



Spatial Analysis of School Accessibility in Tarutung District and Its Policy Implications

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: <https://doi.org/10.9734/sajsse/2024/v21i12914>

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/127336>

Original Research Article

Received: 14/09/2024

Accepted: 21/11/2024

Published: 26/11/2024

ABSTRACT

This study evaluates the accessibility of Junior High School (SMP) educational facilities in Tarutung District, North Tapanuli Regency, with a focus on addressing socio-economic disparities and geographic challenges. Using spatial analysis methods such as buffer and overlay analysis, combined with the Neighborhood Unit theory, the research identifies critical gaps in educational access. Findings reveal that 77.41% of the district's area falls outside the ideal accessibility radius for schools, highlighting significant inequities for students in remote and underserved areas. Contributing factors include inadequate public transportation and the uneven distribution of schools, compounded by the zoning system for student admissions, which prioritizes proximity without considering geographic and infrastructural barriers. This study recommends redistributing

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educational facilities, enhancing transportation infrastructure, and revising zoning policies to better address regional needs. The findings underscore the importance of integrating socio-economic and spatial considerations into educational planning. By improving accessibility, these recommendations aim to foster equitable and inclusive education. This research provides a foundation for future studies and policy initiatives in other regions facing similar challenges.

Keywords: Educational facility accessibility; zoning system; student admission policy; spatial analysis.

1. INTRODUCTION

Education is a fundamental pillar for improving human resource quality and fostering sustainable development. In Indonesia, equitable access to education has been a key priority, and the government has implemented various strategic policies to achieve this goal. One of the notable initiatives is the zoning system for new student admissions, introduced via Ministerial Regulation No. 1 of 2021. This policy determines school placement based on the distance between students' residences and their target schools, aiming to ensure fair access to educational facilities for all students (Kemendikbud, 2021).

However, the implementation of the zoning system faces significant challenges, particularly in regions where educational infrastructure is unevenly distributed. As Idrus (2012) observed, factors such as socio-economic disparities, inadequate facilities, and incomplete policy implementation often hinder the achievement of educational equity. In Tarutung District, North Tapanuli Regency, such challenges are especially pronounced. Despite being the most densely populated district in the region, the distribution of public junior high schools (SMP) is heavily concentrated in urban areas, leaving large rural regions underserved (BPS Tapanuli Utara, 2024). Similar challenges have been noted in other sectors, such as community health programs in Limapuluh District, where limited infrastructure and redirected funding hinder program effectiveness (Arga Abdi Rafiud Darajat Lubis et al., 2024).

To address these issues, frameworks such as Clarence Perry's (1929) Neighborhood Unit theory offer a conceptual basis for evaluating educational facility distribution. Perry emphasized the importance of neighborhood planning, proposing that schools should serve as the center of residential units and be accessible without requiring motor vehicles or crossing major roads. This theory, combined with spatial analysis methods like buffer and overlay techniques, provides a robust approach for

assessing accessibility and addressing disparities (Rustiadi, 2022; Wahyu et al., 2020).

National standards, such as the Indonesian National Standard (SNI) 03-1733-2004, also underscore the importance of accessibility, stipulating that schools should ideally be located within 1,000 meters of residential areas and be supported by public transportation. However, in practice, gaps between policy and implementation remain significant. For instance, many villages in Tarutung District either lack sufficient school facilities within their zones or face barriers such as inadequate transportation infrastructure and challenging terrain (De Chiara & Koppelman, 1975; Maula, 2023; North Tapanuli Regency Government, 2024). These challenges mirror those in Asahan Regency, where land-use transitions and socio-economic factors impact housing and infrastructure development (Eko Suharizki et al., 2024).

Addressing these disparities requires a holistic and data-driven approach. Lessons from sustainable rural development strategies in Angkola Sangkunur Sub-District highlight the importance of integrating technical, legal, and institutional frameworks to create equitable and inclusive policies (Turma et al., 2024). Similarly, findings from regional studies on sustainable agriculture and education emphasize the need to incorporate geographic, socio-economic, and infrastructural considerations into planning (Anisah, 2024; Muliadi et al., 2024).

This study evaluates the accessibility of junior high school facilities in Tarutung District through spatial analysis, utilizing the Neighborhood Unit theory and accessibility standards as benchmarks. By analyzing the spatial distribution of schools, travel distances, and infrastructural barriers, this research seeks to identify gaps in the zoning system and propose actionable recommendations. The findings are expected to contribute to more equitable educational planning and serve as a reference for addressing similar challenges in other regions, thus aligning with

broader goals of sustainable and inclusive development.

2. RESEARCH METHODOLOGY

This study employs a quantitative approach with spatial analysis methods to evaluate the distance and accessibility of Junior High School (SMP) facilities in Tarutung District, North Tapanuli Regency. This approach was chosen for its ability to depict spatial relationships between school locations and residential areas, and to identify educational access disparities resulting from the zoning policy in place. The spatial analysis, in this case, utilizes overlay and buffer analysis techniques to assess the accessibility of public SMPs in Tarutung District, based on the Neighborhood Unit theory, which serves as the conceptual framework for this study.

