3 km is not yet optimal in covering the entire region. Policy recommendations include: (1) Construction of new school units in blank spots, (2) Adjustment of zoning policies based on spatial analysis, and (3) Optimization of school transportation. These findings emphasize the need for GIS integration in spatial-based education planning.

KEYWORDS
Geospatial; Distributive; Zonative; Nearest Neighbor Analysis; Buffering Analysis

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INTRODUCTION

Equitable access to education is one of the important indicators of sustainable development (SDGs), particularly in Goal 4 on quality education (Unterhalter, 2019; Rad et al. 2022; Tonegawa, 2022; Wangenge-Ouma et al. 2024). Equal access to secondary education not only has an impact on improving the quality of human

resources, but also contributes to reducing socio-economic inequality (Germain, 2022). Several countries have mentioned similar problems and solutions, such as Ghana (Anlimachie & Avoada, 2020), Thailand (Chabundit, 2024), and Vietnam (Do et al., 2020). Vietnam (Do et al. 2020). However, in practice, the spatial distribution of schools is often uneven, creating unequal access, especially for people in suburban and rural areas (Tanveer et al. 2020; Owens & Rich, 2023; Zangana et al. 2024).

The development of *Geographic Information Systems* (GIS)-based methodologies has enabled more precise analysis of school accessibility, as seen in several previous studies, including accessibility in Tiruchirappalli City, India (Rekha et al. 2020), Prayagraj district, India (Meena et al. 2023), Qatar
(Abulibdeh et al. 2024), Salihli city in Turkey (Deniz, 2024). GIS not only facilitates school location mapping, but also enables spatial analysis such as buffering and nearest neighbor analysis to identify served areas and blank spots (Cherono et al. 2023; Ganasegeran et al. 2024; Fuady et al. 2024; Garcia et al. 2025).

We review previous work on this issue, such as a spatial analysis on charter school access in the New York metropolitan area (Lee & Lubienski, 2021); Spatial and social inequalities in educational service accessibility - A case study of schools in Greater Mumbai (Sharma & Patil, 2022), An enhanced accessibility-based model for evaluating educational equity: A case study in Wuhan (Wang et al. 2021). The existence of school zoning policies is believed to be an instrument for equalizing access to education.

In the Indonesian context, the 2024 New Student Admission Policy (PPDB) strengthens the zoning system with a certain radius as an instrument for equalizing access to secondary education. However, there has not been much research examining the effectiveness of this radius from a detailed geospatial perspective. In fact, this approach is crucial to evaluate the extent to which the zoning policy is able to reach all areas of the city, especially suburban areas that have the potential to become blank spots. Therefore, this study aims to analyze the spatial distribution and zoning of public senior high schools in Bandar Lampung City using GIS methods, with a focus on the distribution patterns and delineation of service zones.

At the end of our review, we would like to emphasize that this study presents a novelty by evaluating the effectiveness of high school zoning policies (PPDB 2024) in Indonesia through a GIS-based geospatial approach, which specifically identifies access gaps (blank spots) in Bandar Lampung City. This study fills a research gap because there have not been many similar studies that link spatial analysis with the implementation of zoning policies at the city level, especially in Bandar Lampung City.

METHOD

Research Location

This research will be conducted in Bandar Lampung City, Lampung Province, Indonesia. In the context of secondary education, there are 17 public senior high schools (SHS) spread across all subdistricts. The distribution of these schools is the focus of this study because of its relevance to the implementation of the 2024 New Student Admission (PPDB) zoning policy, which sets a 3 km radius as the zoning reference. For this reason, Bandar Lampung is considered a strategic case study in evaluating the effectiveness of spatial-based zoning policies.

Research Approach

This study uses a quantitative approach that utilizes geospatial analysis based on Geographic Information Systems (GIS). The quantitative approach was chosen because it is able to provide measurable and objective results in identifying patterns of school distribution and education service zones. This study uses a spatial-based descriptive method to identify patterns of school distribution and zoning in Bandar Lampung.

Research Procedure

This research method focuses on spatial analysis through GIS analysis, which is carried out through several main stages, namely:

1) Nearest Neighbor Analysis (NNA), used to determine the spatial distribution patterns of 17 public high schools in Bandar Lampung City. The NNA index value allows testing whether the distribution of schools tends to be clustered, random, or uniform.
2) GIS Geoprocessing with Buffering, the buffering technique is used to map school service zones based on a radius of 0–3000 meters in accordance with the 2024 PPDB Technical Guidelines. The buffering results provide an overview of the service areas and unserved areas, as well as identifying educational gaps.

3) Spatial Data Overlay, the zoning analysis results are combined with subdistrict administrative data to evaluate the suitability of school distribution to regional needs.

Figure 1. Research Procedure

Data processing and analysis

This study uses data collection techniques through secondary data processing using ArcGIS to identify zoning and distributive patterns of the education service system in schools in the Bandar Lampung area. The data analysis techniques used two methods, namely nearest neighbor analysis and buffering. Several formulations were used in data processing and analysis, as follows:

Nearest neighbor analysis method

$$T = \frac{Ju}{Jh} \quad (1)$$

Where, the symbol is obtained from:

1) T = Nearest neighbor dispersion value.
2) J_u= The average distance measured between one point and its nearest neighbor.
3) J_h= The average distance obtained if all points have a random pattern $= \frac{1}{2}\sqrt{p}$
4) P = Point density per km, which is the number of points (N) divided by the area in square kilometers (km^2 s) (A), resulting in (N/A).
5) N = Number of data points or number of points.
6) A = Area

The classification of this distribution pattern is presented in Table 1.

Table 1. Classification of Distribution Pattern Results

Value	Classification
0.00-0.70	Clustered pattern
0.70-1.40	Unevenly dispersed pattern
1.40–2.1491	Evenly distributed pattern

Source: Lutfi Muta'ali (2015)

Buffering Method

The next step is to apply buffering to identify the relevant coverage area around the school. Buffering is used to analyze zones that cover the location of public high schools and the residences of students or residential areas in Bandar Lampung City.

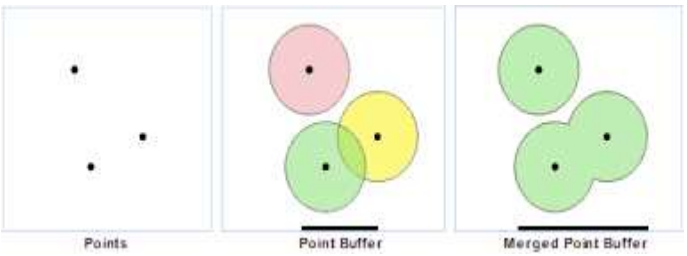


Figure 1. Point Buffering Type

After the buffering process, the next step is to analyze the areas within the buffering zone. This buffering zone indicates the ideal service area that should be accessible to students from the surrounding residential areas.

RESULTS AND DISCUSSION

Analysis of the Distribution of Public High Schools in Bandar Lampung City

Measurements were taken using the straight line method (Euclidean distance) between one school point and another. The closest distance obtained was then analyzed using the nearest neighbor formula (Nearest Neighbor Analysis). The distances between schools are shown in Table 2.

Table 2. Distance Between Public High Schools in Bandar Lampung City

Senior High School's	Distance
SHS 11 Bandar Lampung – SHS 8 Bandar Lampung	3.1 km
SHS 8 Bandar Lampung – SHS 4 Bandar Lampung	1.9 km

Senior High School's	Distance
SHS 4 Bandar Lampung – SHS 10 Bandar Lampung	1.0 km
SHS 10 Bandar Lampung – SHS 1 Bandar Lampung	1.4 km
SHS 1 Bandar Lampung – SHS 2 Bandar Lampung	1.2 km
SHS 2 Bandar Lampung – SHS 3 Bandar Lampung	1.3 km
SHS 3 Bandar Lampung – SHS 16 Bandar Lampung	2.5 km
SHS 16 Bandar Lampung – SHS 9 Bandar Lampung	2.5 km
SHS 9 Bandar Lampung – SHS 14 Bandar Lampung	4.2 km
SHS 14 Bandar Lampung – SHS 7 Bandar Lampung	2.9 km
SHS 13 Bandar Lampung – SHS 15 Bandar Lampung	1.8 km
SHS 15 Bandar Lampung – SHS 5 Bandar Lampung	2.8 km
SHS 5 Bandar Lampung – SHS 12 Bandar Lampung	2.8 km
SHS 6 Bandar Lampung – SHS 17 Bandar Lampung	4.1 km
Total	**33.5 km**

After obtaining the data on the measurement results of the distances between the closest schools, as presented in Table 1, the next step is to perform calculations to determine the distribution pattern of State Senior High Schools (SMAN) using the Nearest Neighbor Analysis (NNA) formula. This analysis aims to identify whether the distribution pattern of schools shows a tendency to be clustered, random, or dispersed.

