Jurnal Pertanian Terapan of **JURNAL ROCE (AGROSCIENCE)**
https://jurnal.rocewisdomaceh.com/index.php/roce e-ISSN : 3032-4505
Vol. 3, No. 1, Thn. 2026
https://doi.org/10.71275/roce.v3i1.144

IDENTIFICATION AND MAPPING OF CRITICAL LAND LEVELS IN THE KRUENG LANGSA WATERSHED USING GEOGRAPHIC INFORMATION SYSTEM

IDENTIFIKASI DAN PEMETAAN TINGKAT LAHAN KRITIS DI DAERAH ALIRAN SUNGAI KRUENG LANGSA MENGGUNAKAN SISTEM INFORMASI GEOGRAFIS

Iswahyudi [1*], Elita Romei Tampubolon [1], Rosmiati[1]

[1] Department of Agriculture, Samudera University, Langsa, Aceh

* Correspondent Email: iswahyudi@unsam.ac.id

Abstract

Langsa City has a river that runs through the city, namely the Krueng Langsa. Critical land will disrupt the land's ability to regulate water management, flood control, and sedimentation in downstream areas. The method used by GIS is a weighted scoring analysis: the weighted overlay method, the scoring method, and the weighted overlay. The weighted overlay is a spatial analysis technique that overlays multiple maps related to the factors affecting the vulnerability assessment. The analytical tool used is the geographic information system (GIS). The search parameters were the sloping map, the erosion risk map, the land use map, and the land management map. The results for land importance in the Langsa River showed that it falls into three categories: not important, potentially important, and slightly important. The most predominant land type was unimportant, covering 13,269.23 ha (65.31%), followed by potentially important land, covering 7,030.22 ha (34.60%). These two land importance criteria were found in Langsa Baro District, Langsa West District, Langsa Lama District, Langsa East District, and Langsa City District. "The Slightly Critical class is the smallest class which is only found in Langsa Lama District, specifically in Pondok Factory Village and Petow Village, which are geographically located between 04◦ 42' 23.99" N – 04◦ 44' 68.91" N North Latitude and 97◦ 91' 86.81" E – 97◦ 90'41, 99" N with an area of 15.12 ha (0.07%).

Keywords: *Critical Land, Watershed, Geographic Information Systems (GIS)*

Abstrak

Kota Langsa memiliki sungai yang membentang dan membelah kota, yaitu Sungai Krueng Langsa. Lahan kritis akan mengganggu fungsi lahan sebagai sarana pengaturan pengelolaan air, pengendalian banjir, dan sedimentasi di daerah hilir. Metode yang digunakan oleh GIS adalah teknik analisis skor dengan bobot. Metode overlay berbobot, metode skor, dan overlay berbobot. Overlay berbobot adalah analisis spasial menggunakan teknik overlay sejumlah peta yang berkaitan dengan faktor-faktor yang mempengaruhi penilaian kerentanan. Alat analisis yang digunakan adalah sistem informasi geografis (SIG). Parameter pencarian adalah peta kemiringan, peta risiko erosi, peta penggunaan lahan, dan peta pengelolaan lahan.
Hasil pentingnya lahan di Sungai Langsa terbagi menjadi tiga kategori: tidak penting, berpotensi penting, dan agak penting. Tipe lahan yang paling dominan adalah tidak penting dengan luas 13.269,23 ha (65,31%), diikuti oleh lahan berpotensi penting dengan luas 7.030,22 ha (34,60%). Dua kriteria kepentingan lahan ini ditemukan di Kabupaten Langsa Baro, Kabupaten Langsa Barat, Kabupaten Langsa Lama, Kabupaten Langsa Timur, dan Kabupaten Kota Langsa. Kelas "Sedikit Kritis" adalah kelas terkecil

yang hanya ditemukan di Kabupaten Langsa Lama, khususnya di Desa Pondok Factory dan Desa Petow, yang secara geografis terletak antara 04◦ 42' 23.99"N – 04◦ 44' 68.91" Lintang Utara dan 97◦ 91' 86.81"E – 97◦ 90'41, 99"N dengan luas 15,12 ha (0,07%).

Kata Kunci: Lahan Kritis, Daerah Aliran Sungai, Sistem Informasi Geografis (SIG)

INTRODUCTION

Langsa City is an expanding city in Aceh Province that is developing facilities and infrastructure to support trade, industry, and government administration. The Krueng Langsa River, which runs through the center of Langsa City, and the rapid development in this area have significantly affected the River.

River watershed and its ecological system. The Krueng Langsa River flows from Langsa Baro District and passes through the villages of Pondok Kemuning, Suka Rakyat, Geudubang, Seulalah, and Pondok Pabrik (in the upstream watershed). The river then flows through the villages of Sidodadi, Sidorejo, and Meurandeh (in the middle part of the river basin) and continues to the Langsa Lama District. Finally, the river empties into Alue Beurawe Village in Langsa Barat District (Langsa City BPS, 2020). The flow conditions of the Krueng Langsa River have changed due to river channel straightening at several points. The development of residential areas and infrastructure that does not take into account environmental conditions or land capacity can also cause erosion or flood inundation. (Kodoatie *et al*., 2002) defines a river basin as a naturally formed unified water management area/territory/region where water is retained (from rainfall) and will flow from that area/region/region towards the river and its associated waterways. Development of residential areas and infrastructure that does not consider environmental or land capabilities can also cause erosion or flood inundation (Isma et al., 2019).