2.1 Research Location

This study was conducted in Tarutung District, located in North Tapanuli Regency, North Sumatra Province. The district was selected as

the research site due to its highest population density within the regency and its imbalanced distribution of educational facilities, particularly public junior high schools (SMPs). The seven public SMPs in Tarutung are unevenly distributed, which allows this study to identify the educational access gaps between different regions.

2.2 Population and Sample

The population in this study consists of all the public junior high schools in Tarutung District, which are seven in total. The analyzed sample includes spatial data regarding the geographic coordinates of each SMP and the zoning areas for new student admissions (PPDB) as outlined in the North Tapanuli Regent Regulation No. 20 of 2021. This study focuses on analyzing the accessibility of each SMP to the residential areas within the designated PPDB zones, considering both distance and travel time from each village/urban village included in the zoning.

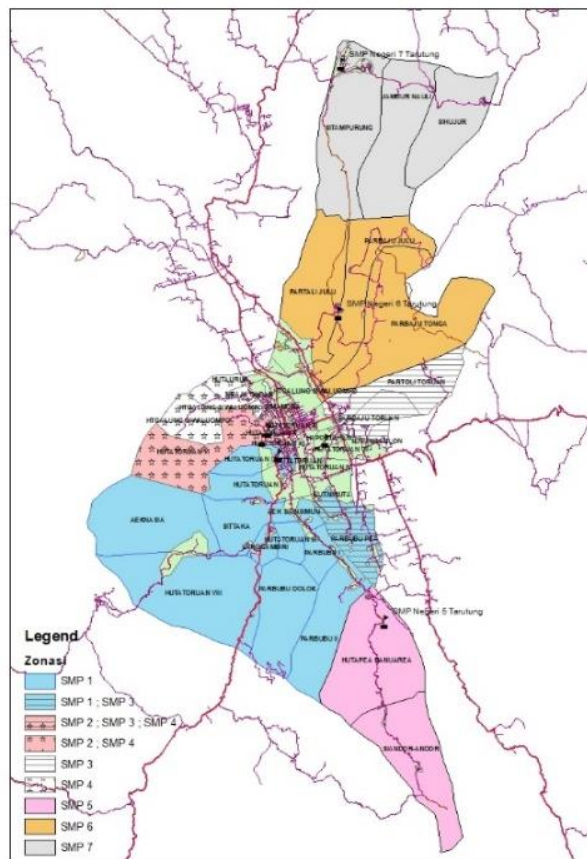


Fig. 1. Research Location

2.3 Types and Sources of Data

The data used in this study consists of both primary and secondary data:

1. **Primary Data:** Primary data were collected through in-depth interviews with the heads of public junior high schools in Tarutung District. These interviews aimed to gather information about the implementation of the zoning policy, school capacity, and the challenges faced in meeting the educational needs within each zone. Additionally, interviews were conducted to understand the schools' perspectives on the accessibility of educational facilities for local communities.
2. **Secondary Data:** Secondary data includes spatial data obtained from the North Tapanuli Regency Government and other relevant agencies. The spatial data collected includes land use maps, road networks, and the geographic coordinates of school locations, as well as the residential areas within the PPDB zoning. Furthermore, secondary data also includes information about the zoning policies applied in Tarutung District.

2.4 Data Collection Techniques

Data collection was carried out through two primary methods:

1. **In-depth Interviews:** Interviews were conducted with school heads and relevant staff to gather information about the zoning policy implementation and the challenges faced in new student admissions. The interviews also included discussions on the level of school accessibility for students from the various villages within the designated zoning areas.
2. **Spatial Data Collection:** Spatial data were collected using Geographic Information System (GIS) software to determine the location and distance between schools and residential areas. Digital maps and geographic coordinates were used to calculate distances and perform more in-depth spatial analysis.

2.5 Data Analysis Techniques

The collected data were analyzed using several spatial analysis techniques, including:

1. **Buffer Analysis:** Buffer analysis was used to create influence zones around each school with specific radii (e.g., 1 km, 1.5

km, and 3 km). These radii were chosen based on the distance guidelines established in the Neighborhood Unit theory and the standards set by SNI 03-1733-2004. Each buffer zone was then analyzed to determine whether the areas within it were accessible to the schools.

2. **Overlay Analysis:** Overlay analysis was used to combine the student admission zoning data (PPDB zones) with the results from the buffer analysis. This allowed for mapping the spatial relationship between school locations and residential areas. The outcome of this analysis helps determine whether the zoning policy covers all areas that require access to schools, or whether some areas are left unserved by the schools within the zones.
3. **Accessibility Analysis:** Based on the results of the buffer and overlay analysis, an accessibility analysis was conducted by categorizing regions according to their level of accessibility to schools. Accessibility categories were defined based on distance, travel time, and the availability of public transportation to reach the schools. Regions were classified as "accessible" or "hard to access" based on criteria set by De Chiara and Koppelman (1975) and SNI 03-1733-2004.

2.6 Validity and Reliability of Data

To ensure the validity and reliability of the data, the study employed source triangulation, which involved comparing data from different sources, such as interviews with school heads, spatial data from GIS, and policy documents from the North Tapanuli Regency Government. Data validation was also carried out by cross-referencing spatial data with field observations and interviews with relevant stakeholders.

