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Research Paper

Study of Landslide Occurance around Teluk Bajau, Ampera Street, Samarinda Seberang Sub District Based On Drone Aerial Photo Analysis and Field Analysis

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ABSTRACT
The research objectives are: (1) To classify land cover around Teluk Bajau, Ampera Street, Samarinda Seberang sub-district based on drone aerial photo analysis; (2) To identify the characteristics of landslides in Bajau Bay, Ampera Street, Samarinda Seberang sub-district based on drone aerial photo analysis and field analysis, and (3) to estimate the causes of landslides around Teluk Bajau, Ampera Street, Samarinda Seberang sub-district based on drone aerial photo analysis and field analysis.
The research was carried out from March to May 2021 at the location of Jalan Ampera in Teluk Bajau Area, Samarinda City, East Kalimantan. The location of the research carried out is the administrative area of the Samarinda Seberang sub-district government.
The method used is descriptive quantitative method. Research activities include: observation, aerial photography (including pre-data acquisition, data acquisition, post-data acquisition), land cover classification, infiltration measurements, documentation, and literature studies.
The results showed that: (1) the use of drone technology for landslide analysis in the area around Teluk Bajau, Ampera Street resulted in 4 (four) land cover classes, namely main roads, shrubs, plantations, and open land as well as determining the point of infiltration rate data collection from three points on each land cover class except main roads; (2) from the aerial photo analysis, it was found that the identified types of landslides were translational landslides and soil creep at the tip of the toe of the landslide; and (3) analysis of landslides carried out through drone aerial photography as well as through field observations it is estimated that the cause of landslides is the length of the slope associated with the slope of the dominant steep slope of 27%, there is no vegetation/stands retaining soil stability or land cover from surface water flow while the soil only shrubs are dominant, and there is no conservation treatment to maximize water flow from the top of the main slope.
Keywords: *Landslide, Drone Aerial Photography and Field Analysis*

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I. INTRODUCTION

Natural disaster is a natural event that can occur at any time, one of which is a landslide disaster. Landslide is the movement of soil or rock mass due to disturbance of slope stability. Factors that trigger landslides are natural factors such as morphology, geological structure, landuse, soil type, geological structure, climatology (rainfall) and seismicity (Utomo and Widiatmaka, 2013). The increased risk of landslides also occurs due to uncontrolled land conversion due to the increase in population so that land development is needed for settlement, economic and infrastructure activities.

Based on the Central Statistics Agency's Disaster Information Data, in 2018 there were 77 landslides in East Kalimantan (Anonymous, 2018). In 2019, the number of landslides throughout Indonesia reached a significant number, namely 719 events, 2019 was the year that many landslides occurred in the last 10 years (Anonymous, 2019). This indicates that changes in land use which have resulted in an increase in hydrometeorological disasters are occurring throughout Indonesia.

Around the Teluk Bajau area, Ampera street was once a dense forest area as seen from the Google Earth satellite image recorded in 2002, but slowly land clearing began, especially in 2010 until now. This significant change in land cover causes impacts, especially landslides, as happened in this location.

The landslide situation got worse when the rainfall intensity was relatively high which occurred in August 2020 to March 2021, causing the Ampera street body to be covered by hillside landslides with a relatively frequent landslide frequency. As a result, the topography around the landslide location changes.

II. RESEARCH METHODS

A. Time and Place

The research was carried out from March to May 2021 at the location of Jalan Ampera in the Bajau Bay Area, Samarinda City, East Kalimantan. The location of the research carried out is the administrative area of the Samarinda Seberang sub District government.

B. Materials and tools

The materials used include: tallysheet, Soil Type Map of Ampera Street Samarinda Seberang area, Aerial Photo of Ampera street Samarinda Seberang area, Acquisition on April 3, 2021 and GPS coordinates for Geodetic Acquisition on April 3, 2021, Supporting data for Google Earth imagery in Pattimura street Samarinda Seberang Download Time Series 2002, 2013, 2015, 2017, 2018, and 2019, and Samarinda City Rainfall Data, and Samarinda City Landslide Vulnerability Map.

The tools used include: ATK, data processing applications (*Agisoft and Arc Map 10.4*), Laptop, *Global Positioning System* (GPS), *DJI Go Phantom 4 Pro Drone* (UAV), *Drone Deploy Application*, Geodetic GPS, DJI GO 4 Application, Double Ring Infiltrometer, Ruler, Hammer, wooden block, water plastic container and stopwatch.

C. Research Procedure

The method used in this research is descriptive quantitative method. Research activities include: Observation, taking aerial photos (including pre-data acquisition, data acquisition, post-data acquisition), land cover classification, infiltration measurements, documentation, and literature studies.

