

# Geomorphology of Landslide Prone Area in Cimanggung District, Sumedang Regency, West Java

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**Abstract**— The research area is located on Cimanggung District, Sumedang Regency, West Java Province at coordinate 6°51'33,0" S - 6°59'38,6" S and 107°42'26,2" E -107°58'44,5" E. This research aims to identify and characterize the geomorphology features related to landslide prone area in the Cimanggung area. This research was conducted using the studio analysis method with several supporting data such as: slope, drainage patterns, geological maps, and satellite images of the Cimanggung area. The results of the research show that the Cimanggung area is located between the morphology of volcanic hills with steep to very steep slopes. Radial and subparallel drainage patterns were identified in the Cimanggung area indicating that the area is relatively close to the hilltop and hillsides. Moreover, the research area is geologically composed by the dominance of undifferentiated young volcanic products. On the other hand, the satellite images show that the Cimanggung area and its surroundings have undergone land use changes, especially into residential areas. These conditions indicate the Cimanggung area has a fairly high level of landslide susceptibility. Therefore, a systematic and integrated regional planning program is needed to minimize the potential for landslides that can occur.

**Keywords**— Cimanggung, drainage pattern, geomorphology, landslide, satellite imagery

## I. INTRODUCTION

The research area is located on Cimanggung District, West Java at coordinate 6°51'33,0" S - 6°59'38,6" S and 107°42'26,2" E - 107°58'44,5" E. The study area is located on a gentle to very steep slope that surrounded by hills. The research area is interesting to study because the Cimanggung area and its surroundings have the potential for landslides to occur. Several researchers have stated that the Cimanggung area and its surroundings have a fairly high potential for landslides [1]–[5]. Therefore, this research is important to do because it can have an impact on human life.

This research aims to identify and characterize the geomorphology features related to landslide prone area in the Cimanggung area. Geomorphological aspects that can be related to landslides such as landscape characteristics and slopes. The geomorphological aspects are also related to land use [6]–[9] such as settlements, industry, etc. Both geomorphological and land use aspects can be investigated by direct field observations and studio analysis, especially remote sensing approaches.

Remote sensing approach can be used as an initial stage in geomorphological research in landslide-prone areas [10]–[12]. It is undeniable that remote sensing approach is important in research related to the earth's surface. This approach is a way to

determine land use conditions in a particular area [13], [14]. Some of the media that can be used with remote sensing methods include satellite images, aerial photography, topographic maps, and others.

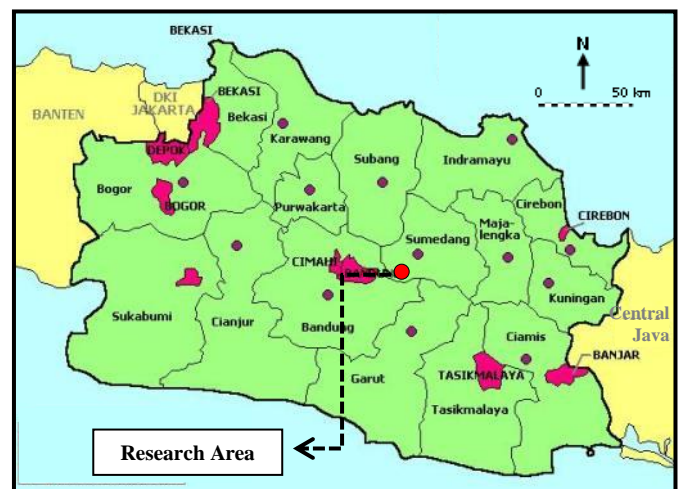


Fig. 1. The research area in the Cimanggung Area

## II. METHOD

This research activity is carried out through studio analysis using a remote sensing approach so that supporting software is needed such as Map Info, Global Mapper, and Google Earth. The data used consists of slope, drainage patterns, lithology, and land use data of the research area obtained from several sources.

