Journal of Applied Science, Engineering and Technology
e-ISSN: 2722-8363 p-ISSN: 2722-8371
doi: 10.47355/aset.v2i1.22

J. ASET

Identification of Landslide Potential Area Based on UAV Data Analysis at Pidada Village Bandar Lampung City, Indonesia

Aldika Rizkiano [1], Muh. Sarkowi [1], Rahmat Catur Wibowo [1*]

[1] Department of Geophysics Engineering, Faculty of Engineering, Universitas Lampung, Jl. Prof. Soemantri Brojonegoro no. 1, Bandar Lampung, Indonesia 35145

* Correspondence: rahmat.caturwibowo@eng.unila.ac.id

Received: 12.01.2022; Accepted: 12.05.2022; Published: 30.06.2022

Abstract: A landslide is a natural disaster caused by activities or processes that disrupt the balance that causes the movement of soil and rock masses from high to low areas. To avoid high losses due to the disaster hazard, efforts are needed to minimize one of them by mapping areas of potential landslide disasters. This study aims to obtain the potential landslide disaster area zone based on the data of slope class, rainfall, and regional geology of the research area. The results of processing based on DTM (Digital Terrain Model) obtained slope classes, namely flat (0° – 2°) 19.36%, undulating slope (2° – 4°) 30.65%, undulating-rolling slope (4° – 8°) 19.72%, rolling-hilly slope (8° – 16°) 16, 4 %, hilly-steeply dissected slope (16° – 35°) 8.03%, steeply dissected-mountainous slope (35° – 55°) 4.58%, and mountainous slope (>55°) 1.27 %. Based on the analysis of slope class data, annual rainfall data, and regional geological maps, there are potential landslide areas with areas marked with orange to red color symbols with a total area of 0.866 ha with hilly-steeply dissected slope (0.501 ha), steeply dissected-mountainous slope (0.286 ha) and mountainous slope (0.079 ha). The rainfall is 2800 – 3200 mm/year, and the regional geology is dominated by tuff.

Keywords: Landslide; potential landslide; slope classification; rainfall; geology

1. Introduction

Natural disasters are natural phenomena that can occur at any time, anytime, and anywhere, so they can cause material and non-material losses to the surrounding community. One of the natural disasters that greatly impact losses is landslides, which impact losses and damage to surrounding facilities and infrastructure [1]. A landslide is a natural disaster caused by an imbalance of activity or process that causes the movement of the mass of soil and rock-forming slopes from high to low areas. Many activities can disrupt soil balance, including land cover such as buildings, space for retaining soil movements such as trees, lithology of constituent rocks, slope, and rainfall [2].

To avoid high losses due to the danger of landslides, mitigation is needed to minimize the impact that will be caused. One of the efforts to minimize it is by mapping the potential for landslides to obtain an overview of areas potentially prone to landslides [3]. The mapping using the help of drone aerial photography, namely Unmanned Aerial Vehicle (UAV) technology, better known as a drone, a flying machine or unmanned aircraft that can be controlled remotely by a pilot using a remote control. Drones can be controlled automatically using a remote control connected to radio wave transmission media or wi-fi, which has been designed through a computer program before use so that it can be controlled remotely by pilots on the ground or in other places [4].

The analysis of potential landslide areas in this study is based on slope, rainfall, and geological Information. Research on potential landslide areas is expected to provide an impetus for efforts to quickly, precisely, and accurately minimize landslide disasters.

2. Materials and Methods

2.1 Materials

This research uses slope analysis, rainfall, and geological Information. The use of drone or UAV DJI Phantom 4 Pro is used to obtain DEM (Digital Elevation Model) data in the form of DSM (Digital Surface Model) and DTM (Digital Terrain Model) as well as Orthophotos as in Fig. 1 and Fig 2, which are used as one of the parameters for determining the potential slip area zone, namely the slope. Processing Orthophotos and DTM are using Agisoft Metashape software and PCI Geomatica software. The rainfall data is secondary data from CHIRPS (Climate Hazards Infra-Red Precipitation with Station). With an annual period from 2019 – 2021. Geological data is obtained from subsurface research information based on the Tanjung Karang sheet [5].

