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Original Article

Analysis of the Projection of Primary School Needs in Sukamakmue District, Sabang Municipality in 2045

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ABSTRACT
The availability of educational facilities, particularly at the elementary level, plays a crucial role in regional development. This study aims to: (a) evaluate the availability of existing elementary school facilities in Sukamakmue District, (b) analyze the projected needs for elementary school facilities in Sukamakmue District by 2045, and (c) recommend appropriate policies to address the future needs for elementary school facilities in the district. The research utilizes a combination of secondary data analysis and primary data obtained through interviews with key stakeholders in the Education Office. The findings indicate that the distribution of public elementary schools is relatively even across all villages in Sukamakmue District, with a total of 7 public elementary schools currently available. However, based on the population projection for 2045, Paya Seunura Village is expected to experience significant population growth, necessitating the addition of more elementary school facilities over the next 21 years. The projection for facility needs was calculated using a facility needs analysis, with the base year set between 2021 and 2045. In contrast, the other villages show declining population growth, suggesting that no additional facilities will be required.

KEYWORDS
educational facilities; availability; needs; elementary school

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INTRODUCTION

Sukamakmue District, a newly established administrative area in the City of Sabang, was formed from the division of Sukakarya and Sukajaya Districts in 2021. It consists of six villages: Paya, Keuneukai, Beurawang, Iboih, Batee Shoek, and Paya Seunura. One of the primary objectives of regional division is to bring public services closer to the community, as public services are a crucial element in fostering social welfare. The government, acting as the regulator and supervisor, plays a key role in ensuring equitable access to education across all regions of Indonesia, as education is considered a fundamental investment for the future, especially in developing countries (Aristo, 2019). Education serves as a solid foundation for national

progress and is vital in preparing for global advancements.

Indonesia's national education system, as stipulated in Law No. 20 of 2003 on the National Education System, guarantees that every citizen has an equal opportunity to access education. The responsibility for organizing and developing the education system lies with the government based on constitutional mandates (M. Fitria, 2023). However, the primary challenge faced by schools, particularly in remote areas, is inadequate educational infrastructure, which leads to disparities in educational quality. The lack of facilities in rural areas exacerbates educational inequality, as these regions often lag behind in human resource development, making it difficult to sustain educational growth (Rajagukguk et al., 2023).

Educational infrastructure includes essential tools and facilities directly used in teaching and learning, such as buildings, classrooms, desks, chairs, and educational media (Fidani & Prarikeslan, 2019). The availability of educational facilities is crucial in regional planning because education is a basic need that must be fulfilled for every member of society. Furthermore, as population growth and urban sprawl increase, so does the demand for land and infrastructure, including educational facilities (Handayati, 2019). A well-distributed and accessible elementary education system is critical to ensure that all children, regardless of location, have the opportunity to receive a quality education.

In Sukamakmue District, which has a population of approximately 8,760 people and a population density of 127 per km^2 (BPS Kota Sabang, 2023), there are currently seven elementary schools spread across the district. However, an imbalance exists in the distribution of these schools, with some villages having more than one school while others face a shortage. This discrepancy leads to overcrowding in some schools and underutilization in others, forcing some residents to seek education outside their immediate area. This situation not only affects the availability of educational resources but also impacts the quality of education. Overcrowded schools tend to have larger class sizes, limiting the amount of attention students receive from teachers and potentially lowering academic performance.

Building on the findings from previous studies, such as that conducted by Shidiq Suko Raharjo (2022) in Colomadu District, which projected the need for 15 additional elementary schools by 2030, it is essential to evaluate the current availability of educational facilities in Sukamakmue District and project future needs based on population growth trends. Therefore, this research aims to: (a) evaluate the current availability of elementary school facilities in Sukamakmue District, (b) project the future needs for elementary school facilities in the district by 2045, and (c) provide policy recommendations for stakeholders to address these needs.