The value generated from the NNA formula will be compared with the *expected mean* distance in a random distribution, so that the type of spatial pattern formed can be concluded. The calculation formula is **T** $= \frac{Ju}{Jh} =$ = 1.14. This value indicates that the distribution pattern of schools in the area is random, based on Hagget's classification of distribution patterns, in which a random pattern has a value of T = 0.70 – 1.40. The NNA analysis map is presented in Figure 2.

After calculating the average nearest neighbor ratio (NNR) and obtaining a value of 1.14, it can be concluded that the distribution pattern of schools in the area is random, based on Hagget's classification of distribution patterns, in which a random pattern has a value if the T value is between 0.70 and 1.40. The distribution of high school locations in Bandar Lampung shows a random pattern because it follows the natural spatial layout of the area. As explained by Lynch (1960) in The Image of the City, urban spatial development is often not entirely planned but rather formed naturally based on community needs and geographical conditions.

This reinforces the argument that if a city such as Bandar Lampung grows without strict centralized planning, educational facilities such as high schools will tend to be scattered irregularly, following existing settlement patterns. This spatial layout plays an important role in the distribution pattern of high school facilities. The existence of high school-level educational facilities is influenced by their location and also the infrastructure of the area, which has been strategically placed following the existing spatial layout (Shahraki et al. 2016; Huang et al. 2023; Jiang et al. 2024).

Zoning Range According to the 2024 Student Admission System

The zoning range of services is based on SNI 03-1733-2004 using the Buffering Technique. The analyzed zoning ranges are 1 km, 2 km, and 3 km.

How Does the 1 Km Service Range Work?

Zone 1 (1 km *buffering*) with a distance between the school area and residential areas of 0–1000 meters indicates that most residential areas in Bandar Lampung City are outside the 1 km buffer zone, with only a small portion included in this zone. The subdistricts whose settlements are maximally included in the 1 km buffer zone service area are Enggal District (Bandar Lampung State High School 1), Tanjungkarang Pusat District (Bandar Lampung State High School 2 and Bandar Lampung State High School 3), Telukbetung Utara District (Bandar Lampung State High School 4), Telukbetung Selatan District (State High School 8 Bandar Lampung), and Langkapura District (Bandar Lampung State High School 9).

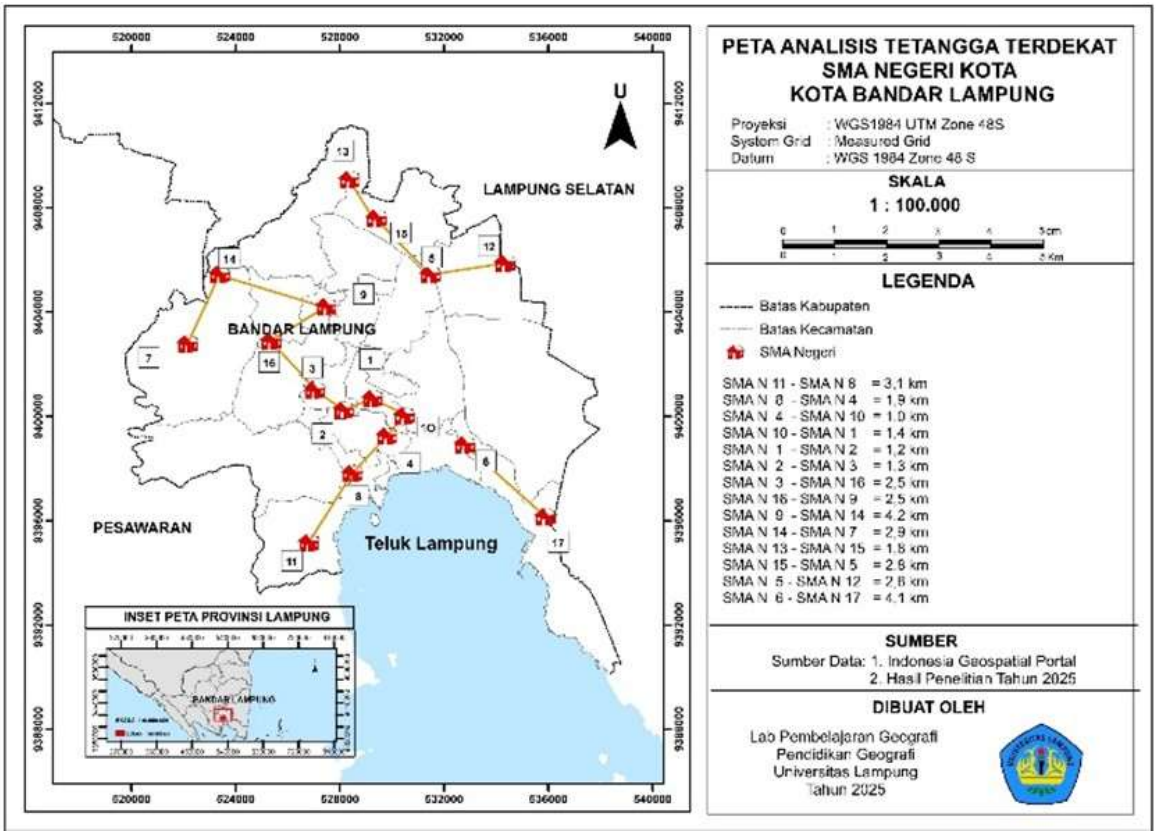


Figure 2. Map of the Nearest Neighbor Analysis of Public Senior High Schools in Bandar Lampung City

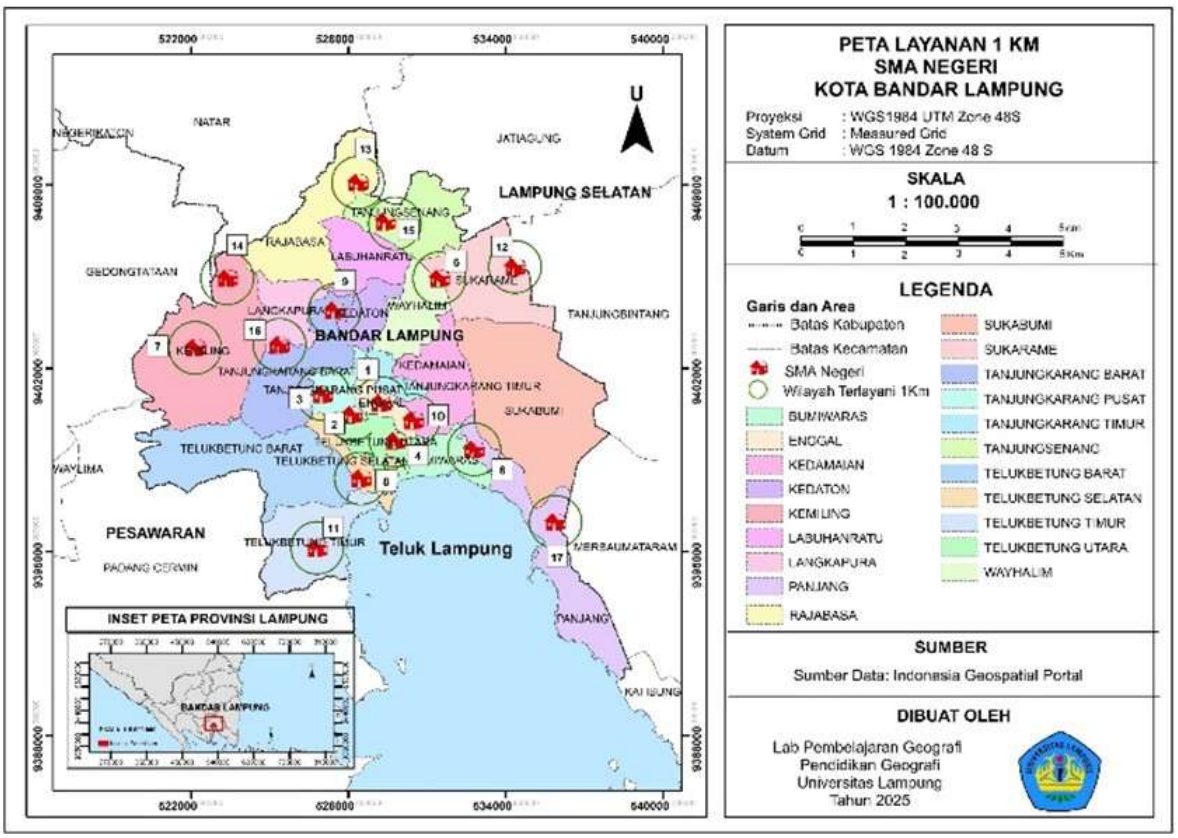


Figure 3. 1 Km Service Area Map

How does the 2 km coverage service work?

