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Analysis of Land Use Suitability in Relation to Flood Risk in Belitung Regency

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Abstract: Flooding poses a threat to spatial utilization and community activities in coastal areas, including Belitung Regency. This study analyzes land-use suitability in relation to flood risk to support disaster risk-based spatial utilization control. A descriptive quantitative approach was employed using Geographic Information Systems (GIS). Flood risk was assessed through scoring, weighting, and spatial overlay of hazard and vulnerability parameters, then integrated with existing land-use data to determine suitability. Results show that flood risk was predominantly low, covering 215,220.21 ha (92.98%), followed by moderate risk at 14,941.76 ha (6.46%) and high risk at 1,301.48 ha (0.56%). Land-use suitability was predominantly suitable, covering 230,204.85 ha (99.40%), while conditionally suitable and unsuitable areas accounted for 0.49% and 0.11%, respectively. Residential and non-residential buildings in moderate-risk zones were conditionally suitable, while those in high-risk zones were unsuitable. The findings support spatial utilization control and flood mitigation in Belitung Regency.

Keywords: Flood Risk, Land Use Suitability, Geographic Information System, Belitung Regency

INTRODUCTION

Flooding is among the most frequent hydrometeorological disasters in Indonesia, affecting communities, the environment, and regional activities (Rahayu et al., 2023). The BNPB (2024) recorded 3,472 disaster events in 2024, with 99.34% classified as hydrometeorological disasters and 1,420 as floods. These flood risk are results from the interaction of hazard, vulnerability, and capacity, requiring the integration of physical, social, and environmental conditions in disaster management and spatial planning (Hariyra et al., 2025; Rendana et al., 2025).

Flood risk is influenced by natural factors and land-use changes, particularly built-up expansion, which can reduce infiltration and increase surface runoff. Rainfall, topography, and land-cover characteristics are associated with flood risk, while built-up expansion can affect

runoff coefficients and flood discharge (Lestari et al., 2025; Rahayu et al., 2023; Tabasi et al., 2025; UNDRR, 2017). This issue is relevant to Belitung Regency, where settlements, agriculture, plantations, coastal areas, and water bodies coexist. In 2025, the local BPBD reported 346 residents affected by flooding (Apriliansyah, 2026). The interaction of these environmental and human factors highlights the need for a spatial approach.

Within the spatial framework, GIS enables the integration of rainfall, elevation, slope, soil type, proximity to rivers or water bodies, and land use through spatial overlay. Previous studies have applied GIS for flood-risk assessment in Palembang City and Sumedang Regency (Ismanto et al., 2023; Rendana et al., 2025). Study case from Maulana (2023) also assessed residential land-use suitability across flood hazard zones using weighted overlay. However, studies integrating flood risk with diverse existing land uses to assess land-use suitability remain limited.

Accordingly, this study analyzes land-use suitability in relation to flood risk in Belitung Regency by integrating hazard, vulnerability, and existing land-use data. Land uses in low-, moderate, and high-risk zones are classified as suitable, conditionally suitable, or unsuitable. The results provide spatial information to support land-use control and disaster risk reduction strategies in Belitung Regency.

Literature Review

Disaster Risk

Disaster risk results from the interaction of hazard, exposure, vulnerability, and community capacity, with its spatial variation shaped by social, economic, physical, and environmental conditions (UNDRR, 2017). Flood risk is also influenced by regional development, increasing exposure, and environmental changes (Di Baldassarre et al., 2018). Therefore, effective flood risk management requires integrating physical and human factors with spatial utilization control (Tabasi et al., 2025).

Flood Hazard-Forming Factors

Flood hazard is influenced by physical and environmental factors, including rainfall, soil type, slope, elevation, distance from water bodies, and land use, as identified by (Hariyra et al., 2025; Ismanto et al., 2023). Rainfall affects water volume, while soil type influences infiltration and runoff. Elevation and slope determine water flow and accumulation, whereas proximity to water bodies increases exposure, particularly in coastal areas (Rahayu et al., 2023). Land use also affects surface conditions and runoff patterns. Therefore, flood hazard assessment requires the integration of multiple parameters to represent its spatial distribution comprehensively (Hariyra et al., 2025; Lestari et al., 2025).

