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Analysis of Flood Vulnerability Level at Secondary Schools in Ranah Pesisir Sub-District

Bayu Wijayanto[1]*, Nofrion Nofrioni[1], Jamiatul Addawiyah[1], Alifvia Putri Handayani[1], Bima Rahman[1], Vanessa Nara Femilia[1], Juli Astuti[1], Fiona Cynthia[1], Daudi Richard Malusu[2], Fadhl Mohammed Awadh Gharamah[3]

[1]*Department of Geography, Faculty of Social Science, Universitas Negeri Padang*
[2]*Tongyi Environmental Service Company Limited,*
[3]*English Language Department, Lahej University*

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ABSTRACT

Ranah Pesisir Subdistrict, located in Pesisir Selatan Regency, is a flood-prone area due to its lowland geographical condition and proximity to the coastline and rivers. This study aims to analyze the flood vulnerability levels of secondary schools using a quantitative descriptive approach based on Geographic Information System (GIS). The study also seeks to describe the preparedness level of schools in mitigating flood disasters in Ranah Pesisir Subdistrict. Parameters analyzed include elevation, slope, rainfall, soil type, land use, and river proximity.The results show that the majority of secondary schools analyzed are located in zones categorized as "Vulnerable" to "Highly Vulnerable" to flooding. Schools such as UPT SMP Negeri 3 Ranah Pesisir, MTSN 2 Pesisir Selatan, MAN 2 Pesisir Selatan, and MTS Bahrul 'Ulum Sungai Tunu fall into the "Highly Vulnerable" category due to their low elevation, close proximity to rivers, and inadequate drainage systems. The dominant contributing factors are low elevation, proximity to rivers, and poor drainage infrastructure. Mitigation recommendations include the construction of protective embankments, improvement of drainage systems, disaster preparedness education, and the development of School Flood Contingency Plans. These findings are expected to serve as a basis for policymaking in disaster risk reduction efforts within the education sector, particularly in strengthening school infrastructure standards in flood-prone areas, establishing mandatory school-based disaster contingency plans, enhancing coordination between schools and local disaster management agencies, integrating flood preparedness into the school curriculum, and prioritizing infrastructure investments such as drainage rehabilitation and protective embankment construction for high-risk schools.

*Corresponding author: bayuwijayanto@fis.unp.ac.id

Introduction

Indonesia is a country with a very strategic location, but it is also in a disaster-prone area that can threaten the lives and livelihoods of the community. Therefore, according to Law No. 26 of 2007 concerning spatial planning, it is necessary to organize disaster mitigation-based spatial planning to reduce disaster risk and improve community safety and comfort. The implementation of spatial planning is further reduced in the Regional Spatial Plan, where one of the stages in its preparation is the processing and analysis of disaster risk reduction data (Al Fadhi et al., 2025). Disaster risk reduction by means of disaster risk assessment, one component of which is testing vulnerability (Robielos et al., 2020). Vulnerability is used to determine the potential damage, property losses, and the number of people exposed during a disaster (Birkmann & Welle, 2015).

The large number of people in an area is one of the factors for the high potential of exposed lives when hit by a disaster. One disaster that is flood disaster. Floods are disaster that always occur every year in several regions in Indonesia. Based on the disaster risk assessment prepared by BNPB in 2015 (BNPB, 2017), in the number of people exposed to flood disaster risk is spread across all regions in Indonesia, with more than 170 million people with an exposed asset value of more than Rp750 trillion. According to hydro-meteorological disaster data, flood studies throughout 2020 occurred up to 1,065 events.

Flooding is one of the natural disasters that often occurs in various regions in Indonesia, including in Ranah Pesisir District, South Pesisir Regency, and West Sumatra Province. This region has geographical characteristics in the form of lowlands and is directly adjacent to the Indian Ocean, making it very vulnerable to flood threat, especially during high rainfall intensity or sea tides (Dhiman et al., 2019). Flooding not only causes physical damage to infrastructure but also disrupts the social and economic activities of the community, including the education sector. Schools, as the center of teaching and learning activities, are highly vulnerable to the impact of such disasters due to potential disruptions to the continuity of the education process, damage to school facilities, and risks to the safety of students and teachers (Lassa et al., 2023).

Ranah Pesisir sub-district, which is geographically located in the coastal area of West Sumatra Province, has topographic characteristics that make it vulnerable to hydro-meteorological disasters, including floods. The rainy season with high rainfall, coupled with overflowing rivers and inadequate drainage, often makes this sub-district prone to flooding. This situation is exacerbated by the presence of dense settlements and important infrastructure, including secondary schools, which are scattered along watersheds or lowlands.

The presence of secondary schools in flood-prone areas raises serious concerns (Habiba et al., 2021). Not only is the school's physical infrastructure at risk of damage, but also the teaching and learning process can be significantly disrupted. Flooding can cause damage to classrooms, libraries, laboratories, and sanitation facilities, which in turn hampers educational activities and even jeopardizes the safety of the school community. In the long run, these disruptions have an impact on the quality of education and students' academic achievement.