METHOD

Research Location

This research employs a descriptive quantitative approach, utilizing needs assessment analysis, population projections, and Geographic Information Systems (GIS) analysis. The study is focused on Sukamakmue District, Sabang City. The selection of this location is based on the regional division that occurred in Sukamakmue District, which resulted from the merger of two previous districts, Sukajaya and Sukakarya. Consequently, the researcher is interested in assessing the projected demand for elementary school facilities in Sukamakmue District for the year 2045. The map of research location was on figure 1.

Data Collection Methods

Data collection in this study was conducted through both primary and secondary methods. Primary data were obtained through observations and interviews with stakeholders at the Sabang City Department of Education. Meanwhile, secondary data were gathered from literature sources, including population data and school numbers from the Central Bureau of Statistics of Sukamakmue District, relevant academic journals, and the Educational Facility Needs Determination Standards from the National Standardization Agency, as presented in the following table.

Table 1.
Standards for Determining Educational Facility Needs

No.	Type of Facility	Supporting Population (people)
1	Kindergarten	1,250
2	Elementary School	1,600
3	Junior High School	4,800
4	Senior High School	4,800
5	Reading Park	2,500

Source: SNI 03-1733-2004 Regarding Procedures for Urban Housing Environment Planning

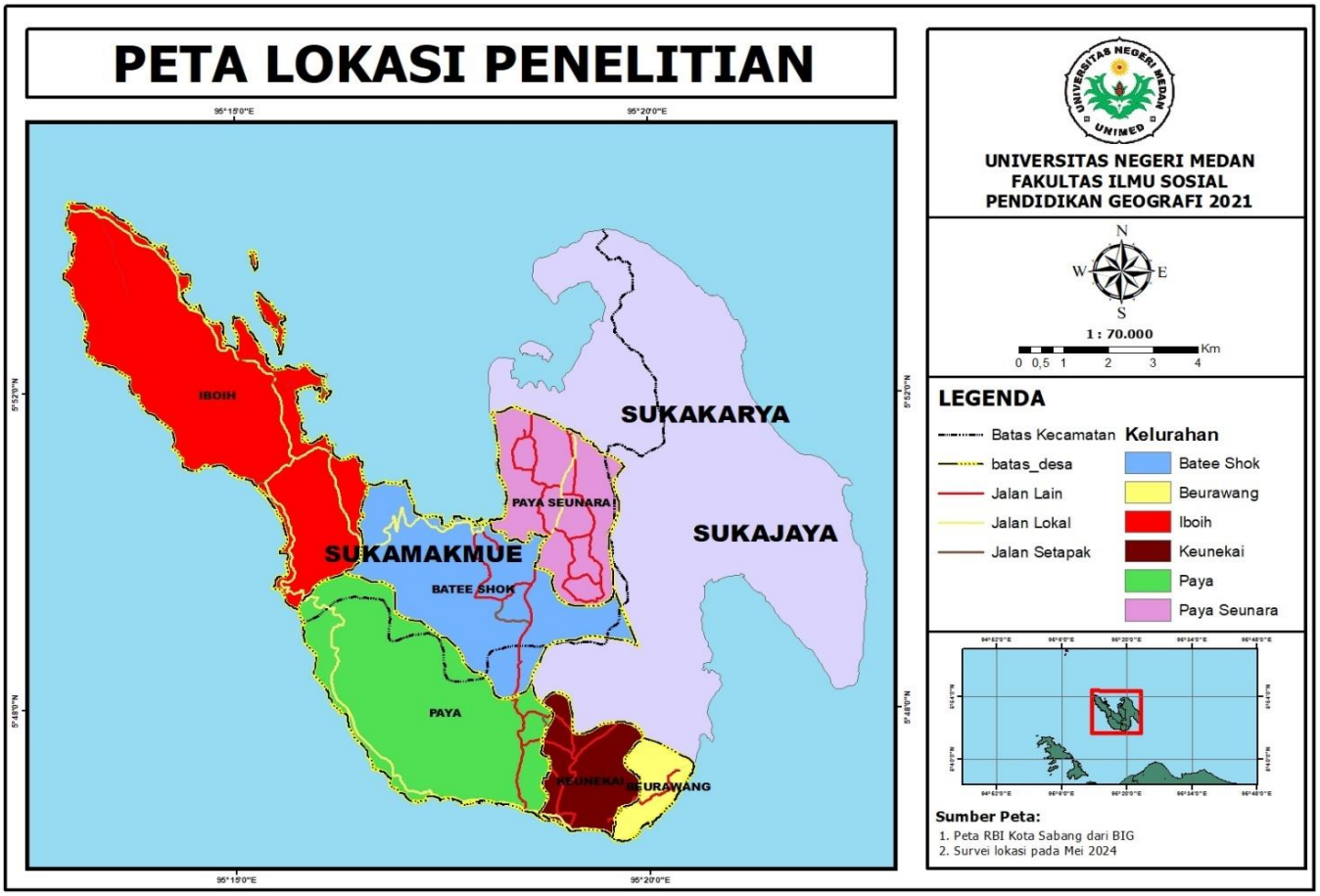

Figure 1. Research location map

Data Analysis

This study employs two types of data analysis: population projection analysis and facility needs analysis. The methods used to project the population for future years include the exponential method and the geometric method. The formulas are as follows:

1. Population Projection Analysis

Population projection is essential for understanding future demographic changes and planning accordingly. Population projection in this study utilizes two primary methods: the exponential method and the geometric method.

Exponential Method:

$$r = \frac{1}{t} \ln \left(\frac{Pt}{Po} \right) \times 100$$

r: Population growth rate
t: Calculation period
ln: Natural logarithm, with a constant value of 2.718281828
Pt: Population in year *t*
Po: Population in the base year

Geometric Method:

$$Pn = Po(1 + r)^n$$

Pn: Projected population in a certain year
Po: Initial population in the base year
1: Constant
r: Population growth rate (derived from the exponential method)
n: Number of years

2. Facility Needs Analysis