Flood Vulnerability

Flood vulnerability reflects the physical, social, economic, and environmental conditions that increase the potential impacts of flooding (Nugraha et al., 2022). Physical vulnerability concerns exposed infrastructure and critical facilities, social vulnerability relates to population characteristics and vulnerable groups, economic vulnerability involves productive land and economic activities, while environmental vulnerability concerns protected areas and natural vegetation. These dimensions should be assessed comprehensively to capture the multidimensional impacts of flooding (Adinata Wirasena et al., 2026; Nugraha et al., 2022).

Land Use and Flood Risk

Land use influences flood risk by determining the activities and assets exposed to hazards. Ekawati et al. (2022), Fikri et al. (2022), and Kuenzer et al. (2020) emphasize the importance of integrating disaster risk into spatial planning, particularly in vulnerable areas. In coastal regions such as Belitung Regency, low-elevation areas and built-up development may increase

exposure. Therefore, spatial analysis of land use and flood risk is needed to assess whether existing land uses are appropriate to their risk levels.

Land-Use Suitability in Relation to Flood Risk

Land-use suitability assesses the compatibility between existing land use and flood-risk levels through spatial overlay (Adinata Wirasena et al., 2026). Suitability is classified as suitable, conditionally suitable, or unsuitable based on land-use sensitivity and flood exposure. Following Hariyra et al. (2026), built-up areas are suitable in low-risk zones, conditionally suitable in moderate-risk zones, and unsuitable in high-risk zones, supporting risk-based spatial utilization control.

METHOD

Research Approach

This study employs a descriptive quantitative approach with GIS-based spatial analysis. Quantitative methods were used to score and weight flood hazard and vulnerability parameters, while descriptive analysis characterized flood risk distribution and its relationship with existing land use. Scoring and overlay methods enable the integration of multiple spatial parameters into flood hazard or risk information (Mataburu et al., 2023; Hanum et al., 2024).

Study Area and Data

The study was conducted in Belitung Regency, Bangka Belitung Islands Province, using spatial and non-spatial data for flood hazard, vulnerability, and land-use suitability analysis.

Metode Analisis Bahaya Banjir

Flood hazard was assessed using weighted overlay of rainfall, elevation, slope, soil type, distance to rivers or water bodies, and land use. These parameters were selected based on previous GIS-based studies (Maulana, 2023; Rendana et al., 2025), classified and scored according to their relative contribution to flood occurrence, then weighted to derive the flood hazard index, expressed as:

$$IB = \sum (W_i \times X_i)$$

Where:

IB = flood hazard index;

W_i = weight of the i -th parameter;

X_i = score of the i -th parameter.

The resulting hazard index was classified into low, moderate, and high categories to determine the spatial distribution of flood hazard in Belitung Regency.

Table 1 Flood Hazard Parameters

Parameter	Classification	Score	Weight
Rainfall	>3,250 mm/year	4	1.5
	2,751–3,250 mm/year	3	
	2,251–2,750 mm/year	2	
	0–2,250 mm/year	1	
Soil Type	Alluvial, Planosol, Grey Hydromorphic, Gleysol	4	1
	Cambisol, Mediterranean Soil	3	
	Andosol, Lateritic Soil, Grumosol, Podsol, Podsollic Soil	2	
	Regosol, Organosol, Litosol, Rendzina	1	
Slope	0–8%	5	1
	8–15%	4	
	15–25%	3	
	25–40%	2	
	>40%	1	

Parameter	Classification	Score	Weight
Elevation	0–50 m a.s.l.	5	2
	50–100 m a.s.l.	4	
	100–200 m a.s.l.	3	
	200–300 m a.s.l.	2	
	>300 m a.s.l.	1	
Distance from Water Bodies	0–150 m	5	2
	150–300 m	4	
	300–450 m	3	
	450–600 m	2	
	>600 m	1	
Land Use	Open land, water bodies, ponds	5	2.5
	Residential areas, non-residential buildings, rice fields	4	
	Plantations, dry agricultural land	3	
	Shrubland, mixed gardens	2	
	Forests, shrubland, coastal ecosystems	1	

These are parameters, classifications, scores, and weights used in the flood hazard analysis. Each parameter was scored according to its contribution to flood occurrence and weighted using the weighted overlay method (Di Baldassarre et al., 2018; Ismanto et al., 2023) .