2.7 Research Procedure

This study was carried out in several phases as follows:

1. **Data Collection:** Spatial and primary data were collected through interviews with school heads and staff, as well as from relevant government agencies.
2. **Data Processing:** Spatial data were processed using GIS software to generate distance and zoning maps and to perform buffer and overlay analyses.

3. **Accessibility Analysis:** The accessibility of educational facilities was analyzed based on the results of the spatial analyses.
4. **Report Preparation:** The findings and recommendations were compiled into a research report based on the analysis

schools in the district. The analysis reveals that most of the school's zoning area is within an accessible range, with a radius of about 1 km to 1.5 km. However, there are areas in the "fairly distant" zone (greater than 1.2 km), indicating that although SMP Negeri 1 has a larger capacity, some villages or urban areas are still quite far from the school.

3. RESULTS AND DISCUSSION

3.1 Spatial Analysis Results

The spatial analysis conducted in this study aimed to evaluate the distance and accessibility of public Junior High Schools (SMP) in Tarutung District. Using buffer analysis and overlay techniques, this study mapped the areas accessible from each school based on specific distance radii. The results of this analysis provide a clear depiction of the school accessibility distribution in the region.

This study analyzes the accessibility of public middle schools (SMP) in Tarutung District, Tapanuli Utara, based on distance and zoning criteria. The data in the table reveals that villages categorized as "Near" (300 meters) meet the ideal standards of SNI 03-1733-2004, with schools easily accessible within walking distance. For example, *Hutatoruan V*, *Hutatoruan IX*, and *Hutatoruan I* are all within 300 meters of SMP 1, providing optimal accessibility. These areas comply with the Neighborhood Unit theory, where schools are ideally located at the center of residential areas, ensuring that they are easily accessible by local residents.

This map shows the spatial analysis results for SMP Negeri 1 Tarutung, one of the largest

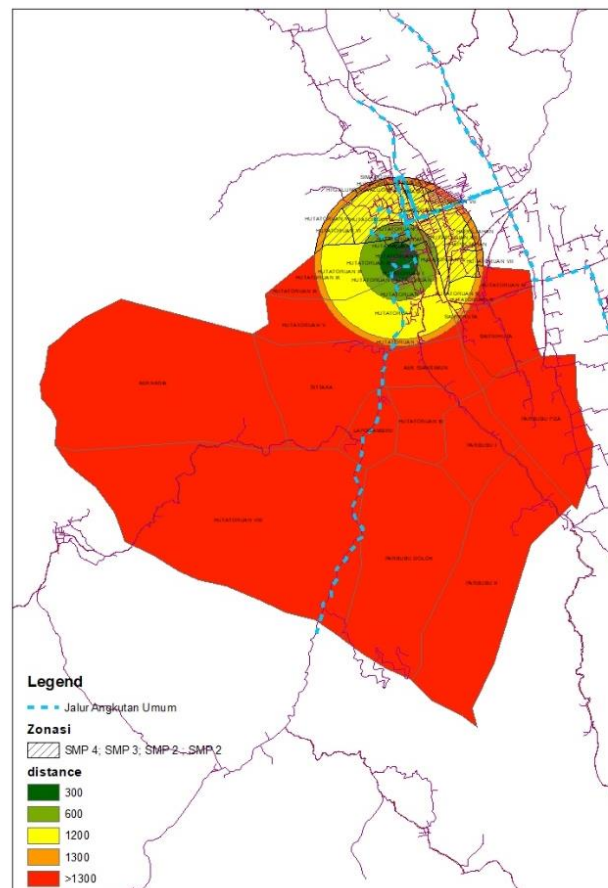


Fig. 2. Spatial Analysis Map of SMP Negeri 1 Tarutung Accessibility

The "Moderate" category (600 meters) still falls within an acceptable range, but the larger area coverage in these villages presents challenges in accessibility. For instance, *Hutatoruan IX* (32.93 km²) and *Hutatoruan V* (19.74 km²) are within 600 meters of SMP 1, but larger geographical areas may face difficulty accessing transport, especially in the more remote parts of the villages. Though they meet SNI standards, some remote areas might require additional transportation solutions to improve accessibility for students living in those areas.

However, for areas in the "Far" (1300 meters) and "Very Far" (>1300 meters) categories, the distance exceeds the ideal range set by SNI 03-1733-2004, with significant barriers to accessibility. These areas, such as *Parbubu Dolok* and *Parbubu I*, are located more than 1,300 meters from the nearest school, and many of these villages are not served by public transportation. These long distances, combined with challenging terrain, make it difficult for students in these regions to access schools, despite being technically within the zoning area according to the theoretical models.

The zoning policy, which prioritizes proximity between students' homes and schools, may result in inequality, especially for students in remote villages. The current distribution of schools, concentrated in certain areas, does not address the needs of those in more distant regions. Therefore, expanding zoning boundaries or establishing new schools in underserved

areas would improve educational accessibility for all students. Additionally, enhancing transportation infrastructure, particularly in remote areas, and revising the zoning policy to include factors like transportation availability and geographic challenges would contribute to a more equitable educational system

This figure illustrates the spatial analysis results for SMP Negeri 2 Tarutung. Although the school has a substantial capacity and serves several villages in the area, the analysis shows that some areas are more than 1,500 meters away from the school, categorized as "hard to reach." These areas often lack adequate public transportation, making it difficult for students from these regions to access the school efficiently.