This analysis determines the adequacy of existing educational facilities in relation to projected population growth. The calculation is as follows:

$$S(n) = \frac{Pn}{Sm}$$

S(n): Type of facility based on standard
Pn: Projected population
Sm: Minimum standard

Responden

The selection of informants in this study utilized the snowball sampling method, focusing on two key informants: the Head of the Primary Education Development Division and the Staff of the Primary Education Development Division. Based on the analysis of availability and accessibility, which refers to normative standards and is compared with existing conditions, the findings are validated by stakeholders from the Sabang City Department of Education. This research aims to provide a comprehensive perspective on fulfilling educational facility needs in Sukamakmue District. The results are expected to contribute to regional development policies, particularly in improving educational services.

RESULTS AND DISCUSSION

Availability of Public Elementary Schools in Sukamakmue District in 2024

The availability of educational facilities is assessed based on the threshold population per service facility, referring to SNI 03-1733-2004 on the Procedures for Planning Residential Environments in Urban Areas (National Standardization Agency, 2004). According to the threshold population for elementary school facilities, which is set at 1,600 individuals, a comparison was made with the existing school conditions. This comparison revealed areas within the district that are adequately served and those that are not, as presented in the following table and map.

Table 2. Availability of Public Elementary Schools in Sukamakmue District

No	Village Name	Population	Existing Public Elementary Schools	Required Public Elementary Schools	Shortage of Public Elementary Schools	Status
1	Beurawang	409	1	1	0	Adequate
2	Keunekai	1,032	1	1	0	Adequate
3	Paya	680	1	1	0	Adequate
4	Paya Seunura	4,017	1	3	2	Inadequate
5	Batee Shoek	1,572	2	1	0	Adequate
6	Iboih	1,3	1	1	0	Adequate

Source: Research findings, 2024

Based on Table 2 and Figure 2, it is evident that the availability of public elementary schools is evenly distributed across each village in Sukamakmue District. The presence of public elementary school buildings in Sukamakmue has met the requirement for each village, with a total of seven public elementary schools. Beurawang Village has one public elementary school building, Keunekai Village has one, Paya Village has one, Paya Seunura Village has one, Batee Shoek Village has two, and Iboih Village has one public elementary school building.