Flood Vulnerability Analysis

Flood vulnerability was assessed by scoring, weighting, and overlaying social, economic, physical, and environmental factors to derive a vulnerability index (BNPB, 2024; Syam et al., 2025) .

Table 2. Vurnability Parameter

Vulnerability Aspect	Parameter	Classification	Criteria	Score	Weight
Physical Vulnerability	Accessibility	High	No access	3	50%
		Moderate	Local roads available	2	
		Low	Arterial/collector roads available	1	
	Public/Critical Facilities	High	No facilities	3	50%
		Moderate	Health center available	2	
		Low	Hospital available	1	
Social Vulnerability	Population Density	High	>427–627 persons/km ²	3	60%
		Moderate	>227–427 persons/km ²	2	
		Low	28–227 persons/km ²	1	
	Vulnerable Population	High	>40%	3	40%
		Moderate	20–40%	2	
		Low	<20%	1	
Economic Vulnerability	Productive Land	High	>50%	3	100%
		Moderate	30–50%	2	
		Low	<30%	1	
Environmental Vulnerability	Protected Areas	High	<20%	3	60%
		Moderate	20–50%	2	
		Low	>50%	1	
	Natural Vegetation	High	<10% of area	3	40%
		Moderate	10–30%	2	
		Low	>30%	1	

The table presents the parameters used to assess flood vulnerability across physical, social, economic, and environmental aspects. Each parameter is assigned a score of 1–3 based on its vulnerability level and weighted before spatial overlay to derive the vulnerability index (Adinata Wirasena et al., 2026) .

Flood Risk Analysis

Flood risk was assessed by overlaying flood hazard and vulnerability maps to classify areas into low, moderate, and high risk. The resulting map was then used to evaluate existing land-use suitability, following the spatial integration approach of (Lizar et al., 2026; Muta'ali, 2014).

Table 3. Flood Risk Level Determination

Vulnerability Level	Hazard Level		
	1 (Low)	2 (Moderate)	3 (High)
1 (Low)	1 (Low)	2 (Low)	3 (Low)
2 (Moderate)	2 (Low)	3 (Low)	4 (Moderate)
3 (High)	3 (Low)	4 (Moderate)	5 (High)

Land-Use Suitability Analysis in Relation to Flood Risk

Land-use suitability was assessed by overlaying existing land-use and flood-risk maps. Each land-use type was evaluated according to its associated risk level and classified as suitable, conditionally suitable, or unsuitable. The resulting map identified land-use distributions by suitability level and areas requiring spatial utilization control (Hariyra et al., 2025; Lestari et al., 2025).

Table 4. Land-Use Suitability in Relation to Flood Risk

Land Use	Low Risk	Moderate Risk	High Risk
Water Bodies	✓	✓	✓
Non-Residential Buildings	✓	●	×
Coastal Ecosystems	✓	✓	✓
Natural Forest	✓	✓	✓
Open Land	✓	✓	✓
Plantation/Garden	✓	✓	✓
Residential Areas	✓	●	×
Rice Fields	✓	✓	✓
Shrubland	✓	✓	✓
Fishponds	✓	✓	✓
Dry Agricultural Land	✓	✓	✓

Notes:

✓ = Suitable

● = Conditionally Suitable

×

Analysis Procedures

Overall, the study followed several analytical stages, including:

