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POLICY DIRECTIONS FLOOD DISASTER MITIGATION IN KAMPAR REGENCY, RIAU PROVINCE

Etika Sihaini*, and Dedi Hermon
Master Program of Geography Education-Faculty of Social Sciences, Universitas Negeri Padang, Indonesia

*E-mail: etikasihaini12@gmail.com

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ABSTRACT

There have been many studies on flood disaster mitigation policy directions, but they have not been widely developed in Indonesia as a tropical country with a unique rainfall pattern. This is an indicator used to assess the level of flood disaster vulnerability. Exceptionally high rainfall intensity always causes flood disaster problems in Kampar Regency. This study aims to 1) formulate the level of flood vulnerability in Kampar Regency, Riau Province, 2) analyse the characteristics of land in Kampar Regency, Riau Province, 3) formulate flood disaster mitigation policy directions by the Kampar Regency Government, Riau Province. The method used in this study is quantitative, and it is a survey and spatial analysis. This study was conducted in Kampar Regency, Riau Province. Furthermore, in processing flood disaster mitigation policy directions, the AHP (Analytical Hierarchy Process) method is used to formulate appropriate priority directions to mitigate flood disasters. Based on the results of the study, the level of flood disaster vulnerability with analysis using the GFI method, there are four flood vulnerability zones in Kampar Regency, namely: a high flood vulnerability zone covering an area of 88,658.36 ha, a moderate flood vulnerability zone covering an area of 142,821 ha, a low flood vulnerability zone covering an area of 86,357.23 ha and a flood-free zone covering an area of 715,850.97 ha. Furthermore, based on data processing through expert choice software, the direction of flood disaster mitigation policies is determined to have 9 alternatives. With these alternatives, it is hoped that they can be formulated to reduce the risk of flood disasters in Kampar Regency.

Keywords: *Disaster Mitigation; Floods; Policy Directions*

INTRODUCTION

Natural disasters are triggers for the destruction of the subsystems of life of living things on the face of the earth, resulting in ecosystem degradation, changes in economic patterns, moral degradation, changes in social structures, changes in governance, degradation of environmental quality, and so on

(Hermon, Ganefri, Erianjoni, Iskarni, & Syam, 2015). Flooding is one of the natural disasters that often occur and have a significant impact. Flooding can occur due to factors such as high rainfall, overflowing rivers, or climate change. One area often hit by flooding is Kampar Regency, a regency in Riau Province, Indonesia. Flood indicators can include various parameters that provide clues about the potential for flooding in an area. These factors include extreme rainfall levels over time, river water levels that exceed their standard capacity, rapid snowmelt in mountainous areas, and the ability of the drainage system to cope with excessive water volumes—recent research conducted by (Rahman, Ali, Khan, & Ahmed, 2022).

Mcgowran & Donovan (2021) found that in the context of the Disaster Mitigation Policy, the importance of the role of science, especially social science, is increasingly emphasised by the Sendai Framework. Hazard and risk assessment is considered a crucial part of disaster risk reduction. However, it needs to be done with sensitivity to the dynamics of power and diverse ontologies in the context of local/national. The disaster risk reduction assembly emphasises the need to understand and challenge how different disaster risk reduction techniques and technologies manage the unequal relations of more-than-human life.

A normative agenda presents both challenges and opportunities. This paper argues that both are necessary to enhance resilience. This paper briefly outlines the concept and recent international efforts to build resilience to shed light on critical questions and under-discussed issues. They highlight the need to move resilience thinking forward by emphasising structural socio-political processes, recognising and acting on the differences between ecosystems and societies, and looking beyond the quantitative simplification of resilience into a single index.

Peresearch by Uddin, Haque, and Khan (2021) found that interactive disaster governance, decentralised disaster management, and adherence to local-level institutions to good governance principles and national policy guidelines can effectively reduce disaster-related losses and damages. According to coastal community members, local governments generally fail to uphold good governance principles, and triangulated data confirm that the region as a whole suffers from rampant corruption, political nepotism, lack of transparency and accountability, and minimal inclusion of local populations in decision-making—all of which seriously hamper the successful implementation of national disaster management policies.

Kampar Regency, located in Riau Province, Indonesia, is often subject to flood attacks that threaten the lives and infrastructure of residents. With its unpredictable geographical and weather conditions, flooding has become a real threat to the residents of Kampar Regency. To deal with this threat, disaster mitigation policy directives in the Kampar Regency are prepared to provide practical mitigation guidelines and strategies (Supardi, 2014).

Various factors, including continuous high rainfall intensity, caused the floods in Kampar Regency. One of the primary sources of flooding is the overflowing Kampar River, which inundates many surrounding areas when the rainfall intensity reaches a certain level. The areas most frequently affected by flooding include Gunung Sahilan Village, Buluh China Village, Lubuk Siam Village, Koto Aman Village, Alam Panjang Village, Teluk Kenidai Village, Kualu Village, Ranah Village, and Kampung Panjang Village. The floods caused material losses such as submerged houses and public facilities and threatened the safety of people's lives (Supardi, 2024).

Data from the Regional Disaster Management Agency (BPBD, 2022) Kampar Regency and the National Disaster Management Agency (BNPB, 2021) provide a clear picture of the impact of flooding in Kampar Regency. According to BPBD (2022), the flood submerged several residents' houses, with water levels reaching 50 cm and 1 meter. The BPBD Disaster Management Operations Control Center (Pusdalops) noted that several villages were affected by the flood, with many houses and families affected. For example, Gunung Sahilan Village, Buluh Cina Village, and Lubuk Siam Village are one of the villages most affected by the flood (Regional Disaster Management Agency, 2022).