Zone 2 (2 km *buffer zone*) with a distance between the school area and residential area of 0-2000 m indicates that the residential areas in Bandar Lampung City include:

1. Enggal Subdistrict (SHS 1 Bandar Lampung);
2. Tanjungkarang Pusat District (SHS 2 and 3 Bandar Lampung);
3. Bumi Waras District (SHS 4 Bandar Lampung);
4. Sukarame District (SHS 5 Bandar Lampung and SHS 12 Bandar Lampung);
5. Telukbetung Timur District (SHS 11 Bandar Lampung);
6. Telukbetung Selatan District (SHS 8 Bandar Lampung);
7. Telukbetung Utara District (SHS 4 Bandar Lampung)
8. Kedaton District (SHS 9 Bandar Lampung) and;
9. Tanjungkarang Timur Subdistrict (SHS 1 Bandar Lampung).

How about the 3 km service range?

Zone 3 (3 km *buffer* zone) with a distance between schools and residences of 0–3000 meters shows that most settlements in Bandar Lampung City are outside the 3 km *buffer* zone, including:

1. Enggal District (SHS 1 Bandar Lampung)
2. Tanjungkarang Pusat District (SHS 2 Bandar Lampung and SHS 3 Bandar Lampung)
3. Bumi Waras District (SHS 4 Bandar Lampung)
4. Sukarame District (SHS 5 Bandar Lampung and SHS 12 Bandar Lampung)
5. Telukbetung Timur (SHS 11 Bandar Lampung)
6. Telukbetung Selatan Subdistrict (SHS 8 Bandar Lampung)
7. Telukbetung Utara District (SHS 4 Bandar Lampung)
8. Kedaton District (SHS 9 Bandar Lampung)
9. Tanjungkarang Timur Subdistrict (SHS 1 Bandar Lampung)
10. Rajabasa District (SHS 13 Bandar Lampung)
11. Telukbetung Barat Subdistrict (SHS 8 Bandar Lampung)
12. Wayhalim District (SHS 5 Bandar Lampung)
13. Kemiling District (SHS 7 Bandar Lampung and SHS 14 Bandar Lampung)
14. Kedamaian District (SHS 6 Bandar Lampung and SHS 10 Bandar Lampung)
15. Tanjungkarang Barat District (SHS 16 Bandar Lampung and SHS 9 Bandar Lampung)
16. Rajabasa District (SHS 13 Bandar Lampung and SHS 14 Bandar Lampung)

The buffering results (3 km radius from each public high school) show that several areas in Bandar Lampung City are still not fully covered by public secondary education services. Specifically, the underserved areas include (1) the western tip of West Telukbetung Subdistrict; (2) most of Sukabumi Subdistrict; and (3) most of Panjang Subdistrict.

These three areas are outside the maximum coverage of the 3 km service zone, which is indicated by the blue line on the map. However, these areas are quite densely populated residential areas, as can be seen from the blue buffer circle on the map. Other subdistricts that are outside the administrative area of Bandar Lampung City include Padang Cermin and Gedong Tataan subdistricts, which are located in Pesawaran Regency, as well as Natar, Merbaumataram, Jati Agung, Tanjung Bintang, and Ketibung subdistricts, which are located in South Lampung Regency.

How do blank spots in the zoning system occur?

The main cause of blank spots is the uneven distribution of public schools. In Bandar Lampung City itself, the construction of public schools is uneven, with only 12 of the 20 subdistricts having public high schools in Bandar Lampung City.

Formulation:

$$\text{Percentage} = \left(\frac{\text{Area section (ha)}}{\text{Total Area (ha)}}\right) \times 100\% \qquad (2)$$

Table 15. Blank Spot Area

No	**District**	**Blankspot Area (%)**
1	Panjang	36.47
2.	Sukabumi	43.16
3.	West Telukbetung	55.52
4.	Kedamaian	0.53
5.	Rajabasa	1.32
6.	Tanjung Seneng	0.10
7.	Kemiling	1.31
8.	West Tanjungkarang	0.91

Source: Data Processing Results (2025)

In Bandar Lampung City, the implementation of the school zoning system faces three main obstacles that are also found in various other regions in Indonesia.