The meaning and definition of critical land are described in the Decree of the Minister of Environment and Forestry No.SK.306/MENLHK/PDASHL/DAS.0/7/2018 on the identification of national critical land, in which critical land is defined as land that can no longer function as a specific means of water production and management. Barren areas, a barren appearance, and the presence of rocks on the surface characterize critical lands. They are often found in hilly or steep areas (Ruhama, 2020).

According to Talakua & Osok (2019), land use is the most vulnerable element and remains the primary target of human-induced change, compared with other elements such as climate, soil, and topography. Meanwhile, soils that lose vegetation are no longer able to retain rainwater, and falling rain can damage soil aggregates, leading to loss of organic matter, increased soil runoff, and water seeping into the soil (infiltration) (Armijon, 2020).

Critical land, according to Law No. 37 of 2014 on soil and water conservation, is land that has poor function as a productive medium for growing crops or is not cultivated. Therefore, it is necessary to identify and map the extent of critical land in the Krueng Langsa River Basin to inform planning efforts to restore and improve the river basin's natural ecosystem functions. play a role in regulating the hydrological cycle. To identify important land areas in a river basin, use Geographic Information Systems (GIS) and remote sensing to map or graph them.

https://jurnal.rocewisdomaceh.com/index.php/roce e-ISSN : 3032-4505
Vol. 3, No. 1, Thn. 2026
https://doi.org/10.71275/roce.v3i1.144

RESEARCH METHODS

This research uses the Weighted Overlay, Scoring, and Weighting methods. Weighted overlay is a spatial analysis technique that combines multiple maps related to factors affecting vulnerability assessment. The weighted overlay considers the factors or criteria identified during the suitability selection process (Sofyan *et al*., 2010). Spatial analysis is carried out by overlaying several spatial data (parameters deter- mining critical land), namely slope slope, level of erosion hazard, land management and land use to produce a new mapping unit that will be used as an analysis unit, which is guided by the Regulation of the Director General of Watershed Management and Social Forestry Number P.4/V-SET/2013 concerning Technical Instructions for Com- piling Spatial Data on Critical Land. Determination of critical land is classified into 3 regional functions: protected forest areas, agricultural cultivation areas, and protected areas outside forest areas. This research focuses on 1 regional function, namely: agricultural cultivation areas. The parameters used in preparing the Land Criticality Map are: Slope Slope Map (20% weight), Erosion Map (20% weight), Land Coverage Map (50% weight), and Management Map (10% weight). These four maps are then overlaid to produce a Land Criticality Level Map for the Krueng Langsa watershed.

Geographic information systems (GIS) can be used throughout the watershed restoration process. Several studies related to the prioritization of watersheds for conservation actions have been carried out, specifically on soil erosion (Singh et *al*., 2019; Choudhary *et al*., 2020), watershed morphometry (Mohammed *et al*., 2018; Tukura *et al*., 2021), and the sediment yield index (Jang *et al*., 2013). The analytical tool used is the geographic information system (GIS). The process of determining an area’s suitability is carried out through spatial operations in GIS applications. Common GIS operations include data collection, data management, data query, vector data analysis, raster data analysis, and data visualization (Chan, 2016). Through GIS applications, decision-makers can edit spatial and geographic data, create interactive searches to analyze it, and visualize the results (Balaman, 2019).

Materials

The materials used in this research are: the Krueng Langsa watershed boundary map, the Digital Elevation Model (DEM), the Shuttle Radar Topography Mission (STRM) 30 m resolution, 2022 rainfall data obtained from BMKG Staklim Aceh, the administrative map, and the thematic maps of Langsa City (soil type, slope, erosion hazard level, land management, and land use) obtained from the Department of Agriculture.

Critical Land Assessment Using Spatial

The parameters used to assess the importance of land comply with the Regulation of the Director General of the Department of Watershed Management and Social Forestry No. P.4/V-SET/2013 on technical guidelines for synthesizing spatial assessment data of important land, including: Land cover, slope, erosion, and management. The diagram for determining critical

https://jurnal.rocewisdomaceh.com/index.php/roce e-ISSN : 3032-4505
Vol. 3, No. 1, Thn. 2026
https://doi.org/10.71275/roce.v3i1.144

land levels is shown in Figure 1. After the spatial data on the parameters that determine critical land is compiled, the data will be analyzed to obtain critical information about the land. Spatial analysis is performed by overlaying several spatial datasets (parameters that determine important land areas) to create a new mapping unit, namely the map of land importance. Scoring and weighting are carried out for each analysis unit. The score results obtained will be linked to the score of the agricultural cultivation area. The score used in this research is the critical land score for agricultural cultivation.