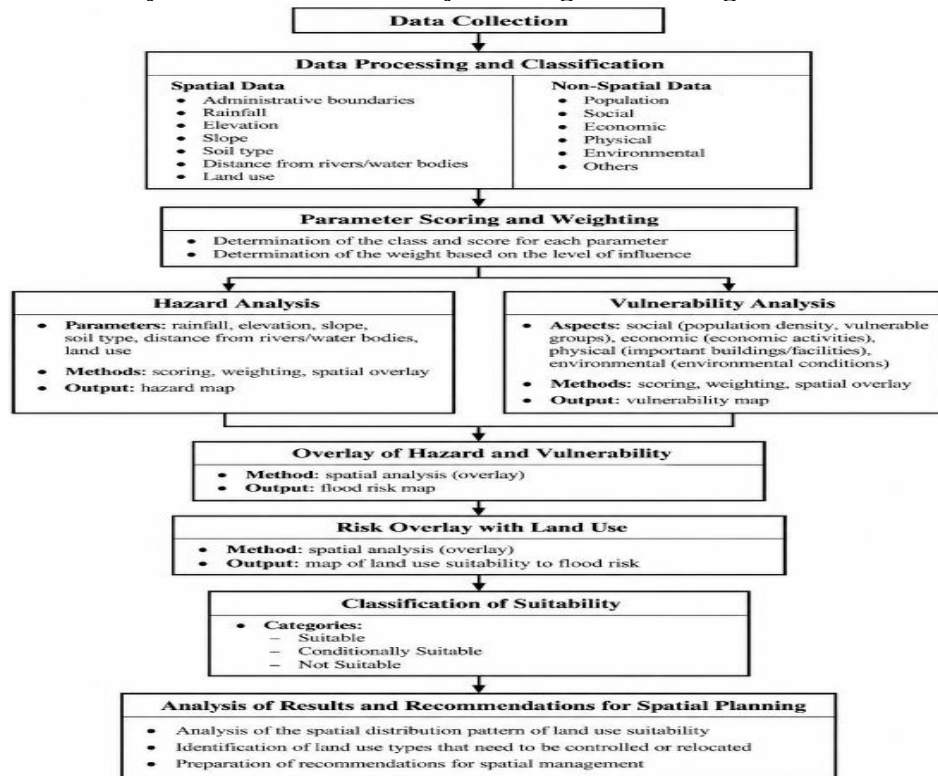


Figure 1. Analytical Process

RESULTS AND DISCUSSION

Flood Hazard

Flood hazard was determined based on six factors: rainfall, soil type, slope, elevation, distance from water bodies, and land use. Each factor was assigned a score according to the established parameter classification. The scoring results for all parameters are presented from Table 5 down to Table 10.

Table 5. Rainfall

Rainfall (mm/year)	Score	Area (ha)
>3,250	4	12,238.30
2,751–3,250	3	68,769.72
2,251–2,750	2	6,775.71
0–2,250	1	141,169.85

Most of Belitung Regency falls within the 0–2,250 mm/year rainfall class (141,169.85 ha; score 1), while areas receiving >3,250 mm/year cover only 12,238.30 ha. Thus, rainfall-related flood susceptibility is generally low across the region. Rainfall remains an important factor in flood vulnerability by controlling water input into the hydrological system, consistent with Rahayu et al. (2023), which highlights rainfall, topography, and land cover as key factors influencing flood risk.

Table 6. Soil Type

Soil Type	Score	Area (ha)
Alluvial	5	17,302.08
Glisol	5	8,288.27
Cambisol	3	46,285.14
Podsollic	2	152,315.20
Regosol	1	3669,10

Podzolic is the most extensive soil type, covering 152,315.20 ha with a score of 2. In contrast, Alluvial and Glisol soils receive the highest score of 5, covering 17,302.08 ha and 8,288.27 ha, respectively. This variation reflects differences in soil characteristics that influence flood susceptibility. Soil type is also incorporated as a parameter in flood-susceptibility and risk modeling by Fitriansyah et al. (2024) and Rendana et al. (2025) in their past research.