III. RESEARCH RESULTS AND DISCUSSION

A. Zoning of Landslide Area

The landslide area zone is divided into three landslide zones, in zone A there is vegetation with low density or which is more dominated by shrubs. The slope in area A is still relatively steep compared to other zones. Zone area B is the part of the landslide that is affected, it can be seen in the area B zone image that there are characteristics of irregular vegetation growth, this also indicates that the landslide that occurred was quite large and deep. Zone C area is an open land that used to be a coal mine, and blackish soil can still be seen indicating the former coal excavation. The area is only overgrown with thin shrubs and grass, plus there is no conservation treatment yet.

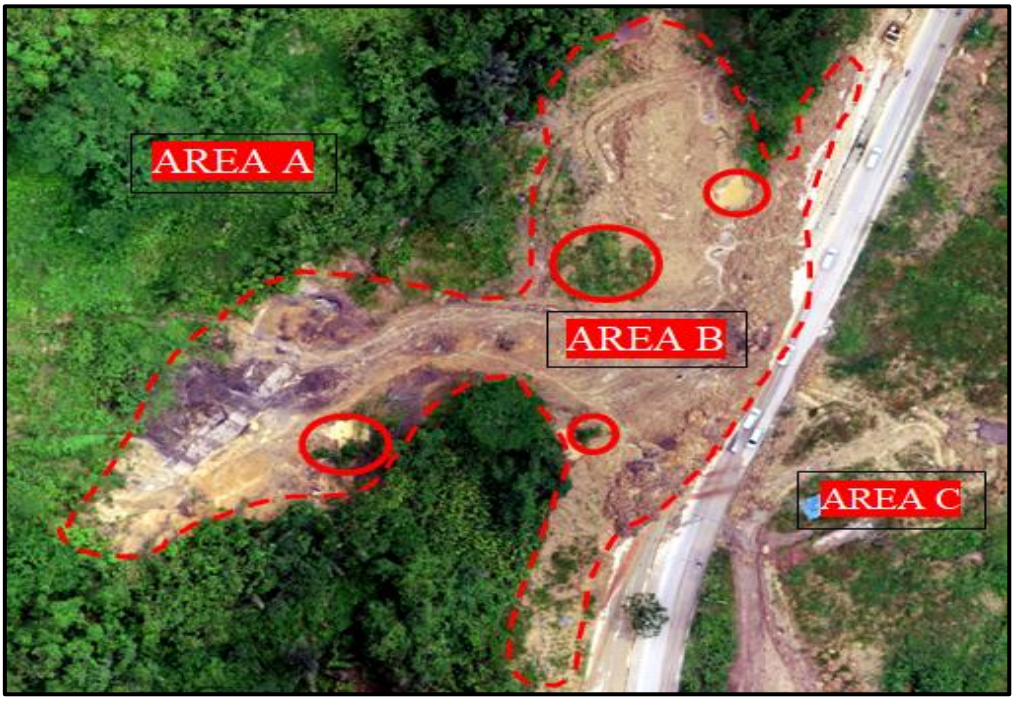


Figure 1. Landslide Zone Division in the Ampera Street Teluk Bajau Area

B. Land Cover Classification

The results of the land cover analysis in the research area obtained four land covers, namely: (1) shrubs, (2) main roads, (3) plantations, and (4) open land. The result of the widest land cover in the research area is 4.49 hectares of shrubs and the smallest area is the main road of 0.55 hectares. The land cover area in the research area is 7.8 hectares, the researcher gives a class of open land cover in areas affected by landslides, and plantation land cover during field observations is dominated by non-timber plants such as tubers, spices and bananas. perennials such as sugar palm and coconut which are planted irregularly. If we look at the land cover recorded from Google Earth imagery in 2002, 2013, 2015, 2017, 2019, and 2020, the landslide area (open land) used to be shrubs..