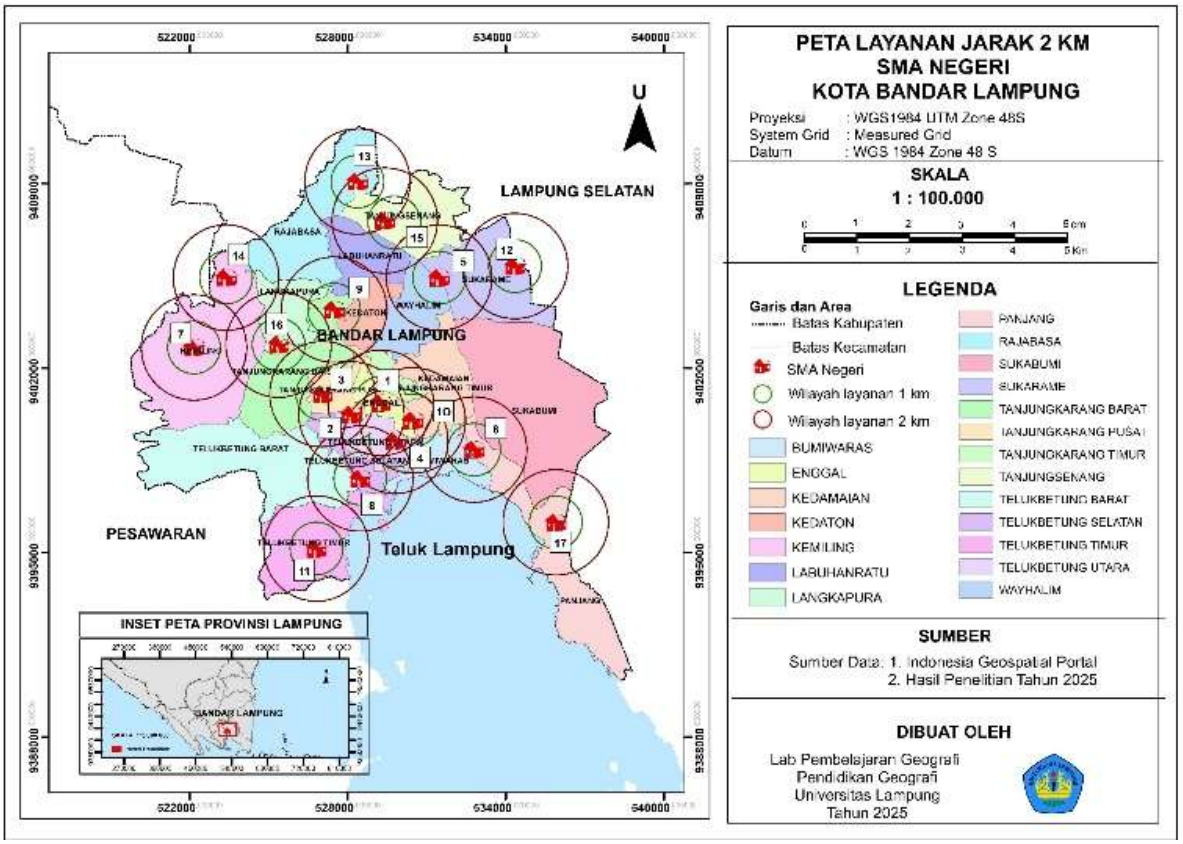


Figure 4. 2 Km Service Map

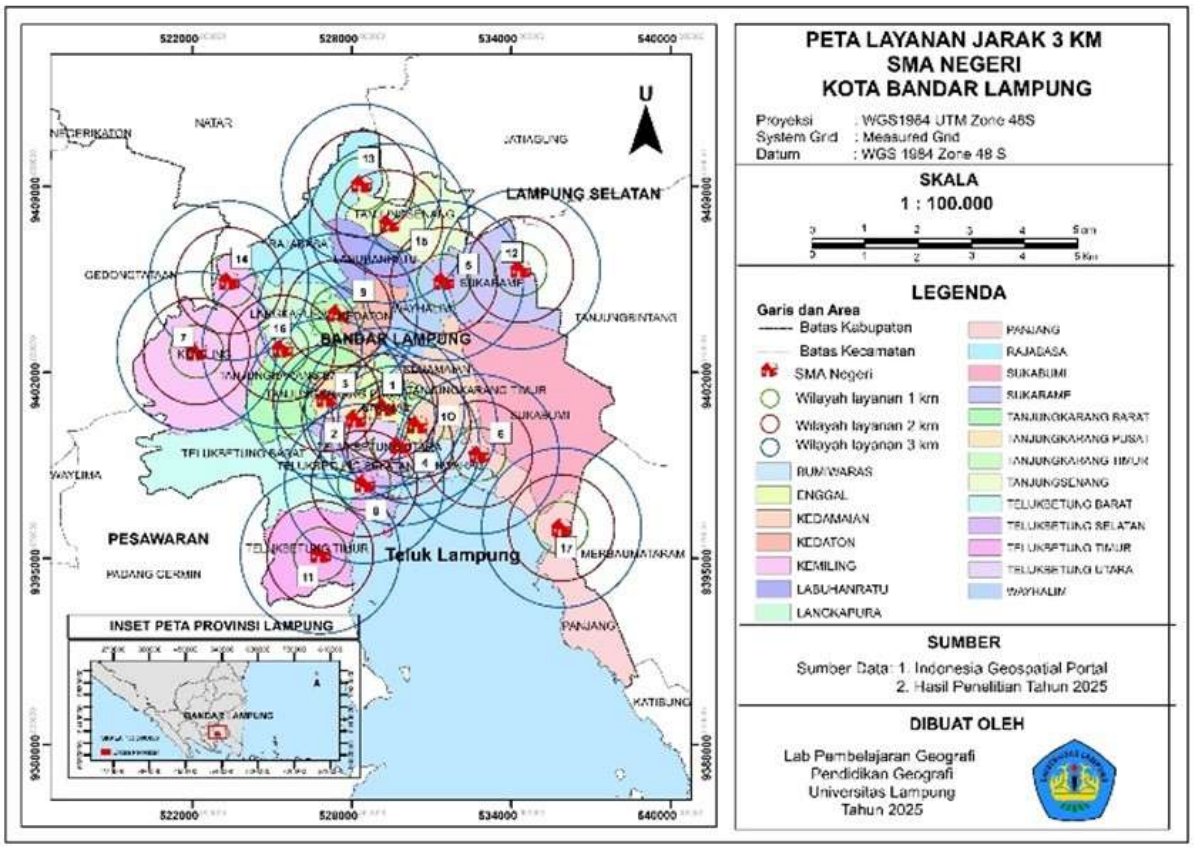


Figure 5. 3 Km Service Coverage Map

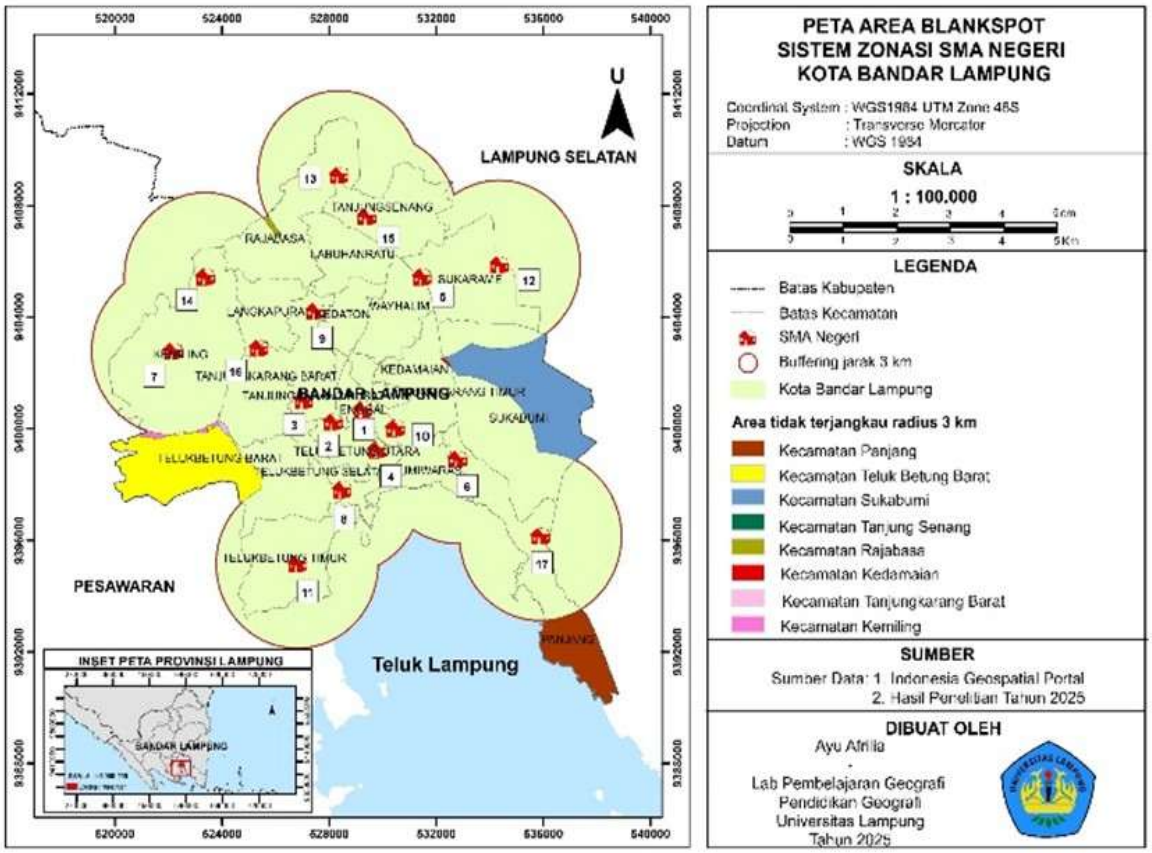


Figure 6. Map of Blank Spots in the Zoning System

First, the capacity quota (Riyanti et al. 2020; Ardi et al. 2023) for New Student Admissions (PPDB) is often unable to accommodate the number of graduates each year, resulting in many students being unable to enroll in public schools even though they are in the same zone. Second, the uneven distribution of public schools is a problem (Chaniago et al. 2024; Riyan Ardiansyah, 2025), where some areas have a limited number of public schools or even none at all, while other areas may have more schools that are easier to access.

Third, the unclear zoning mechanism is also a problem, as there is confusion about how zones are defined and how schools determine who can be accepted in a particular zone, which often causes uncertainty and unfairness for parents and students (Sulistyosari et al. 2023; Aulia et al. 2025). These problems are closely related to spatial aspects, which include two important things: the location and distribution of schools and the reach of educational services, which determine the extent to which students can access schools in accordance with existing zoning policies.

How are service zones defined based on the Technical Guidelines (JUKNIS) for the 2024 Bandar Lampung City PPDB?