Given the importance of the school function a center of education and character building, a flood vulnerability analysis is a must. This analysis includes not only the identification of high risk school locations, but also an evaluation of the school's capacity to cope with and recover from disasters. A comprehensive understanding of the level of vulnerability will be the main foundation in formulating appropriate and effective mitigation strategies (Haque & Burton, 2025)

Secondary schools, both SMP/MTs and SMA/MA/SMK, play an important role in producing the next generation of the nation (Dunn et al., 2011). However, when flooding occurs, teaching and learning activities can be halted, school facilities damaged, and other educational assets lost. This negatively impacts the quality of education and the future of students. Moreover, secondary schools accommodate a relatively large number of students and have more complex infrastructure compared to primary schools. Therefore, identifying the level of flood vulnerability in secondary schools is crucial to minimize the risk and prepare appropriate mitigation measures.

Factors that cause flooding include high rainfall, slope, soil type, land use, elevation, and proximity to rivers or water bodies (Basri et al., 2022). In Ranah Pesisir sub-district, many secondary schools are located in low-lying areas and near rivers, making them more vulnerable to overflows. Historical data shows that some schools have experienced disruptions due to flooding, such as inundation in classrooms, blocked access roads, and damage to school facilities (Conteh, 2015). Without an in-depth risk analysis, these potential disruptions will continue to recur and become more detrimental. Therefore, this research was conducted to provide a comprehensive picture of the level of flood vulnerability in each secondary school in Ranah Pesisir Sub-district based on physical, geographical, and historical flooding factors.

Methodology

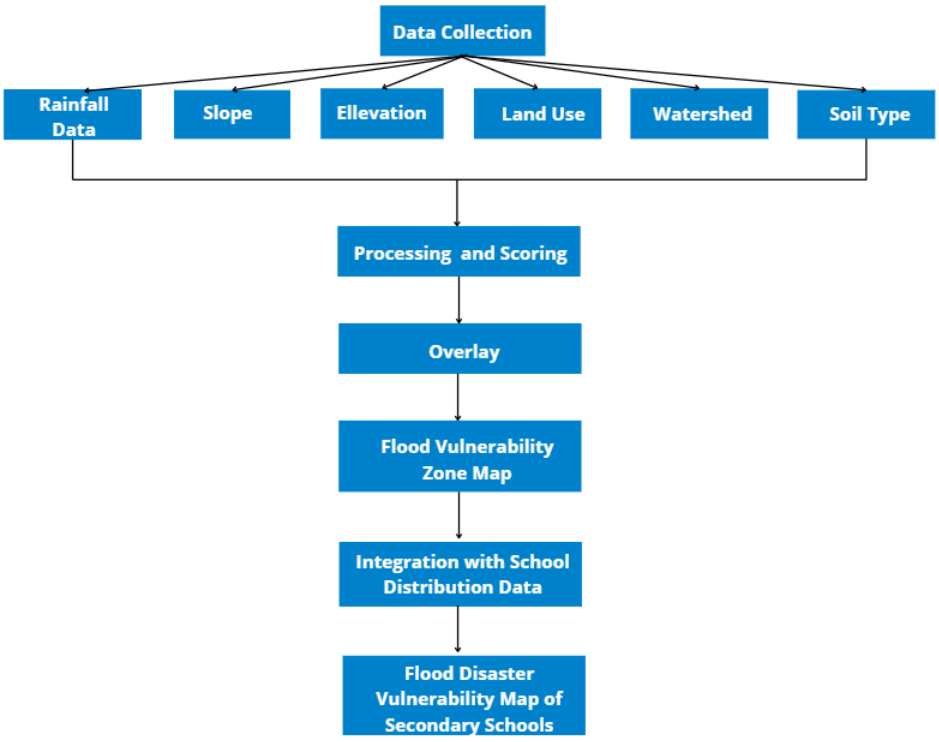

Figure 1. Flow Chart

This study was conducted in the Ranah Pesisir Sub-district, South Pesisir Regency, West Sumatra. The subjects of this research were secondary schools in the Ranah Pesisir Sub-district, including students, teachers, school staff, and school managers involved in the process of flood disaster preparedness and mitigation.

This research uses a quantitative descriptive approach to describe the level of school preparedness for flood disaster mitigation in the Ranah Pesisir Sub-district, Pesisir Selatan Regency. This approach was chosen to obtain a systematic, factual, and accurate picture of the actual condition of the preparedness of secondary schools in the coastal domain sub-

district. The descriptive design allows researchers to map various preparedness indicators based on parameters from LIPI-UNESCO/ISDR (2006), such as knowledge and attitudes towards disaster risk, policies and guidelines, emergency plans, early warning systems, and resource mobilization capabilities (International Strategy for Disaster Reduction (ISDR), 2005).

This research is a field study because the data were obtained directly from the research location through observation and interviews. Data analysis was conducted by interpreting the findings based on the predetermined preparedness indicators. Using this design, researchers can identify the strengths and weaknesses of the existing disaster mitigation system in schools, as well as provide evidence-based recommendations to improve schools' capacity and resilience in facing flood risks. In this study, the researcher will collect data through surveys, interviews, and direct observations in the sampled schools. The data collected will include students' and teachers' knowledge and awareness of flood disasters, flood emergency response plans and procedures in schools, facilities and infrastructure supporting flood disaster preparedness in schools, and community and government participation in flood disaster preparedness in schools.