Table 7. Slope

Class	Slope	Score	Area (ha)
0–8%	Flat	5	197573,2
8–15%	Gentle	4	6605,245
15–25%	Moderate	3	4694,185
25–40%	Steep	2	19970,8
>40%	Very Steep	1	1784,909

The slope parameter shows that flat areas (0–8%) dominate the study area, covering 197,573.20 ha and receiving the highest score of 5. Flat terrain can increase flood susceptibility due to lower surface drainage compared with steeper areas. This finding is consistent with Rendana et al. (2025), which identifies slope as an important factor in flood-risk modeling.

Table 8. Elevation

Elevation	Score	Area (ha)
0–50 m a.s.l.	5	207,154.49
50–100 m a.s.l.	4	17,326.37
100–150 m a.s.l.	2	3,484.03
150–200 m a.s.l.	2	1,649.00
200–255 m a.s.l.	2	1463,14

The elevation parameter shows that 207,154.49 ha of Belitung Regency lies at 0–50 m above sea level, receiving the highest score of 5. The predominance of low-lying areas indicates that topography is an important factor in flood susceptibility, particularly near rivers and coastal areas. This finding is consistent with Rendana et al. (2025), which identifies elevation as a factor associated with flood-risk distribution.

Table 9. Distance From Water Bodies

Range	Score	Area (Ha)
150	5	8378,32
300	4	6813,67
450	3	5944,66

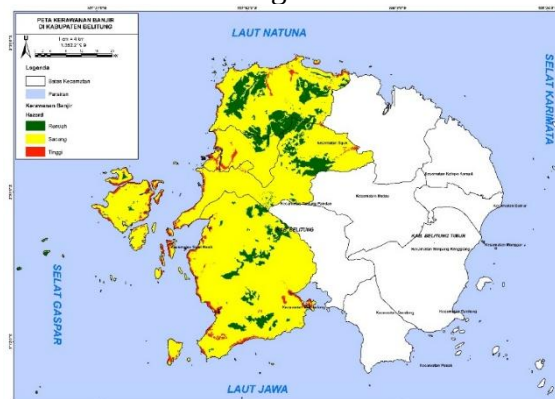
600	2	5336,68
1000	1	12673,09

Areas within 150 m of water bodies receive the highest score (5), covering 8,378.32 ha. Their proximity to rivers and other water bodies increases flood exposure due to potential overflow and rising water levels. This factor is also incorporated in flood-risk modeling by Rendana et al. (2025) in Palembang.

Table 10. Land Use

Land Use	Score	Area (ha)
Water Bodies	5	1,939.30
Non-Residential Buildings	4	68.75
Coastal Ecosystems	1	2,820.47
Natural Forest	1	37,739.11
Open Land	5	16,763.38
Plantation/Garden	3	84,362.12
Settlement	4	2,650.20
Rice Fields	4	100.46
Shrubland	2	78,178.35
Fish Ponds	5	91.37
Dry Agricultural Land/Farmland	3	5,577.25

Land use varies considerably, with plantations/gardens (84,362.12 ha) and shrublands (78,178.35 ha) as the dominant classes, while settlements cover 2,650.20 ha. Land use is an important flood-risk parameter because land-cover characteristics influence water infiltration and runoff. This is consistent with Rahayu et al. (2023), which links land cover, topography, and rainfall to flood risk. Lestari et al. (2025) on their past research also shows that increasing built-up areas can intensify runoff and flood discharge.



Flood Vulnerability

Physical vulnerability represents the potential for damage and losses caused by disasters. In this study, it was assessed using two indicators: public/critical facilities and accessibility. Both indicators were analyzed using a scoring method to determine the level and category of physical vulnerability in each district. The scoring results are presented below.

Table 11. Physical Vulnerability

District	Public/Critical Facilities	Accessibility	Physical Vulnerability Score	Category
Badau	1	0.5	1.5	Low
Membalong	1	0.5	1.5	Low
Selat Nasik	1	1	2.0	Moderate
Sijuk	1	0.5	1.5	Low
Tanjung Pandan	0.5	0.5	1.0	Low

Economical vulnerability reflects population conditions that may be affected by disasters. It was assessed using population density and the vulnerable population ratio, weighted at 0.6 and 0.4, respectively. The scores were used to classify social vulnerability by district, as presented in Table 12.