The analysis of school accessibility in Tarutung District reveals that the proximity of schools significantly impacts students' access to education. Villages categorized as "Very Near" (300 meters) and "Near" (600 meters) to their respective schools, such as *Hutatoruan X* and *Simamora*, align with the standards set by SNI 03-1733-2004, ensuring easy access for students. These areas fall within the ideal "walking distance" to schools, consistent with the principles of *Neighborhood Unit*, where schools should serve as the central point of residential communities. In these cases, students can easily reach schools without needing transportation, making these areas highly accessible.

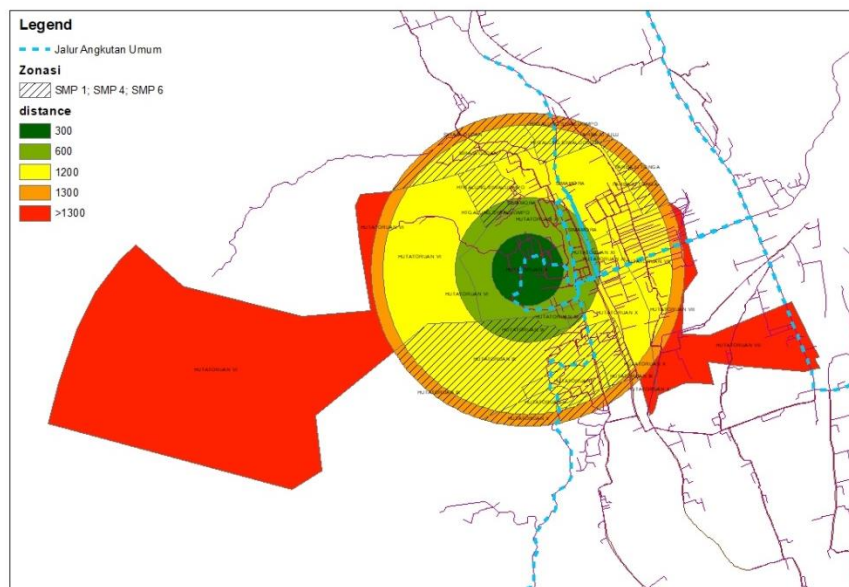


Fig. 3. Spatial Analysis Map of SMP Negeri 2 Tarutung Accessibility

However, the "Moderate" (1200 meters) category presents more challenges, even though it still complies with the guidelines of De Chiara and Koppelman (1975). Villages such as *Hutatoruan VII* and *Simamora* remain accessible but are at the threshold where walking may not always be feasible, especially for students living in the more distant parts of these areas. While still considered within range according to the standards, the larger area coverage and potential lack of transportation options create accessibility issues for some students.

The "Quite Far" (1300 meters) and "Far" (>1300 meters) categories reveal significant challenges in accessibility. Villages such as *Hutatoruan VI* and *Hutatoruan X* face greater difficulty due to both their distance from schools and the lack of adequate transportation infrastructure. Although theoretically within reach under De Chiara and Koppelman's criteria, these areas are harder to serve due to their remote locations, which often lack public transportation routes. These villages, with large coverage areas and difficult terrain, require urgent attention to ensure equitable access to education.

To address these disparities, it is recommended that the zoning policy be revised to include more remote areas within school zones, expanding access for students living in "Quite Far" and "Far" categories. Improving public transportation infrastructure and offering subsidized transport for students in distant areas would alleviate the challenges caused by long distances. Furthermore, the zoning policy should be revised to account for transportation access and geographic barriers, ensuring a more equitable and inclusive educational system. These changes would help ensure that all students, regardless of location, have equal opportunities to access quality education.

Spatial analysis for SMP Negeri 3 Tarutung shows that most of the zoning area is within an accessible range, between 1,000 meters and 1,200 meters. However, several villages still fall beyond 1,200 meters and are categorized as "fairly distant" or "hard to reach." This indicates that although SMP Negeri 3 has better accessibility compared to other schools, there are still gaps in equitable access to education.