Data collection in this study began with collecting data covering various important variables that affect flood risk, including rainfall data, slope, elevation, land use, watershed, and soil type. The collected data are processed using statistical methods or mathematical models to assign a numerical value (score) to each risk factor, which represents the contribution of each factor to flood risk. After scoring, all data layers were combined (layered). The overlay technique is generally performed using Geographic Information System (GIS) software. Through overlay, it can be seen how the interaction between risk factors (such as rainfall, elevation, and soil type) shapes the pattern of flood vulnerability in a particular area.

Result and Discussion

Result

1. The Level of Flood Vulnerability of Each Secondary School in Ranah Pesisir Sub-district Based on Physical, Geographical, and Historical Flood Factors

The physical and geographical characteristics of secondary schools in the research area were significantly correlated with potential flood vulnerability.

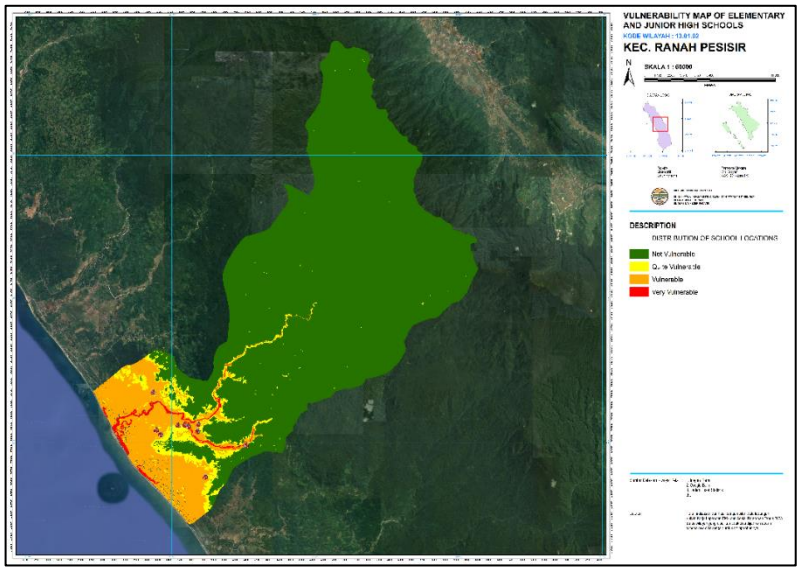

Figure 2. Map of Disaster Vulnerability Level of Secondary Schools

The The macro map shows that most of the Ranah Pesisir sub-district is dominated by the "Not Vulnerable" (dark green) and "Moderately Vulnerable" (light green) zones to flooding, indicating a relatively safe topography or higher elevation; this pattern is inversely proportional to the location of the majority of secondary schools. UPT SMP Negeri 3 Ranah Pesisir, MTSN 2 Pesisir Selatan, MAN 2 Pesisir Selatan and MTS Bahrul 'Ulum Sungai Tunu, which are all in the "Very Vulnerable" zone (red), indicate the most vulnerable locations owing to the lowest elevation and direct proximity to the crucial points of river overflow. Meanwhile, SMA Negeri 1 Ranah Pesisir and UPT SMP Negeri Ranah Pesisir, which are in the "Vulnerable" zone (orange), show similar levels of risk, although slightly lower. Therefore, it can be concluded that the physical characteristics of low local topography and geographical proximity to the river system are the main determinants of the high potential flood vulnerability for these secondary education facilities in the Ranah Pesisir sub-district. Flood vulnerability research parameters can be used to measure the potential for flooding in an area, considering aspects such as:

a. Slope

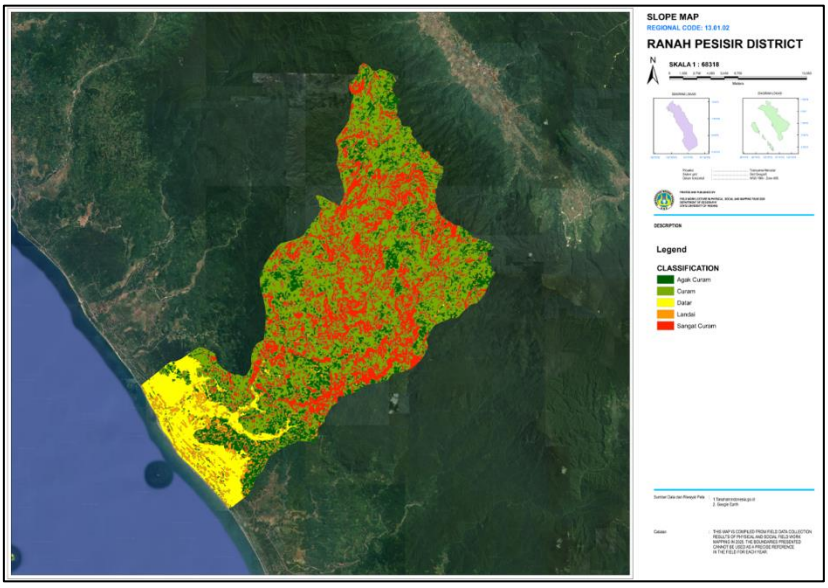

Figure 3. Slope Map

This map shows that the central and northwestern areas of Ranah Pesisir have steep slopes, making them prone to disasters. The southern and southwestern areas are relatively gentle and flat, making them safer and more suitable for development