According to the Regulation of the Minister of Education and Culture of the Republic of Indonesia (Permendikbud) Number 1 of 2021 concerning New Student Admissions, a service zone is a geographical area designated by the local government as the coverage area for educational services. An underserved zone is an area that does not have direct or adequate access to educational services, either due to a limited number of schools, excessive distance, or other geographical factors.

Table 16. Service Zones for Public High Schools in Bandar Lampung City

No	Senior High School's (SHS)	Analysis of Serviced Areas (districts)
1	SHS 1 of Bandar Lampung	5
2	SHS 2 of Bandar Lampung	6
3.	SHS 3 of Bandar Lampung	6
4.	SHS 4 of Bandar Lampung	8
5.	SHS 5 of Bandar Lampung	6

No	Senior High School's (SHS)	Analysis of Serviced Areas (districts)
6.	SHS 6 of Bandar Lampung	6
7.	SHS 7 of Bandar Lampung	6
8.	SHS 8 of Bandar Lampung	7
9.	SHS 9 of Bandar Lampung	8
10.	SHS 10 of Bandar Lampung	9
11	SHS 11 of Bandar Lampung	4
12	SHS 12 of Bandar Lampung	7
13	SHS 13 of Bandar Lampung	7
14.	SHS 14 of Bandar Lampung	7
15.	SHS 15 of Bandar Lampung	6
16	SHS 16 of Bandar Lampung	8
17.	SHS 17 of Bandar Lampung	6

Source: Field Observation (2024)

The map of public high school service zones in Bandar Lampung City shows the complexity of implementing the zoning system in the 2024 PPDB, reflecting the geographical and demographic characteristics of the urban area. Analysis of data from 17 public high schools reveals a highly heterogeneous spatial distribution, with zoning ranges varying extremely from 853 meters (SMAN 9) to 17,765 meters (SMAN 17), indicating significant differences in educational service coverage between regions. This disparity in coverage reflects the challenges of zoning planning in accommodating the diversity of demographic and geographic characteristics of cities, where areas with high population density require more intensive services within a limited radius, while areas with low density require wider geographic coverage to achieve service effectiveness.

The visualized spatial distribution shows a pattern of high concentration in the central area of Bandar Lampung, where several public high schools such as SMAN 1, 2, 3, 5, 8, 9, and 10 have service zones that are close to each other with a relatively limited range of between 853 and 1,410 meters. SMAN 9, with a minimum range of 853 meters, represents the most compact service area, located in the central part of the city with a high population density, which allows for effective educational services within a limited radius.

This concentration phenomenon reflects the characteristics of an urban core with high population density and intensive educational service needs in a relatively narrow geographical area. This pattern also indicates spatial competition between schools in serving a concentrated population, which can have implications for the quality of student selection and the efficient use of educational resources.

In contrast, schools located in suburban areas show a very extensive zoning pattern. SMAN 17, with a maximum range of 17,765 meters, serves a very large area, followed by SMAN 11 with a range of 12,774 meters and SMAN 16 with a range of 4,449 meters. This radial distribution pattern shows that schools located on the outskirts of the city have the responsibility to serve a wider area as compensation for the lower population density in those areas.

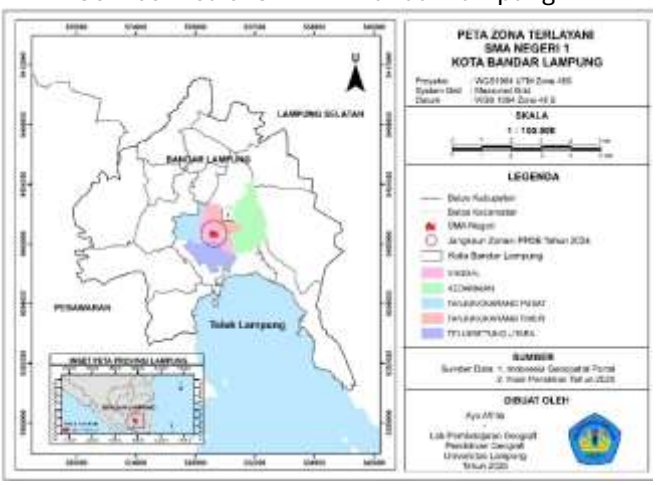
This condition is consistent with the principle of spatial efficiency in the provision of public services, where areas with low density require greater geographical coverage to achieve service effectiveness. However, this very wide coverage also creates challenges in terms of accessibility and service quality, especially for students at the edge of the service zone.

A more in-depth analysis of the correlation between zoning coverage and the number of students accepted reveals a paradox in the zoning system. SMAN 17, with the widest coverage, only accepts 72 students, while SMAN 13, with a coverage of 2,899 meters, can accept 187 students. This phenomenon indicates that a wide zoning range does not always correlate positively with the number of students accepted, but is more influenced by factors such as the density of school-age population and the attractiveness of the school. Schools in the central region, such as SMAN 2, 5, 7, 9, 10, and 12, which have a moderate coverage (911-2,509 meters), were able to accept 160-176 students, demonstrating optimal efficiency in the balance between geographical coverage and admission capacity.

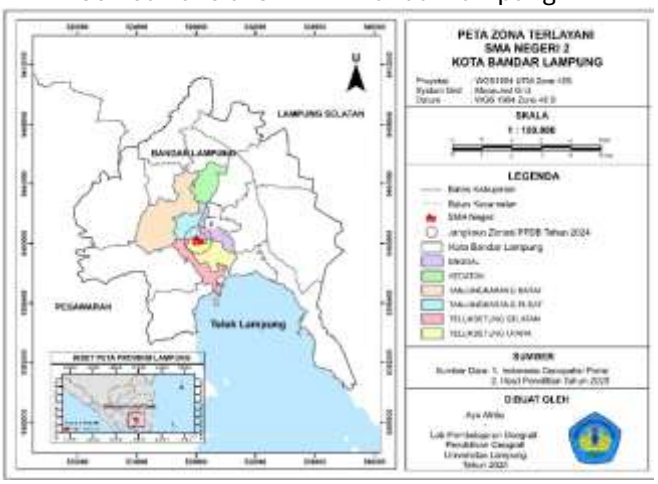
The very wide zoning range of SMAN 17 is due to complex geographical and demographic factors. The location of SMAN 17 in Pidada Village, Panjang District, which is the southernmost area of Bandar Lampung City, creates significant accessibility challenges. This geographical position is objectively less strategic for most prospective students who live in the city center or northern areas, such as Tanjungkarang Pusat, Kemiling, and Kedaton Districts. The non-strategic location not only affects physical accessibility but also creates a perception of psychological distance that can reduce prospective students' interest in enrolling. Additionally, the demographic characteristics of the southern region, which has a relatively low density of school-age population, force the school to expand its zoning coverage to meet the set student enrollment targets.