Overall, the total number of public elementary school buildings in each village within Sukamakmue District is insufficient. Paya Seunura Village requires three public elementary schools according to established standards. However, the actual situation on the ground reveals that only one public elementary school has been constructed in Paya Seunura. This contrasts sharply with Batee Shoek Village, which has two public elementary school buildings. Ideally, one public elementary school in Batee Shoek should be sufficient to accommodate a population of 1,600 residents. This situation indicates that the distribution of elementary school facilities, which are intended to serve local communities, has not been effectively implemented in Sukamakmue District. This finding is supported by research conducted by Ramadhana (2018), which indicates that based on service capacity analysis, Metro City still requires an increase in the quantity of public elementary and junior high schools in each district. Therefore, the development of additional primary education facilities is essential to meet the educational service needs at the elementary and junior high school levels in Metro City.

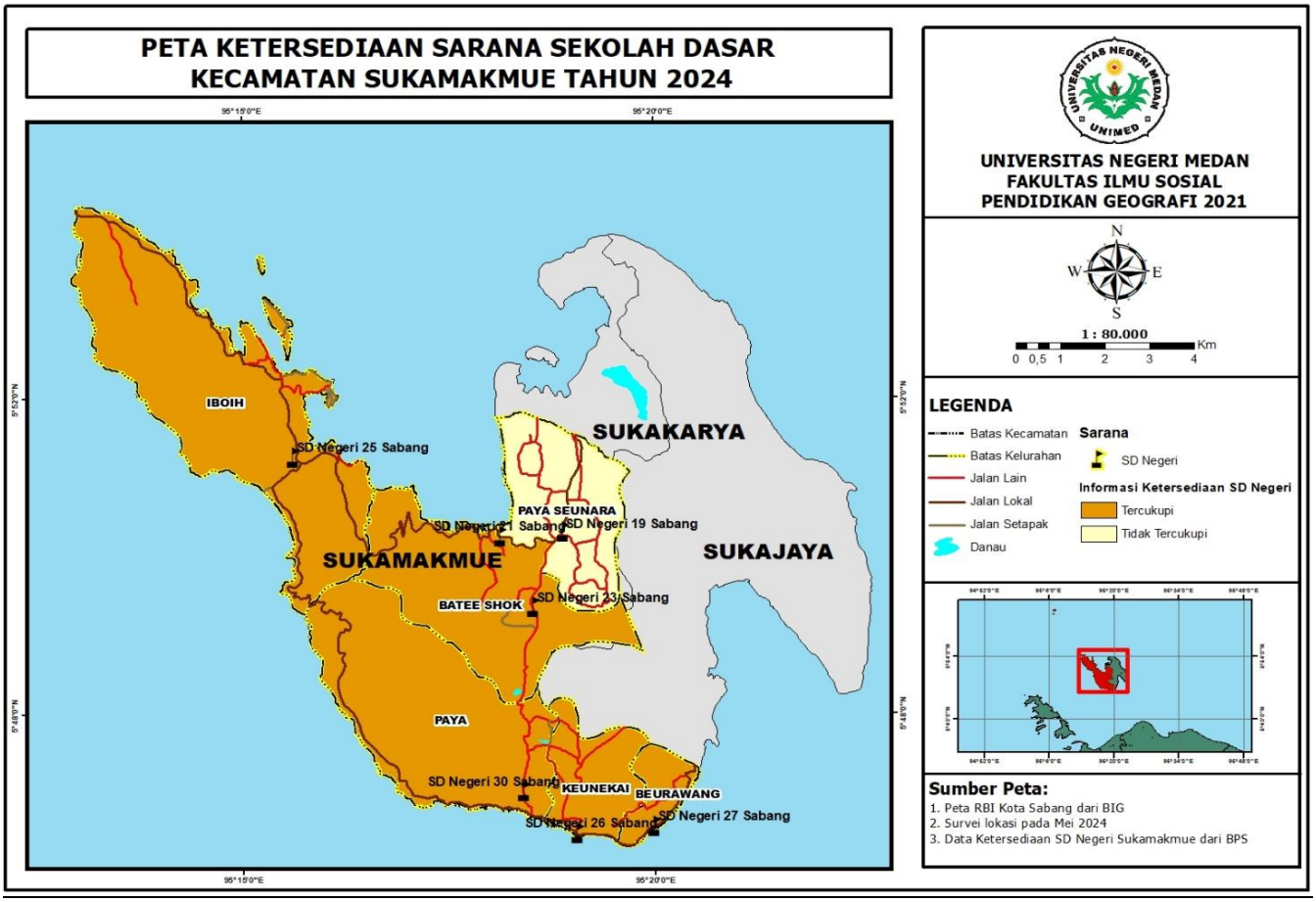

Figure 2. Map of the Availability of Public Elementary School Facilities in Sukamakmue District

Population Projection in Sukamakmue District for 2045

The calculation of population growth and projections in Sukamakmue District was conducted using the exponential and geometric methods, with the base year for calculations set from 2021 to 2045. The results of the calculations are presented in the table 3.

The results of the population growth calculations in Sukamakmue District, based on six villages, indicate that only one village, Paya Seunura, exhibits a positive growth rate of 0.08%. Conversely, the other five villages—Beurawang, Keunekai, Paya, and Iboih—are experiencing negative population growth due to a relatively high rate of out-migration.

Table 3. Population Projection for Sukamakmue in 2045

No.	District	2021	2022	r	2023	2024	2025	2045
1	Beurawang	421	417	-0.01	413	409	405	335
2	Keunekai	1076	1061	-0.01	1046	1032	1017	768
3	Paya	770	739	-0.04	709	680	653	285
4	Paya Seunura	3149	3419	0.08	3706	4017	4353	21805
5	Batee Shoek	1775	1705	-0.04	1637	1572	1510	670
6	Iboih	1482	1419	-0.04	1358	1300	1244	518
	Total	8673	8760	-0.06	8869	9010	9182	24381

Source: Research findings, 2024