Table 1. Slope Score and Weight

No	*Elevation*	*Score*	*Weight*	*Result*
1	*25*	*9*	*2*	*18*
2	*50*	*7*	*2*	*14*
3	*75*	*5*	*2*	*`0*
4	*100*	*3*	*2*	*6*
5	*2800*	*1*	*2*	*2*

In the Ranah Pesisir sub-district, most secondary schools are located in areas with a 0–8% slope (flat), which has the highest flood vulnerability score, and an accumulated value of 22.5 and an accumulated value of 22.5. These flat areas are prone to inundation owing to slow water flow and poor drainage systems. Zones with a slope of 8-15% (gentle) had a score of 7 and a value of 17.5. Although water flow is faster, the risk of flooding is still high, especially if drainage is inadequate or if there is land conversion Slopes of 15-25% (slightly steep) were associated with a lower risk (score

5, value 12.5). Water drains faster, but can exacerbate flooding in lower areas.Areas with slopes of 25-40% (steep) and >40% (very steep) had scores of 3 and 1 (scores of 7.5 and 2.5, respectively). The risk of flooding is low, but the main threats are landslides, erosion and rapid runoff that can, overall, flat and gentle zones are most prone to flooding, whereas steep zones are at risk of landslides and large water runoff

b. Elevation

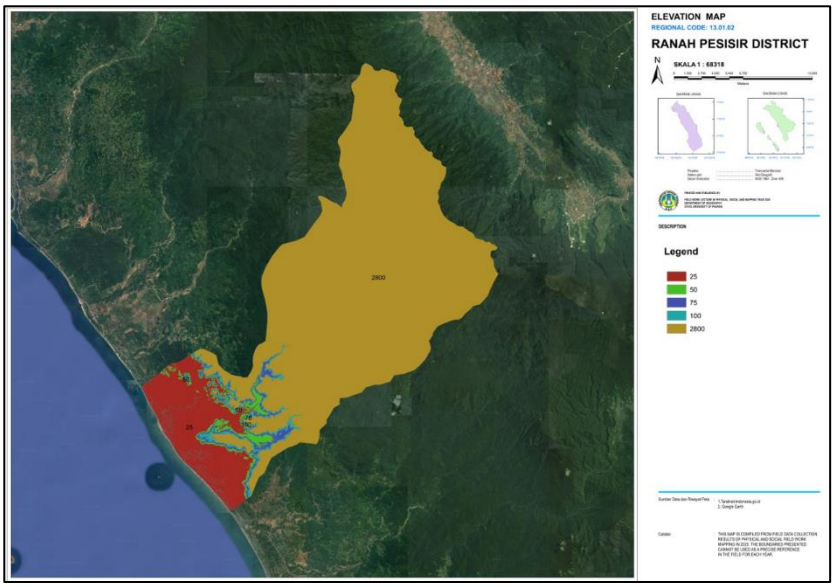

Figure 4. Elevation map of Ranah Pesisir Sub-District

This map shows the elevation variation in the Ranah Pesisir sub-district, with the northern and central areas at higher elevations (200-300m above sea level) and relatively stable, while the southern areas are at lower elevations (0-50m above sea level) and therefore prone to flooding. This map is important for land-use planning and disaster mitigation.

Table 2. Elevation Score and Weight

No	*Elevation*	*Score*	*Weight*	*Result*
1	*25*	*9*	*2*	*18*
2	*50*	*7*	*2*	*14*
3	*75*	*5*	*2*	*`0*
4	*100*	*3*	*2*	*6*
5	*2800*	*1*	*2*	*2*

In the Ranah Pesisir sub-district, the elevation parameter was divided into five classes that affect flood vulnerability around schools. Zones with an elevation of 25m above sea level had the highest score (9) and a final score of 18, indicating very high flood proneness, as they were located in lowlands where water accumulated.

Elevation of 50 m above sea level (score 7, score 14) is also quite prone to flooding, especially if drainage is poor or the ground surface is flat. Elevations of 75m and 100m had scores of 5 and 3 (scores of 10 and 6), respectively, indicating moderate to low risk, although they could still be inundated owing to runoff from above or local topographic conditions. The highest zone (2800 masl) is the safest from flooding with a score of 1 and a value of 2, but could potentially be a source of water flow to lower areas. Schools in this area are protected from inundation but must be aware of erosion and landslides. In general, the lower the elevation, the higher the risk of flooding; conversely, high areas are safer from flooding but pose a risk to slope stability and landslides.