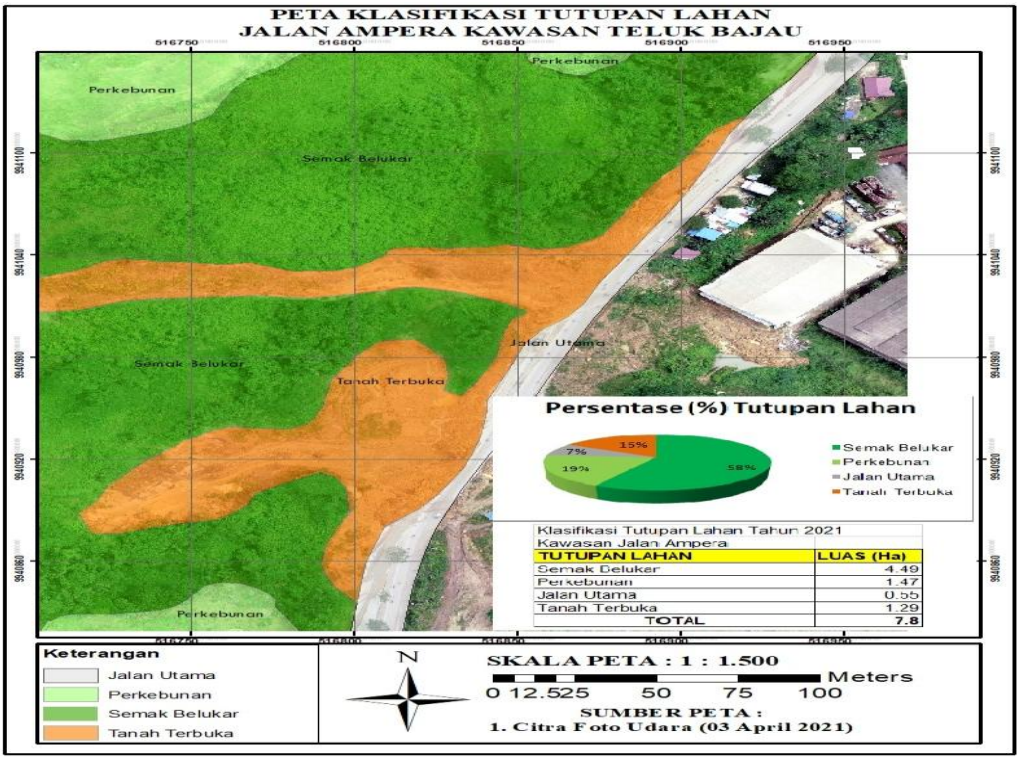


Figure 2. Land Cover Class Map

C. Landslide Characteristics and Size

1. Direction of Landslide Movement

The direction of landslide movement is the direction of the landslide that starts from the highest point on the cliff section of the landslide. The direction of landslide movement is written in units of direction angle, identified in landslides that occur in the direction of landslide movement towards 72.36˚, or if you look at the picture the landslide image moves towards the main road.

The direction of landslide movement is identified using the COGO tools in the ArcMap application by providing two points, namely the initial highest point of the landslide section and the end point of the ground movement, then given a straight line transect connecting the two lines. If analyzed with orthomosaic image zoom, it will be seen that the landslide movement follows the groove formed by water flowing from the top of the slope.

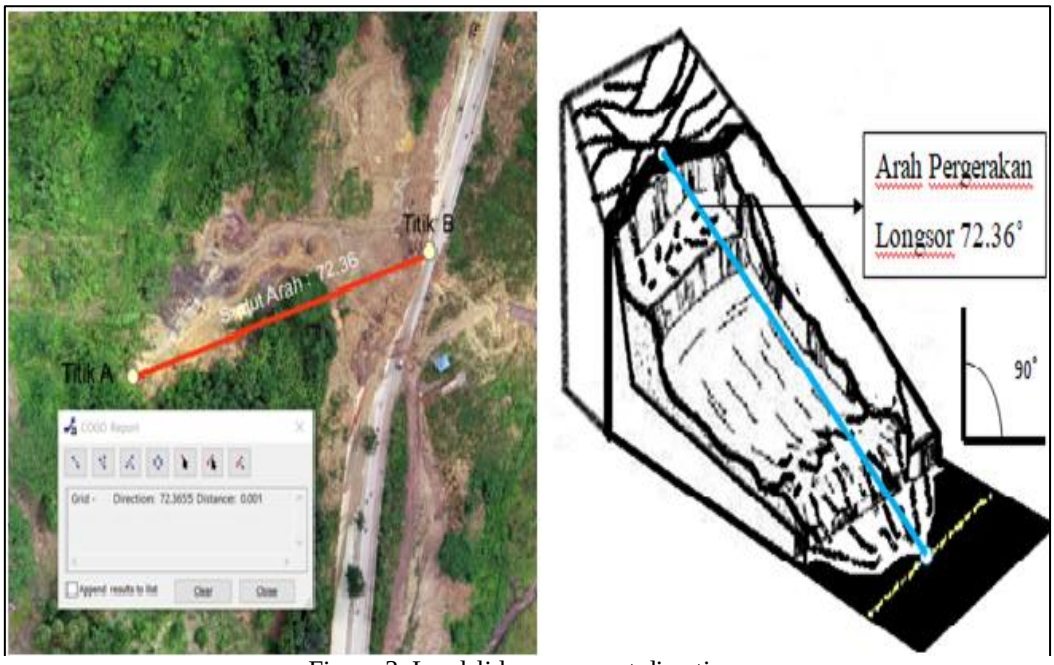


Figure 3. Landslide movement direction

2. Slope

The slope in the landslide area is calculated using the slope slope formula, namely:

$$Slope = \frac{Height\ Difference}{Flat\ Distance}\ X\ 100\%$$

Notes :

Slope = slope angle

Height Difference = the difference between the value of the upper slope - the value of the lower slope

Flat Distance = the distance measured as the shortest link between 2 points whose position has been projected on a flat plane

The height difference value is obtained from the upper slope value of 70 and the lower slope value of 40 which means the height difference is 30. For the flat distance value, it is known from the calculation results in the ArcMap calculate geometry, which is 110.10 meters.

