Mapping the Distribution of Junior High School Educational Facilities in South Nias Regency Using Geographic Information Systems

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Abstract. South Nias Regency is part of the 3T ((frontier, outermost, disadvantaged:(Bahasa Indonesia: terdepan, terluar, tertinggal)) cluster of regions in Nias Island. Based on the Small Nias Regency RPJMD for 2021-2026, there is a need to analyze the availability of educational facilities, especially considering the current condition of damaged educational facilities in South Nias Regency. In order to address education issues in South Nias Regency in a systematic and easily accessible manner, a strategic plan is needed, one of which is the creation of a map showing the distribution of junior high school education facilities in South Nias Regency. This research uses data collection methods such as observation and interviews. After collecting the data, an analysis is performed on the data points and profiles of the junior high schools obtained. The result of this study is a GIS-based map of the distribution of junior high school educational facilities, which can serve as a reference for regulatory development by the South Nias Regency government. The process includes planning, data collection, analysis, and presentation of data in the form of a map illustrating the educational facility needs in South Nias Regency.

Keywords: Educational Facilities, Junior High School, GIS, South Nias.

1 Introduction

The use of geodata has increased significantly during the last ten years. This has a lot to do with how widely used Geographic Information Systems (GIS) are and how technology has advanced to extract, record, and collect geospatial data. The study of geographic phenomena explains their shape, size, direction, patterns of expression, and linkages with other phenomena in addition to

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describing their presence and processes on the surface of the Earth. This has became easier with the help of information technology, such as Geographic Information Systems (GIS).

Situated on the western side of Sumatra Island, South Nias Regency is roughly 92 nautical miles away from Tapanuli Tengah, also known as Sibolga. It is spread throughout 2,487.99 km2. South Nias has steep, unstable soil structures as part of its natural terrain. With 451.43 km2, Tanah Masa is the largest district by area, and North Batu Islands District is the smallest, at 6.30 km². There are two urban sub-districts, 35 districts, and 459 villages within the South Nias Regency. Pasar Pulau Tello and Pasar Telukdalam are the two urban sub-districts [1].

Based on the mid-year population projection data (June) using the 2020 Population Census results (September), the population of South Nias Regency in 2022 is 373,674 people, consisting of 186,047 females (49.79 percent) and 187,627 males (50.21 percent). The population growth rate from 2010 to 2022 is 1.79 percent. The sex ratio is 101, meaning that for every 100 females, there are 101 males. The district with the largest population is Telukdalam, with 26,201 people (7.01 percent), while the district with the smallest population is Simuk, with 1,949 people (0.52 percent) [1].

South Nias Regency is one of Indonesia's 3T (disadvantaged, remote, and outermost) regions. Areas classified as 3T, particularly rural areas, often face difficulties in meeting their educational needs, including the need for educational facilities such as Junior High Schools. Educational facilities can be defined as activities or resources that serve the community's needs for social, mental, and spiritual satisfaction by creating a learning environment and process that enables students to actively develop their potential. This development includes fostering religious spiritual strength and acquiring the skills necessary for themselves, their community, the nation, and the state [2]. In such conditions, it is certain that the regency lacks accurate data on the quality and standards of education, particularly for junior high schools. Therefore, research is needed to obtain a comprehensive education database for junior high schools in South Nias Regency using GIS analysis..

According to the National Minister of Education Regulation No. 24 of 2007, facility and infrastructure standards for elementary, junior high, and senior high schools require that each district must be served by at least one junior high school capable of accommodating all elementary school graduates in the district. Additionally, in permanent and remote residential clusters with a population of more than 1,000 people, junior high schools must be within a maximum distance of 6 km to ensure that students can travel on safe routes..

According to the National Development Planning Agency Bappenas (2014)[3], the equitable distribution of education across various regions faces numerous challenges. These issues arise because areas distant from urban centers still experience uneven distribution of educational services [4]. Educational planning is closely related to location theory. Proper placement of educational facilities is expected to reach the entire population within an educational area, and one aspect of this is the hierarchy of educational facility services. At the village level, where the population is relatively small, there are elementary school facilities. At the district level, there are junior high schools or senior high schools, which serve a broader area compared to village-level facilities [4].

The inequality in education in Indonesia represents a challenge and responsibility for the government, due to the lack of attention given to the state of education in the country [5]. The

fundamental issue with educational facilities lies in their provision and distribution, which remains uneven across regions and does not yet align with the specific needs and characteristics of the local population [6].