SERVED AREA OF STATE-OWNED HIGH SCHOOLS IN THE CITY OF BANDAR LAMPUNG

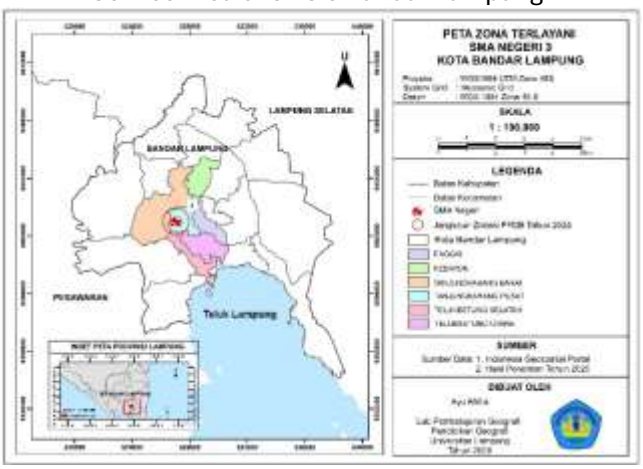
Service Area of SMA N 1 Bandar Lampung



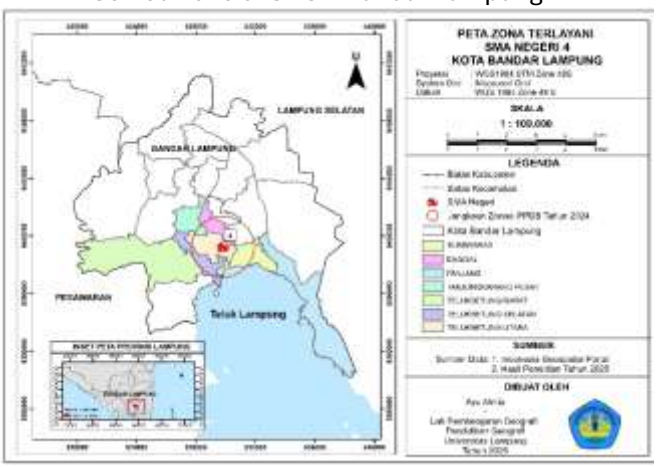
Served Zone of SMA N 2 Bandar Lampung



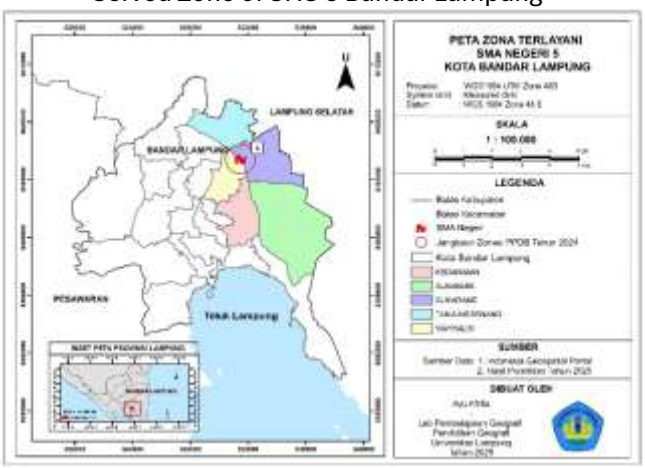
Service Area of SHS 3 Bandar Lampung



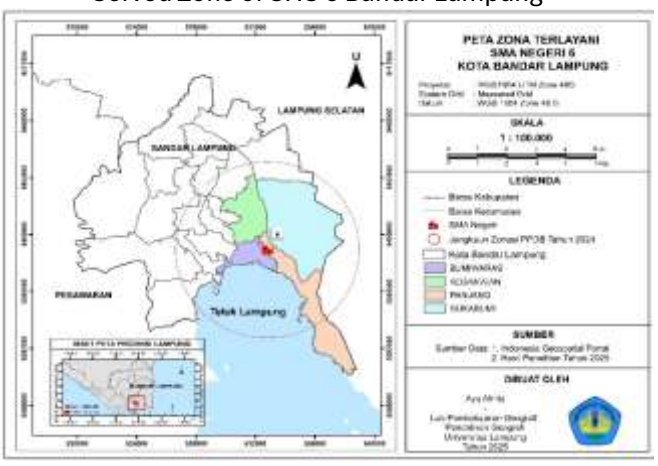
Served Zone of SHS 4 Bandar Lampung



Served Zone of SHS 5 Bandar Lampung

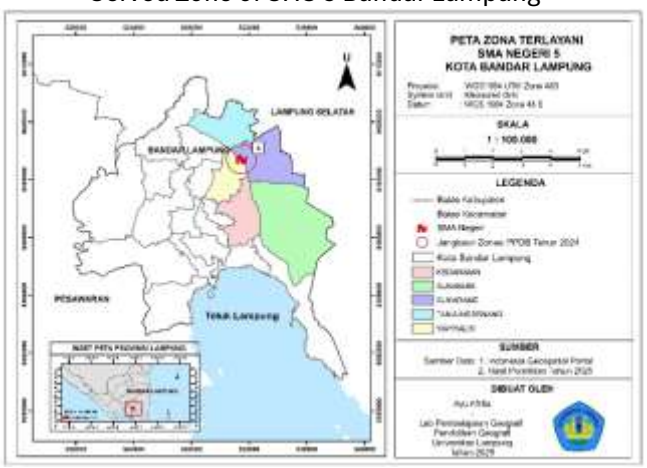


Served Zone of SHS 6 Bandar Lampung

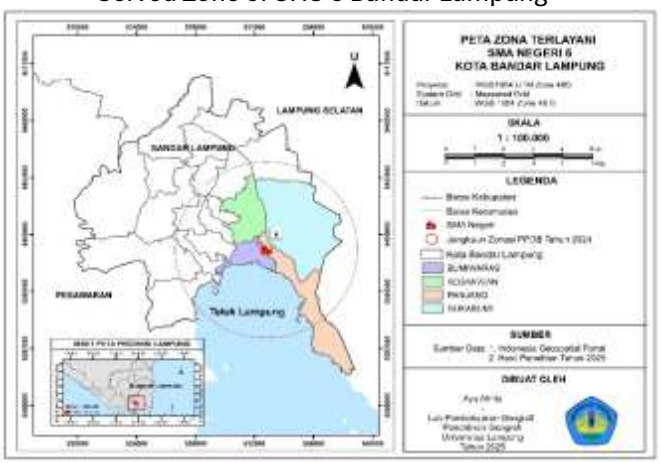


SERVICED ZONE FOR STATE-RUN SECONDARY SCHOOLS IN THE CITY OF BANDAR LAMPUNG

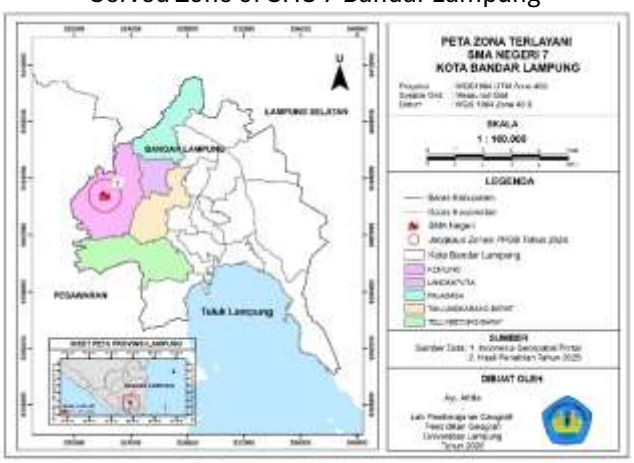
Served Zone of SHS 5 Bandar Lampung



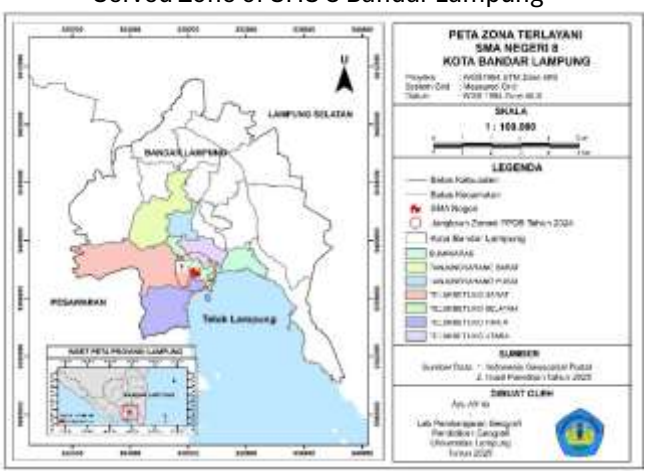
Served Zone of SHS 6 Bandar Lampung



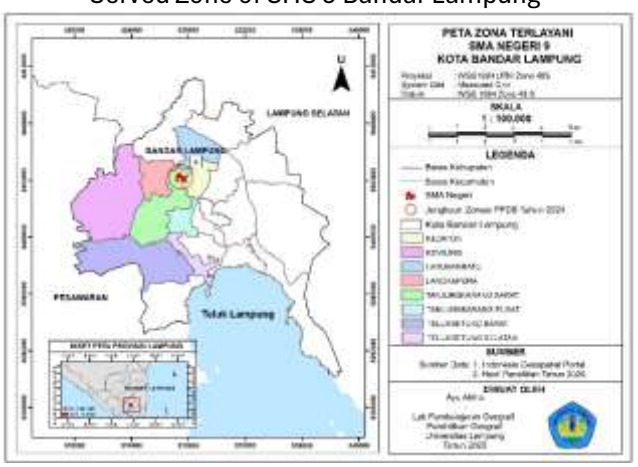
Served Zone of SHS 7 Bandar Lampung



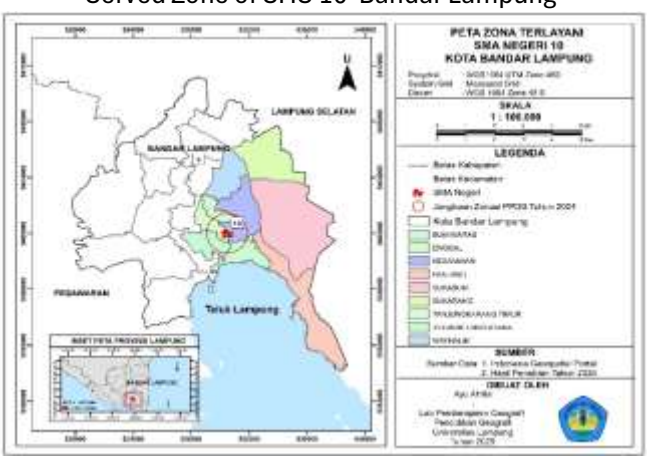
Served Zone of SHS 8 Bandar Lampung



Served Zone of SHS 9 Bandar Lampung

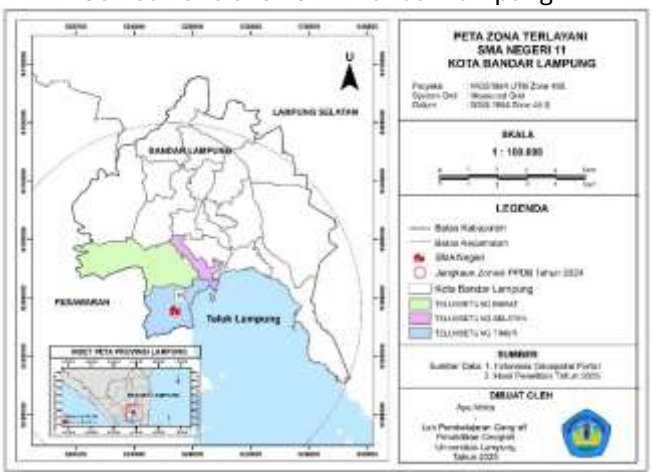


Served Zone of SHS 10 Bandar Lampung

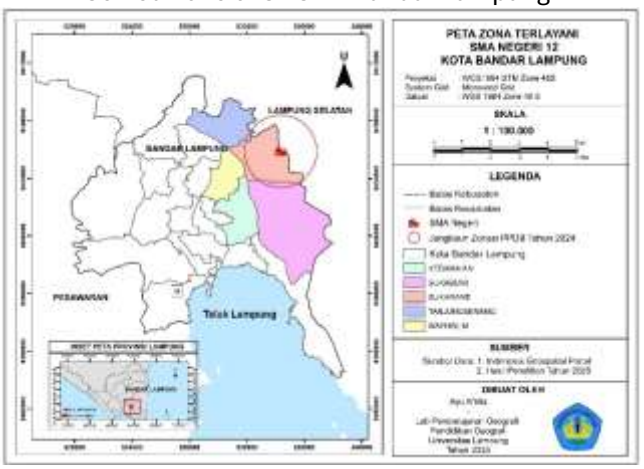


SERVICED ZONE FOR STATE-RUN SECONDARY SCHOOLS IN THE CITY OF BANDAR LAMPUNG

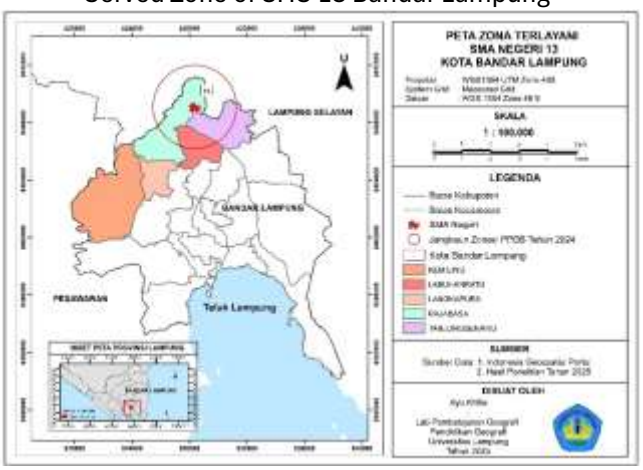
Served Zone of SHS 11 Bandar Lampung



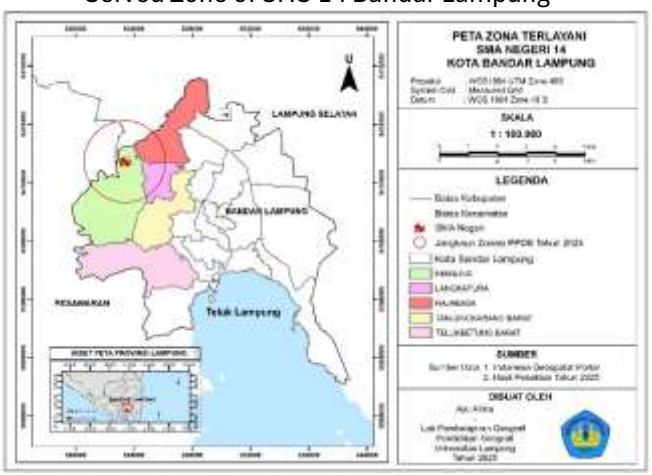
Served Zone of SHS 12 Bandar Lampung



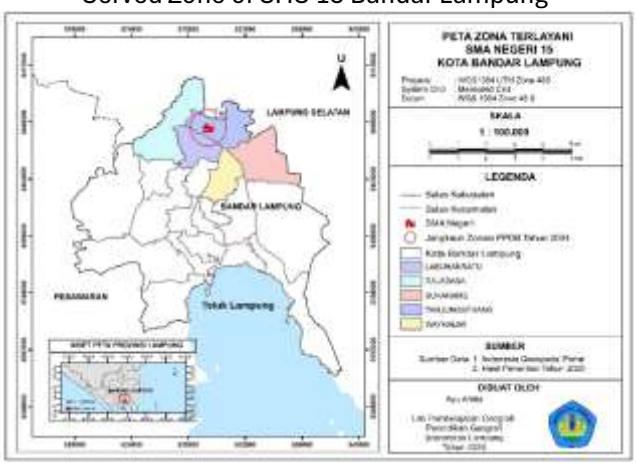
Served Zone of SHS 13 Bandar Lampung



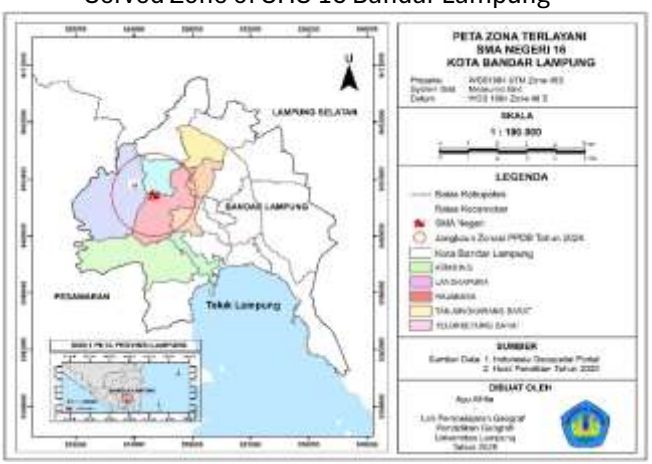
Served Zone of SHS 14 Bandar Lampung



Served Zone of SHS 15 Bandar Lampung

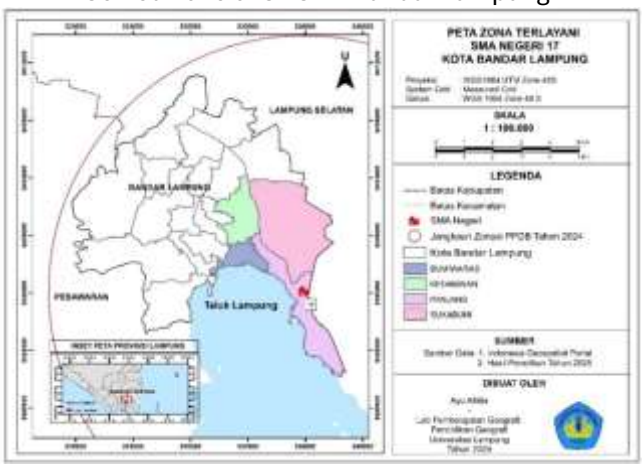


Served Zone of SHS 16 Bandar Lampung

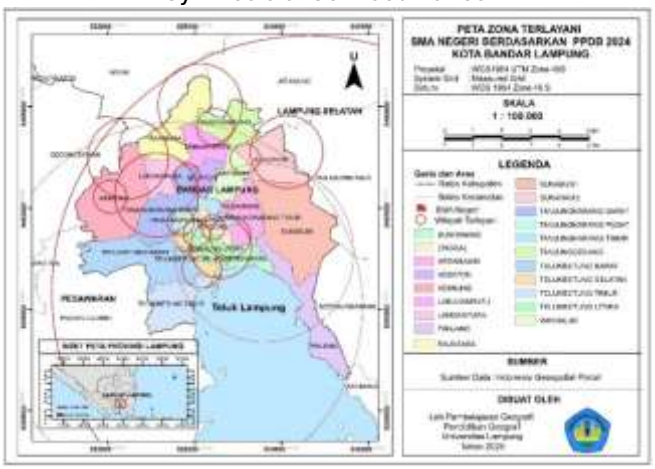


SERVICED ZONE FOR STATE-RUN SECONDARY SCHOOLS IN THE CITY OF BANDAR LAMPUNG

Served Zone of SHS 17 Bandar Lampung



Synthesis of Serviced Zones



The implications of this heterogeneous zoning system create challenges in terms of fairness and efficiency in access to education. Students in the city center have easier access to quality schools with minimal travel distance, while students in the suburbs must travel very long distances to access equivalent educational facilities. This disparity can affect the quality of the educational experience, where students with long travel distances are potentially physically exhausted and have limited time for extracurricular activities. In addition, extreme differences in zoning ranges also indicate the need for a re-evaluation of the distribution and capacity of public schools to achieve more optimal equitable access to education.