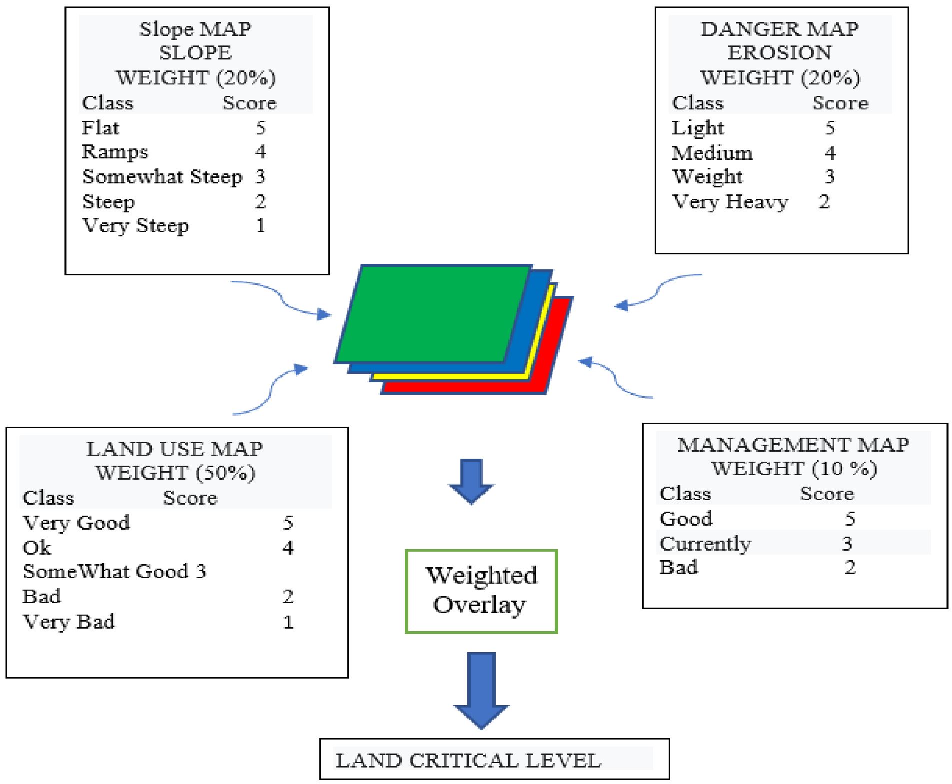

Figure 1: Flowchart for Determining Critical Land

Table 1. Critical Level of Land

Critical Level of Land	Forest Areas Protects	Cultivation Areas Agriculture	Protected Areas Outside.
	Total score	Total score	Total score
Very Critical	120-180	115-200	110-200
Critical	181-270	201-275	201-275
Somewhat Critical	271-360	276-350	276-350
Critical Potential	361-450	351-425	351-425
Not Critical	451-500	426-500	426-500

https://jurnal.rocewisdomaceh.com/index.php/roce e-ISSN : 3032-4505
Vol. 3, No. 1, Thn. 2026
https://doi.org/10.71275/roce.v3i1.144

Slope

Slope is the ratio of the elevation difference (vertical distance) of land to its horizontal distance. The steepness of a slope can be expressed in a variety of units, including percentage (%) and degrees (°) (Asra *et al.*, 2019). Steep slopes pose a high risk of accidents (Albarkah et al., 2022). The slope greatly influences the river basin's condition; the steeper the slope, the higher the river's surface flow speed. Apart from that, the more sloping a slope is, the more piles of raindrops will splash down, and the more soil grains. Thus, as the slope of the land surface becomes steeper, the likelihood and extent of erosion increase (Cohen *et al*., 2018; Yumai *et al*., 2019). Slope and erosion sensitivity are directly proportional: the higher the slope percentage, the more sensitive it is to erosion (Indrihastuti, 2016).

Spatial data on slope can be compiled from processed height data (contour lines) derived from topographic or landform maps. The weight for slope parameters in preparing critical land is 20%. The distribution of slopes in the Krueng Langsa watershed has only four classes: flat, gentle, moderate, and somewhat steep. The most dominant layer is the flat layer with a slope of 5 (kl) < 8% covering an area of 19,664.85 ha or (96.80%) of the total area of Langsa City. Most of the Langsa City river basin has a slope of 0-8%, indicating a generally flat terrain. Details are provided in Table 2 and Figure 2.