Since the 2009 fiscal year, the government has allocated 20% of the National Budget (APBN) to the education sector, in accordance with the mandate of the 1945 Constitution. This substantial budget is expected to gradually fulfill the compulsory 9-year education requirement and improve the quality of education, particularly at the elementary level, to meet national education standards. Before the budget is distributed, the government, specifically the Department of National Education, must have an accurate database regarding the quality of education in every school across the regencies and cities throughout Indonesia [7]. It is hoped that with an accurate database, educational assistance can be targeted effectively and used appropriately. Therefore, the aim of this research is to map the junior high schools in South Nias Regency based on their locations and distribution using GIS analysis.

School mapping began in France in 1963. [8]. School mapping is a strategic method for planning school locations at a micro level. It is also employed to assess and guarantee the fair and effective distribution of resources both within individual schools and across school systems, particularly during major reforms or extensive expansions of the education system [8]. Such reforms may involve government policies, such as Kenya's [8] implementation of free and compulsory primary education in 2003 conducted a study using Geographic Information Systems (GIS) to map the distribution of public schools in Jeddah. This research focused on primary and secondary schools to determine their distribution across the city of Jeddah, Saudi Arabia, and to highlight the importance of GIS tools in assisting educational planning authorities. The study aimed to understand and address challenges related to school location, distribution, and availability in Jeddah. Data was collected from the Ministry of Education and analyzed using ArcGIS. The results showed the categorization and location of public schools for boys in Jeddah.

The objectives of school mapping [9] are as follows:

1. To improve accessibility and equal educational opportunities for all.
2. To ensure the equitable distribution of educational facilities to communities in need and to optimize their use.
3. To ensure safety and comfort in traveling to and from school.
4. To accommodate potential future expansions in terms of land area and increasing student enrollment.
5. To ensure cost-effectiveness and efficiency by improving the cost-performance ratio.
6. To avoid excessive localization or concentration of schools in certain areas while other areas lack sufficient schools.

The roles of school mapping, as outlined by Caillods in Adaja and Osagie and Varghese in [9] are as follows:

1. Establish conditions that facilitate the attainment of universal primary and secondary education.
2. Improve access for traditionally underrepresented socio-economic groups, which in most cases are women.

3. Encourage the fair distribution of educational benefits across various regions and populations.
4. Improving the quality of education efforts.
5. Maximize the efficient utilization of available capital, human, and financial resources.
6. Organize, coordinate and rationalize technical, vocational and post-secondary education efforts.

Educational facilities in South Nias Regency are generally allocated for Elementary and Junior High Schools, while Senior High Schools are managed by the Provincial Education Office. This division of management is based on Law No. 23 of 2014 on Regional Government, which stipulates that the management of primary education, early childhood education, and non-formal education falls under the jurisdiction of the regency or city government [10].

This research is expected to provide the local government with information about junior high schools in South Nias Regency, including details on students, educational staff, and facilities. Additionally, it aims to offer insights into the locations and geographical placement of these junior high schools, enabling both government and private sector assistance to be effectively targeted and utilized.

2 Methods

2.1 Research Location and Timing

This research was was carried out in South Nias Regency and took place in April 2024. The researcher carried out direct field observations at junior high schools to collect data through observations, interviews, and documentation necessary for the study.

2.2 Population and Sample

The population and sample for this study include all junior high schools in the 35 districts of South Nias Regency, totaling 145 schools, which consist of both public and private junior high schools.

2.3 Data Collection Techniques

Observation. Data collection involved direct observation of school conditions. Researchers visited the study sites, systematically observing and recording phenomena related to the research objects. Observed data included school coordinates and additional information about each school.

Literature Review. This process involved reviewing books, journals, e-journals, and e-books to obtain references useful for discussing Geographic Information Systems (GIS).

2.4 Data Analysis Techniques

Data analysis begins with examining all available data from various sources, including observations and literature reviews. The next step involves organizing the data into specific units, which are then categorized in subsequent steps. The final stage of data analysis is to process the data into spatial data, which will be presented in the form of maps.