Table 12. Economical vulnerability

District	Productive Land (%)	Economic Vulnerability	Category
Badau	49.92%	2	Moderate
Membalong	36.64%	2	Moderate

Selat Nasik	9.27%	1	Low
Sijuk	38.00%	2	Moderate
Tanjung Pandan	53.00%	3	High

Based on Table 13, most districts have low social vulnerability. In contrast, Tanjung Pandan shows high social vulnerability, with a score of 2.8, indicating greater social vulnerability compared with other districts.

Table 13. Social vulnerability

District	Population Density (people/km ²)	Score	Weighted Density (×0.6)	Vulnerable Population Ratio	Score	Weighted Ratio (×0.4)	Social Vulnerability	Category
Membalong	28	1	0.6	2.5	1	1.6	1.6	Low
Tanjung Pandan	627	3	1.8	2.5	1	2.8	2.8	High
Badau	33	1	0.6	3.0	1	1.2	1.8	Low
Sijuk	69	1	0.6	2.5	1	1.0	1.6	Low
Selat Nasik	33	1	0.6	2.5	1	1.0	1.6	Low

Environmental vulnerability varies across the study area. Sijuk and Tanjung Pandan have high vulnerability, each with a score of 2.6, while Badau and Selat Nasik are classified as moderate. Membalong has low environmental vulnerability, with a score of 1.6.

Table 14. Environmental vulnerability

District	Protected Area (%)	Score	Weighted Protected Area (×0.6)	Natural Vegetation (%)	Score	Weighted Natural Vegetation (×0.4)	Score	Category
Badau	27.70%	2	1.20	18.96%	2	0.80	2.0	Moderate
Membalong	21.15%	2	1.20	42.16%	1	0.40	1.6	Low
Selat Nasik	11.44%	3	1.80	76.38%	1	0.40	2.2	Moderate
Sijuk	6.25%	3	1.80	17.29%	2	0.80	2.6	High
Tanjung Pandan	6.46%	3	1.80	14.85%	2	0.80	2.6	High

After scoring each vulnerability sub-variable, further scoring and weighting were conducted based on Table 15. The results are presented in Tables 15 and 16, which show the flood vulnerability classification.

Table 15. Vulnerability Scoring and Weighting

District	Physical *0.25	Total	Economic *0.25	Total	Social *0.4	Total	Environmental *0.1	Total	Total Score *Weight	Vulnerability Classification
Badau	1	0.25	3	0.75	1	0.4	3	0.3	1.7	Low
Membalong	1	0.25	3	0.75	1	0.4	1	0.1	1.5	Low
Selat Nasik	3	0.75	1	0.25	1	0.4	3	0.3	1.7	Low
Sijuk	1	0.25	3	0.75	1	0.4	5	0.5	1.9	Low
Tanjung Pandan	1	0.25	5	1.25	5	2	5	0.5	4	High

Table 16. Flood Vulnerability Level Classification

Flood Vulnerability Level	Score	Area (ha)	Percentage
Low	1.5	98,517.06	42.55%
Low	1.7	66,605.59	28.77%
Low	1.9	48,642.87	21.01%
High	4.0	17,740.17	7.66%

Flood vulnerability assessment shows that low vulnerability dominates the study area, covering 98,517.06 ha (42.55%), while high vulnerability covers 17,740.18 ha (7.66%) and is concentrated in Tanjung Pandan District. Overall, Tanjung Pandan exhibits the highest vulnerability, whereas most other areas fall within the low-vulnerability category. These findings

highlight that areas with similar flood hazards may have different risk levels due to differences in vulnerability, consistent with Rendana et al. (2025), which emphasizes social, economic, physical, and environmental factors in flood-risk assessment.