BNPB also reported that the flood in Kampar Regency on September 25th, 2021, affected 160 houses. This flood was caused by high-intensity rain and a lack of water absorption due to company activities around the affected area. The high water discharge caused the Suram River to overflow, worsening the flood conditions. The impact of this flood was felt by the community physically, materially, and psychologically because it caused discomfort and uncertainty (National Disaster Management Agency, 2021).

The impact of flooding in Kampar Regency is very significant in terms of material and non-material losses. Material losses include damage to houses, public facilities such as schools and places of worship, and economic losses due to the loss of crops. Floods also have non-material impacts, such as loss of human life, psychological trauma, and disruption to people's daily activities. Data on the level of hazard risk, as estimated by the inarisk The study shows that Kampar Regency has a moderate to high level of flood hazard potential. This area is identified as one of the areas vulnerable to flooding, with 21 sub-districts threatened by the threat of flooding (National Disaster Management Agency, 2021).

Kampar Regency Communication and Information (2024) explains, based on data from BMKG (2022), that Kampar Regency has experienced a series of significant flood events in the last five years. This period recorded several fairly serious flood incidents, especially during the intense rainy season. High rainfall caused the main rivers in the area, such as the Tapung River and the Hilir River, to overflow and cause waterlogging in the surrounding areas. These floods often cause infrastructure damage and disrupt people's daily lives. Kampar Regency from 2019 to 2024, the rainfall level in Kampar Regency was very high, causing the Kampar River to overflow and flood. From 2019 to 2024, thousands of houses were submerged, main roads were cut off, and thousands of residents were forced to evacuate. Even the worst flood in 2024 was on January 18th 2024; severe flooding occurred in most areas of Kampar Regency, causing significant losses to the community.

The floods in Kampar Regency also put pressure on the resources and infrastructure of the area. Floods not only threaten the safety and security of human lives but also disrupt the economic and social activities of the community. Material losses caused by floods, such as damage to houses, road infrastructure, and public facilities, often require repair and recovery efforts that take significant time and resources. In addition, the psychological impacts of floods, such as stress, anxiety, and trauma, can also have long-term impacts on the mental well-being of the community, requiring special attention and support in recovery efforts (Hermon et al., 2024).

Local governments and relevant stakeholders must develop effective and sustainable disaster mitigation strategies to face these complex challenges. Holistic and integrated mitigation measures must consider various aspects, including increasing community capacity to deal with disasters, improving drainage infrastructure and river management, and improving early warning and emergency response systems. In addition, close collaboration between the government, non-governmental organisations, the private sector and civil society is also needed to ensure the implementation of effective and sustainable disaster mitigation policies. With this joint effort, it is hoped that Kampar Regency can become more resilient in facing the threat of flooding and improve its people's quality of life and resilience (Adams & Brow, 2020).

Based on the background stated above, this study aims to determine the level of flood vulnerability in Kampar Regency and the land characteristics in Kampar Regency, as well as formulate policy directions for flood disaster mitigation in Kampar Regency, Riau Province.

MATERIALS AND METHODS

The research conducted is quantitative. The research method used is quantitative research, which is used to obtain more valid, comprehensive, and objective data (Sugiyono, 2019). This study requires tools and materials to determine the level of flood vulnerability in Kampar Regency and the land characteristics in Kampar Regency, as well as formulate flood disaster mitigation policy directions in Kampar Regency, Riau Province.

The tools needed in this study can be presented as follows:

a) GPS to determine the coordinates of flood-prone locations
b) Computer with QGIS Software to analyse flood-prone zone determination
c) Computer with Expert Choice 2024 Software to determine the direction of flood disaster mitigation policies in Kampar Regency, Riau Province

This research was conducted in Kampar Regency with astronomical lines 01°00'40” north latitude to 00°27'00” south latitude and 100°28'30” – 101°14'30” east longitude. As for seeing clearly, it can be seen in **Figure 1.**

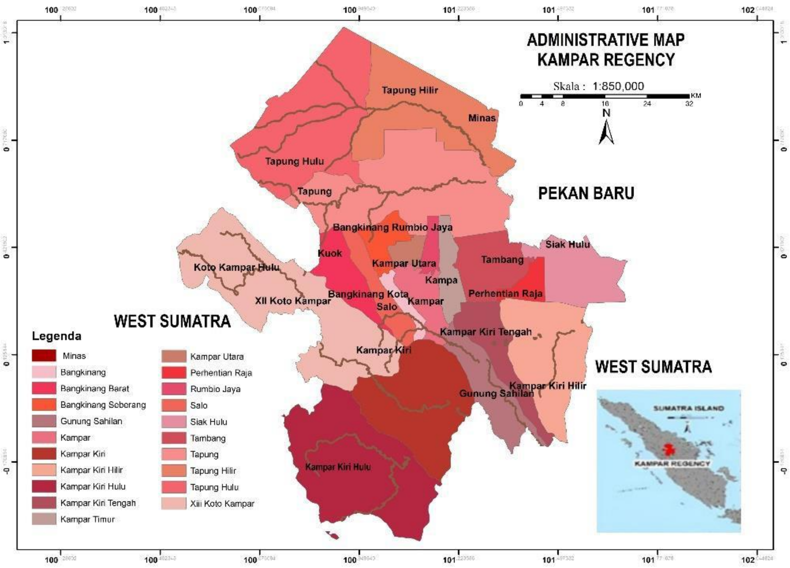

Figure 1. Research Location Map

The materials used for the research on flood disaster mitigation policy directions in Kampar Regency, Riau Province, can be seen in **Table 1**.