Once the data has been processed into spatial data, the next step is to analyze it using Geographic Information System (GIS) methods and present the results in the form of maps. Spatial data analysis is a multidisciplinary activity that encompasses fields such as water resources, geography, urban planning, hydrology, and earth sciences. This data can originate from various sources, including texts, maps, charts, organizations, aerial photographs, satellite imagery, and field information. Managing and analyzing large volumes of spatial data necessitates a computer-based system known as Geographic Information Systems (GIS). GIS is defined as a hardware and software system that enables users to collect, manage, analyze, and retrieve substantial amounts of spatial reference data along with associated attributes from diverse sources [11].

In the regional planning process, it is essential to integrate various spatial data and attributes to generate different alternatives. Geographic Information Systems (GIS) serve as a valuable tool for combining and analyzing multithematic information for specific applications. They provide managers and planners with the necessary resources to derive new insights from existing thematic layers tailored to particular needs. In GIS, both spatial data (such as satellite imagery and thematic maps) and non-spatial data (like census surveys and socio-economic levels) can be integrated, allowing for the analysis of a series of spatially referenced layers either independently or in combination with others. GIS supports diverse data views and facilitates integration that reduces redundancy while ensuring data integrity and security. Additionally, GIS allows for simultaneous access by multiple users and enables efficient processing of user transactions. Due to its numerous capabilities, GIS has quickly become an essential tool for resource management. Nowadays, it is difficult to imagine resource planning or mapping without GIS. Figure 1 illustrates GIS as used for management purpose (Agrawal and Garg, 2000) in [11].

Thus, GIS is now an essential tool in planning and is used for a variety of applications such as district-level planning, transportation route planning, location suitability analysis, and more. GIS is also applied in various urban applications, such as land suitability analysis for urban land use, environmental impact assessment of human settlements, urban growth and trend analysis, and other applications. The digital databases created at each stage of GIS can be used in the future to easily and efficiently extract related information, as GIS is fundamentally an information system. New thematic maps can also be integrated, and information with newly established user conditions can be created and updated (Peuquet and Marble, 1990) in [11].

After conducting spatial data analysis through GIS, the result is a map depicting the distribution of junior high schools in South Nias Regency. This map illustrates the researched objects, namely the locations and profiles of junior high schools in South Nias Regency, based on the data collected during the study. The results are then analyzed and used to draw conclusions.

2.5 Tools Used

The tools used in conducting this research are as follows :

1. Mobile phone as a documentation tool.
2. Laptop as the primary research tool.
3. Google Chrome for searching primary and secondary data.
4. ArcGIS software for creating maps and analyzing research results.

2.6 Research Stages

Overall, this research is carried out through the following stages :

1. Collect data by conducting observations at junior high school locations.
2. Analyze the collected data.
3. Download spatial data in .shp format from the Geospatial Information Agency website for the purpose of creating junior high school distribution maps.
4. Import the .shp spatial data into mapping software.
5. Compile the report and design the layout for the maps to be used as research outcomes.

Table 1. The Number of Junior High Schools by Status in Each District of South Nias Regency, Nias Province

District	Status of Junior High Schools		Amount
	Public	Private	
Amandraya	4	-	3
Aramo	3	-	4
Boronadu	4	-	4
Fanayama	4	2	6
Gomo	2	-	2
Hibala	3	2	5
Hilimegai	2	-	2
Hilisalawa Ahe	3	-	3
Huruna	6	-	6
Idanotae	4	-	4
Lahusa	5	4	9
Lolomatua	4	-	4
Lolowau	2	-	2
Luahagundre Maniamolo	1	1	2
Maniamolo	5	2	7
Mazino	2	1	3
Mazo	5	-	5
Onohazumba	3	-	3
Onolalu	3	-	3
O'o'u	2	-	2
Pulau - Pulau Batu	2	1	3
Pulau - Pulau Batu Barat	1	-	1

Pulau - Pulau Batu Timur	1	-	1
Pulau - Pulau Batu Utara	2	-	2
Sidua'ori	3	-	3
Simuk	1	-	1
Somambawa	4	3	7
Susua	8	-	8
Tanah Masa	2	1	3
Teluk Dalam	3	7	10
Toma	3	-	3
Ulu Idanotae	4	1	5
Ulunoyo	6	-	6
Ulususua	3	6	9
Umbunasi	3	-	3
Amount	113	31	144

Source : analysis result, 2024

3 Results and Discussion

3.1 Data Description

In this data description, the author employed several techniques used in this research, namely observation and documentation. The documentation conducted in this study aimed to supplement the information or findings, such as photographs of the observed junior high schools.