The slope map was obtained from the results of processing SRTM DEM data with a resolution of 30 meters using Global Mapper software. Drainage pattern map was obtained from the extraction and digitization of river data using Map Info software. Geological maps obtained through literature studies of previous researcher [15]. Satellite images are obtained from the results of downloading images using the Google Earth software.

The process of identifying drainage patterns in the research area is carried out by referring to the classification of drainage patterns that have been determined by previous researchers [16], [17]. The determination of the slope class of the research area refers to the research that has been done previously [18], as well as the determination of land use based on previous researchers [19]–[21].

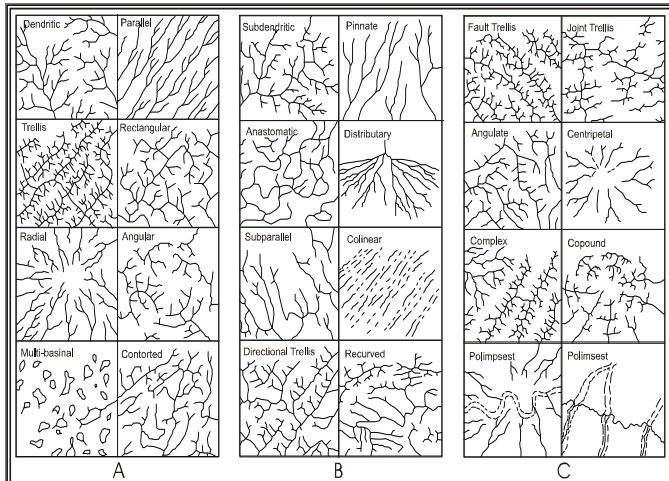


Fig. 2. Classification of drainage patterns [16], [17]: (A) Basic pattern; (B and C) Modified pattern

TABLE 1. Slope classification (modified after [18])

Classification	Slope	
	Percentage (%)	Degree (°)
Flat	0-2	0-2
Gently Slope	2-7	2-4
Sloping	7-15	4-8
Moderately Steep	15-30	8-16
Steep	30-70	16-35
Very Steep	70-140	35-55
Extremely Steep	>140	>55

### III. RESULT AND DISCUSSION

Initial research results show that the research area in the Cimanggung area is located between hills with steep to very steep slopes. It can be seen in slope map of the research area (Fig. 3). Only a small part of the research area in the southwest has a gentle to very gentle slope. In addition, the hills on the east and west of the research area show the slope direction towards the center to the south of the research area.

It can be seen that the radial drainage pattern is located in the east and west of the research area and the subparallel

drainage pattern is located in the center and southwest of the research area (Fig. 4). The radial drainage pattern shows the direction of the river flow from a hilltop that spreads in various directions while the subparallel drainage pattern shows the relatively parallel flow of tributaries between one tributary and other tributaries. The drainage patterns also indicate that the research area is near the peaks and slopes of mountains or hills so that most of the research area is on steep to very steep slopes.

The drainage patterns indicate that geologically the research area is located on a volcanic landscape and the dominant rock composition is volcanic rock without a dominant geological structure. It is confirmed from the geological map of the research area (Fig. 5). It can be seen that the research area is mostly composed of volcanic rocks [15], namely: Undifferentiated young volcanic products (Qyu) such as tuffaceous sand, lapili, lava, agglomerate; Young lava (Qyl); and a small part is composed of lake deposits (Ql) such as tuffaceous clay, sandstone, gravel, and conglomerate in the southwest of the research area. It also proves that there is a relationship between drainage patterns and the geological conditions of the research area [22]–[25].

The radial drainage pattern in the research area is associated with volcanic domes [16], [17] as evidenced by the presence of Mount Kareumbi on the east and Mount Bukitjarian on the northwest of the research area. The parallel drainage pattern is closely related to the radial drainage pattern which shows the morphology of elongated hills and steep slopes [16], [17]. It can be seen in the satellite images of the research area (Fig. 6 and Fig. 7).

Based on satellite images of the research area (Fig. 6 and Fig. 7), it can be seen that the Cimanggung area is located between two mountain morphologies, namely Mount Bukitjarian and Mount Kareumbi. It is also seen that the Cimanggung area has undergone a change in land use into residential and industrial areas. Changes in land use will gradually occur in line with the increasing number of people and the community's need for housing is getting higher.