Table 1. Materials used in the research

No	Name	Output	Data Source	Year	Collection Method
1	District Boundaries	Administrative Boundaries of Kampar Regency	Inageoportal	2024	Digitised administrative boundary maps
2	Land Use	Land Use Map	Inageoportal	2024	Remote sensing and field validation
3	Soil Type	Landform Unit Map	Soil Research Center	2024	Soil surveys and laboratory analysis
4	Geology	Geological Map	Geological Agency	2024	Geological mapping and geospatial analysis
5	River Network	River Network Map of Kampar Regency	BWS V (River Basin Organization)	2024	Hydrological surveys and geospatial mapping
6	Rainfall	Rainfall Map	BMKG (Meteorological, Climatological, and Geophysical Agency)	2024	Weather stations and climatological models
7	Slope Gradient	Slope Gradient Map	Inageoportal	2024	Topographic analysis using GIS tools

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No	Name	Output	Data Source	Year	Collection Method
8	History of Flood Events	Flood Event Map of Kampar Regency	Inarisk	2024	Historical flood records and geospatial tools

The stages of flood vulnerability analysis in Kampar Regency, the potential inundation area can be obtained using the method developed by Samela et al., 2018, namely the Geomorphic Flood Index (GFI) through an additional analysis tool (plugin) available in QGIS software. GFI is a method that can be used to estimate flood inundation areas on a large watershed scale and is an effective and fast procedure for an area with limited hydrological data. GFI is calculated using an equation that can be seen in **Figure 2**.

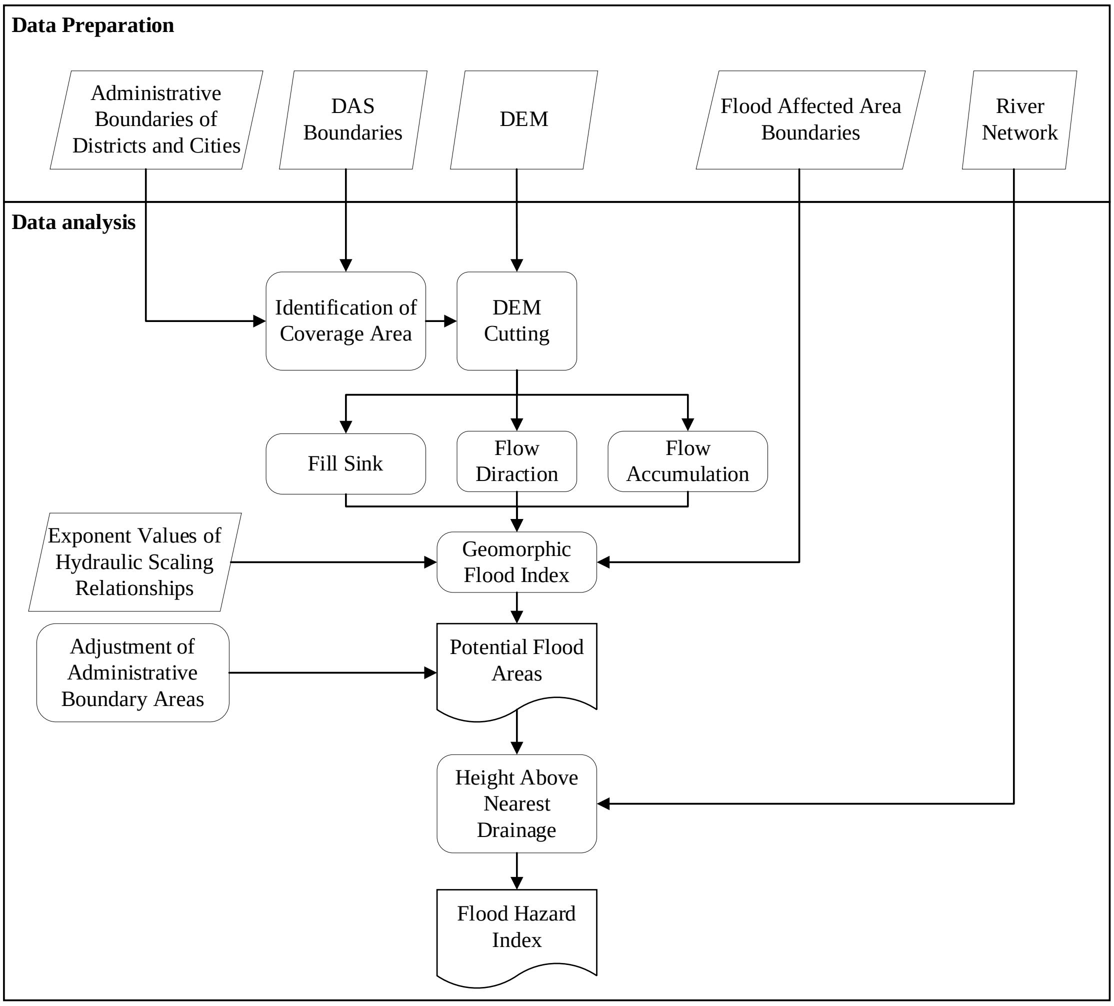

Figure 2. Data Preparation and Data Analysis

Data validation ensures the accuracy and reliability of the information used in the research. Data validation was conducted through cross-referencing with credible sources such as Inageoportal, BMKG, and the Geological Agency to ensure consistency and accuracy. Field validation using GPS coordinates confirmed the location and conditions of flood-prone areas. Analytical methods, such as the Geomorphic Flood Index (GFI), were applied systematically using QGIS software, and expert evaluations were incorporated through the AHP method to prioritise mitigation policies.