The next step involved outlining the observation procedures to be carried out by the author. Subsequently, the author began observing or examining the condition of the junior high schools and their profiles. The following step involved interviewing relevant parties regarding the junior high school profiles.

3.2 Research result

From the observations conducted, the results include the distribution of junior high schools in South Nias Regency as follows:

The detailed distribution of junior high schools by name in each district is as follows:

Table 2. Names of Junior High School Facilities in Each District of South Nias Regency, Nias Province

No	District	Name of Junior High School
1	Amandraya	SMP N 1 AMANDRAYA
		SMP N 2 AMANDRAYA

		SMP N 3 AMANDRAYA
		SMP N 4 AMANDRAYA
		SMP N 1 ARAMO
2	Aramo	SMP N 2 ARAMO
		SMP N 3 SATU ATAP ARAMO
		SMP NEGERI 1 BORONADU
3	Boronadu	SMP NEGERI 2 BORONADU
		SMP NEGERI 3 BORONADU
		SMP NEGERI 4 BORONADU
		SMP NEGERI 1 FANAYAMA
		SMP NEGERI 2 FANAYAMA
4	Fanayama	SMP NEGERI 3 FANAYAMA
		SMP NEGERI 4 FANAYAMA
		SMP SWASTA FANAYAMA BAWOMATALUO
		SMP SWASTA SENORA
5	Gomo	SMP N 1 GOMO
		SMP N 2 GOMO
		SMP Negeri 1 Hibala
		SMP Negeri 2 Hibala
6	Hibala	SMP Negeri 3 Hibala
		SMP Swasta Kristen Providensia Fahasaradodo
		SMP Swasta Kristen Providensia Hibala
7	Hilimegai	SMP NEGERI 1 HILIMEGAI
		SMP NEGERI 2 HILIMEGAI
		SMP NEGERI 1 HILISALAWAAHE
8	Hilisalawa Ahe	SMP NEGERI 2 HILISALAWAAHE
		SMP NEGERI 3 HILISALAWAAHE
		SMP NEGERI 1 HURUNA
		SMP NEGERI 2 SATU ATAP HURUNA
9	Huruna	SMP NEGERI 3 HURUNA
		SMP NEGERI 4 HURUNA
		SMP NEGERI 5 HURUNA
		SMP NEGERI 6 HURUNA
10	Idanotae	SMP NEGERI 1 IDANOTAE
		SMP NEGERI 2 SATU ATAP IDANOTAE

		SMP NEGERI 3 SATU ATAP IDANOTAE
		SMP NEGERI 4 IDANOTAE
		SMP N 1 LAHUSA
		SMP N 2 LAHUSA
		SMP N 3 SATU ATAP LAHUSA
		SMP N 4 LAHUSA
11	Lahusa	SMP N 5 LAHUSA
		SMP SWASTA AMAL MAS 1 LAHUSA
		SMP SWASTA FAJAR MAS LASORI I
		SMP SWASTA RIDO BALAEKHA CEMERLANG
		SMP SWASTA TAMAN INDAH SEJATI
		SMP NEGERI 1 LOLOMATUA
12	Lolomatua	SMP NEGERI 2 LOLOMATUA
		SMP NEGERI 3 LOLOMATUA
		SMP NEGERI 4 LOLOMATUA
		SMP NEGERI 1 LOLOWAU
13	Lolowau	SMP NEGERI 2 LOLOWAU
		SMP NEGERI 3 LOLOWAU
14	Luahagundre Maniamolo	SMP NEGERI 1 LUAHAGUNDRE MANIAMOLO
		SMP SWASTA FANAYAMA HILIMAENAMOLO
		SMP NEGERI 1 MANIAMOLO
		SMP NEGERI 2 SATU ATAP MANIAMOLO
		SMP NEGERI 3 MANIAMOLO
15	Maniamolo	SMP NEGERI 4 MANIAMOLO
		SMP NEGERI 5 MANIAMOLO
		SMP SWASTA CITRA SAKTI
		SMP SWASTA KRISTEN BNKP HILISIMAETANO
		SMP SWASTA KRISTEN BNKP MAZINO
16	Mazino	SMP NEGERI 1 MAZINO
		SMP NEGERI 2 MAZINO
		SMP NEGERI 1 MAZO
		SMP NEGERI 2 MAZO
17	Mazo	SMP NEGERI 3 MAZO
		SMP NEGERI 4 MAZO
		SMP NEGERI 5 MAZO

