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AN IDENTIFICATION OF LANDSLIDE POTENTIAL AREAS BY USING THE SHUTTLE RADAR TOPOGRAPHY MISSION (SRTM) IMAGES

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ABSTRACT

This study aims to identify slope conditions along the shaft roads of Palopo-North Toraja using SRTM imagery related to landslide potential areas. The method used in identifying these areas comprises two approachesutilizing satellite imagery and field surveys. SRTM images are proposed to satellite imagery which was analyzed spatially by using the slope feature in the arctoolbox ArcGIS. On the other hand, field surveys were carried out by observing 19 location points which were used as observation stations in terms of recording coordinates and description of land cover, slopeand landslide potential area. As the results, areas that experience cracks (landslide crawling) are foundedfrom flat-slope to low-slope areas whereas medium-slope locations at 35,9% up to high-slope locations around 72,5% are landslides potential areas with the type of translation avalanche.

KEY WORDS: SRTM, ArcGIS

INTRODUCTION

Palopo is one of the cities that has a high-risk potential area to get landslides. Based on the Indonesia Disaster Hazard Index for districts and towns, it is ranked 229 with a high vulnerable classification. While for the category of Landslide Hazard Index, it is ordered 20th in the national rate with high classification. One of the sub-districts that had experienced landslides was West Wara Sub-District. One of the landslide disasters that took place in WestWara Sub-District occurred on November 8, 2009. In the incident, 14 inhabitants floated (detik News, November 9, 2009). In addition, the material losses caused by this landslide were 15 houses collapsed due to buried landslides and 51 landslide points between the 20thkilometres and the 30thkilometres on the Palopo-TanaToraja road. On November 2, 2016 a landslide natural disaster struck near the Palopo-Toraja axis, Battang Village, West Wara District, Palopo. Landslides hoard plantations and rivers. Its location is right behind the Battang office (Soeharto, 2016).

In the last decades, remote sensing technology has significantly been developed. This technology is possibly to identify an object on the earth surface without making direct contact with the object. Remote sensing utilizes satellites as a vehicle. One of the outcomes produced by satellite is Digital Elevation Model (DEM) data. It is a type of Digital Terrain Model (DTM) (Nugraha and Hani'ah, 2013). One form of DEM data is the Shuttle Radar Topography Mission (SRTM) image. At present, SRTM is an image that is widely utilized to quickly see the shape of the surface. It is outfitted with a high-resolution digital elevation data to represent topography of the earth with global coverage around 80 per centin the world. SRTM data are earth elevation data generated from satellites launched by the National Aeronautics and Space Administration (NASA) (Somantri, 2008). This project will be depicted about the slope of the incline in Palopo especially along the North Palopo-Toraja axis road in West Wara Sub-District using SRTM imagery. This is related to the identification of the distribution of landslide potential areas.

METHODOLOGY

This research was carried out for two months starting from December 2017 to January 2018. It began from the initial survey to data analysis. The research location in West WaraSub-District precisely along the shaft roads of Palopo-North Toraja.

1. Material and tools

Here is a list of the tools which are used for this study :

a. Global Positioning System (GPS)

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b. Camera
c. Computer/Laptop is outfitted with softwares such asMicrosoft Office, Global Mapper, ArcGIS, Google Earth.
d. Aiming off compass
e. Fieldbooks

While the material and data are utilized:
a. Palopo'sDEM SRTM data
b. Digital Data of RupaBumi Indonesia (RBI) in 1999 on PalopoandBeringin Jaya Sheet.
c. Palopo's Google Earth Imagery.

2. DataAnalisys

These eight steps of data analysis are to identify landslide potential area at the research location using SRTM imagery. Geospatial usage of SRTM images in identifying landslide potential can be follow by:
a. Conduct research problem by literature study
b. Determine the study area. In this case, the West WaraSub-District was opted because the selection of sub-districts as the study locationincludes the area as one of the areas prone to landslides.
c. Based on the SRTM DEM, an elevation accuracy test using a RBI map reference is then corrected to produce the smallest accuracy of the RBI map.
d. The slope of the West WaraSub-District incline.
e. Field survey regarding the slope of the location of the study area.
f. Use ArcGIS software to create the slope West WaraSub-District.
g. Plot observation station (slope, land cover, landslide potential, mitigation).
h. Observation station map
i. Identify landslide potential area using SRTM imagery.

RESULTS AND DISCUSSION

In this field survey, there were 19 location points which were used as observation stations. Each of these stations is directly recorded with coordinates and a description of land cover, slope slope and landslide potential. The distribution of observation station points can be seen in the following figure