Land characteristic analysis using stratified random sampling of the map based on the research analysis map on flood disaster vulnerability, which in the study was taken at 4 sample points, namely Tambang District, Perhentian Raja District, XII Koto Kampar District, and Kampar Kiri Hulu District. The method is carried out quickly with two stages of the method, namely: 1) Identifying potential flood inundation areas with a geomorphological approach to a river area, which can be calibrated with the availability of data on impact areas that have occurred (Samela, Troy, & Manfreda, 2017), 2) Estimating the height of the inundation based on the elevation height (vertical distance) above the river surface within the potential inundation area that was generated in stage 1—classification of land characteristic levels based on the number of flood parameter scores. Land characteristic criteria are listed in **Table 2**.

Table 2. Classification of Land Characteristic Level

Type	Indicator	Criteria	Score
Land Type	Structural (P), Denudational (D), Volcanic (V)	Excellent	1
	Solutional (S)	Good	2
	Anthropogenic (A)	Moderate	3
	Fluvial (F)	Poor	4
	Marine (M)	Very Poor	5
Natural Embankment Potential	Slope >25% (low flood potential)	Excellent	1
	Slope 15-25% (relatively low flood potential)	Good	2
	Slope 8-15% (moderate flood potential)	Moderate	3
	Slope <8% (high flood potential)	Poor	4
	Slope <8% (very high flood potential)	Very Poor	5
River Flow Pattern	Rectangular	Excellent	1
	Radial, Parallel	Good	2
	Trellis	Moderate	3
	Dendritic	Poor	4

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Type	Indicator	Criteria	Score
	Annular, Multi-basinal	Very Poor	5
Rainfall (mm/year)	<1000	Excellent	1
	1000-1500	Good	2
	1500-2500	Moderate	3
	2000-2500	Poor	4
	>2500	Very Poor	5
Slope of Riverbank (%)	>8 (very steep)	Excellent	1
	6-8 (steep)	Good	2
	4-6 (moderate slope)	Moderate	3
	2-4 (slightly steep)	Poor	4
	<2 (flat)	Very Poor	5
Damming by Tides/Branches	No damming	Excellent	1
	High tide damming	Good	2
	River tributaries	Moderate	3
	Main river branches	Poor	4
	Main river	Very Poor	5
Meandering Sinusitis	1.0-1.1	Excellent	1
	1.2-1.4	Good	2
	1.5-1.6	Moderate	3
	1.7-2.0	Poor	4
	>2.0	Very Poor	5
Average Slope of Watershed (%)	>45	Excellent	1
	26-45	Good	2
	16-25	Moderate	3
	8-15	Poor	4
	<8	Very Poor	5
Land Use	Protected/Conserved Forests	Excellent	1
	Production Forests/Plantations	Good	2
	Yards/Terraced Fields	Moderate	3
	Settlements	Poor	4

Analysis to determine land characteristics uses a formula developed by Dibyosaputro (1999) that is :

$$I = \frac{c - b}{k} = \frac{45 - 9}{3} = 12$$

The formula calculates the class interval size (I) based on the range of scores and the desired number of classes. Where c represents the highest score, b the lowest score, and kkk is the desired number of score categories—resulting in a class interval 12. This calculation facilitates the classification of land characteristics into distinct categories, aiding in the interpretation of flood vulnerability levels.

Table 3. Results of Land Characteristic Interval Calculations

Zone	Interval	Land Characteristics
I	<24	Good
II	25-37	Currently
III	>38	Bad

Based on **Table 3**, Zone I consists of stable land with a low potential for flooding. This zone represents areas less likely to experience significant flood impacts due to their stable geological and environmental characteristics. Zone II includes less stable land with a moderate potential for flooding. These areas require attention in planning and management to mitigate potential flood risks effectively. Zone III comprises unstable land with a high potential for flooding. This zone demands priority in flood mitigation efforts as it is highly vulnerable to flood-related disasters.

The Analytical Hierarchy Process (AHP) method determines effective mitigation policy directions. Experts assess and compare factors using a pairwise scale of 1 to 9. **Table 4** provides the value and definition of expert opinions within this scale. The hierarchical structure of flood disaster mitigation policy directives is illustrated in **Figure 3.**

Table 4. Assessment Criteria in AHP

Mark	Information
1	A is as important as B
3	A is slightly more important than B.
5	A is clearly more important than B.
7	A is clearly more important than B.
9	A is absolutely more important than B.
2,4,6,8	When in doubt between two adjacent values