In contrast, the other five villages are experiencing a decline in population growth due to residents migrating outside the region for work. A local tour guide in Sabang indicated that many individuals, once reaching working age, tend to leave their hometowns in search of better opportunities elsewhere. He noted that numerous homes in the area remain unoccupied as residents have migrated away and have not returned to their places of origin.

Projection of the Need for Public Elementary School Facilities in Sukamakmue District for 2045

Based on the previous population projection results for Sukamakmue District in 2045, it was found that the village of Paya Seunura is experiencing significant population growth. This indicates that there will be a need for additional educational facilities in the next 21 years. The calculation of the projected needs for facilities in Sukamakmue District was conducted using a facilities needs analysis, with the base year for calculations set from 2021 to 2045. The results of the calculations are presented in the table 3.

From the table 3, the highest demand for public elementary school facilities is found in the Paya Seunura sub-district, with a total of 14 facilities needed. In contrast, other sub-districts do not require additional elementary school facilities due to a declining population growth trend. The importance of sustainable management of educational facility needs in the Sukamakmue District is underscored by projections indicating that by 2045, there will be a need for additional elementary school facilities in several sub-districts, such as Paya Seunura. A study conducted by Zhu et al. (2023) in Nanjiang County, China, also emphasizes that the planning of educational accessibility must consider topographical factors and the geographical distribution of schools. This supports the assertion that the availability and accessibility of educational facilities are critical elements in preventing spatial injustices in educational services, especially in areas with high population growth. This is in line with research conducted by Sakti et al. (2022), which asserts that population growth and spatial changes must be accompanied by an increase in educational facilities to avoid spatial injustices. Therefore, the additional need for elementary school facilities in the Paya Seunura sub-district can also be supported by data-driven spatial policies. Comprehensive data on the demand for public elementary school facilities can be viewed in the map below.