18	Onohazumba	SMP NEGERI 1 ONOHAZUMBA
		SMP NEGERI 2 ONOHAZUMBA
		SMP NEGERI 3 SATU ATAP ONOHAZUMBA
19	Onolalu	SMP NEGERI 1 ONOLALU
		SMP NEGERI 2 ONOLALU
		SMP NEGERI 3 ONOLALU
20	O'o'u	SMP NEGERI 1 OOU
		SMP NEGERI 2 OOU
21	Pulau - Pulau Batu	SMP Negeri 1 Pulau-Pulau Batu
		SMP Negeri 2 Pulau-Pulau Batu
		SMP Swasta Kristen BNKP Pulau Tello
22	Pulau - Pulau Batu Barat	SMP Negeri 1 Pulau-Pulau Batu Barat
23	Pulau - Pulau Batu Timur	SMP Negeri 1 Pulau-Pulau Batu Timur
24	Pulau - Pulau Batu Utara	SMP Negeri 1 Pulau-Pulau Batu Utara
		SMP Negeri 2 Pulau-Pulau Batu Utara
25	Sidua'ori	SMP N 1 SIDUA ORI
		SMP N 2 SIDUA ORI
		SMP N 3 SIDUA ORI
26	Simuk	SMP Negeri 1 Pulau Simuk
27	Somambawa	SMP N 1 SOMAMBAWA
		SMP N 2 SOMAMBAWA
		SMP N 3 SOMAMBAWA
		SMP N 4 SOMAMBAWA
		SMP SWASTA EMANUEL PENABUR KASIH
		SMP SWASTA FAJAR MAS LASORI II
		SMP SWASTA HOYA SEJAHTERA
28	Susua	SMP NEGERI 1 SUSUA
		SMP NEGERI 2 SUSUA
		SMP NEGERI 3 SUSUA
		SMP NEGERI 4 SUSUA
		SMP NEGERI 5 SUSUA
		SMP NEGERI 6 SUSUA
		SMP NEGERI 7 SATU ATAP SUSUA
		SMP NEGERI 8 SUSUA
29	Tanah Masa	SMP Negeri 1 Tanah Masa

		SMP Negeri 2 Tanah Masa
		SMP Swasta Kristen Providensia Tanah Masa
		SMP SWASTA MITRA KASIH BKPN
		SMP NEGERI 1 TELUK DALAM
		SMP NEGERI 2 TELUK DALAM
		SMP NEGERI 3 DHARMA CARAKA
		SMP SWASTA BINTANG LAUT
30	Teluk Dalam	SMP SWASTA DARMA KASIH TELUKDALAM
		SMP SWASTA HARAPAN NIAS
		SMP SWASTA IMANUEL TELUKDALAM
		SMP SWASTA KRISTEN BNKP TELUK DALAM
		SMP SWASTA NUSANTARA TELUK DALAM
		SMP NEGERI 1 TOMA
31	Toma	SMP NEGERI 2 TOMA
		SMP NEGERI 3 TOMA
		SMP NEGERI 1 ULU IDANOTAE
		SMP NEGERI 2 ULU IDANOTAE
32	Ulu Idanotae	SMP NEGERI 3 ULU IDANOTAE
		SMP NEGERI 4 ULU IDANOTAE
		SMP SWASTA GARUDA HARAPAN MASA DEPAN
		SMP NEGERI 1 ULUNOYO
		SMP NEGERI 2 ULUNOYO
		SMP NEGERI 3 ULUNOYO
33	Ulunoyo	SMP NEGERI 4 ULUNOYO
		SMP NEGERI 5 ULUNOYO
		SMP NEGERI 6 SATU ATAP ULUNOYO
		SMP N 1 ULUSUSUA
		SMP N 2 ULUSUSUA
		SMP N 3 ULUSUSUA
		SMP SWASTA AFORE
34	Ulususua	SMP SWASTA BINTANG HARAPAN ULUSUSUA
		SMP SWASTA HARAPAN SUSUA
		SMP SWASTA KRISTEN BNKP ULUSUSUA
		SMP SWASTA NUSANTARA ULUSUSUA
		SMP SWASTA PERSIAPAN NEGERI 4 ULU SUSUA