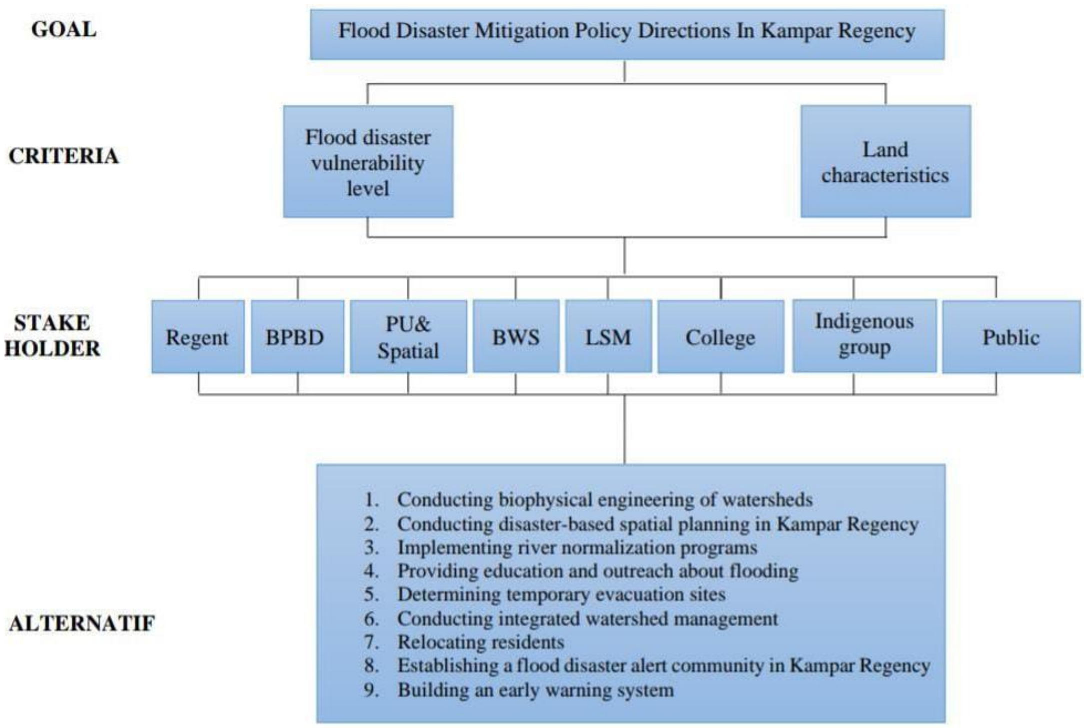

Figure 3. AHP Hierarchy Model

RESULTS AND DISCUSSION

Flood Vulnerability Level

Morphologically, the natural conditions of Kampar Regency demonstrate a diverse topography ranging from plains to hilly areas, with altitudes reaching up to 1250 meters above sea level (masl). The flat plains (0–500 masl) dominate an area of 15,888.96 km², primarily in the southern and northern parts. Meanwhile, the sloping regions (500–750 masl) cover 3,840.68 km², the undulating terrains (750–1000 masl) encompass 5,128.53 km² and hilly zones exceeding 1000 masl occupy 6,098.85 km², distributed in the northeastern and western regions. The steepest areas, surpassing 1250 masl, span 6,160.83 km² across the north and parts of the west.

In comparative terms, these findings are consistent with studies such as those by Becker (2021) and Rahman et al. (2022), highlighting the significance of morphological diversity in determining flood risk zones and their management strategies. Like previous studies, the current research underscores the correlation between altitude variations and flood vulnerability, particularly in low-altitude areas prone to inundation. However, unlike the study by Cobbinah et al. (2023), which primarily focused on urban topographies, this research offers a broader perspective by including rural and semi-rural landscapes.

The findings align with Samela et al. (2017), who emphasised the critical role of geomorphological classification in flood management. While the study was restricted to riverine flood zones, the current research integrates a more comprehensive analysis, including hilly and undulating terrains, to evaluate flood mitigation strategies effectively. This broader scope supports existing knowledge and provides an expanded framework applicable to diverse geographical settings.

By linking these findings with prior studies, this research enriches the understanding of topographical influences on disaster mitigation, reinforcing the need for tailored strategies in regions with complex morphological features like the Kampar Regency. The Kampar Regency land system map can be seen in **Figure 4**.

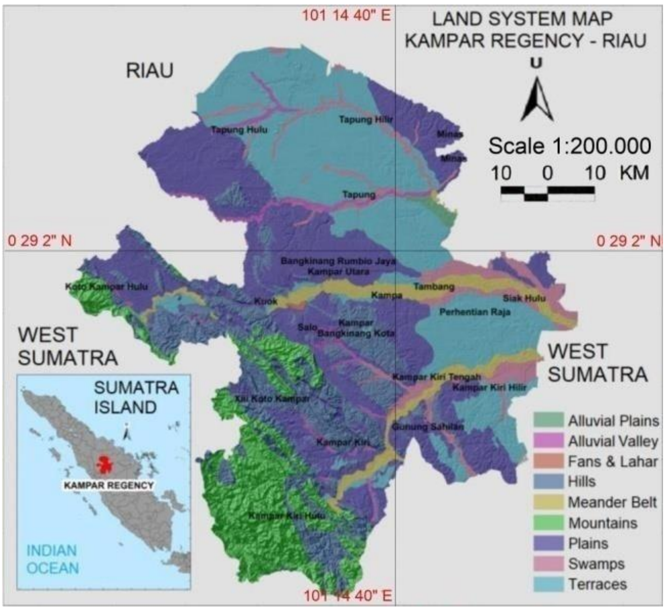

Figure 4. Map of Land System, Kampar Regency

Topographically, the Kampar Regency is an undulating area with lowlands, swamps, highlands, or hills and is slightly mountainous. The highest slope above 40% has an area of 283,708.00 ha (26.50%), while the lowest slope is below 8% with an area of 434,653.00 ha (40.60%). The lowest land slope below 8% indicates the area most prone to flooding due to the nature of water-seeking lower places. Scoring with modification against four slope classes with the lowest score of 20 in the slope class> 40%, while the highest score of

100 is given to the lowest slope class <8% (see **Figure 5**).