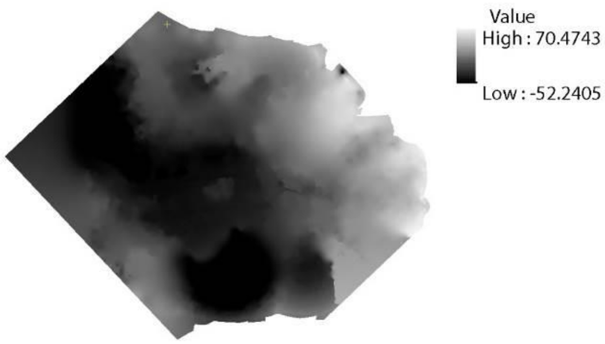


Figure 1. DTM data

(**a**) (**b**)

Figure 2. (**a**) and (**b**). are Orthophoto in the measurement area.

2.2 Slope Classification

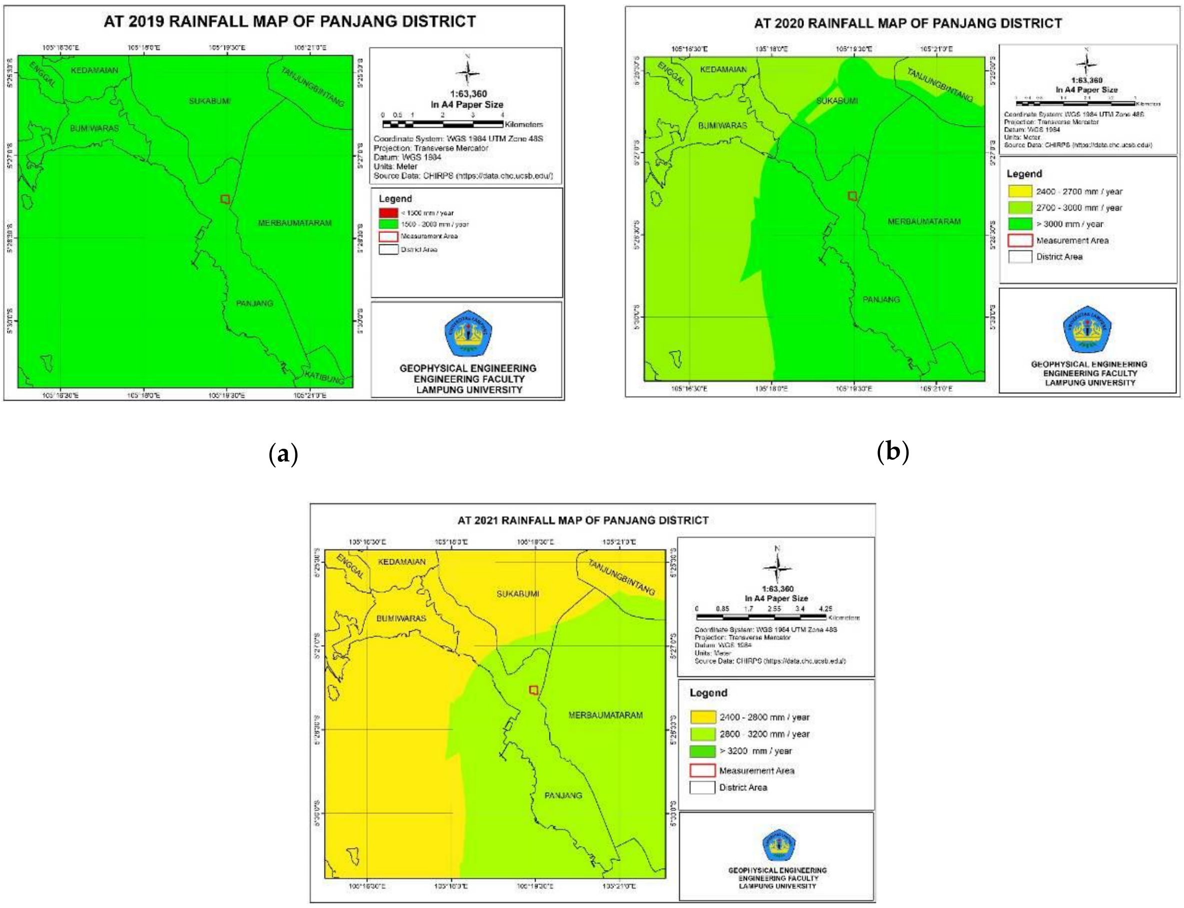
Based on this study uses a slope classification reference from slope classification Van-Zuidam (1979) [6]. This classification is in table 1.