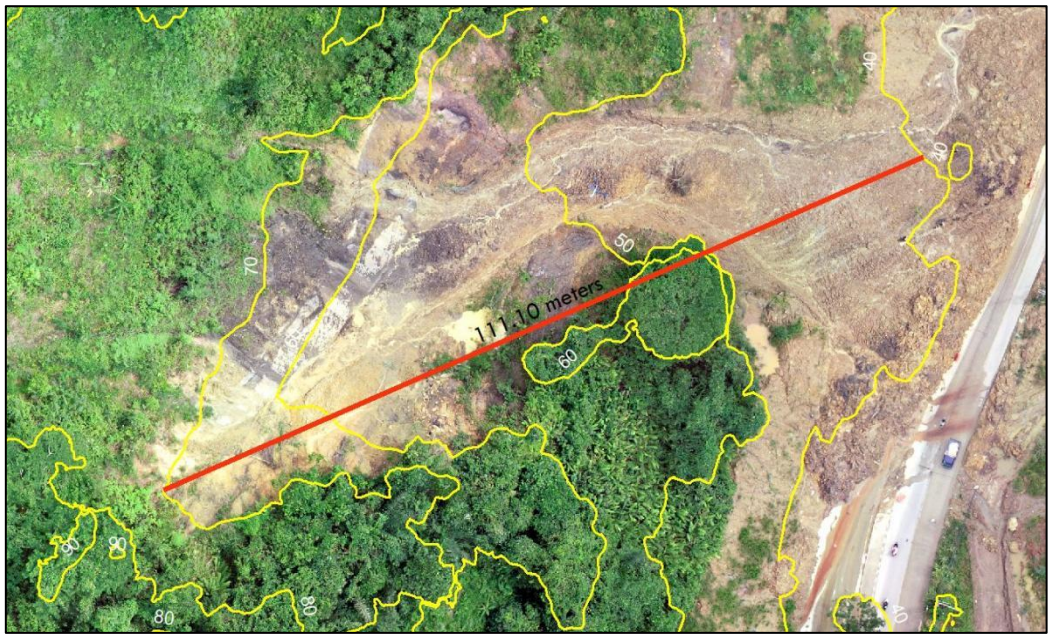


Figure 4. Flat Distance from Landslide Head to Landslide Foot

Calculation of the slope value in the landslide area:

$$Slope = \frac{(70 - 40)}{110{,}10}\ x\ 100\% = 27\ \%$$

The slope in the landslide area of 27% is classified as steep in the range of 25-45%. The slope of this slope is the slope that is calculated only in the landslide area, the results of this slope will be related to the calculation of the depth of the landslide in that area. The picture shows the results of calculate geometry getting the results of a flat distance and the picture shows a sketch of the calculated slope.

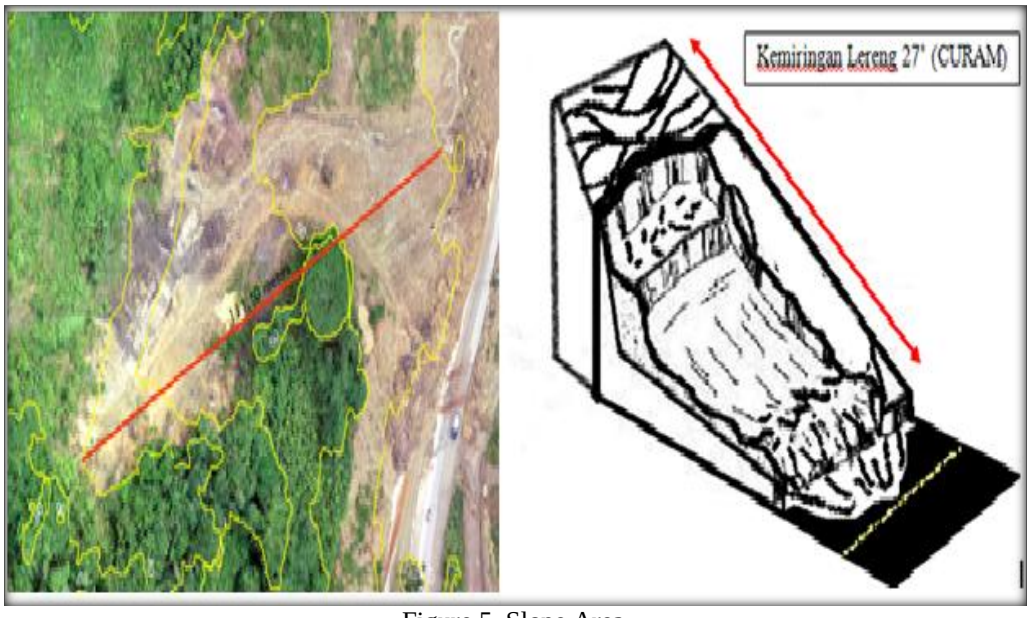


Figure 5. Slope Area

3. Slope Length

The length of the slope is closely related to the slope, the longer the slope with a steep slope, the potential for landslides around the area will be more prone to landslides. It is identified that the length of the slope in the landslide area is 533.88 meters or if it is converted to 0.534 kilometers. The length of the slope of the landslide