c. Soil type

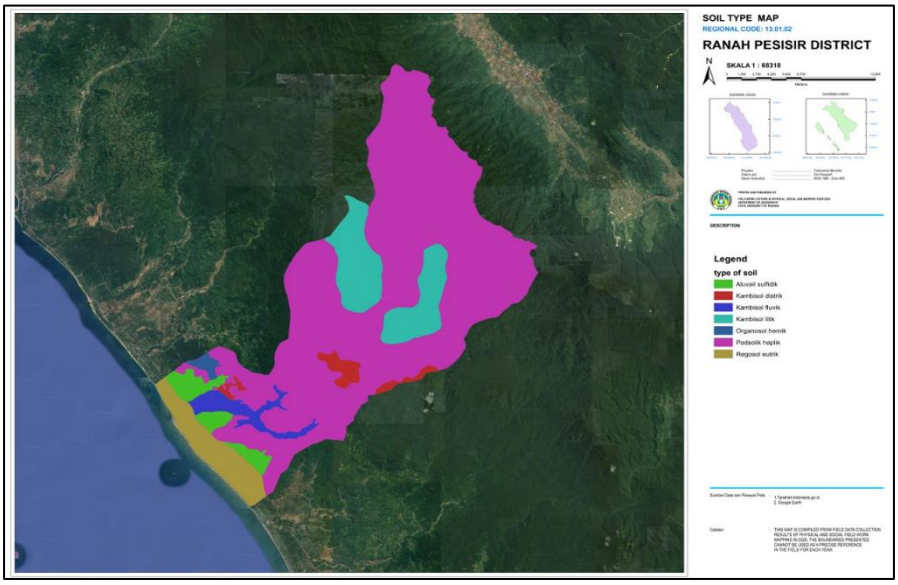

Figure 5. Soil type map of Ranah Pesisir Sub-District

This soil-type map shows the distribution of various soil types in the Ranah Pesisir sub-district. The northern and central areas are dominated by organic soils (dark purple color), which are generally fertile but prone to erosion if not managed appropriately. In the south, there is a mixture of alluvial soils (green) and coastal soils (blue), which are suitable for rice farming or flood-prone land. The central region also has small areas of lateritic soils (red), which tend to be hard and less fertile. River courses are marked in blue, indicating the relationship between water drainage and the characteristics of the surrounding soils. The results of this mapping are important for land-use planning, such as the identification of agricultural potential, disaster mitigation, and effective management of natural resources.

Table 3. Score and Weight of Soil Type

Depth	*Drainage*	*pH*	*CEC**	*Base Saturation*	*Soil type*	*Score*	*Weight*	*Result*
Deep	*Moderately well*	*Slightly acidic*	*Low*	*Moderate*	*Fluvic cambisol*	*5*	*1*	*5*
Deep	*Well*	*Very acidic*	*Low*	*Very low*	*Dystric cambisol*	*5*	*1*	*5*
Deep	*Well*	*Acidic*	*Low*	*Low*	*Haplic podzolic*	*7*	*1*	*7*
Deep	*Well*	*Very acidic*	*Low*	*Very low*	*Dystric cambisol*	*5*	*1*	*5*
Deep	*Well*	*Acidic*	*Low*	*Low*	*Haplic podzolic*	*7*	*1*	*7*
Shallow	*Well*	*Acidic*	*Low*	*Very low*	*Lithic cambisol*	*5*	*1*	*5*
Medium	*Impeded*	*Very acidic*	*High*	*Very low*	*Hemic organosol*	*3*	*1*	*3*
Deep	*Impeded*	*Acidic*	*Low*	*Moderate*	*Sulfidic alluvial*	*3*	*1*	*3*
Deep	*Rapid*	*Slightly acidic*	*Low*	*High*	*Eutric regosol*	*3*	*1*	*3*

In the analysis of soil types in Kecamatan Ranah Pesisir, nine soil types were grouped based on their physical and chemical characteristics, such as texture, drainage, pH, cation exchange capacity (CEC), and base saturation. Each soil type was assigned a flood vulnerability score based on a combination of these criteria. The soil types with the highest scores (5-7) were fluvic Cambisol, district Cambisol, haplic Podsolik, and lithic Cambisol. These soils have parent materials of andesite, tuff, and granite, fine to moderately fine texture, impeded or moderately good drainage, and very acidic to acidic pH with low CEC and base saturation. The water infiltration ability is low; therefore, there is a high potential for inundation during heavy rains. Areas with these soils are categorized as very prone to flooding, especially if the topography is flat and drainage is poor. Schools in this zone are particularly vulnerable and require effective artificial drainage.

Meanwhile, the sulfidic Alluvial and eutric Regosol scored 3 with a final grade of 3. The soil texture is rather fine, drainage is fast to moderate, pH is slightly acidic, and base saturation is moderate to high, indicating better infiltration ability. Even so, the potential for flooding still exists, but the risk is lower than that of the previous soil type. In general, fine-textured soils with poor drainage are more prone to flooding, whereas better-drained soils have a lower risk.