Table 4. Results of the Calculation of Public Elementary School Needs in Sukamakmue District for the Year 2045

No	District	Population (People)		r	Population Projection (People)		Number of Elementary School Facilities	
		2021	2022		2024	2045	2024	2045
1	Beurawang	421	417	-0,954661188	409	335	1	1
2	Keunekai	1076	1061	-1,403860211	1032	767	1	1
3	Paya	770	739	-4,10925939	680	282	1	1
4	Paya Seunura	3149	3419	8,226316854	4017	21065	3	14
5	Batee Shoek	1775	1705	-4,023531219	1572	664	1	1
6	Iboih	1482	1419	-4,34401287	1300	511	1	1

Source: Research findings, 2024

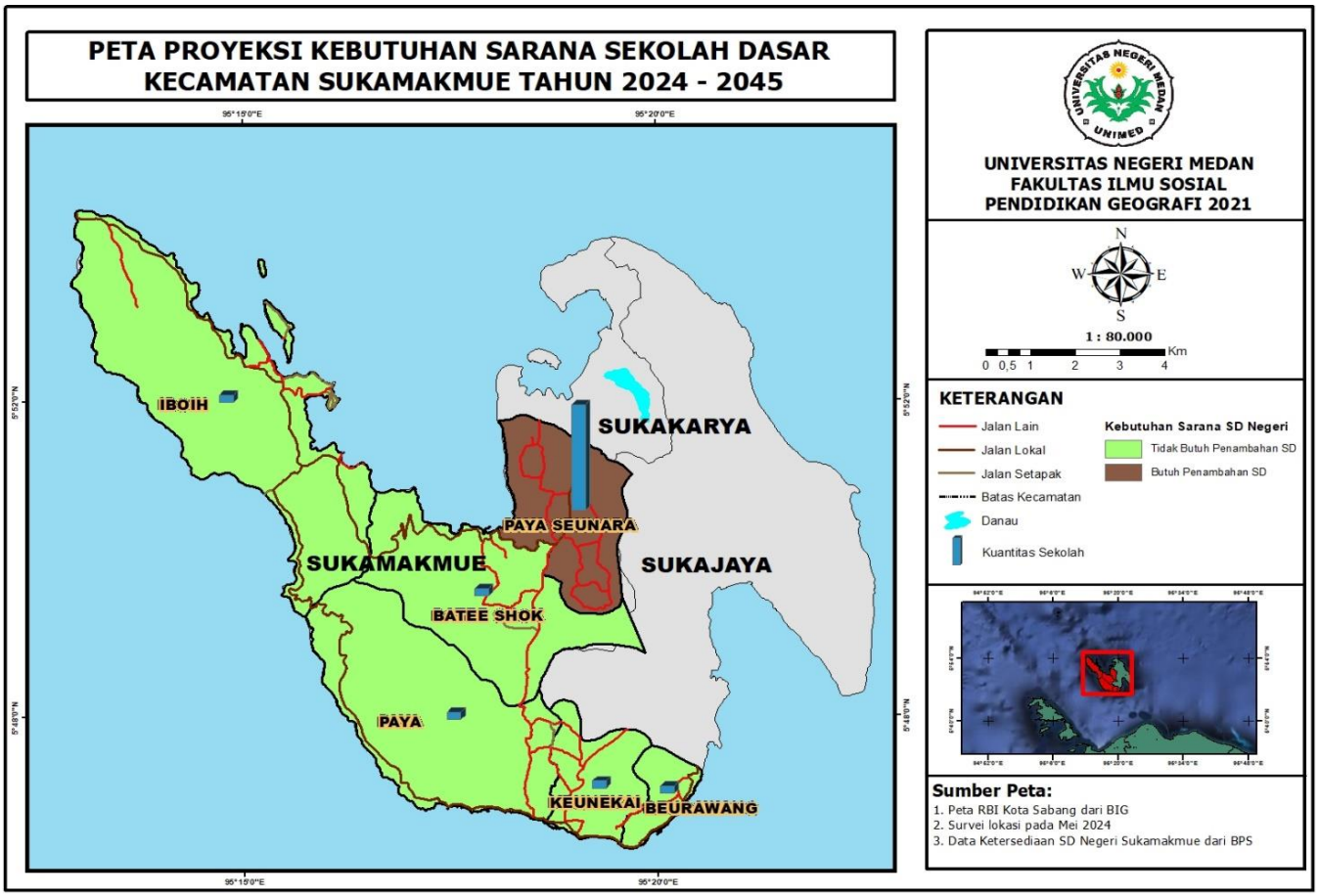

Figure 3. Map of Projected Public Elementary School Facility Needs in Sukamakmue District for the Year 2045

Policy Recommendations from Education Department Stakeholders to Meet Public Elementary School Needs in Sukamakmue District by 2045

In the context of the availability of basic educational facilities in Sukamakmue District, the current condition indicates adequate sufficiency. Based on interviews conducted by the researcher with stakeholders from the Sabang City Education Department, the following results were obtained: "For elementary schools in Sukamakmue District, the current provision is sufficient, as each village already has one. The number of students per elementary school here ranges from 250 to 260 students per unit." This is in line with the standards set by SNI 03-1733-2004, which stipulates that one elementary school unit ideally serves 1,600 residents.

Although the number of students per elementary school unit in Sukamakmue is still below maximum capacity, this situation can be viewed as an opportunity for improving educational quality through better teacher-student ratios. However, considering the projected population growth until 2045, long-term planning for the addition of educational facilities is necessary. As expressed by the stakeholder, "If we are talking about 2045, there will definitely be a need for additional elementary schools due to the annual population increase." This statement aligns with research conducted by Wu et al. (2020), which states that one of the primary causes of classroom shortages is rapid population growth. With the increasing number of school-age children, the education system must expand its capacity to accommodate more students, especially in developing countries where population growth often outpaces that in developed countries.