		SMP NEGERI 1 UMBUNASI
35	Umbunasi	SMP NEGERI 2 UMBUNASI
		SMP NEGERI 3 SATU ATAP UMBUNASI

Source : analysis result, 2024

Based on the table above, it can be seen that the district with the highest number of junior high schools is Teluk Dalam, with 10 junior high schools, followed by Lahusa and Ulususua, each with 9 junior high schools, and Susua with 8 junior high schools. Conversely, the districts with the fewest junior high schools are West Batu Islands, East Batu Islands, and Simuk, each with 1 junior high school. Additionally, the districts of Hilimegai, Gomo, Lolowau, Luahagundre Maniamolo, O'o'u, and North Batu Islands have 2 junior high schools each. The districts of Amandraya, Hilisalawa Ahe, Mazino, Onohazumba, Onolalu, Batu Islands, Sidua'ori, Tanah Masa, Toma, and Umbunasi each have 3 junior high schools. The remaining districts have an average of 4 to 7 junior high schools each.

Below is the map of junior high schools distribution in South Nias Regency based on the number in each district.

Fig 1. (Left) Map of the Distribution of Junior High Schools in South Nias Regency, Nias Province.
Source: analysis result, 2024

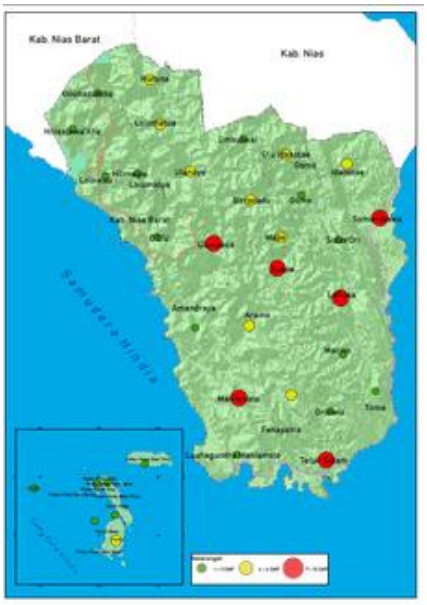

Fig. 2. (Right) Aggregate Map of junior high schools in South Nias Regency, Nias Province.
Source: analysis result, 2024

Based on the analysis presented in the map above, it can be observed that the distribution of junior high schools is still predominantly concentrated in the administrative center of South Nias Regency, namely Teluk Dalam District, which has 10 junior high schools. This is followed by nearby areas such as Lahusa District (9 junior high schools) and Maniamolo District (7 junior high schools). Additionally, the areas on Nias Island, which serves as the main region of South Nias Regency, have a generally higher number of junior high schools compared to the Batu Islands region. For example, Teluk Dalam District has 10 junior high schools, Lahusa and Ulususua Districts each have 9 junior high schools, whereas East Batu Islands and West Batu Islands have only 1 junior high school each. This indicates a disparity in the availability of educational facilities in South Nias Regency, particularly between the main island and the island regions, driven by factors such as regional conditions and population size.

The development of public facilities in Teluk Dalam District is more advanced compared to neighboring districts, which significantly impacts the development of educational facilities in Teluk Dalam. As public facilities become more comprehensive and advanced in a region, the development and completeness of social facilities tend to improve as well [9]. In addition to the well-developed public facilities, Teluk Dalam District also benefits from improved accessibility compared to other districts. Accessibility, such as transportation infrastructure and public facilities that support access, plays a significant role. The accessibility infrastructure greatly influences the mobility of residents, both within Teluk Dalam District and for travel to and from other districts, such as the movement between Teluk Dalam and Lahusa District.

4 Conclusion

The conclusion of this study is that the research aimed to map and analyze the distribution of junior high school facilities in South Nias Regency using Geographic Information Systems (GIS). The study seeks to address strategic needs in improving accessibility and educational quality in 3T ((frontier, outermost, disadvantaged:(Bahasa Indonesia: terdepan, terluar, tertinggal)) areas. Data collection methods included observation and literature review, resulting in a distribution map of junior high schools that can serve as a reference for government planning and educational regulation development. The findings indicate that South Nias Regency has 144 junior high schools, predominantly concentrated in Teluk Dalam District, with an uneven distribution. This presents a challenge for the government to achieve equitable access to education across South Nias Regency, especially in the island regions.

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