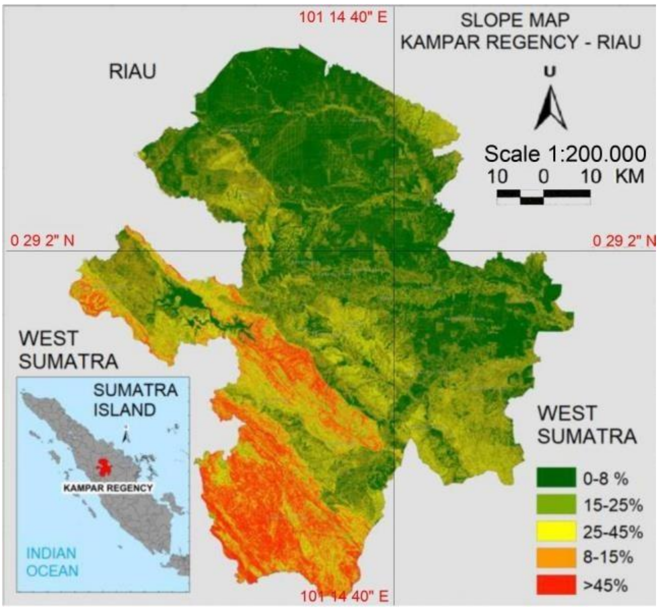

Figure 5. Map of Topograhy, Kampar Regency

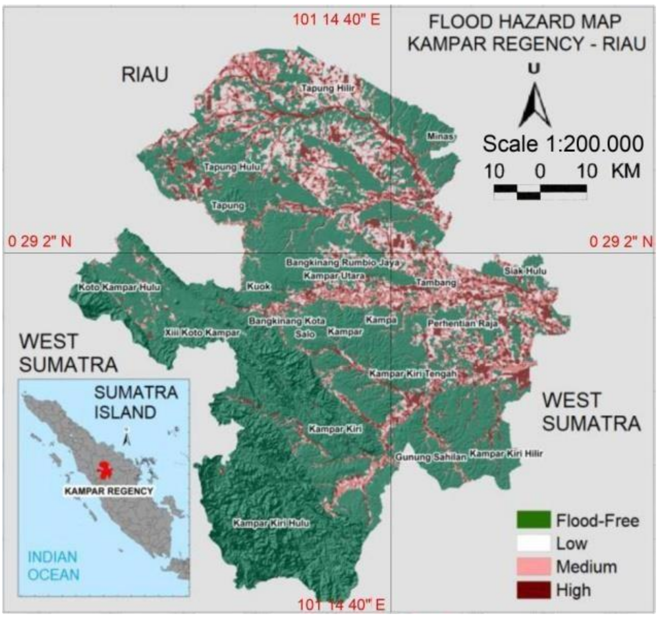

Figure 6. Map Flood Hazae, Kampar Regency

Figure 6 shows that the level of flood vulnerability is divided into four zones, including high flood-prone zone, moderate flood prone-zone, low flood prone-zone, and flood-free zone.

Table 5. Classification of Flood-Prone Zones in Kampar Regency

Area	**Flood Hazard Class (Hectares)**				
	Flood Free Zone	**Low Flood Risk**	**Moderate Flood Risk**	**High Flood Risk**	**Total**
Bangkinang	11.935,51	1.068,94	1.535,47	867,70	15.407,62
Bangkinang Kota	6.370,71	223,71	729,54	692,35	80.16,32
Gunung Sahilan	24.937,60	1.092,89	4.064,74	3.507,51	33.602,74
Kampa	10.998,07	1549,99	3.199,62	1.316,65	17.064,34
Kampar	16.682,33	562,96	2.823,25	1.189,64	21.258, 18
Kampar kiri	70.965,71	2.142,92	8.668,42	5.076,79	86.853,84
Kampar Kiri Hilir	38.715,23	5.788,55	12.726,25	10.562,26	67.792,28
Kampar Kiri Hulu	127.212,66	189,05	696,60	389,62	12.8487,94
Kampar Kiri Tengah	246.86,10	1.382,44	2.850,17	2.190,10	31.108,81
Kampar Utara	4.741,54	1.236,12	2.008,33	1.307,30	9.293,29
Koto Kampar Hulu	36.954,46	416,87	1.797,06	604,95	39.773,34
Kuok	21.255,73	999,83	2.924,42	1.233,95	26.413,93
Minas	5.191,37	3,45	218,29	332,28	5.745,40
Perhetian Raja	4.156,17	1.885,52	2.549,44	1.933,66	10.524,80
Rumbio Jaya	3.088,92	1.110,50	1.767,24	1.030,30	6.996,96
Salo	17.874,36	659,49	1.762,71	864,01	21.16057
Siak Hulu	14.060,31	6.454,92	12.360,27	8.436,40	41.311,88
Tambang	12.103,06	7.186,83	12.755,92	6.472,16	38.517,96
Tapung	74.374,38	17.334,11	23.701,23	14.024,97	129.434,69
Tapung Hilir	39.045,28	18.432,51	17.514,46	11.076,11	86.068,36
Tapung Hulu	51.686,52	15.947,13	24.377,16	13.685,32	105.696,14
XII Koto Kampar	98.814,94	688,49	1.791,26	1.864,34	103.159,02
Grand Total	**715.850,97**	**86.357,23**	**14.2821,84**	**88.658,36**	**103.3.688,39**