Table 2: Slope of Langsa City

No	Score	Class	KL	Wide (Ha)	Percentage (%)
1	5	Flat	< 8 %	19.664,85	96,80
2	4	Sloping	8 – 15 %	49,18	3,0
3	3	Slightly Steep	16 – 25 %	0,55	0,2
		Total		20.314,58	100

Source: Results of Contour Processing and DEM (Digital Elevation Model)

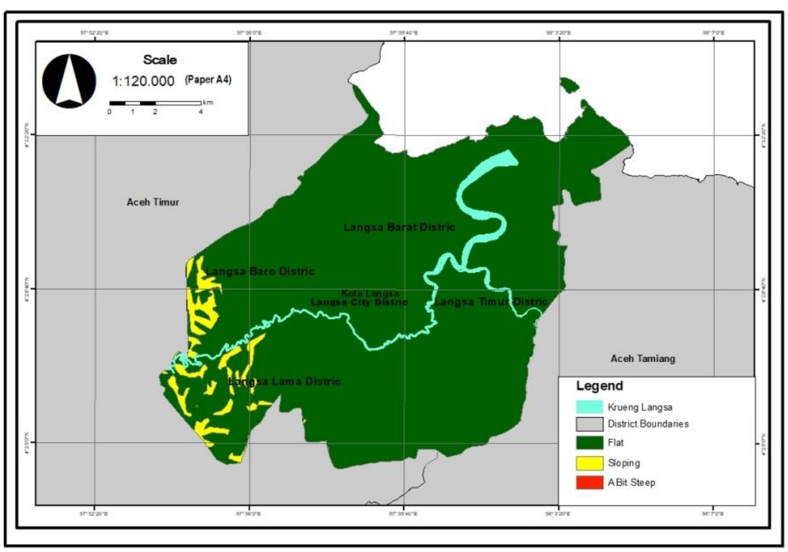

Figure 2: Slope MAP Slope

https://jurnal.rocewisdomaceh.com/index.php/roce e-ISSN : 3032-4505
Vol. 3, No. 1, Thn. 2026
https://doi.org/10.71275/roce.v3i1.144

Erosion Hazard Level

Erosion is the process by which soil particles are eroded and transported on land by wind and water (Arsyad, 2010). The erosion hazard level comprises the erosion hazard index, erosion potential, and erosion hazard level (Suyanti, 2017). Calculation of the Erosion Hazard Level using the USLE formula was previously used mostly at the plot scale, but it is now also applied to larger land areas. Many models have been used to estimate soil loss due to water erosion, including the Universal Soil Loss Equation (USLE) (Wischmeier & Smith, 1978). This is one of the most relevant methods for assessing soil loss (Alewell *et al.*, 2019). Several researchers (Kefi *et al.*, 2009; López–García *et al.*, 2020) have integrated the USLE and GIS in their studies. Erosion risk analysis across a large area, such as a watershed or sub-watershed, is more effective when using Geographic Information System (GIS) technology (Herawati, 2010). The weight of the Erosion risk parameter during the preparation of important land areas is 20%. The distribution of erosion risk in the Krueng Langsa watershed is organized into three categories: very light, light, and moderate.TBE is most dominant at erosion risk level 5, with a very light level covering 17,196.97 ha (84.65%) of the total watershed area. Details are provided in Table 3 and Figure 3.

Table 3: Langsa City Erosion Hazard Level

No	Score	Class	TBE	Wide (Ha)	Percentage (%)
1	5	Very Light	< 15 %	17.196,97	84,65
2	4	Light	15 - 60 %	3.110,46	15,31
3	3	Medium	60 – 180 %	7,14	0,03
		Total		20.314,58	100

Source: Results of overlay analysis of slope, rainfall, soil type, and land use

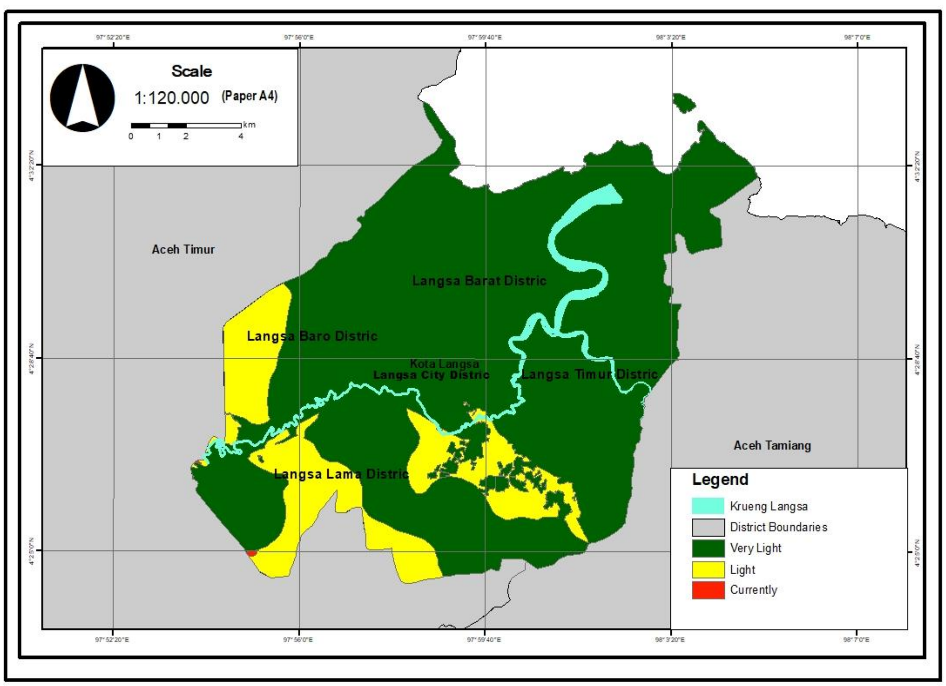

Figure 3: Danger Map Erosion

Jurnal Pertanian Terapan of JURNAL ROCE (AGROSCIENCE)
https://jurnal.rocewisdomaceh.com/index.php/roce e-ISSN : 3032-4505
Vol. 3, No. 1, Thn. 2026
https://doi.org/10.71275/roce.v3i1.144