Table 1. Slope classification [6].

Slope	Relief Class (Topography
0° - 2°	Flat
2° - 4°	Undulating
4° - 8°	Undulating – Rolling
8° - 16°	Rolling – Hilly
16° - 35°	Hilly – Steeply Dissected
35° - 55°	Steeply Dissected – Mountainous
> 55°	Mountainous

2.3 Rainfall Map and Rainfall Classification

Based on this study uses rainfall data from CHIRPS (Climate Hazards Infra-Red Precipitation with Station) with an annual time from 2019 to 2021. Those data are displayed in the layout as in Fig. 3. The rainfall classification is based on other previous results, as presented in Table 2 [6].



(a) (b)

(c)

Figure 3. Rainfall map layout: (**a**) Rainfall map in 2019; (**b**). Rainfall map in 2020; and (**c**). Rainfall map in 2021.

 doi: 10.47355/aset.v2i1.22

Table 2. Rainfall classification [6].

Rainfall (mm/year)	Rainfall Class
< 1500	Very low
1500 - 2000	Low
2000 - 2500	Medium
2500 - 3000	High
> 3000	Very high

2.4 Geological Information

The geology of this research area is in Panjang District, Bandar Lampung Province, located in the Tarahan Formation (Tpot) and composed of welded tuff and breccia with intercalations of chert. Way Galih Schist (Pzgs) comprises green amphibole-schist and dioritic orthogneiss amphibolites. Lampung formation (QTl) comprises pumiceous tuff, rhyolitic tuff, welded tuff tuffit, and tuffaceous claystone. Campang formation (Tpoc) has two-part, lower and upper; the lower is composed of alternating claystone, shale, breccia, and welded tuff, and the upper part is composed of polymict breccia with intercalation sandstone and siltstone. Alluvial (Qa) comprises cobble, pebble, sand, clay, and peats [7]. Volcanic deposits such as tuff are easily weathered rocks with a high level of weathering to perfection so that when the rainy season arrives, water will absorb more easily into the rock and cause the rock mass to get heavier, which then has the potential for landslides to occur. Less strong rocks are generally volcanic and sedimentary rocks of sand size and a mixture of sand, gravel, and clay [8].

As for the geological structure, the research area is adjacent to the Lampung – Panjang Fault, which has been identified on the Tanjungkarang Geological Map with direction from NW-SE, as in Fig. 4 below [5].

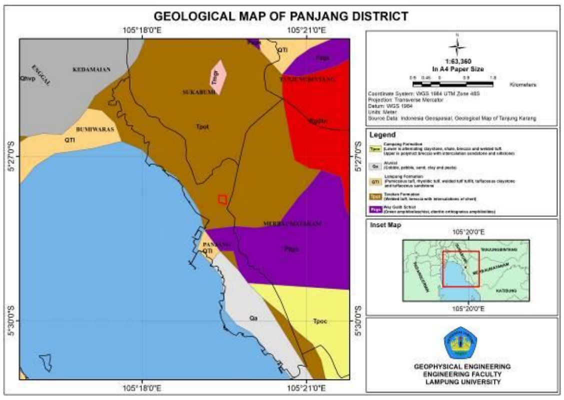
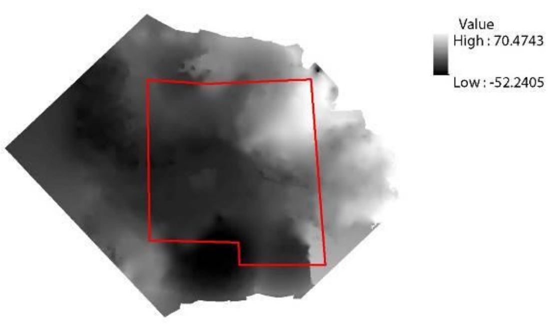


Figure 4. Geological map of Panjang District [5].