d. Rainfall

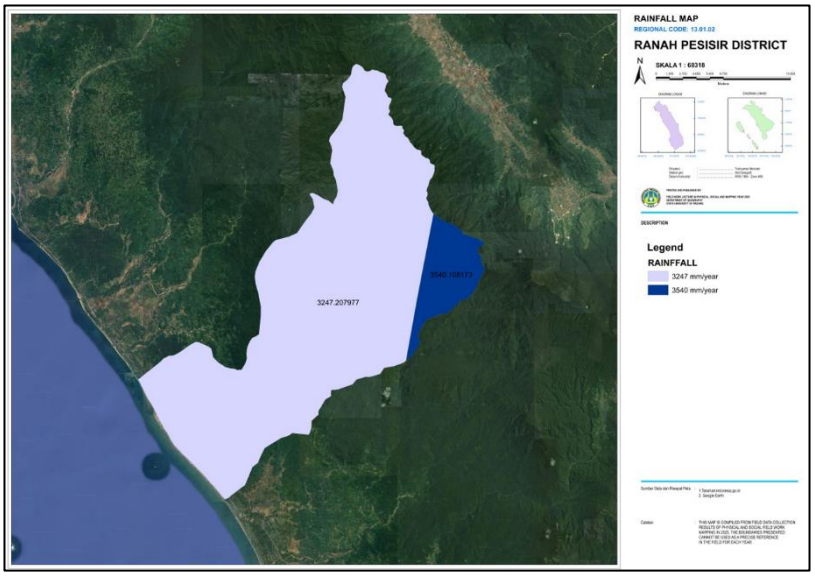

Figure 6. Rainfall Map of Ranah Pesisir Sub-district

This rainfall map shows the distribution of rainfall in the Ranah Pesisir sub-district. The northern and central areas are dominated by high rainfall (purple color), with an average value between 1,247-2,603 mm per year, indicating that the area is very humid and has potential for water management and agriculture. Meanwhile, the southeastern region is characterized by low rainfall (green color), with an average value of 858-1,287 mm per year, which is drier than other parts. The results of this mapping are important for planning water resource management, mitigating disasters such as floods or droughts, and determining climate adaptation strategies in the region.

Table 4. Rainfall Scores and Weights

No	*Rainfall*	*Score*	*Weight*	*Result*
1	*3247.207977*	*9*	*1.5*	*13.5*
2	*3540.108173*	*9*	*1.5*	*13.5*

In the rainfall parameter, there are two areas in the Ranah Pesisir sub-district with very high rainfall, namely 3,247.21 mm and 3,540.11 mm per year. Both received a score of 9 (weighted 1.5), resulting in a final score of 13.5, which placed these areas in the highly flood-prone category. High rainfall accelerates the accumulation of water on the surface, particularly if drainage is poor and soil absorption is low. This is consistent with the distribution of flood-prone zones on the vulnerability map, indicating that the area has a natural vulnerability to flooding, particularly during the rainy season

e. Land Use

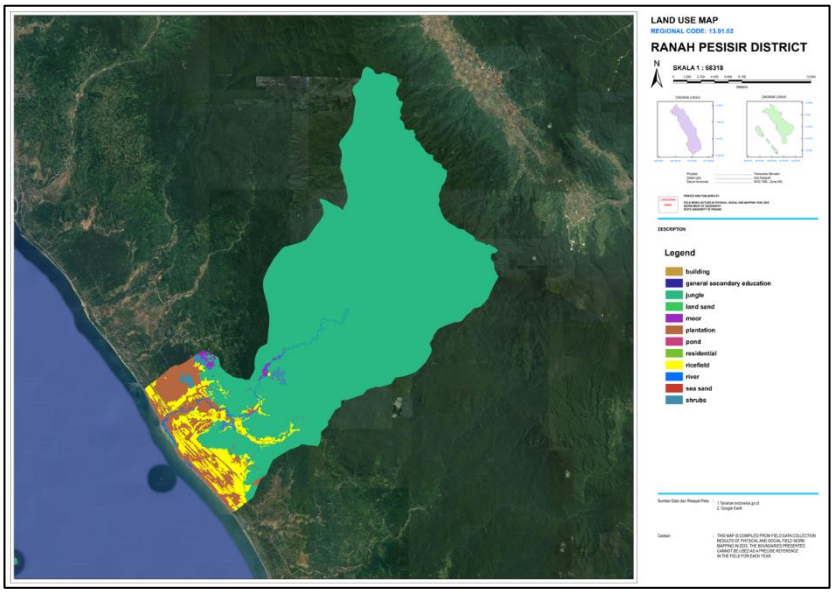

Figure 7. Land Use Map of Ranah Pesisir Sub-District

This land-use map shows the distribution of different types of land use in the Ranah Pesisir sub-district. The northern and central areas are dominated by agricultural land (brown), which covers most of the area, indicating that this area relies on agricultural activities as the main economic source. In the south, there is a mixture of flood-prone land (blue) and urban/construction land (red), indicating infrastructure and settlement development. River channels are marked in blue, indicating the importance of drainage management in preventing flooding. The results of this mapping provide an important overview of land use patterns, which can be used for regional planning, natural risk mitigation, and optimization of natural resource management in the region.

Table 5. Land Use Scores and Weights

No	*Land Use*	*Score*	*Weight*	*Result*
1	*Pond*	*9*	*2.5*	*22.5*
2	*Building/Building*	*7*	*2.5*	*17.5*
3	*Jungle*	*1*	*2.5*	*2.5*
4	*Sand/Sand Dunes*	*9*	*2.5*	*22.5*
5	*Sand/ Sand Dunes*	*9*	*2.5*	*22.5*
6	*Education General Secondary Education*	*7*	*2.5*	*17.5*
7	*Plantation/ Farm*	*5*	*2.5*	*12.5*
8	*Settlements and Activity Places*	*7*	*2.5*	*17.5*
9	*Rice Field*	*7*	*2.5*	*17.5*
10	*Scrub*	*3*	*2.5*	*7.5*
11	*River*	*9*	*2.5*	*22.5*
12	*Farm/Field*	*5*	*2.5*	*12.5*

In the land use parameter in the Ranah Pisisir Sub-district, ponds, sand/sand dunes (land and sea), and rivers had the highest score (9) with a weight of 2.5 and a final score of 22.5, indicating that they were very vulnerable to flooding. Empang and rivers have the potential to overflow during high rainfall, while sand areas tend not to absorb water, causing large runoff.