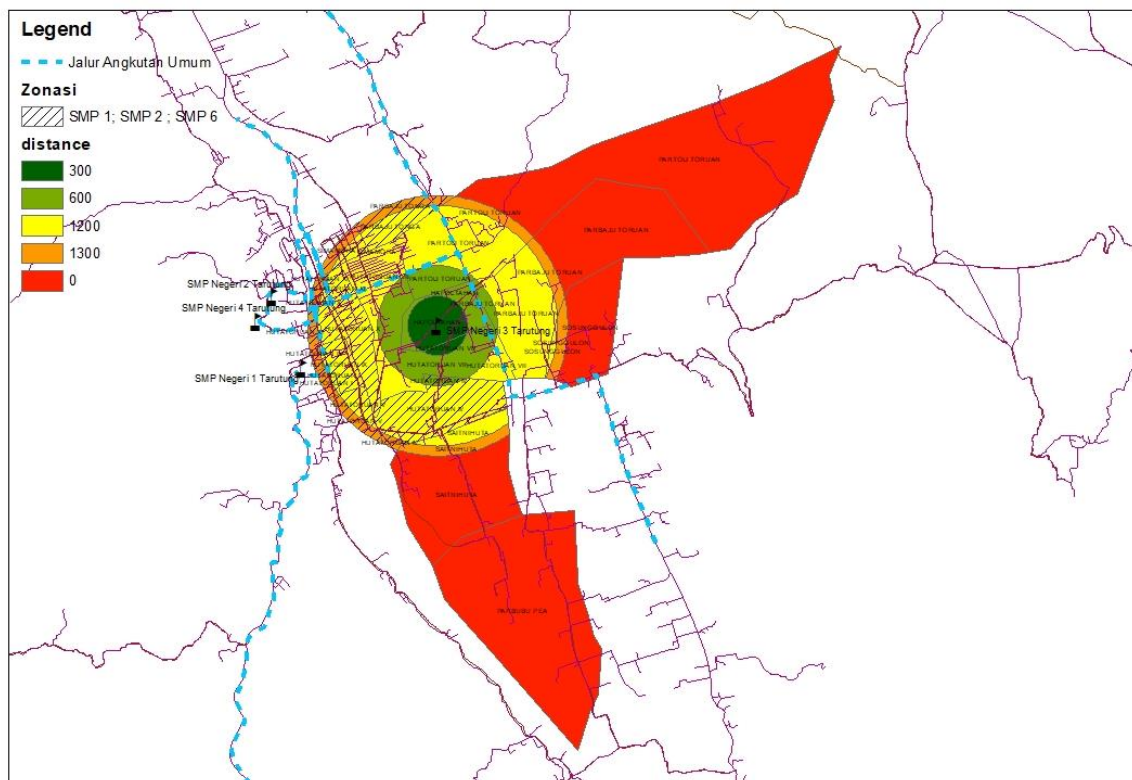


Fig. 4. Spatial Analysis Map of SMP Negeri 3 Tarutung Accessibility

3.2 Accessibility Based on Distance and Zoning Standards

The analysis of school accessibility in Tarutung District, based on the data provided, reveals significant differences in the accessibility of schools depending on the distance between residential areas and the schools. The distance is divided into five categories: "Very Near" (300 meters), "Near" (600 meters), "Moderate" (1200 meters), "Quite Far" (1300 meters), and "Far" (>1300 meters). Areas categorized as "Very Near" and "Near" show excellent accessibility to schools. For example, villages like *Hutatoruan VII* and *Hapoltahan*, both within 300-600 meters of their respective schools (SMP 2, SMP 3, and SMP 4), are easily accessible and comply with SNI 03-1733-2004 standards for school proximity. These villages are within walking distance, which aligns with the concept of *Neighborhood Unit* where schools should be at the heart of residential areas, facilitating easy access for local residents.

The "Moderate" category (1200 meters) still meets the standards of De Chiara and Koppelman (1975), but challenges begin to appear, particularly in larger areas with less direct access. Villages such as *Partoli Toruan* and *Hutatoruan VII* are within 1200 meters of their designated schools, and while still theoretically accessible, they face challenges such as greater area coverage and potential lack of transport services for remote areas. For instance, *Partoli Toruan* (61.99 km²) and *Hutatoruan VII* (50.81 km²) may have larger population distributions, meaning that while they fall within the moderate zone, some residents, especially those living further from the school, may experience difficulty accessing the facilities.

3.3 "Quite Far" and "Far" Categories

For areas categorized as "Quite Far" (1300 meters) and "Far" (>1300 meters), the accessibility to schools becomes more difficult. These regions are more distant from the nearest schools and may not be adequately served by public transportation. Villages such as *Hutatoruan X* (1300 meters) and *Hutatoruan V* (1300 meters) demonstrate the challenges posed by distance. While still theoretically accessible based on the De Chiara and Koppelman model, the lack of transport options and challenging geography, especially in larger areas like *Partoli Toruan* (292.70 km²), exacerbates the issue. These areas face significant barriers in terms of

both physical distance and lack of infrastructure, making access to schools much more difficult for students.

Moreover, villages that fall into the "Very Far" category, such as *Saitnihuta* and *Partoli Toruan*, show even greater challenges, with some areas having difficulty being reached at all due to extreme distances and lack of adequate transport options. These regions are classified as "Hard to Reach" under the zoning system, as the distances exceed the 1300-meter threshold and face significant logistical issues in terms of accessibility to educational facilities.

3.4 Implications for Zoning Policy

The zoning policy, which determines school assignments primarily based on proximity, often results in inequities, particularly for students residing in more distant areas. While the current zoning system works well for those living near schools, it disadvantages students who live in remote regions such as *Partoli Toruan* and *Saitnihuta*, where access to schools is difficult, and transport options are limited. This raises concerns about the fairness of the zonal system, as students in these remote areas may not be able to compete fairly for school placements. The lack of consideration for transportation availability and geographic barriers means that some students are unfairly excluded from local school zones, despite being within the overall geographical catchment area.