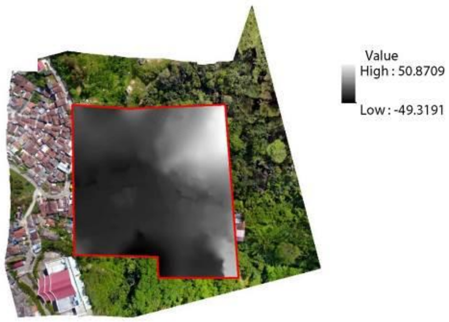
3. Results and Discussion

In this study, processing was carried out to obtain a slope map using the Van-Zuidam classification [6]. The measurement area is based on areas with the opportunity to have material and non-material losses, which means areas with residential land cover adjacent to the slope area. Then the results of processing in the research area are determined by determining the extent of the slope areas according to the slope class, as displayed in Fig. 5.

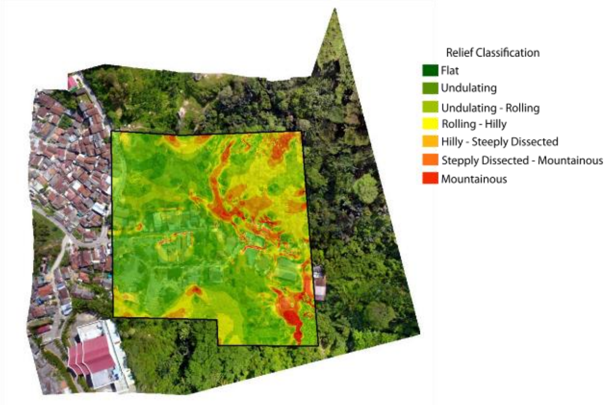
e-ISSN: 2722-8363 p-ISSN: 2722-8371



(**a**)



(**b**)



(**c**)

Figure 5. Overlay map measurement area: (**a**) DTM (Digital Terrain Model) with measurement area; (**b**). The Orthophoto with measurement area; and (**c**). The slope map relief classifications with measurement area.

Based on the slope data processing, the slope class measurement area can be classified and is obtained as presented in table 3. Also, the layout slope map of Pidada, Panjang district is shown in Fig. 6.

Table 3. Slope classification in the area of a hectare

Relief Class (Topography	Area (Ha)	Percent (%)
Flat	1.207	19.36
Undulating	1.911	30.65
Undulating – Rolling	1.229	19.72
Rolling – Hilly	1.023	16.4
Hilly – Steeply Dissected	0.501	8.03
Steeply Dissected – Mountainous	0.286	4.58
Mountainous	0.079	1.27

e-ISSN: 2722-8363 p-ISSN: 2722-8371

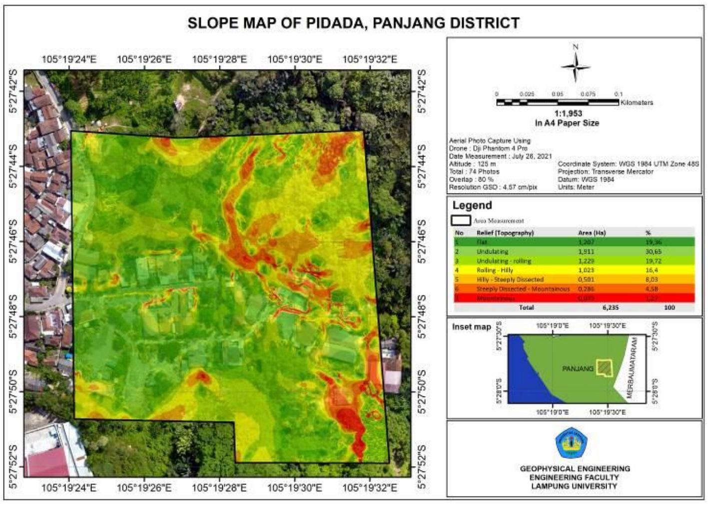


Figure 6. The layout of the slope map measurement area.

