Spatial data of landslide disasters in west Bandung

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Abstract. West Bandung has the potential for landslides and other disasters such as floods, earthquakes, and volcanic eruptions. One of the most frequent hazards in West Bandung Regency is landslide; some critical occurrences for landslides cover these important locations, including Lembang districts, Cililin, Padalarang, Cikalong Wetan, and Cipatat, etc. In this study the landslide data will be matched to spatial data, resulting in correction of spatial arrangement in west Bandung.

1. Introduction
Indonesia geographically has landslide area in West Bandung regency. It is a new district in the development of Bandung regency in 1999. West Bandung district capital city is Ngamprah, West Bandung regency. The area of KBB (Regency of West Bandung) is 2,324.84 km² with the surrounding area of Bandung City and Cimahi City. It is adjacent to Purwakarta and Subang regencies in the west and north, Bandung Regency and Cimahi City in the east and Cianjur Regency to the west and south. West Bandung Regency had about 1.4 million residents from 42.9% of the old district of Bandung (HTTP://BandungBaratkab.go.id/Halaman/Sejarah-kbb). West Bandung has an exciting tourism potential, which covers a natural tourist attraction such as tourism Tangkuban parahu, Farmhouse, Floating market, Curug Malela, Bamboo Village, Lerenganteng Panoramic Coffee, Keraton cliffs and The Lodge. Overall, the level of visits to all tourist attractions in West Bandung throughout 2016 was about 1.8 million people. The landscape of the south Bandung area consists of mountains, hills, Pangalengan highlands, and Bandung highlands. In stratigraphic volcanoes, rocks are grouped into eleven units, nine including the identification of the source of the eruption, aged Pliocene to Quaternary [1].

On the other hand, there is mining potential such as andesite, limestone, sand, and marble; agriculture such as vegetables, fruits such as avocado, guava, banana; and plantation in West Bandung Regency. It also has some tea plantations developed into palm plantations quinine, clove, coffee, and rubber. In addition to having potential in various areas, West Bandung Regency has the possibility of an intensive landslide. West Bandung Regency has a morphological picture as follows: in the north (Lembang), it has a morphology from medium to steep; in the southern part or Mount Halu, it has a slope above 150 and the slope in the western and southern part is below 150.

2. Spatial data of landslide in west Bandung
Spatial arrangement in West Bandung is influenced by disaster. Some disaster occurrences in West Bandung regencies are landslide and flood. West Bandung development tends to affect the increase in the number of people in a region, causing concerns on the changes in the extent of a type of land use. The conversion of agricultural land to non-agricultural land is a serious problem [3] of significant development for it required preparation and knowledge of landslides, landslide types and which areas...
will be affected in case of landslide occurs. In West Bandung district, these are the locations that often experience landslide: Cililin, Lembang, Padalarang, Cikalong Wetan and Cipatat.

2.1. Padalarang village
One of the landslide research areas is Padalarang [Fig 1], which is the dominant sub district city of its exploitation of limestone. Limestone becomes one of the mainstays of livelihood. The landslide occurred in the area of Padalarang was categorized as a compound landslide with slope 22.29° - 44.28° especially in Citatah Village. The compound landslide is a combination of the most significant size to the smallest size landslide and avalanche products such as slope, glide, and rock fall. [7] The avalanche in Pasir Pabeasan, Citatah was a composite long-type with lateral spread (lateral spread).

2.2. Cililin village
The type of land movement occurred in Kampung Jati Radio, Cililin Village was an avalanche (slide) that turned into a flow (Flow Slide). The direction of the flood is relative to the east: 14 meters wide, 23 meters long, grounding length or soil movement material reaching 149 meters with slopes 32°-40°. Disaster impacts caused: 4 injured, two of whom were treated at Puskesmas Cililin and three houses were severely damaged. Approximately 90 families evacuated because of these types of land movement, an avalanche (slide) that turns into a flow (Flow Slide) that occurred in Kp. Cinangsi, Karangtanjung Village, Kec Cililin. The direction of the landslide was relative to the northwest. The width of the crown was 8 meters, the length of avalanche was 23 m, the range of the soil or the soil movement material reached 150 meters with slope >40° [4].

2.3. Lembang Area
There are several landslide points in the Lembang area such as on Jl Kolonel Masturi. The landslide around Alam Sejuk occurred when heavy rain flushed. Landslide with an altitude of about 70 meters and a width of 15 meters of slump avalanche type took place in the Kuyambon. The analysis on path 1 suggests that there was a slip field with values ranging from 17.3 - 31.1 ohm.meters and an area of contrast resistivity between two rocks that are close together. If the resistivity of the top layer is much lower than the resistivity of the lower layer, then it is possible for avalanche to occur [1].

2.4. Cikalong Wetan Village
Movement of land that occurred was estimated in the form of the avalanche. The road between Cikalong wetan District and Cipeundeuy District was disconnected, and 2 (two) houses were threatened. In general, the topography around the location of the soil movement of hills had an altitude of more than 660 mdpl. Based on the Geological Map of Cianjur Sheet, Java, the constituent rocks of the old volcano (Qob) consist of breccia lava and lava. Based on the Map of Forecasting Potential of Land Movement in West Java Province December 2015 (Geological Agency, Volcanology, and Geological Hazard Mitigation), disaster area which is included as potential zone of medium-high land movement means that the city has medium to high potential [5].

2.5. Cipatat Area
In general, the location of land movement is in the valley of Cirawa River and Cibodas River flowing to the west. The slope is slightly steep to steep. The location of the disaster is at an elevation of 575 and 600 meters above sea level. Based on the geological map of the Cianjur Sheet, Java (Sudjatmiko, P3G, 1972), the disaster area is composed of volcanic breccia, flow breccia and lava sediment from Old Volcanoes (Qob). These rocks are generally axle, coarse-grained, sometimes coating, easily decay with relatively thick weathering soil. Based on the Map forecast of Potential Areas of Soil Movement in November 2016 in West Bandung Regency (Geological Agency, Volcanology, and Geological Disaster Mitigation), the disaster location is in the potential zone of the Medium Land movement. This means that the area has medium potential for land movement. In this region disaster can occur if the action of the ground rainfall is above average, especially in areas adjacent to river valleys, escarpments, road
cliffs or if the slopes are impaired. The factors causing the movement of the land are estimated: high rainfall before and during the movement of the land slopes are steep and unbearable. The weathering ground is thick and axle and water saturated. Therefore, it has improper surface water management [6].

Figure 1. Map of landslide overlap with soil map.

3. Conclusions
Spatial arrangement in western Bandung is still constrained by various disasters, one of which is landslide. Landslides cause some damaged locations in need of recovery. The type of landslide that often occurs is the slump; the causal factor is high rainfall and steep slopes. For spatial planning, a more detailed analysis of landslide areas is required. Further study is needed in areas stricken by disasters.

Development in landslide areas requires more attention; it is necessary to apply various disciplines in planning the construction of builders in the landslide disaster area. It is essential to note the types and mechanisms of landslides that take place, so that if a landslide strikes, it will be possible to overcome.

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