Land Management

Land management is the process of managing land use to protect and sustainably use it. Actions taken include plant management and land conservation (Ministry of Forestry, 2013). Land management criteria in agricultural cultivation areas include information on whether soil conservation technology is applied in accordance with instructions, whether maintenance is complete, and whether soil conservation is implemented. The weight for land management parameters in preparing critical land is 10%. The land management criteria are then divided into three classes: good, medium, and poor. The French Land Management class is the largest of the three middle classes, covering 8,945.14 ha of the Krueng Langsa River Basin's total area. The results of interviews and field observations show that the areas included in the medium land management class, namely the forest land cover, water bodies and irrigated rice fields, in which this land cover class has good vegetation management, good soil and water conservation. have been implemented, ditch control, terracing and tree planting in the direction of contour lines as well as clear boundaries for terrestrial land covers. The analysis results show that Langsa town is dominated by land management with moderate criteria. The reason is that people still carry out land conversion and indiscriminate deforestation, which can cause landslides and soil erosion in Langsa town. Details are shown in Table 4 and Figure 4.

Table 4. Langsa City Land Use

No	Score	Class	Land Use	Wide (Ha)	Percentage (%)
1	5	Very Good	Forest (Production, Protection, Mangrove, Conversion)	7.658,26	36,63
2	4	Good	Settlements	8.945,14	44,03
3	2	Bad	Rice Fields	3.827,97	18,84
4	1	Very Bad	Plantations	99,21	0,48
		Total		20.314,59	100

Source: Analysis Results (2023).

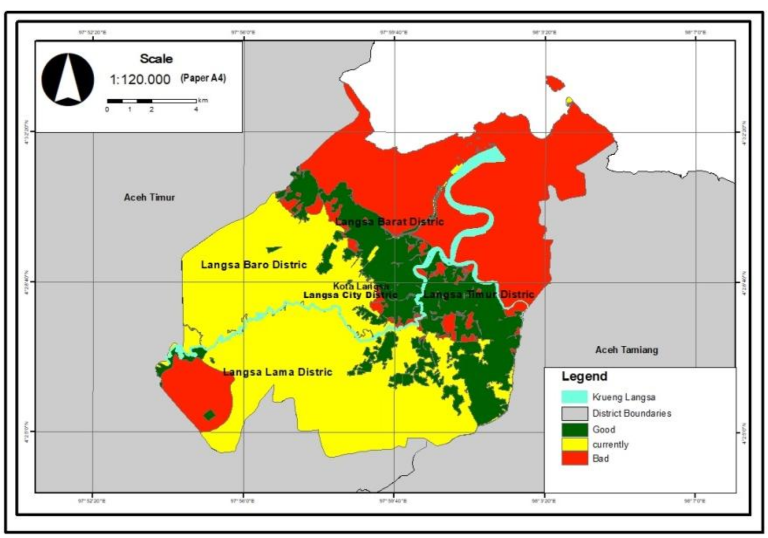

Figure 4: Peta Management Map

https://jurnal.rocewisdomaceh.com/index.php/roce e-ISSN : 3032-4505
Vol. 3, No. 1, Thn. 2026
https://doi.org/10.71275/roce.v3i1.144

Land Use

Land use that is not suitable for its capacity will lead to land degradation (Rosyada *et al., 2015;* Kubangun *et al.*, 2016). Land, as defined by Law No.41 of 2009, is the land part of the earth's surface as a physical environment, including soil and all factors affecting land use, such as climate, topography, geological, and hydrological aspects formed naturally or as a result of human impact. The weight of land-use parameters in determining important land areas is 50%.

The land-use distribution in the Krueng Langsa River Basin has only 4 categories: very good, good, poor, and very poor. The dominant land use comprises 4 good types, with residential land use covering 8,945.14 ha (44.03%) of the total area of the Krueng Langsa basin. Details are provided in Table 5 and Figure 5.