From an urban planning perspective, the existing zoning pattern indicates the need for better integration between educational planning and regional development. The concentration of schools in central areas needs to be balanced with the development of educational infrastructure in developing suburban areas. In addition, an effective public transportation system is key to overcoming accessibility challenges, especially for students who are at the edge of the service zone. The evaluation of the zoning system also needs to consider population growth projections and regional development to anticipate future educational service needs, so that an education system can be created that is not only spatially efficient but also equitable in providing quality education access for all city residents.

Table 6. Student Distance Data in the 2024 PPDB Zoning Admission

Senior High School's (SHS)	Zoning		Number Accepted
	Nearest	Farthest	
SHS 1 of Bandar Lampung	76 meters	866 meters	**129**
SHS 2 of Bandar Lampung	116 meters	911 meters	**160**
SHS 3 of Bandar Lampung	41 meters	912 meters	**112**
SHS 4 of Bandar Lampung	53 meters	2,106 meters	**158**
SHS 5 of Bandar Lampung	125 meters	1,022 meters	**160**
SHS 6 of Bandar Lampung	332 meters	6,179 meters	**162**
SHS 7 of Bandar Lampung	113 meters	1,147 meters	**176**
SHS 8 of Bandar Lampung	168 meters	1,349 meters	**140**
SHS 9 of Bandar Lampung	97 meters	853 meters	**160**
SHS 10 of Bandar Lampung	108 meters	1,410 meters	**160**
SHS 11 of Bandar Lampung	22 meters	12,774 meters	**109**

Senior High School's (SHS)	Zoning		Number Accepted
	Nearest	Farthest	
SHS 12 of Bandar Lampung	30 meters	2,509 meters	**174**
SHS 13 of Bandar Lampung	84 meters	2,899 meters	**187**
SHS 14 of Bandar Lampung	27 meters	1,800 meters	**174**
SHS 15 of Bandar Lampung	66 meters	1,265 meters	**158**
SHS 16 of Bandar Lampung	87 meters	4,449 meters	**174**
SHS 17 of Bandar Lampung	143 meters	17,765 meters	**72**

Analysis of each subdistrict and alternative public high schools that can be attended:

1. There are 2 school alternatives: Tanjung Karang Timur District (State High Schools 1 and 2 Bandar Lampung), Teluk Betung Timur District (State High Schools 8 and 11 Bandar Lampung)
2. There are three school options: Rajabasa District (SMA N 6, 13, 15, and 16 Bandar Lampung), Kedaton (SMA N 2, 3, 9, and 16 Bandar Lampung).
3. There are 4 school options: Labuhan Ratu District (State High Schools 9, 3, and 15 in Bandar Lampung), Tanjung Senang District (State High Schools 5, 12, and 13 in Bandar Lampung), Sukarame (SMA N 5, 10, 12 and 15 Bandar Lampung), Way Halim (SMA N 5, 10, 12 and 15 Bandar Lampung), Panjang (SMA N 4, 6, 10 and 17 Bandar Lampung).
4. There are 5 alternative schools: Enggal District (SMA N 1, 2, 3, 4, and 10 Bandar Lampung), Telukbetung Utara (SMA N 1, 2, 3, 4, and 8 Bandar Lampung), Kemiling (SMA N 16, 14, 13, 9, and 6 Bandar Lampung), Sukabumi (SMA N 5, 6, 10, 12, and 17 Bandar Lampung), Langkapura (SMA N 6, 9, 13, 14, and 16 Bandar Lampung), Bumiwaras (SMA N 4, 2, 6, 8, and 17 Bandar Lampung).
5. There are 6 alternative schools: Kedamaian District (SMA N 1, 5, 6, 10, 12, and 17 Bandar Lampung), (SMA N 1, 5, 6, 10, 12, and 17 Bandar Lampung),