Furthermore, van Heerden et al. (2022) emphasize that plans for the addition of educational facilities must be based on comprehensive demand projections, including simultaneous consideration of capacity and location factors to ensure equitable access for all segments of society. In the author's view, this perspective is highly relevant to future challenges. If proactive steps are not taken in educational planning, including the addition of school facilities, we risk facing significant crises in the future. Therefore, planning the development of educational facilities based on population growth

projections is a crucial strategic step to ensure equitable and adequate educational quality for all children.

In an interview with a second stakeholder, the researcher and the Sabang City Education Department stakeholder discussed the trend of low population growth in five villages in Sukamakmue District. The stakeholder shared their perspective on the role of the city government in influencing population growth and access to education. According to them, the factors affecting population growth and educational conditions in this city are closely linked to government policy. "It all depends on the city government; perhaps this low population growth is due to government programs like family planning. The low population growth may also be attributed to the rising costs of schooling each year. Access for children to schools is already good, as public transportation reaches the school locations. The government also continuously strives to equip all educational facilities, reviewing reports annually to assess the condition of school infrastructure, and if anything is damaged, assistance will be provided for repairs.

This statement is consistent with findings from research conducted by Muhadi et al. (2021), which indicates that education department stakeholders need to advocate for increased budgets for public elementary school facilities from the central government, local authorities, and other sources such as CSR funds or donations. This budget increase can be utilized for the procurement of new infrastructure, renovation of aging facilities, and maintenance of existing ones. In the author's opinion, the government's efforts to improve and enhance educational facilities and accessibility are crucial for supporting the educational development of children in the region.