Based on the results of the processing carried out by determining the results of the slope class, it can be analyzed that the areas marked with orange to red areas (slope > 30°) with 13.88% area with an area of 0.866 ha, respectively Hilly-steeply Dissected class is 8.03% (0.501 ha), Steeply Dissected-Mountainous class is 4.58% (0.286 ha), and Mountainous class is 1.27% (0.079 ha), the three classes have slope levels which are speculated to be areas of potential landslides this can also be influenced by the amount of annual rainfall the area is 2800 – 3200 mm/year. Based on the geological map, Panjang District is dominated by solid tuff, which can cause soil movement. Because according to other results [8].

5. Conclusions

Based on the analysis of slope class data, annual rainfall data, and regional geological maps, there are potential landslide zones with areas marked with orange to red symbols with a total area of 0.866 ha with a hilly-steeply dissected slope (0.501 ha), steeply dissected-mountainous slope (0.286 ha), and mountainous slopes (0.079 ha), rainfall is 2800 – 3200 mm/year, and regional geology is dominated by tuff. Volcanic deposits such as tuff are rocks that are easily weathered so that when the rainy season arrives, water will absorb more easily into the rock and increase the rock mass.

References

1. C. N. Poland and P. Zientara, "Advancing Culture of Living with Landslides," *Advancing Culture of Living with Landslides*, 2017, doi: 10.1007/978-3-319-53487-9.
2. A. Zamroni, A. C. Kurniati, and H. N. E. Prasetya, "The assessment of landslides disaster mitigation in Java Island, Indonesia: a review," *Journal of Geoscience, Engineering, Environment, and Technology*, vol. 5, no. 3, pp. 139–144, 2020, doi: 10.25299/jgeet.2020.5.3.4676.
3. A. el Jazouli, A. Barakat, and R. Khellouk, "GIS-multicriteria evaluation using AHP for landslide susceptibility mapping in Oum Er Rbia high basin (Morocco)," *Geoenvironmental Disasters*, vol. 6, no. 1, 2019, doi: 10.1186/s40677-019-0119-7.

4. A. Lucieer, S. M. de Jong, and D. Turner, "Mapping landslide displacements using Structure from Motion (SfM) and image correlation of multi-temporal UAV photography," *Progress in Physical Geography*, vol. 38, no. 1, pp. 97–116, 2014, doi: 10.1177/0309133313515293.
5. S. A. Mangga, Amirudin, T. Suwarti, S. Gafoer, and Sidarta, "Peta Geologi Lembar Tanjungkarang, Sumatera, skala 1:250.000," 1993.
6. R. A. van Zuidam and F. I. van Zuidam-Cancelado, *Terrain Analysis and Classification Using Aerial Photographs: A Geomorphological Approach*. International Institute for Aerial Survey and Earth Sciences, 1979. [Online]. Available: https://books.google.co.id/books?id=krziHAAACAAJ
7. R. Mulyasari, S. Suharno, N. Haerudin, H. Hesti, I. B. S. Yogi, and S. P. Saputro, "Aplikasi Metode Geolistrik dan Analisis X-Ray Diffraction (XRD) untuk Investigasi Longsor di Pidada, Kecamatan Panjang, Bandar Lampung," *Eksplorium*, vol. 42, no. 2, p. 131, 2021, doi: 10.17146/eksplorium.2021.42.2.6304.
8. R. Mulyasari *et al.*, "Aplikasi Metode Geolistrik Resistivitas Untuk Analisis Bidang Gelincir Dan Studi Karakteristik Longsoran Di Jalan Raya Suban Bandar Lampung," *Jurnal Geofisika Eksplorasi*, vol. 6, no. 1, pp. 66–76, 2020, doi: 10.23960/jge.v6i1.61.