6. There are 7 alternative schools: Tanjungkarang Pusat District (SMA N 1, 2, 3, 4, 8, 9, and 16 Bandar Lampung), Telukbetung Selatan (SMA N 2, 3, 4, 9, 8, 11, and 16 Bandar Lampung), West Telukbetung (SMA N 4, 6, 8, 9, 11, 14, and 16 Bandar Lampung), West Tanjungkarang (SMA N 2, 3, 6, 8, 9, 14 and 16 Bandar Lampung).

CONCLUSION

The NNA calculation results show a Nearest Neighbor Ratio (Rn) value of 1.14, which indicates a random school distribution pattern. This means that the distribution of public high school locations does not follow a centralized pattern as described in Central Place Theory (Christaller). This irregularity is caused by the construction of schools that is based more on land availability, sectoral policies, and ad-hoc considerations, rather than systematic long-term spatial planning.

The results of the 1-3 km zoning range analysis (SNI buffering) found that only central subdistricts such as Tanjungkarang Pusat, Enggal, and Telukbetung Utara received optimal service coverage. Meanwhile, subdistricts in peripheral areas such as Panjang, Sukabumi, and part of Way Halim show limited access because they are outside the ideal service radius. This condition highlights the spatial inequality in access to public high schools in Bandar Lampung City.

This imbalance has a direct impact on students' opportunities in the zoning-based PPDB selection process. Meanwhile, the school zoning range mapped based on radius distance according to the 2024 PPDB results from each public high school location shows an overlap of zoning areas between schools in the city center. This has the potential to cause inefficiencies in the zoning-based new student admission system (PPDB). Although the zoning policy in PPDB aims to equalize access to education, in practice it still faces various challenges. Among them are the concentration of applicants in favorite schools such as SMAN 1, 2, and 3, as well as the manipulation of domicile by prospective students from outside the zone. The imbalance between the number of schools and the density of school-age population also means that the service zones are not yet fully fair and proportional.

The Buffering technique assumes that all areas within the buffering have the same characteristics, whereas the actual conditions vary greatly and the buffering results are highly dependent on the selected coordinate system, which can result in distortion over a large area. These two techniques are limited in their comprehensiveness due to the need for detailed digitization and ground checks to verify the analysis results. This technique is recommended for further

research with different innovations to enrich future research results.

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Conflict of Interest The authors have no competing interests to declare that are relevant to the content of this article.

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