Based on **Table 5,** the high flood risk zone is estimated to experience a very high annual flood risk. The high flood risk zone includes lowland areas along the Kampar River and its tributaries, including around Tambang District, Bangkinang City, the capital of Kampar Regency, and coastal areas in the central and southern parts. This zone is at an altitude of 50 meters above the earth's surface. Land use in this zone is predominantly agricultural land, settlements, and plantations. However, the high population density and large rivers often overflow, making this area vulnerable to flooding. In addition, high rainfall during the rainy season, coupled with water flow from the river's upper reaches, causes widespread waterlogging, often covering roads, houses, and agricultural land. In each rainy season, flooding can reach 1 meter, causing damage to infrastructure and economic disruption that depends on agriculture. Flooding in this zone causes physical damage and affects the livelihoods of people who depend on agriculture. The area with a high flood zone in Kampar Regency is 88,658 ha.

Low flood-prone zones have the potential for flooding that occurs once a year. Low flood-prone zones in Kmpar Regency include areas located at an altitude of more than 1000 meters above sea level, especially in the northern and western parts of the Regency. These areas are generally located in hilly areas with a 15-25% slope. These areas have good natural drainage systems, with little waterlogging even during high rainfall. In areas with low flood-prone zones in Kampar Regency, which is 86,357 ha, the risk of flooding in this zone is very low. Even if it does occur, flooding is limited to small rivers with minimal inundation and does not interfere with community activities.

The moderate flood-prone zone is estimated to experience flooding 1 to 3 times in five years. The moderate flood-prone zone is located between 50-100 meters above sea level, with an area covering the lowlands between the hilly areas and the flood plains. This zone is spread across the northeastern and southern regions of Kampar Regency. Land use in this zone includes settlements and some agriculture close to the river flow. Usually, there is moderate to high rainfall in this zone with a more limited drainage system than in the low zone. In this zone, rivers often overflow during the rainy season, but the water recedes quickly. The Kampar area is a moderate flood-prone zone; the area is 142,821 ha.

Flood-free safe zones do not have the potential for flooding; these zones generally consist of mountainous areas and highlands, so they are safe from flood disasters. The flood-free safe area in Kampar Regency is 715,821 ha.

Land Characteristics in Kampar Regency

Land Characteristics of Kampar Regency Based on the Flood Vulnerability Map Analysis Based on the results of the flood vulnerability map analysis in Kampar Regency, Riau Province, land characteristics in each zone vary depending on topography, land use, soil type, and hydrological factors. Based on the stratified random sampling method taken at 4 sample points. It shows that the results of the land characteristic analysis using the Paimin method, 2007, were modified, namely that there were four characteristics taken based on the side stratification, namely:

1. Tambang District (TH 42) is classified as having poor land characteristics, indicating a high flood risk.
2. Perhentian Raja District (TH 39) is also rated poor, reflecting significant vulnerability to flooding.
3. XII Koto Kampar District (TH 35) is slightly poor, suggesting moderate flood risk.
4. Kampar Kiri Hulu District (TH 23) is rated good, representing low flood risk or flood-free conditions.

This classification provides valuable insights into prioritising flood mitigation policies, with areas like Tambang and Perhentian Raja requiring immediate attention.

The high flood-prone zone based on sample 1 in Tambang District shows that the characteristics of the land have a value of 42, which means terrible and has a high potential for flooding. Tambang District is an area dominated by residential land use. Land characteristics dominated by dense residential use can potentially increase the risk of flooding due to several factors related to changes in land function. Dense settlements reduce the area of open land that functions as a water catchment area. As a result, the ability of the land to absorb rainwater is significantly reduced so that more water flows directly as surface runoff. Settlements dominated by buildings, roads, and concrete infrastructure that do not absorb water increase the intensity of surface flow, leading directly to the nearest drainage system or river. Drainage in dense areas is often inadequate to drain high volumes of rainwater, especially during heavy rains, so puddles occur in various places and can even overflow and cause flooding.

The moderate flood-prone zone based on sample 2 taken in Perhentian Raja District shows that the characteristics of the land have a value of 39, which means bad and has a moderate level of flood risk. Perhentian Raja, a district is dominated by rice fields, plantations, and several settlements, potentially causing a moderate flood risk. Rice fields and plantations generally have sufficient capacity to absorb water into the soil, especially compared to settlements. Rice field areas, for example, are designed to

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accommodate large amounts of water during the planting season so that some rainwater can be absorbed or retained temporarily. However, these plantation and agricultural areas still have capacity limits in managing water, especially during heavy rain or long durations, which can result in temporary inundation or surface flow into drainage channels and rivers.

Based on the low flood-prone zone in sample 3 taken in XII Koto Kampar District, the land characteristics have a value of 35, which means it is rather bad and has moderate flood potential. XII Koto Kampar The District is an area dominated by oil palm plantation land use that can potentially cause a low level of flood vulnerability. The land characteristics in XIII Koto Kampar District, which is dominated by oil palm plantation land use, have the potential to cause a low level of flooding. Oil palm plantations have good vegetation cover, with deep and dense oil palm roots, so they can hold the soil and absorb most of the rainwater that falls to the surface. This dense vegetation structure helps reduce surface flow and hold back the rate of water runoff, allowing more water to be absorbed into the soil and reducing the volume of water that flows directly into drainage channels or rivers.