Table 5. Land Management at the Research Location

No	Score	Class	Wide (Ha)	Percentage (%)
1	5	Good	3.927,18	19,33
2	3	Currently	8.945,14	44,03
3	1	Bad	7.442,26	36,63
Total			20.314,59	100

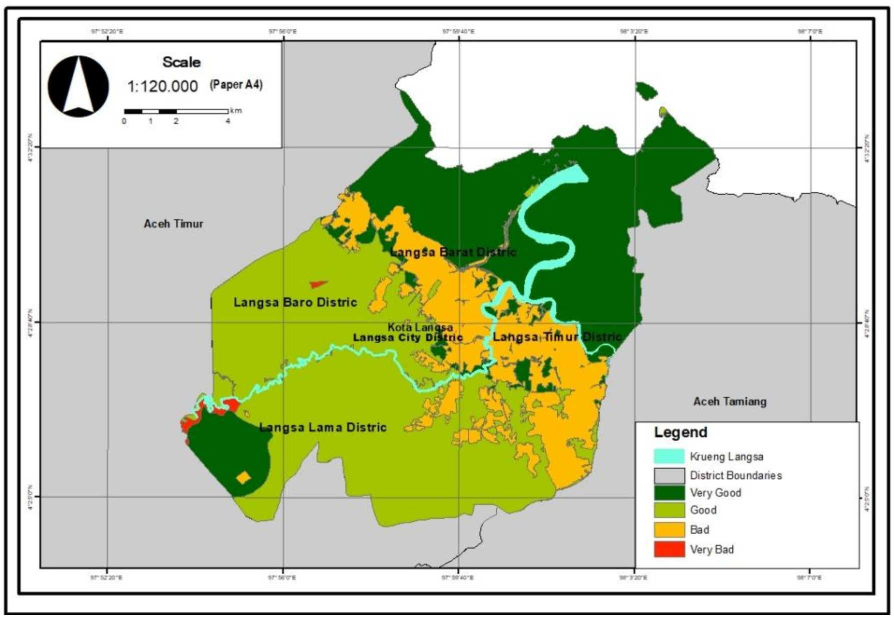

Figure 5: Land Use Map

Land Critical Level

Dry conditions, a barren appearance, and the presence of rocks on the surface are the main characteristics of critical soils. They are often found in hilly or steep areas (Ruhama, 2020). The consequences of critical soils include reduced soil fertility, reduced water availability during the dry season, and flooding during the rainy season (Basuki *et al.*, 2020). Furthermore, a decline in soil quality, such as reduced land productivity, results from land use that is not in accordance with the soil's capabilities (Achmad *et al.*, 2021).

Jurnal Pertanian Terapan of JURNAL ROCE (AGROSCIENCE)
https://jurnal.rocewisdomaceh.com/index.php/roce e-ISSN : 3032-4505
Vol. 3, No. 1, Thn. 2026
https://doi.org/10.71275/roce.v3i1.144

Factors that influence land criticality are: soil, slope, vegetation, and soil erosion. Several measures can be taken to prevent land criticality: land classified as somewhat critical should pay greater attention to maintaining land capacity by arranging commodity combinations and good management, thereby reducing land degradation (Kubangun, 2016). The distribution of land importance in the Krueng Langsa watershed is divided into three categories: unimportant, potentially critical, and marginally critical. Scoring based on cultivated area shows that the most important land type in the Krueng Langsa watershed is unimportant, with a score of 430, covering 13,269.23 ha (65.31%) of the watershed area. The details are provided in Table 6 and Figure 6.

Table 6: Land Criticality in Langsa City

No	Score	Class	Wide (Ha)	Percentage (%)
1	430	Not Critical	13.269,23	65,31
2	420	Critical Potential	7.030,22	34,60
3	280	Critical	15,12	0,07
Total			20.314,58	100

Source: Results of Slope Slope Analysis, Erosion Hazard Level, Land Management, and Land Use