Research Discussion

Sukamakmue District, overall, has met national standards in terms of the number of elementary schools (SD). However, behind the overall satisfactory figures, there are issues of unequal distribution of schools among the villages. For example, the Paya Seunura Village, which has a significant population, only has one elementary school, which is far below the established standard. This condition has the potential to hinder community access, especially for children, to quality basic education. The uneven distribution of educational facilities in Sukamakmue District raises accessibility issues for some community members, particularly those living in Paya Seunura Village. As a central area with significant projected population growth, this village requires more educational facilities to ensure that basic education needs are met in the future. This finding aligns with research conducted by Nurse & Melhuish (2021), which states that educational distribution inequality also occurs in Europe, where spatial segregation creates significant disparities in access to quality education, especially for disadvantaged groups.

Previous research conducted by Podcawa et al. (2018) has shown that easy access to educational facilities is vital for improving the quality of life in communities and regional development. Unequal distribution of schools, especially in rural areas, can widen educational gaps and hinder community potential. This statement is also supported by research by Muhaimin et al. (2022), which indicates that a balanced spatial distribution of educational facilities is crucial for enhancing accessibility and reducing educational disparities. In the context of Sukamakmue District, the uneven distribution of elementary schools in several villages, such as in Paya Seunura, may obstruct children's access to quality basic education.

In the context of educational facility planning, it is essential to consider spatial accessibility and population growth, especially in areas with significant growth such as Paya Seunura Village. As indicated in the research conducted by Han et al. (2023) in rural Changyuan, China, optimizing school locations is vital for maximizing service coverage, particularly in regions with limited school accessibility. This framework provides a model for enhancing educational equity in areas with continually growing populations, thus serving as a reference for long-term planning to improve access to basic education in Sukamakmue.

The equitable development of educational facilities is critical for supporting social and economic sustainability. The distribution and accessibility of elementary school facilities must be well planned, especially in the face of rapid population growth in urban and rural areas. For instance, research conducted by Jiang et al. (2024) in Chengdu, China, indicates that although the number of basic educational facilities is increasing, spatial distribution imbalances remain a challenge. This is similar to the situation in Sabang, where educational facilities require careful planning to meet the needs of the growing community. In research conducted by Yue & Shan (2021), it is suggested that addressing the imbalance in educational facility layouts requires optimization strategies involving capacity expansion in high population

load areas, as well as enhancing accessibility in underserved peripheral areas. This recommendation is pertinent to Sukamakmue District, especially in preparing for an increase in educational facilities in regions with high population growth projections, such as Paya Seunura.

For future planning, the geographic education pathway approach used in research by Jażdżewska et al. (2022) can provide valuable insights for policymakers. By utilizing GIS and statistical analysis, the government can map and plan the addition of educational facilities based on population growth projections and student mobility. This will ensure that every village in Sukamakmue has better access to basic educational facilities.

CONCLUSION

Based on the analysis of the availability of public elementary school facilities referring to the SNI 03-1733-2004 standards, it was found that, in general, the availability of public elementary schools in Sukamakmue District is already adequate and evenly distributed across each sub-district in 2024. However, through projections of population growth and facility needs analysis, it was determined that by 2045, an additional 14 new public elementary schools will be required, particularly in the Paya Seunura sub-district, which is projected to experience significant population growth. Meanwhile, stakeholders from the Sabang City Education Office recommend increasing the budget from the central and regional governments, as well as other sources, for the procurement, renovation, and maintenance of elementary school facilities. Additionally, there is a need for guidance and supervision in the management of educational facilities to ensure that their management complies with regulations. This research is expected to contribute to policy development in the region, particularly in fulfilling educational services in Sukamakmue District.

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