area is classified as very long, the range is >500 meters and the dominant shape is concave because it is a lot of hilly.

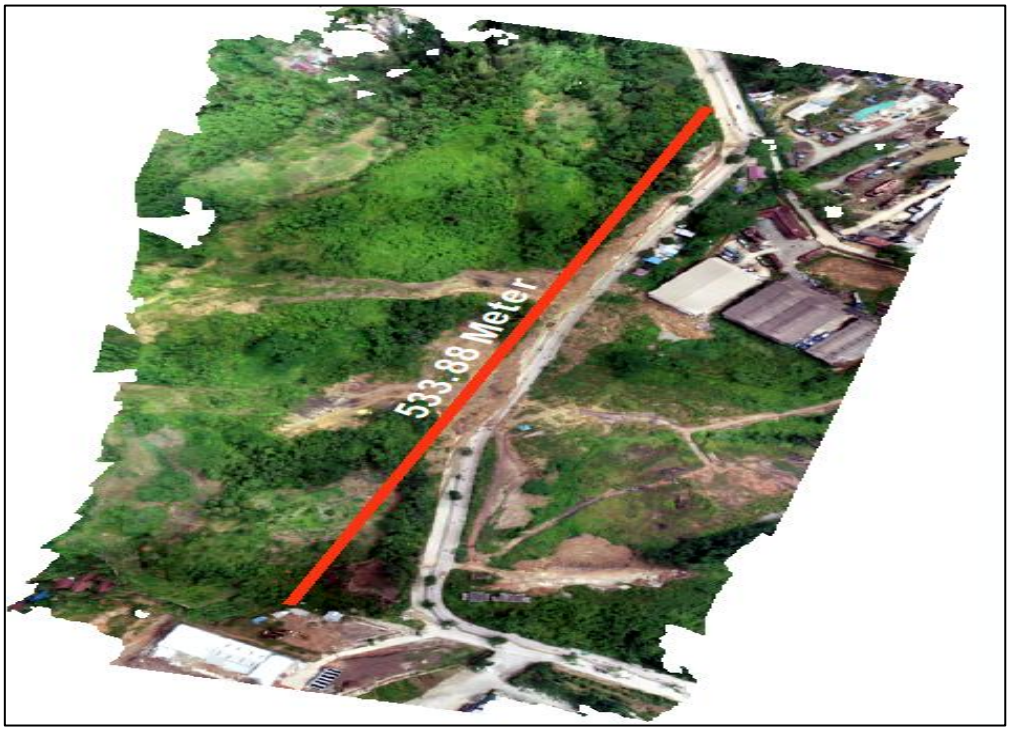


Figure 6. The length of the slopes of Ampera street

4. Height of Main Scarp

The height of the main scarp is the height of the main cliff of the landslide. The height of the main scarp is identified through DSM data processing by providing two points connected by a transect line and then using the add surface information tool function in the arc toolbox of the Arc Map application. It was identified that the height of the main scar in the landslide area was 15.48 meters.

The height of the main scar will be related to the identification of the estimated depth of the landslide that occurred in the landslide area. In the picture, the height value of the main scar can be seen from the difference in the elevation values of the two points that are connected to each other