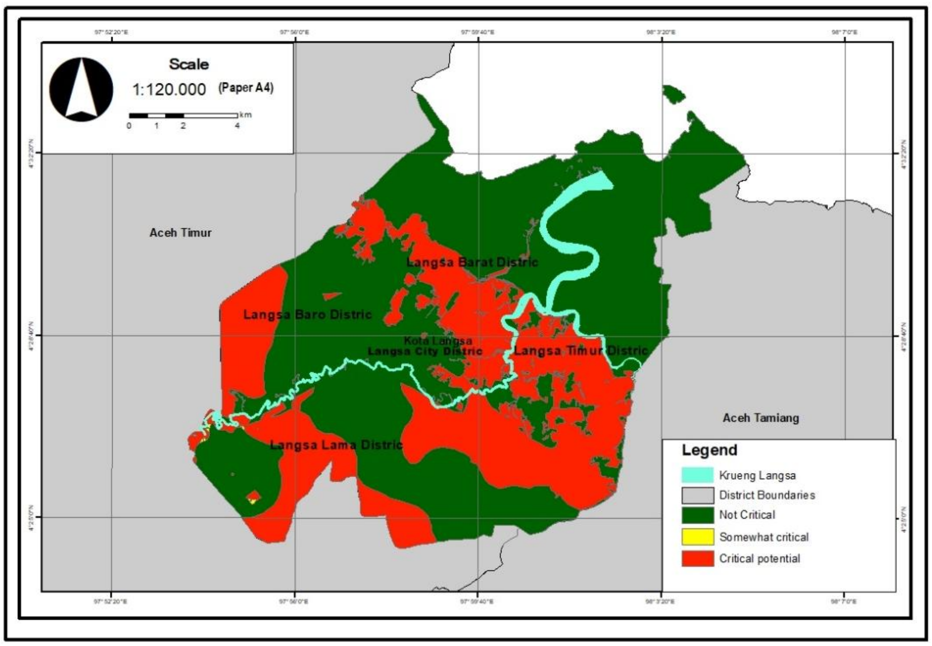

Figure 6: Map Critical Land

RESULTS AND DISCUSSION

The slope of the land in the study area has three types: flat, gentle, and slightly steep. The most dominant layer is the flat layer with a score of 5, slope <8%, covering an area of 19,664.85 Ha (96.8%). The level of erosion risk has three levels: very light, light, and medium. The most dominant layer is the very light layer, with a score of 5, covering 17,196.97 Ha (84.65%). Land management has three types: good, medium, and poor. The most dominant French class is the

https://jurnal.rocewisdomaceh.com/index.php/roce e-ISSN : 3032-4505
Vol. 3, No. 1, Thn. 2026
https://doi.org/10.71275/roce.v3i1.144

medium class, with a score of 3, covering 8,945.14 ha (44.03%). Land use has four categories: very good, good, poor, and very poor. The most dominant class is the good class with an area of 8,945.14 ha (44.03%). In the Krueng Langsa River area, land is important; the region is categorized into three types: unimportant, potentially important, and slightly important.

The most dominant critical land type is uncritical with an area of 13,269.23 ha (65.31%), followed by potentially critical with an area of 7,030.22 ha (34.60%). These two criteria for importance are found in Langsa Baro District, Langsa West District, Langsa Lama District, Langsa East District, and Langsa City District. The important vapor layer is the smallest found only in Langsa Lama district, specifically in Pondok industrial village and Petow village, with an area of 15.12 ha (0.07%).

The analysis shows that Langsa City is dominated by non-critical land. However, land that falls into the potentially critical category has also begun to expand by 7,030.22 ha, therefore the people of Langsa City and also the government must increasingly protect the environment, carry out reforestation, prohibit land conversion, Do not dispose of waste indiscriminately in the Krueng Langsa river basin area, agricultural land in Langsa City will continue to receive good water flow and when it rains Langsa City will be protected from floods, landslides, and erosion.

CONCLUSION

This study found that the Krueng Langsa watershed is predominantly classified as non-critical land (65.31%), with a considerable proportion classified as potentially critical (34.60%), and only a very small fraction as slightly critical (0.07%). The dominant factors influencing land criticality were slope, erosion hazard, land management, and land use, with land cover and management playing a particularly significant role. The findings highlight that although most areas remain non-critical, the expansion of potentially critical lands indicates increasing vulnerability. Therefore, conservation actions such as reforestation, sustainable land management, and strict control of land conversion are urgently required to maintain watershed functions and reduce the risks of flooding, erosion, and land degradation.

REFERENCES

Achmad E, Mastur A K, Lestari Y (2021). Analysis of Critical Land Distribution in KPHP Unit XII Batanghari Jambi Province. *Wilderness Journal*. 4:127– 139.

Albarkah M, Lihawa F, Koem S (2022). Geographical Review of Efforts to Develop the Puncak Meranti Natural Tourism Attraction Area JoGSE 6:57–66.

Alewell C, Borrelli P, Meusburger K, Panagos P (2019). Using the USLE: Chances, Challenges and Limitations of Soil Erosion Modelling. Int. *Soil Water Conservation Res*. 7:1–23.

Armijon (2020). Identification of Critical Land for Determining Conservation Areas Based on Geographic Information System Region-1, South Lampung Regency. *J.Explor. Geophys.* 6:228-242

https://jurnal.rocewisdomaceh.com/index.php/roce e-ISSN : 3032-4505
Vol. 3, No. 1, Thn. 2026
https://doi.org/10.71275/roce.v3i1.144

Asra R, Nurnawati A A, Irwan M (2019). Mapping and Identification of Critical Land Using Remote Sensing Techniques and Geographic Information Systems in the Bungin Sub-Watershed, South Sulawesi Province. *Agrisystems J* 15:83-88

Arsyad S (2010). *Soil and Water Conservation*. Bogor Agricultural Institute, Bogor, Indonesia.

Balaman S Y (2019). Modeling and Optimization Approaches in Design and Management of Biomass-Based Production Chains. In Decision-Making for Biomass-Based Production Chains 1:185– 236.

Langsa City Central Statistics Agency (2021). Langsa City in Figures for 2020. Central Statistics Agency. Langsa, Indonesia.

Basuki A, Takumansang E D, Tarore R C (2020). Critical Land Level Analysis Based on GIS (Geographic Information System) in Banggai Regency. Spat J 7:186-194.

Chang K T (2016). Geographic Information System. *International Encyclopedia of Geography: People, the Earth, Environment and Technology*, Wiley. pp 1–9.