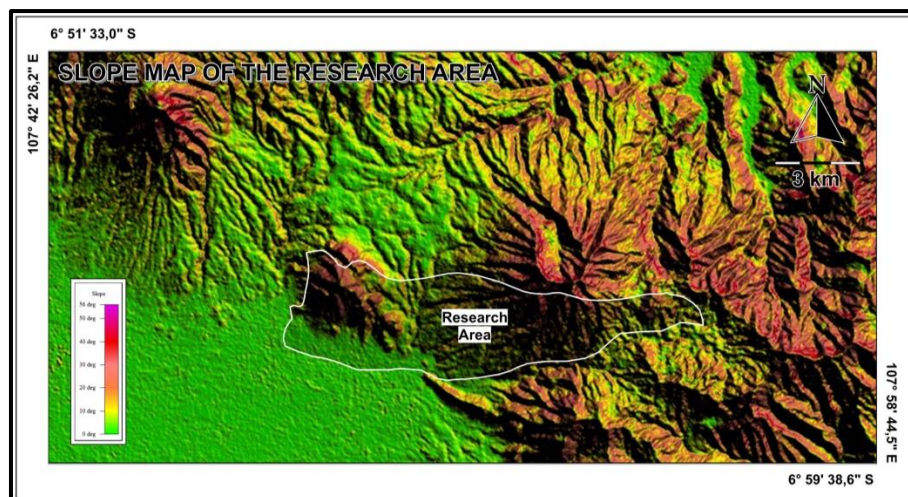


Fig. 3. Slope map of the Cimanggung area

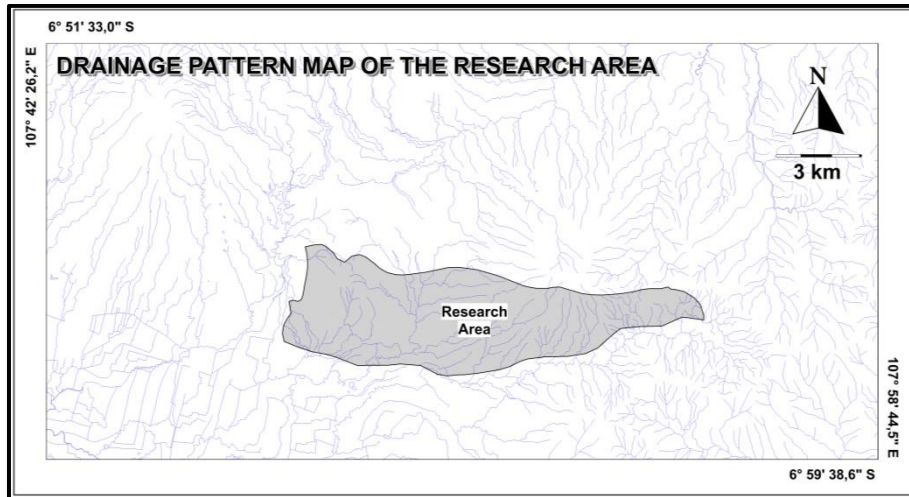


Fig. 4. Drainage pattern map of the Cimanggung area

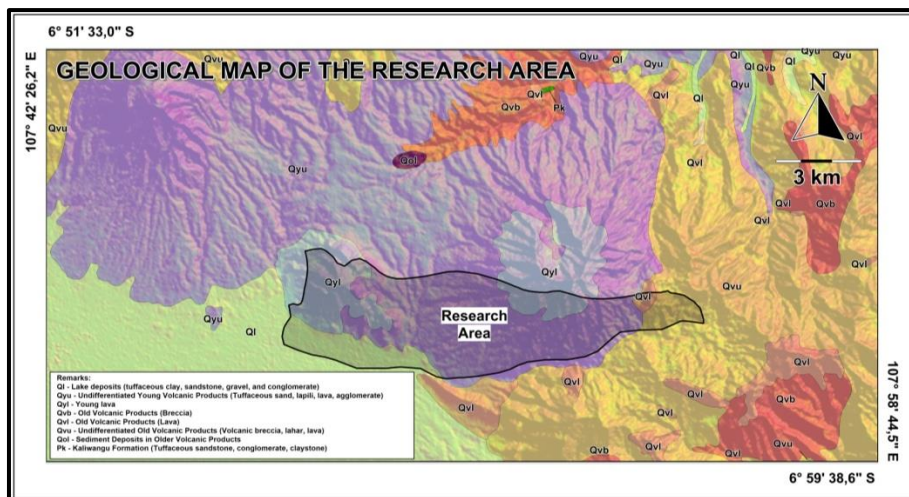


Fig. 5. Geological map of the Cimanggung area (modified after [15])

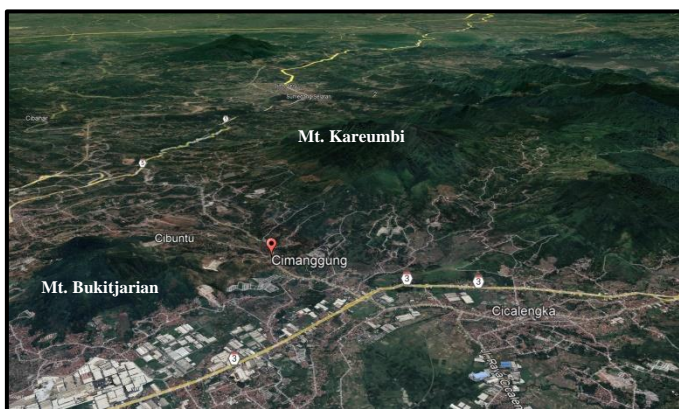


Fig. 6. Satellite image of the Cimanggung area (source: Google Earth)

Based on geomorphological, geological, and land use conditions of the research area, the Cimanggung area has a fairly high level of landslide susceptibility. Natural conditions (geomorphology and geology) accelerated by changes in land use conditions are important factors that can trigger landslides. This can be seen from several landslides that occurred in the Cimanggung area and its surroundings. Therefore, a systematic

and integrated regional planning program is needed to minimize the potential for landslides that can occur.

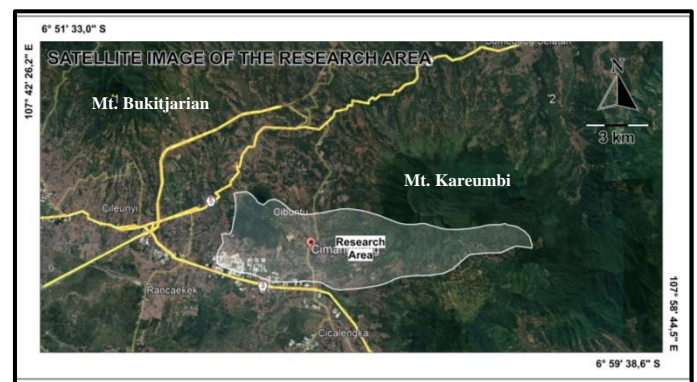


Fig. 7. Satellite image of the Cimanggung area (source: Google Earth)

#### IV. CONCLUSION

The research area is located on Cimanggung District, West Java. It is located between hills with steep to very steep slopes. Only a small part of the research area in the southwest has a

gentle to very gentle slope. Radial and subparallel drainage patterns were identified in the Cimanggung area indicating that the area is relatively close to the hilltop and hillsides. It has been confirmed that the drainage patterns is also related to the geological conditions of the research area which is in a volcanic landscape and the dominance of volcanic rocks without a dominant geological structure. It is also seen that the Cimanggung area has undergone a change in land use into residential and industrial areas. Natural conditions (geomorphology and geology) accelerated by changes in land use conditions are important factors that can trigger landslides. This can be seen from several landslides that occurred in the Cimanggung area and its surroundings. Therefore, a systematic and integrated regional planning program is needed to minimize the potential for landslides that can occur.

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