3.5 Recommendations for Policy Revisions and Infrastructure Development

To address these challenges, several policy revisions and infrastructure improvements are recommended. First, the zoning system should be expanded to include more remote areas and account for factors such as transportation accessibility and terrain. Additionally, increasing the availability of public transportation, particularly in more remote areas, would improve access for students who are otherwise hindered by geographic and logistical barriers. Moreover, creating more schools in underserved areas, especially in regions like *Partoli Toruan* and *Saitnihuta*, would help balance the educational opportunities for students across the district. By taking these factors into account, the zoning system can be adjusted to create a more equitable and inclusive educational environment for all students, regardless of their location.

3.6 Accessibility Analysis Based on Standards

The spatial analysis results for the accessibility of SMP facilities in Tarutung District can be seen in the map below.

Based on the map, it is evident that the majority of the Tarutung District is categorized as "hard to reach" for SMP facilities. The data in the map can be further clarified in the following Table 1.

It is clear that the percentage of areas that are "hard to reach" is significantly higher than the areas that are accessible. The "hard to reach" areas cover 77.41% of the total area, while the accessible areas account for only 22.59%. The

following table provides a comparison of accessibility at the village level, further highlighting these disparities.

3.7 Zoning Discrepancies Between Regulations and Accessibility Analysis

The spatial analysis has revealed that SMP facilities in Tarutung are concentrated in certain locations, leading to inequities in the admission process. Since the primary factor for student acceptance is proximity to the school, some students in villages near SMPs are excluded from the zoned areas despite being geographically close to these schools. The following table compares the zoning based on the *Peraturan Bupati* (Regulation of the Regent) with the zoning derived from spatial analysis and the *Neighborhood Unit* theory.

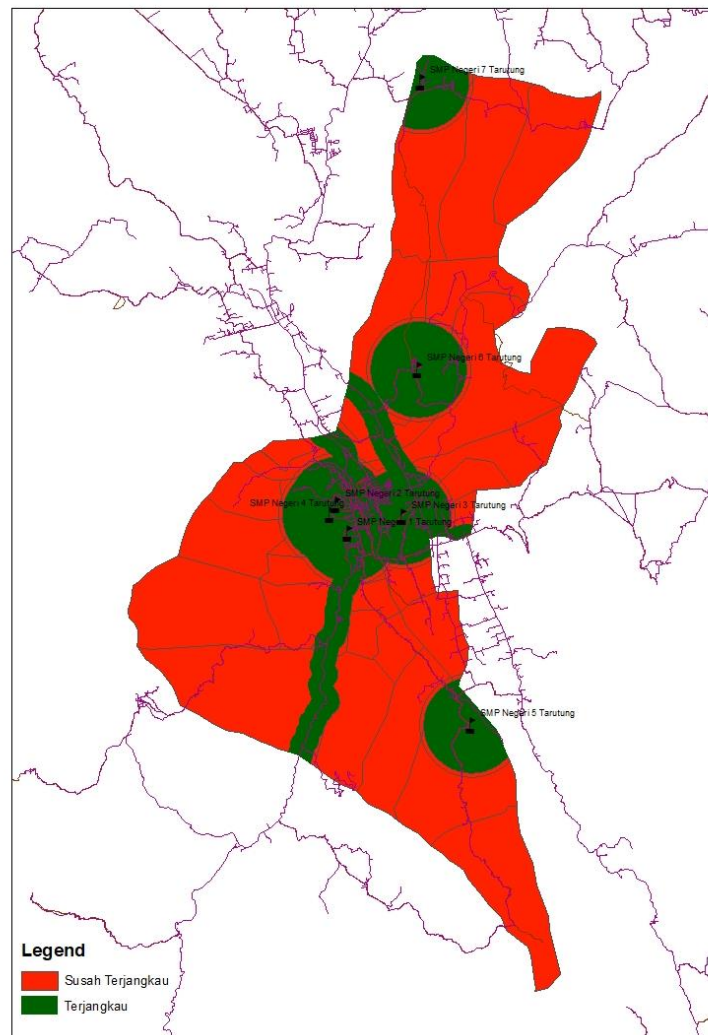


Fig. 5. Accessibility Map of SMP Facilities in Tarutung District

Table 1. Accessibility Data

No	Description	Area (km ²)	Percentage
1	Hard to Reach	8465.03	77.41%
2	Reachable	2470.24	22.59%
Grand Total		10935.28	100%

Table 2. Accessibility Levels by Village According to Their Zoning in Tarutung District