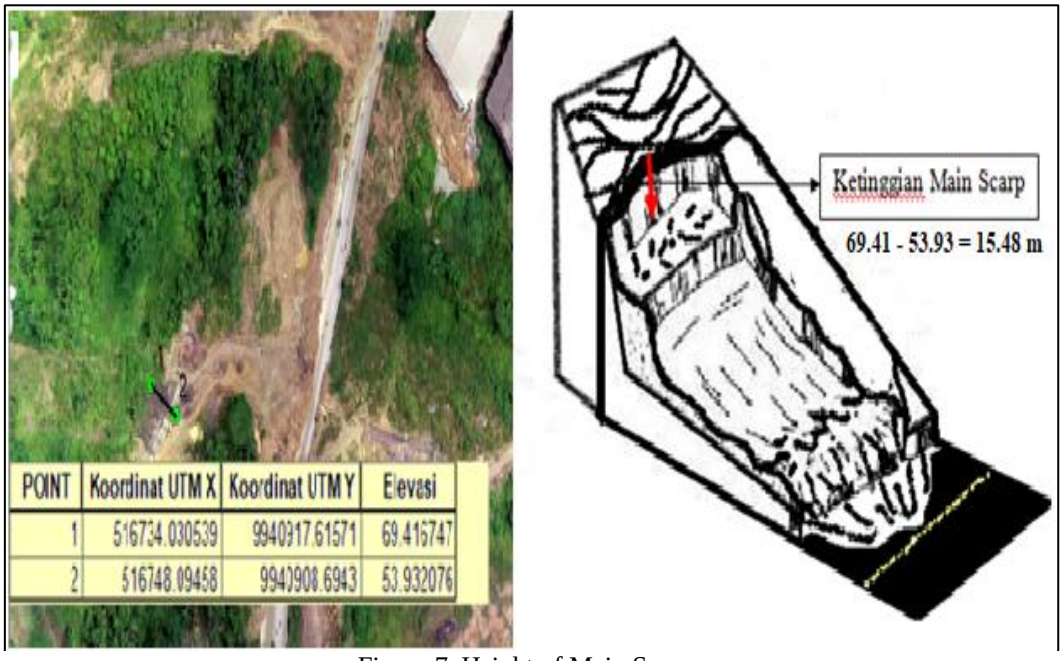
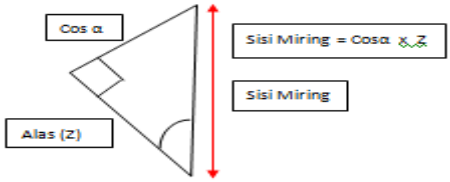


Figure 7. Height of Main Scarp

5. Estimation of Landslide Depth

The estimated depth of the landslide was identified by calculating the value of the height of the main scar and the value of the slope. Using the formula for the angle value of cos multiplied by the height value, the height value in question is the height value of the main scarp.



$$Landslide\ Depth = \cos\alpha\ x\ H$$

Notes :
Cos α = slope angle value (slope)
H = measured height value (height of the main scarp)

It was identified that the estimated depth of the landslide was 13.79 meters. If you look at the landslide depth classification table, the landslide in this area is included in the deep landslide class where the range of deep landslides is 5 – 20 meters.

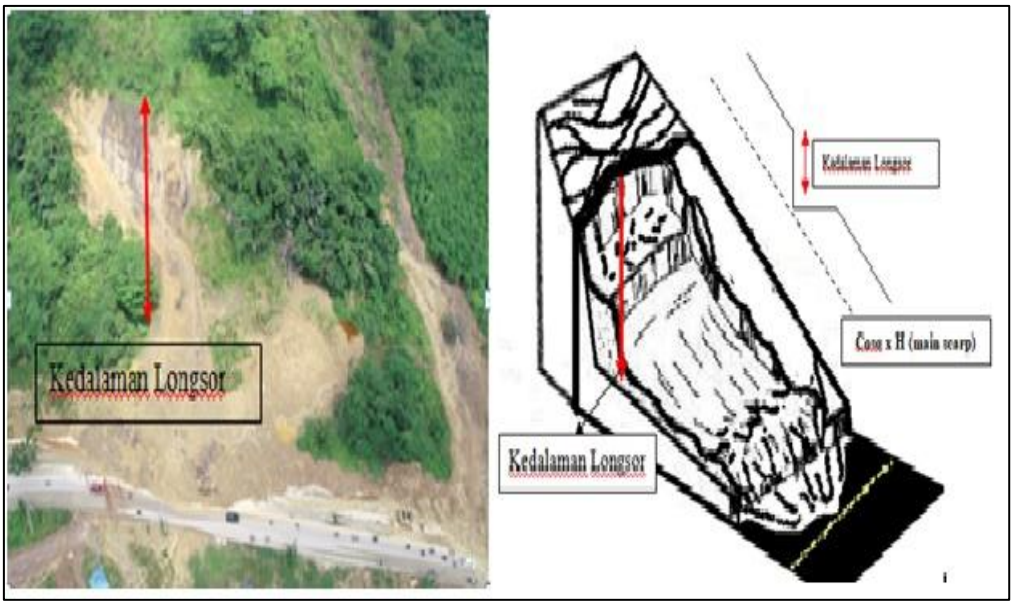


Figure 8. Estimation of landslide depth

6. Total landslide Height

The height of the landslide is the height from the foot of the landslide to the head of the landslide, the height of the landslide is listed in meters. In this study, the result of the landslide height was 37.84 meters. Knowing the height of the landslide by providing 2 points in the analysis of determining the head and foot of the landslide. Then use the application function, add XY data management tools and add surface information to ArcMap. It is known that the elevation value of point 1 is 74.61 meters and the value of point 2 is 36.77 meters.