Land such as plantations, settlements, secondary schools, and paddy fields received a score of 7, with a final value of 17.5, falling into the moderate to high category. Settlements are particularly vulnerable if drainage is poor, and schools in these areas can be disrupted during the rainy season.

In contrast, shrubs and moorland/fields had lower scores (3 and 5), with final values of 7.5 and 12.5, indicating a lower flood risk, although there is still potential for inundation depending on local conditions. In general, the higher the intensity of land use and the lower the surface absorption capacity, the higher is the flood risk

f. River density

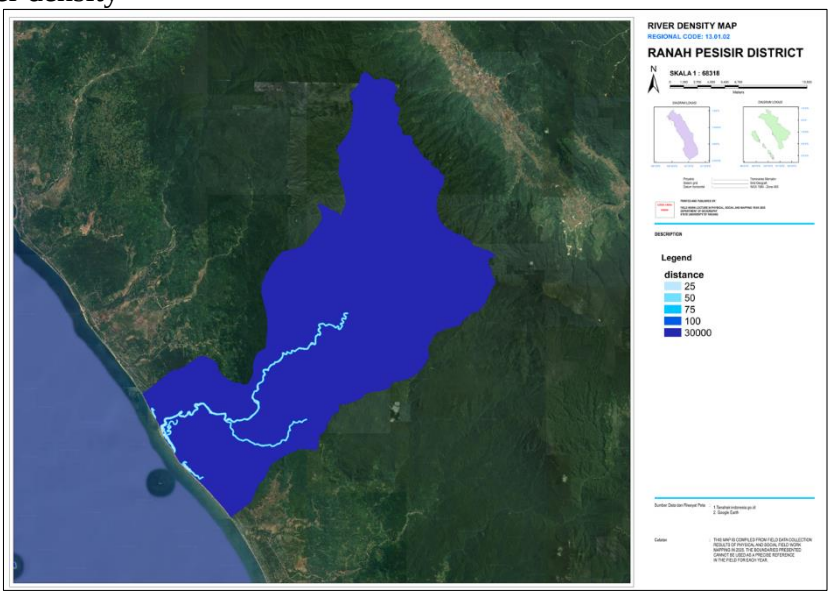

Figure 8. River Density Map in Ranah Pesisir Sub-District

This river density map shows the distribution and intensity of river flow in the Ranah Pesisir sub-district. The northern and central areas are dominated by low river density (yellow color), this indicates that the area has little or no significant river flow. The southern areas are characterized by a high river density (green color), indicating a dense river network, including main streams and tributaries. River channels are denser in the south, which is a potential flood-prone area owing to high rainfall or ocean tides. The results of this mapping are important for planning drainage management, disaster mitigation, and water resource management in the region.

Table 6. River Density Scores and Weights

No	*Distance*	*Score*	*Weight*	*Result*
1	*25*	*9*	*2*	*18*
2	*50*	*7*	*2*	*14*
3	*75*	*5*	*2*	*10*
4	*100*	*3*	*2*	*6*
5	*30000*	*1*	*2*	*2*

For the river density parameter, the Ranah Pesisir sub-district was divided into five zones based on the distance from the river: 0-25 meters, 26-50 meters, 51-75 meters, 76–100 m, and >100 m. The closest zone (0-25 m) had the highest score (9)

with a weight of 2 and a final score of 18, indicating that it was very prone to flooding because it was on the riverbank and vulnerable to overflowing water. The 26-50 m zone scored 7 (value 14), indicating that it is highly vulnerable, although the risk is slightly lower.

Zones 51-75 m scored 5 (score of 10), a medium category, with the risk of inundation reduced but still present if drainage is poor or topography is flat. Zones 76-100 m scored 3 (score 6), classified as low risk and generally safer from direct overflow. The farthest zone (>100–30,000 m) was given the lowest score (1) with a final value of 2; therefore, it was categorized as not flood-prone from the aspect of river proximity. In general, the closer the area to the river, the higher the flood risk

2. Data on the Number of Teachers and Students in Secondary Schools in Ranah Pesisir Sub-district

Table 7. Data on the Number of teachers and students based on gender in secondary schools in Ranah Pesisir sub-district

Code Name of Junior High School	*Teacher Data*			*Student Data*									*Wide*
	Gender		*Total*	*VII Class*		*Total*	*VIII Class*		*Total*	*IX Class*		*Total*	
	M	*F*		*M*	*F*		*M*	*F*		*M*	*F*		
1	*18*	*49*	*67*	*74*	*109*	*183*	*89*	*105*	*194*	*93*	*125*	*218*	*3,470*
2	*0*	*16*	*16*	*2*	*0*	*2*	*5*	*0*	*5*	*8*	*1*	*9*	*-*
3	*8*	*20*	*28*	*13*	*9*	*22*	*18*	*12*	*30*	*13*	*14*	*27*	*2,400*
4	*11*	*34*	*45*	*57*	*65*	*122*	*51*	*45*	*96*	*73*	*55*	*128*	*5,085*
5	*46*			*57*	*43*	*100*	*30*	*38*	*68*	*57*	*46*	*103*	*20,000*
6	*7*	*14*	*21*	*24*	*21*	*45*	*23*	*24*	*47*	*14*	*33*	*47*	*324*
7	*18*	*39*	*57*	*37*	*68*	*105*	*32*	*56*	*88*	*49*	*85*	*134*	*3,411*
8	*25*	*60*	*85*	*153*	*207*	*360*	*135*	*157*	*292*	*131*	*128*	*313*	*10,000*
9	*15*	*24*	*39*	*152*	*19*	*171*	*139*	*13*	*152*				*-*
10	*27*	*49*	*76*	*78*	*83*	*161*	*84*	*133*	*217*	*60*	*135*	*195*	*45,677*