Meanwhile, based on the flood-free zone in sample 4 taken in Kampar Kiri Hulu District, the land characteristics have a value of 23, which means it is good and can avoid flooding. Kampar Kiri Hulu District is an area dominated by hills, mountains, and production forests. Kampar Kiri Hulu District, which is dominated by mountainous hills, production forests, and plantations, has land characteristics that support the formation of a flood-free zone.

Flood Disaster Mitigation Policy Directions in Kampar Regency

The results of the AHP analysis on the direction of flood disaster mitigation policies in Kampar Regency, the inconsistency ratio (CR) value of expert opinion is 0.7, which can be seen in **Figure 7**.

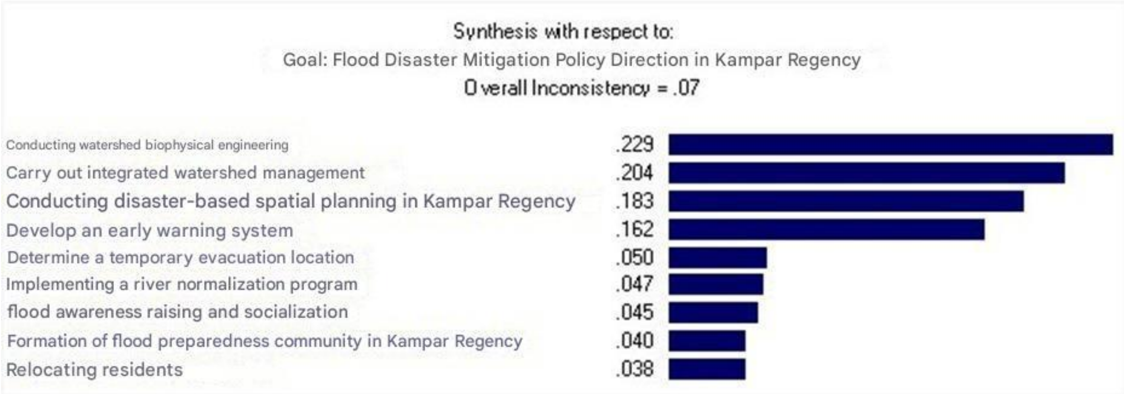

Figure 7. Flood Disaster Mitigation Policy Priorities, Kampar Regency

The implementation of flood disaster mitigation policies in Kampar Regency is highly dependent on the active involvement of stakeholders to ensure the sustainability and effectiveness of these measures. Based on the AHP analysis, the priority actions include integrated watershed management (weight: 0.234) and biophysical engineering (weight: 0.213). Stakeholders, such as government agencies, non-governmental organisations (NGOs), community groups, and the private sector, play crucial roles in supporting these efforts.

The government acts as the primary regulator and implementer, ensuring the integration of disaster-based spatial planning (weight: 0.171) and establishing early warning systems (weight: 0.150). Agencies like the National Disaster Management Authority (BNPB) and Regional Disaster Management Agencies (BPBD) must allocate resources, coordinate efforts, and enforce compliance with spatial planning regulations.

Community groups are essential in sustaining grassroots initiatives like flood alert communities (weight: 0.050) and in the success of counselling and socialisation programs (weight: 0.032). Local participation increases awareness, fosters preparedness, and strengthens social resilience against flood risks.

The private sector contributes to infrastructure development, such as river normalisation programs (weight: 0.049) and the construction of temporary evacuation sites (weight: 0.057). Through public-private partnerships, businesses can provide funding, technical expertise, and innovative technologies to enhance mitigation efforts. NGOs and academic institutions offer research-based insights, capacity-building initiatives, and advocacy for sustainable practices. They ensure that policies like the relocation of residents (weight: 0.042) are socially equitable and environmentally sound. Kampar Regency can build a robust and sustainable mitigation framework by fostering collaboration among these stakeholders, ensuring long-term resilience against flood disasters.

CONCLUSIONS

Based on the research results on the level of flood vulnerability, land characteristics, and flood disaster mitigation policy directions in Kampar Regency. The level of flood vulnerability in Kampar Regency, Riau Province, shows significant variability between sub-districts. Several areas, especially those along large rivers like the Kampar River, are vulnerable due to high rainfall, topographic factors, and low drainage channel capacity. Meanwhile, areas with higher land elevations and far from water bodies tend to have lower vulnerability.

Land Characteristics in Kampar Regency, Riau Province Land characteristics in Kampar Regency vary widely, including land with flat to undulating topography. Most of Kampar Regency consists of lowlands, with many wetlands and swamps that are easily flooded. The dominant soil types are alluvial and peat soils, susceptible to rising water levels during the rainy season. In addition, the presence of forests and large agricultural lands also affect changes in water flow patterns and groundwater absorption capacity. These factors also exacerbate flood-prone conditions in the area.

Policy Direction for Flood Disaster Mitigation in Kampar Regency, Riau Province The policy direction for flood disaster mitigation in Kampar Regency needs to integrate various approaches, including prevention, preparedness, and recovery. Some of the recommended policies include conducting watershed biophysical engineering, integrated watershed management, conducting disaster-based spatial planning in Kampar Regency, developing an early warning system, determining a river normalisation program, providing education and socialisation about floods, establishing a flood alert community, and relocating residents. With this alternative, it is hoped to be formulated to reduce the risk of flooding in Kampar Regency.

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