When viewed during field observations, the landslide was seen as very severe because the area with a lower elevation with the main position of the landslide was also buried by the landslide, for example, a shop building owned by civilians who set up a small shop next to the road, the building was no longer intact so that it fell to the ground the lower one.

This makes the officers appeal to civilians not to build any buildings around the road, especially the side of the road because landslides are still happening.

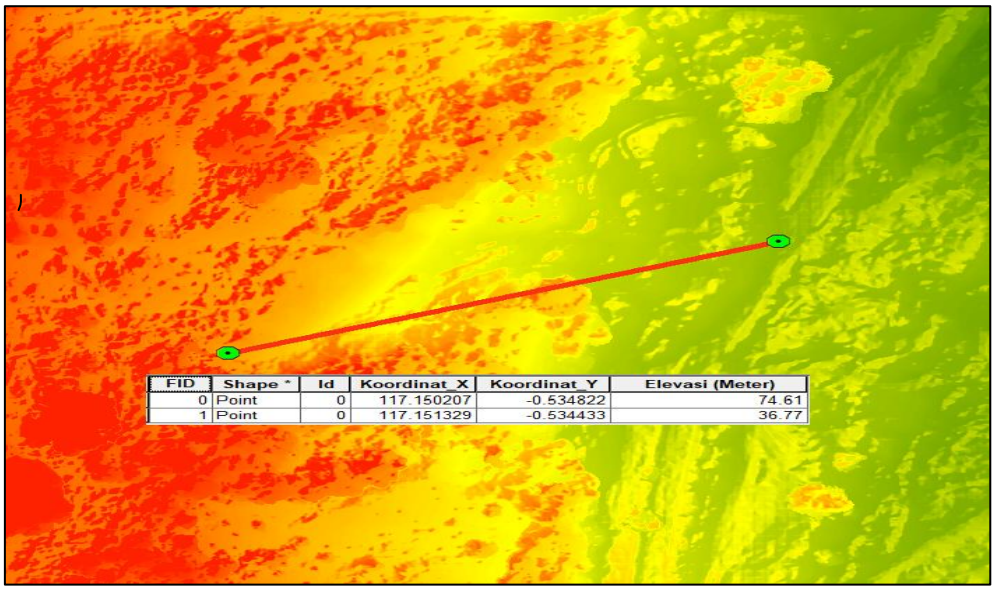


Figure 9. Identification of Landslide Height from DSM Data

7. Landslide Area

The landslide area in the research area is 0.745284 hectares. The area of landslides is expected to continue to increase considering that the monthly rainfall is still relatively moderate in the Samarinda City area. If there is heavy rain, the landslide area will continue to experience landslides that cover the main road which results in road cuts. Identify the landslide area using closed polygon digitization and then activate calculate geometry in the open attribute table.

If viewed from the aerial photo analysis, the landslide area extended to the northern part of the main landslide, precisely at the coordinates of UTM X 117.1505028 and Y -0.533586228 at an altitude of 64.08 meters. Landslide can be seen that follow the flow of water on the surface or form like rill erosion.

The area of the landslide affected by the main landslide was 0.487316 Ha, including wide coverage because the affected area was still on the same slope path as the main landslide. If the affected landslide continues to spread, it is possible that the cliff edge of the slope will also slide too.

Figure 10. Area of Identified Landslide (Main Landslide and Landslide Affected)

8. Landslide Type

In the photo, the landslide condition looks more detailed, starting from the soil layer to the damage to the vegetation that occurred in the area affected by the landslide. The main scar on the tip of the landslide that is

visible indicates that the landslide that occurred was a deep landslide, and the hillside was slowly being eroded by the flow of water that formed on the landslide body. The overflow of landslides also consumed the main one-lane road leading to Samarinda Seberang from the direction of Palaran sub-District.

The results of the analysis of the types of landslides that occur in the Ampera street landslide are translational landslides and soil creep. It is called a translational avalanche because the landslide part in the form of soil and rock forms high waves that cover the original soil on that part of the slope, then it is also called soil creep because slowly the landslide impulse when it rains takes up part of the road and the median of the road which causes some road infrastructure to become damaged. damaged.

The soil creep is in the form of coarse soil, clay loam, and small to medium sized rocks. If you look at the soil type map that has been made, this area has Ultisols or the composition of the soil-forming is more clay than sand and dust, it can also be estimated that the soil will be slower to absorb water when it rains as a result, a lot of water flow is formed in the landslide body.

Figure 11. Identification Type :slide that occurs

9. Landslide Section

Through 3D (3 Dimensional) photos, all parts of the landslide that occurred in the research area were identified. It can be seen in the picture, the area numbered 1 is the head scarp, section number 2 is the main scarp (main cliff), section number 3 is the peak that collapsed, section number 4 is the outermost side of the landslide body, section number 5 is the landslide body (the main part of the landslide), part number 6 is the foot of the landslide and part number 7 is the tip of the landslide.