Description
1: State Islamic Junior High School 12 Ranah Pesisir
2: Bahrul Ulum Sungai Tunu Private Islamic Junior High School
3: State Junior High School 5 Ranah Pesisir
4: State Junior High School 1 Ranah Pesisir
5: State Junior High School 3 Ranah Pesisir
6: State Junior High School 4 Ranah Pesisir
7: State Islamic Senior High School 3 Pesisir Selatan
8: State Senior High School 1 Ranah Pesisir
9: Adi Karya Technology Vocational High School Ranah Pesisir
10: State Vocational High School 1 Ranah Pesisir

Discussion

The analysis results were obtained in the form of a flood-prone map of the Ranah Pesisir Subdistrict, which has four levels of flood vulnerability: very prone, prone, moderately prone, and not prone. Most of the Ranah Pesisir sub-district area is dominated by the "Not Prone" (dark green) and "Moderately Prone" (light green) zones. The distribution of secondary schools in relation to the flood vulnerability map shows that UPT SMP Negeri 3 Ranah Pesisir, MTSN 2 Pesisir Selatan, MAN 2 Pesisir Selatan, and MTS Bahrul 'Ulum Sungai Tunu are all in the "Very Prone" zone (red), while SMA Negeri 1 Ranah Pesisir and UPT SMP Negeri Ranah Pesisir are in the "Prone" zone (orange).

Most of the secondary schools in the Ranah Pesisir sub-district are located in areas with 0–8% slope (flat), his flat zone has the highest flood vulnerability score (9), and an accumulated value of 22.5, which is highly vulnerable to inundation owing to slow water flow and poor drainage systems. Zones with a slope of 8-15% (gentle) also had a high flood risk (score 7, accumulated value 17.5). The steeper the slope, the lower the risk of inundation flooding, but the potential for landslides, erosion, and rapid runoff that can cause flooding (Pirasteh & Li, 2017)

The zone with an elevation of 25m above sea level had the highest score (9) and a final score of 18, indicating very high flood vulnerability. Elevation of 50 masl (score 7, score 14) is also moderately prone to flooding, especially if drainage is poor or the land surface is flat. The higher the elevation, the lower the risk of flooding, although high areas are still potential sources of water flow to lower areas (Botzen et al., 2013; Radwan et al., 2019; Stoffel et al., 2016)

Ranah Pesisir sub-district has two areas with very high rainfall, namely 3,247.21 mm and 3,540.11 mm per year. This condition places this area in a highly flood-prone category because the high rainfall accelerates the accumulation of water on the surface (Marwah et al., 2021). Other lands, such as plantations, settlements, secondary schools, and rice fields, also have moderate to high risks (score 7, final value 17.5). The zone closest to the river (0-25 m) had the highest score (9) with a weight of 2 and a final score of 18, indicating that it was highly prone to flooding because it was on the riverbank. The further away the area is from the river, the lower the risk of flooding.

This vulnerable geography has serious implications for the entire school community, which consists of various age groups (Blum et al., 2002). Although relatively independent, these age groups require extra supervision and protection in the event of a disaster. Junior high school students (12-15 years old) may be more prone to panic and less able to make quick decisions than high school students (15-18 years old) (Germeijs et al., 2006). Likewise, the teacher community has a diverse age range of teachers. Young teachers (e.g 20-35 years old) may be more physically adaptive in dealing with emergency conditions and more proficient in using technology for post-disaster distance learning (Senanayake et al., 2023).

Conclusion

Based on the results of the study on flood vulnerability in secondary schools in Ranah Pesisir sub-district, it can be concluded that most schools are in the vulnerable to highly vulnerable category to flood disasters. This level of vulnerability is influenced by a number of physical and geographical factors, including low site elevation, flat slopes, high rainfall, soil types with low absorption capacity, and proximity to rivers. These conditions are exacerbated by suboptimal drainage systems and land uses that increase the risk of inundation. These findings indicate that schools in the area face significant risks of disrupting the teaching and learning process and potentially damaging infrastructure due to flooding. Therefore, planned and sustainable mitigation measures, such as upgrading flood defence infrastructure, developing contingency plans at the school level, and educating the entire school community on disaster preparedness, are needed to create a safer and more resilient educational.

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Competing Interests

The author(s) declare no competing interests.

Data Availability

The datasets generated and/or analyzed during the current study are not publicly available due to ethics related to protecting the privacy and confidentiality of research participants but are available from the corresponding author upon reasonable request.

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