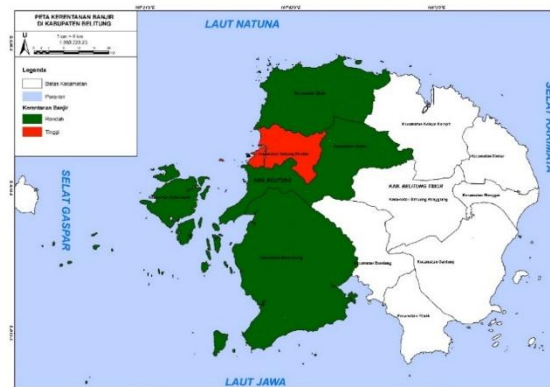


Figure 2. Flood Vulnerability Map of Belitung Regency

Flood Risk

Flood risk analysis was conducted by integrating flood hazard and vulnerability through scoring and spatial overlay. The results were classified into three categories: low, moderate, and high risk. The flood risk analysis results for Belitung Regency are presented below.

Table 17. Flood Risk Level Classification of Belitung Regency

Risk	Area (Ha)	Percentage
Low	215220,21	92,98%
Medium	14941,76	6,46%
High	1301,48	0,56%

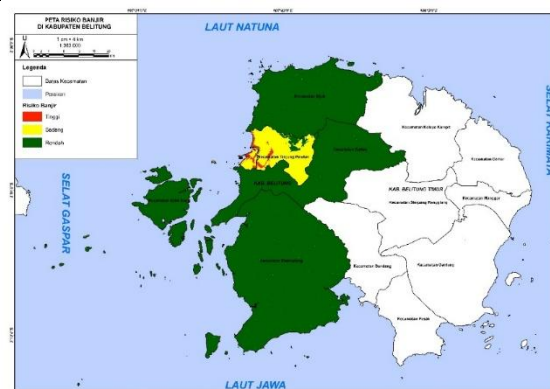


Figure 3. Flood Risk Map of Belitung Regency

The results show that Belitung Regency is predominantly classified as low flood risk, covering 215,220.21 ha (92.98%). Moderate and high-risk areas cover 14,941.76 ha (6.46%) and 1,301.48 ha (0.56%), respectively. The predominance of low-risk areas indicates that Belitung Regency generally has limited flood risk. However, moderate- and high-risk zones remain important due to their association with physical conditions, community vulnerability, and land use. This integrated hazard–vulnerability approach is consistent with Rendana et al. (2025), which highlights the interaction of physical characteristics and spatial land use in shaping flood risk.

Land-Use Suitability in Relation to Flooding

Land-use suitability was assessed by overlaying existing land use with the flood-risk map following Muta'ali (2014) research. Most areas were classified as suitable (99.40%), while 0.49% were conditionally suitable and 0.11% unsuitable.

Table 18. Land-Use Suitability in Relation to Flood Risk Levels

Land Use	Area (ha)	Low Risk	Moderate Risk	High Risk
Water Bodies	3,198.02	2,591.32 (Suitable)	410.04 (Suitable)	196.66 (Suitable)
Non-Residential Buildings	68.76	13.54 (Suitable)	54.92 (Conditionally Suitable)	0.30 (Not Suitable)

Land Use	Area (ha)	Low Risk	Moderate Risk	High Risk
Coastal Ecosystems	2,820.48	2,332.09 (Suitable)	458.97 (Suitable)	29.42 (Suitable)
Natural Forest	37,739.35	37,739.35 (Suitable)	0.001 (Suitable)	0.001 (Suitable)
Open Land	16,790.07	14,572.46 (Suitable)	1,684.03 (Suitable)	533.58 (Suitable)
Plantation/Garden	84,362.13	76,779.09 (Suitable)	7,583.03 (Suitable)	0.001 (Suitable)
Settlements	2,650.30	1,306.92 (Suitable)	1,090.02 (Conditionally Suitable)	253.36 (Not Suitable)
Rice Fields	100.46	76.67 (Suitable)	23.80 (Suitable)	0.00 (Suitable)
Shrubland	78,205.25	76,066.90 (Suitable)	1,898.99 (Suitable)	239.37 (Suitable)
Fishponds	91.37	91.37 (Suitable)	0.001 (Suitable)	0.001 (Suitable)
Dryland Agriculture/Farmland	5,577.25	3,789.92 (Suitable)	1,738.30 (Suitable)	49.02 (Suitable)