The identified size is part number 2 (main scarp), and overall the landslide area is identified. In the section bordered by the black line is the area affected by the identified main landslide, this section was formed due to the flow of water coming from the top of the slope. If you look at all parts of the landslide, it can be estimated that the flow of water flowing over the slope is quite heavy so that it gradually erodes the soil so that the occurrence of soil creep. It can also be estimated that the water does not flow in its path because there is no conservation treatment on the slopes where landslides occur.

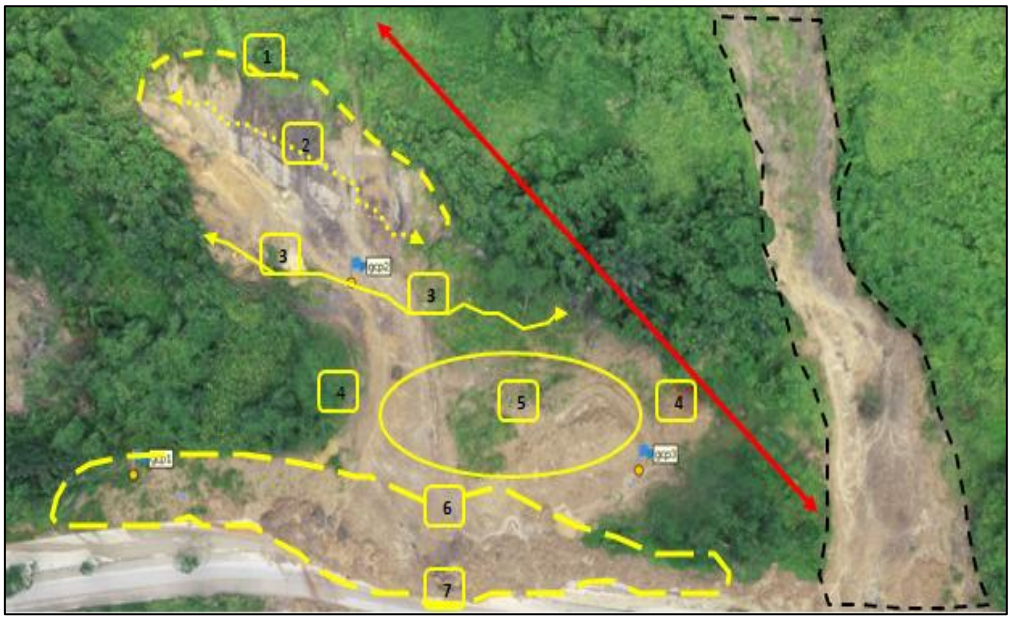


Figure 12. Identified Landslide Section on 3D Photo

IV. CONCLUSIONS AND SUGGESTIONS

A. Conclusion

Based on the results of the analysis of the occurrence of landslides around Teluk Bajau, Ampera street Samarinda Seberang using Drone Aerial Photo Interpretation, it was concluded that:

1. Utilization of drone technology for landslide analysis in the area around Teluk Bajau, Ampera street resulted in 4 (four) land cover classes, namely main roads, shrubs, plantations, and open land as well as determining the infiltration rate data collection point of 3 (three) points in each class land cover except the main road.
2. From the aerial photo analysis, the results of the landslide size and type of landslide are the direction of landslide movement 72.36˚, the slope of the land slope is 27% steep, the slope length is 533.88 meters, the classification is very long, the height of the main scarp (main cliff) is 15, 48 meters, the estimated depth of the landslide is 13.79 meters with deep landslide classification, the landslide height is 36.77 meters, the main landslide area is 0.74 hectares and the landslide area affected is 0.48 hectares, then the identified landslide types are translational landslides and landslides at the toe landslide.
3. Analysis of landslides carried out through drone aerial photography as well as through field observations, it is estimated that the cause of landslides is the length of the slope associated with the slope of the dominant steep slope of 27%, there is no vegetation/stands retaining soil stability or land cover from surface water flows, and external factors that have an effect, possibly also from the load of large vehicles passing by causing vibrations on the slopes of the soil.

B. Suggestion

The suggestions that can be stated from the results of this study are as follows.

1. It is recommended that when determining the GCP (Ground Control Point) point it is done at the end of the boundaries of the research area and in an open area that can be clearly seen because when the photo is taken, the 3D drone will be recorded from all directions.
2. For landslide events, in order to minimize soil creep that continues to occur, it is possible to take soil and water conservation actions gradually.
3. For vegetative action in the landslide area or along the slope of the landslide area, planting plants or slope-reinforcing stands, for example, can be Bamboo Trees, Breadfruit Trees, Mahogany Trees, and Fragrant Roots, then ensure that all land cover in the slope area has a minimum vegetation density of moderate to moderate tall.

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