	Village	Hard to reach (km ²)	%	Reachable (km ²)	%	Grand Total (km ²)
1	AEK SIANSIMUN	73.78	79.58	18.93	20.42	92.71
2	AEKNASIA	671.73	100.00	0.00	0.00	671.73
3	HAPOLTAHAN	0.00	0.00	39.84	100.00	39.84
4	HTGALUNG	184.45	85.01	32.53	14.99	216.99
	SIWALUOMPO					
5	HUTAPEA BANUAREA	438.82	59.62	297.16	40.38	735.99
6	HUTATORUAN I	0.00	0.00	14.13	100.00	14.13
7	HUTATORUAN III	86.94	94.26	5.30	5.74	92.23
8	HUTATORUAN IV	1.51	2.47	59.81	97.53	61.33
9	HUTATORUAN IX	23.01	16.36	117.67	83.64	140.67
10	HUTATORUAN V	103.84	43.72	133.69	56.28	237.53
11	HUTATORUAN VI	338.18	76.79	102.22	23.21	440.41
12	HUTATORUAN VII	0.00	0.00	101.92	100.00	101.92
13	HUTATORUAN VIII	738.36	84.98	130.47	15.02	868.83
14	HUTATORUAN X	0.00	0.00	110.05	100.00	110.05
15	HUTATORUAN XI	0.00	0.00	13.60	100.00	13.60
16	HUTAUROK	61.38	86.54	9.55	13.46	70.92
17	JAMBUR NAULI	618.01	99.92	0.51	0.08	618.52
18	LAPOGAMBIRI	8.03	10.84	66.01	89.16	74.04
19	PARBAJU JULU	337.55	58.23	242.16	41.77	579.71
20	PARBAJU TONGA	873.45	89.09	107.00	10.91	980.45
21	PARBAJU TORUAN	114.79	62.88	67.77	37.12	182.56
22	PARBUBU DOLOK	398.30	91.08	39.03	8.92	437.32
23	PARBUBU I	122.97	100.00	0.00	0.00	122.97
24	PARBUBU II	415.98	96.39	15.58	3.61	431.56
25	PARBUBU PEA	224.42	99.22	1.76	0.78	226.18
26	PARTALI JULU	349.98	53.83	300.22	46.17	650.20
27	PARTOLI TORUAN	299.45	79.27	78.31	20.73	377.77
28	SAITNIHUTA	109.36	89.14	13.32	10.86	122.68
29	SIANDOR-ANDOR	570.64	100.00	0.00	0.00	570.64
30	SIHUJUR	476.43	100.00	0.00	0.00	476.43
31	SIMAMORA	0.01	0.02	52.90	99.98	52.91
32	SIRAJA OLOAN	81.18	70.72	33.61	29.28	114.79
33	SITAMPURUNG	486.78	68.82	220.53	31.18	707.31
34	SITAKA	213.72	90.02	23.70	9.98	237.42
35	SOSUNGGULON	42.00	66.73	20.94	33.27	62.93
Grand Total		8465.03		2470.24		10935.28

From the 35 villages in Tarutung, only 9 villages have more than 60% of their areas considered "reachable," namely Hapoltahan, Hutatoruan I, Hutatoruan IV, Hutatoruan X, Hutatoruan XI, Lapogambiri, and Simamora. Additionally, 7 villages are completely "hard to reach" and are not served by SMP facilities, including Aeknasia, Jambur Nauli, Parbubu I, Parbubu II, Parbubu Pea, Siandor-andor, and Sihujur.

Table 3. Comparison of Zoning Between Regulations and Accessibility Analysis

No	Name of SMP Educational Unit	Zoning According to Tapanuli Utara Regent Regulation No. 20 of 2021	Zoning According to Distance and Accessibility Analysis
1	SMP N 1 Tarutung	Kelurahan Hutatoruan V, Desa Aek Siansimun, Desa Hutatoruan, Desa Parbubu I, Desa Parbubu II, Desa Lapogambiri, Desa Sitakka, Desa Aeknasia, Desa Saitnihuta, Desa Parbubu Pea	Hapoltahan, Hutagalung Siwaluompu, Hutatoruan I, Hutatoruan IV, Hutatoruan IX, Hutatoruan V, Hutatoruan VI, Hutatoruan VII, Hutatoruan X, Hutatoruan XI, Saitnihuta, Simamora
2	SMP N 2 Tarutung	Kelurahan Hutatoruan VI, Kelurahan Hutatoruan VII, Kelurahan Hutatoruan X, Kelurahan Hutatoruan IX, Kelurahan Hutatoruan XI, Desa Simamora	Hutagalung Siwaluompu, Hutatoruan I, Hutatoruan IX, Hutatoruan V, Hutatoruan VI, Hutatoruan VII, Hutatoruan X, Hutatoruan XI, Parbaju Julu, Parbaju Tonga, Simamora, Sirajaoloan
3	SMP N 3 Tarutung	Desa Hapoltahan, Desa Parbaju Toruan, Desa Sosunggulon, Desa Hutagalung, Kelurahan Hutatoruan VII, Desa Saitnihuta, Desa Parbubu Pea	Hapoltahan, Hutatoruan I, Hutatoruan IV, Hutatoruan IX, Hutatoruan V, Hutatoruan VII, Hutatoruan X, Hutatoruan XI, Parbaju Tonga, Parbaju Toruan, Partali Toruan, Saitnihuta, Simamora, Sosunggulon
4	SMP N 4 Tarutung	Kelurahan Hutatoruan VI, Kelurahan Hutatoruan VII, Kelurahan Hutatoruan X, Kelurahan Hutatoruan IX, Kelurahan Hutatoruan XI, Desa Simamora, Desa Hutagalung, Desa Hutatoruan X Parbubu, Desa Siraja Oloan, Desa Hutaauruk	Hutagalung Siwaluompu, Hutatoruan I, Hutatoruan IX, Hutatoruan V, Hutatoruan VI, Hutatoruan VII, Hutatoruan X, Hutatoruan XI, Simamora, Sirajaoloan
5	SMP N 5 Tarutung	Desa Siandorandor, Desa Hutapea Banuarea	Hutapea Banuarea, Parbubu II, Parbubu Pea
6	SMP N 6 Tarutung	Desa Parbaju Tonga, Desa Parbaju Julu, Desa Partali Julu	Parbaju Tonga, Parbaju Julu, Partali Julu
7	SMP N 7 Tarutung	Desa Sitampurung, Desa Jamburnauli, Desa Paronggitan, Desa Sihujur	Jambur Nauli, Sitampurung