Most land uses are suitable in low-risk areas. In moderate-risk areas, most remain suitable, while non-residential buildings and settlements are conditionally suitable. In high-risk areas, settlements (253.36 ha) and non-residential buildings (0.30 ha) are unsuitable, while other land uses remain suitable.

Table 19. Land Use Suitability

Suitability	Area (Ha)	Percentage
Suitable	230.204,85	99,40%
Conditionally Suitable	1144,94	0,49%
Not Suitable	253,66	0,11%

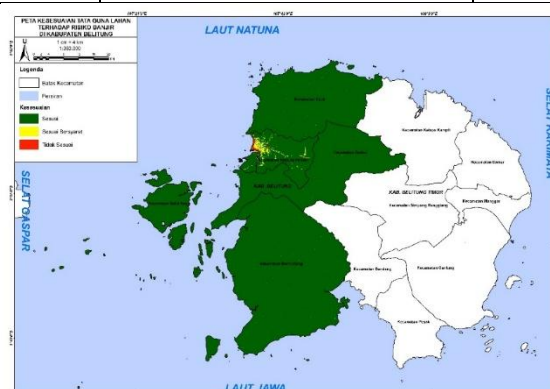


Figure 4. Land-Use Suitability Map in Relation to Flood Risk

The results show that most of the study area is classified as suitable, covering 230,204.85 ha (99.40%). Meanwhile, 1,144.94 ha (0.49%) is classified as conditionally suitable, and only 253.66 ha (0.11%) is unsuitable. This indicates that existing land uses are generally compatible with the identified flood-risk levels, although areas with conditional or unsuitable status require further spatial management. Most land-use types, including forests, plantations, rice fields, shrubs, ponds, coastal ecosystems, and open land, were classified as suitable across different flood-risk levels. In contrast, residential and non-residential buildings showed a distinct pattern: suitable under low risk, conditionally suitable under moderate risk, and unsuitable under high risk.

These findings indicate that the main concern is not the presence of all land-use types in flood-prone areas, but particularly built-up land in moderate- and high-risk zones. This pattern is consistent with Hariyra et al. (2025), which found that settlements and buildings in flood-risk areas require stricter spatial suitability considerations. This study extends that approach by incorporating a broader range of land-use types in Belitung Regency.

CONCLUSION

This research demonstrates and finds that flood risk in Belitung Regency is predominantly low, with low-risk areas covering 215,220.21 ha (92.98%), while moderate- and high-risk areas account for 14,941.76 ha (6.46%) and 1,301.48 ha (0.56%), respectively. The spatial pattern is associated with variations in flood hazard and vulnerability, particularly physical conditions, land use, and vulnerability characteristics. Tanjung Pandan represents the area with the highest vulnerability, while most other districts are classified as low vulnerability. This finding is generally consistent with previous flood-risk studies emphasizing the combined influence of physical and vulnerability characteristics on spatial flood-risk patterns.

Land-use suitability analysis shows that 230,204.85 ha (99.40%) of existing land use is suitable for the identified flood-risk conditions, while 1,144.94 ha (0.49%) is conditionally suitable and 253.66 ha (0.11%) is unsuitable. Most land-use types remain suitable across different risk levels. However, settlements and non-residential buildings require greater spatial control, being conditionally suitable in moderate-risk zones and unsuitable in high-risk zones. This pattern supports previous research highlighting the importance of incorporating flood risk into land-use suitability assessment, particularly for built-up areas. Overall, integrating flood hazard, vulnerability, and existing land use provides a spatial basis for risk-based land-use management in Belitung Regency, with priority given to moderate- and high-risk areas, particularly built-up zones.

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