Cohen-Waeber J, Bürgmann R, Chaussard E, Giannico C, Ferretti A (2018). Spatiotemporal Patterns of Precipitation-Modulated Landslide Deformation From Independent Component Analysis of InSAR Time Series. *Geophys Res*. Lett 45:1878–1887.

Choudhary S, Jaiswal R K, Nema A K, Thakur A, Gangwar A (2020). Watershed Prioritization for Soil Conservation Measures Using the USPED Model in the Nagwan Watershed. J *Soi. Wat. Conser*. 19:235–243.

Herawati T (2010). Spatial Analysis of Erosion Hazard Levels in the Cisadane Watershed Area, Bogor Regency. *J For. Res. Nat. Conserv*.

Isma F, Purwadito M, Zacky M (2019). Estimation of Land Erosion and Sedimentation in the Langsa Watershed Based on Geographic Information Systems (GIS). *Syiah Kuala University J CE*. 8:20-28.

Jang T, Vellidis G, Hyman J B, Brooks E, Kurkalova L A, Boll J (2013). Model for Prioritizing Best Management Practice Implementation: Sediment Load Reduction. Environ. Manage 51:209–224.

Kefi M, Yoshino K, Zayani K, Isoda H (2009). Estimation of Soil Loss by Using a Combination of Erosion Model and GIS: Case Study of Watersheds in Tunisia. J Arid Land Stud 19:287–290.

Decree of the Minister of Environment and Forestry Number SK.306/MENLHK/PDASHL/ DAS.0/7/2018.

Kodoatie R J, Sugiyanto (2002). Floods – Several Causes and Control Methods from an Environmental Perspective, Yogyakarta, S, Indonesia

López-García E M, Torres-Trejo E, Reyes L, Flores-Domínguez A D, Peña-Moreno R D, López-Olguín J F (2019). Estimation of Soil Erosion Using USLE and GIS in the Locality of Tzicatlacoyan, Puebla, México. *J Soil Water Res*. 15:9–17.

Ministry of Forestry (2013). Regulation of the Director General of Watershed Management and Social Forestry Number: P 4/V-Set/2013 concerning Technical Instructions for Compiling Spatial Data on Critical Land. Jakarta, Indonesia.

https://jurnal.rocewisdomaceh.com/index.php/roce e-ISSN : 3032-4505
Vol. 3, No. 1, Thn. 2026
https://doi.org/10.71275/roce.v3i1.144

Mohammed A, Adugna T, Takala, W (2018). Morphometric Analysis and Prioritization of Watersheds for Soil Erosion Management in Upper Gibe Catchment. *J Degrade.Min.Land Management.*

Kubangun S H, Haridjaja O, Gandasasmita K (2016). Land Cover/Use Change Model for Identifying Critical Land in Bogor Regency, Cianjur Regency, and Sukabumi Regency. *J Globe V Scientific Magazine*. 18: 21–32.

Regulation of the Director General of River Watershed Management and Social Forestry, Social Forestry Number P.4/V-SET/2013, regarding Technical Instructions for Compiling Critical Land Spatial Data, Indonesia.

Rosyada M, Prasetyo Y, Hani'ah (2015). Determination of Critical Land Level Using the Weighting Method and NDVI Algorithm (Case Study: Garang Hulu Sub Watershed). *J Undip Geodesy*. 14:85-94.

Ruhama (2020). Mapping Critical Land Levels Using Remote Sensing and Geographic Information Systems (Case Study: Blora Regency). *J Undip Geodesy*. 4: 200-207.

Sofyan I, Rommie J, Yusni I S (2010). Application of Geographic Information Systems in Determining the Suitability of Seaweed and Net Cage Areas in the Waters of Bunguran Island, Natuna Regency. *J Fish Marit Aff*. 15:111-120.

Singh G, Singh R M, Singh S, Kumar A R S, Jaiswal R K, Chandola V K (2019). Multicriteria Analytical Hierarchical Process-Based Decision Support System for Critical Watershed Prioritization of Andhiyarkhore Catchment. *J Soil Conservation*. 47:263–272.

Talakua S M, Osok (2019). Development of a Land Degradation Assessment Model Based on Field Indicators Assessment and Prediction Methods in Wai Sari Sub-Watershed, Kairatu, District Western Sera, Maluku Province, Indonesia. J Sci Nat. 2: 66–70.

Tukura N G, Akalu M M, Hussein M, Befekadu A (2021). Morphometric Analysis and Sub-watershed Prioritization of Welmal Watershed, Ganale-Dawa River Basin, Ethiopia: Implications for Sediment Erosion. *J Sediment Environ*.

Law Number 37 of 2014 concerning Soil and Water Conservation, Indonesia.

Wischmeier W H, Smith D D (1978). *Predicting Rainfall Erosion Losses: A Guide to Conservation Planning* (No. 537). Oregon, U.S.: Department of Agriculture, Science and Education Administration, Oregon State University.

Yumai Y, Tilaar S, Makarau V H (2019). Study of Surface Land Use in the Hilly Area of Manado City. J Spat. 6:862-871.