4. DISCUSSION

4.1 Standards for Educational Facility Accessibility

According to SNI 03-1733-2004, the ideal distance between junior high schools (SMP) and residential areas should not exceed 1,000 meters. However, the location of educational facilities in Tarutung District does not meet this standard. Spatial analysis shows that only a small portion of residential areas falls within the "accessible" category. With the implementation of the zoning system for new student admissions (PPDB), students living in areas outside of the accessible zones have lower chances of being accepted due to the primary consideration of distance between home and school. This disparity highlights the need to reassess the zoning policy in the region.

In addition to SNI 03-1733-2004, De Chiara and Koppelman (1975) offer an extended standard for educational accessibility, allowing up to 1,200 meters. Although this standard offers more flexibility, spatial analysis reveals that many residential areas in Tarutung still remain difficult to reach by the available schools. This reinforces the fact that the current distribution of schools does not meet accessibility standards based on either SNI or De Chiara and Koppelman.

4.2 Transportation Infrastructure Limitations

De Chiara (1975) emphasized that for low-density areas like Tarutung, public transport is a crucial component in determining educational accessibility. Tarutung has three city transport routes, but these only serve specific villages and fail to reach all residential areas. Schools like SMP Negeri 5, SMP Negeri 6, and SMP Negeri 7 are not served by public transport, creating significant barriers for students.

4.3 Evaluation Based on the Neighborhood Unit Theory

The Neighborhood Unit theory stresses that schools should serve as central hubs within residential neighborhoods, ideally located within walking distance. However, in low-density areas like Tarutung, schools located far from residential centers indicate that this theory is not fully

realized. Spatial analysis shows that SMP Negeri 5, SMP Negeri 6, and SMP Negeri 7 are located far from the main residential areas, while three other schools are concentrated around the central urban area. This uneven distribution not only affects the PPDB zoning system but also creates educational access inequities for students in rural areas.

4.4 Inequality in the Zoning System

With 77.41% of residential areas being hard to access, many students in these regions have a lower chance of being admitted to schools based on the zoning system. This stands in contrast to places like Cimahi, which according to Ruuhulhaq (2024), has a more equitable distribution of educational facilities near residential areas, ensuring better educational access.

4.5 Recommendations for Zoning Policy

Kosasih (2020) emphasizes the need to revise PPDB zoning policies with flexibility in determining quotas and mapping areas. Based on the analysis in Tarutung, policy revisions could focus on:

1. **Integrating Transportation Factors:** Including public transportation availability as a key consideration in zoning decisions. Areas without transport access should be prioritized in the zoning policy.
2. **Redistributing Educational Facilities:** The placement of new schools or the relocation of existing ones to bring facilities closer to residential centers, particularly in the "hard to reach" areas.
3. **Mapping Educational Resources:** Local governments should develop a comprehensive educational resources map that includes geographic, demographic, and spatial data to guide zoning policy decisions.

5. CONCLUSION AND RECOMMENDATIONS

This study demonstrates that the distribution of public Junior High Schools (SMP) in Tarutung District does not meet the accessibility standards set by SNI 03-1733-2004 and the Neighborhood Unit theory. A significant portion of the residential areas, specifically **77.41%**, falls into the "hard to reach" category, primarily due to the concentration of schools in the city center, the

lack of adequate public transportation, and challenging geographical conditions. The zoning system for new student admissions (PPDB), which prioritizes the distance between students' homes and schools, creates inequities for students living in areas with limited accessibility. As a result, there is a clear need for a more comprehensive evaluation of the zoning policy.

To address these issues, it is recommended that the local government focus on redistributing educational facilities, which could involve building new schools in rural areas or relocating schools that are too concentrated in urban centers. In addition, expanding public transport routes to reach remote areas would greatly improve student access to schools. The PPDB zoning policy should be revised to incorporate geographic factors, the availability of public transport, and road conditions in order to ensure more equitable access to education for all students. Moreover, the local government should create a comprehensive educational resource map, based on demographic, geographic, and infrastructural data, to guide future zoning decisions. This should be accompanied by improvements to supporting infrastructure, ensuring that students in remote areas can easily access educational facilities.

These recommendations are essential for creating a more equitable and inclusive educational system, ensuring that all students, regardless of their geographic location, have equal opportunities to access quality education.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
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