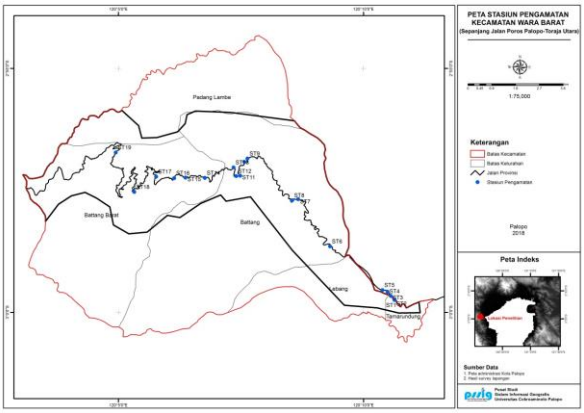

Figure1.Distribution map of observation station points

1) Slope sonditions along the shaft of Palopo-North Toraja roads. The research location was perfomed along Palopo-North Toraja axis road. Administratively, the study location, West Wara Sub-district, consists of five villages namely Tamarundung, Lebang, Battang, Padang Lambe and West Battang.Slope is one of the determinants of a landslide. The slope of the incline at the study location is also divided into five groups.These groups are Flat category, Light Slope, Medium Slope, High and Steep Slope.
2) Observation of Potential Landslides for this area. To identify potential landslides area along the Palopo-North Toraja axisroad uses two approaches. In addition, to utilize satellite imagery, a field survey was also proposed. Satellite imagery analysis used is SRTM image. This image is analyzed spatially by utilizing the slope feature in the ArcGIS arctoolbox. The results of spatial analysis in terms of slope maps. Another approach is a field survey. This field survey is intended to obtain information directly from the field. This information comprises land cover, landslide potential, and mitigation that has been implementedfor this area. In addition, this field survey is intended as a step to validate slope maps that have been prepared using SRTM imagery..

The Palopo-North Torajaroute is an vital accessfor the community. It connects the two regions and locates on the slopes of the mountains so that it has characteristics of winding, derivatives and slopes with sharp turns. On the left and right of roads, there are hills that have a fairly steep slope and quite deep ravineson the other side. In some places on this road there were several points that could potentially experience landslides. Also, other placesfound several points that risk experienced landslides. According to observations,we obtained the location of points that have the potential to landslide in regard to soil cracks which found on the asphalt.

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Symptoms for this can be observed in several locations ranging from ST02 to ST04.

Figure2.Ground cracks on the Palopo-North Toraja axis route

This ground crack is one of land movement forms that can generate land slide namely land sediment. This sediment is one of landslide types where the gesticulation of this land moves slowly due to the ground types in this location consisting of coarse and fine grains. This ground movement is difficult to identify caused by its slow movement. After a long time, this landslide can cause some traffic signs along the road slope.

Figure3.Translation avalanchein ST08

In addition,not only several locations that experienced land crawling, but also experienced the movement of land in terms of translation avalanches in several places precisely on the ST07, ST08 and ST09 observation stations. Translation avalanches are a type of avalanche that prevail due to the movement of a soil mass and rock in a flat or evenly sloping slope. This is also triggered by land cover which shapes bushes and rocky weathering.

According to the slope map along the Palopo- North Toraja axis, it can be shown that the slope along with the routes starts from flat to high slope. These roads that experience cracks (landslide creeping) come from a flat slope to a low slope while areas that meet landslides are from medium to high slope categories.

3) Mitigation Process

West Wara Sub-District is one of the landslide prone areas. In this area, there are several landslides welcoming from the past. For this, along with this path a number of landslide mitigation measures have been made by the local government. Making this mitigation simplicity aims to repeat the risk of landslides. Some mitigation measures that have been taken include making gabions on the side of ex-excavated roads, making concrete on the side of the road to prevent creeping landslides, making retaining walls for buildings on the hill, and planting trees in roadside forests in Battang Village.

Figure 4.Building retaining walls in SDN 4 Mappatongko

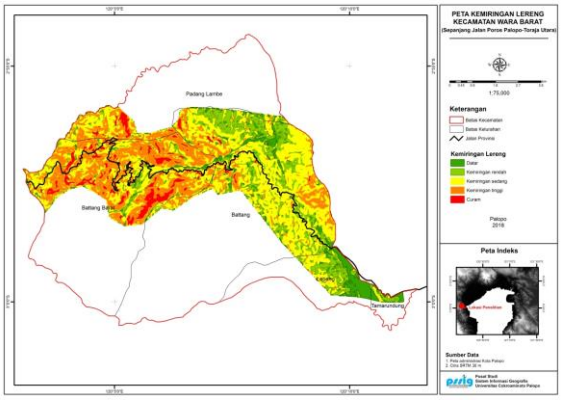

Figure5.Incline Slopes in West Waraalong with Palopo-North Toraja Routes

Slope maps are arranged based on SRTM imagery. These maps are made by utilizing the spatial analysis feature in ArcGIS software. The steps for making slope maps using ArcGIS software beginwith the process of adding SRTM image data into ArcGIS. Then, a spatial slope analysis is performed on Arctoolbox ArcGIS. The datum format which is generated from this process is

raster data. To facilitate further processing, the data are converted to data vector (polygon). The final step is to do a map layout. The results of the overall map making process can be shown in Figure 2.

Based on the DEM data analysis, the SRTM images obtainedincline slope classification in the study location. It is flat slope at 8.6%, low slope at 21.9%, and Medium slope at 35.9%, while the high slope and Steep are around 27,5 per cent and 6,1 per cent respectively. Moreover, Figure 2 illustrates the distribution of slope along with the Palopo-North Toraja axis road. The east of this area has the slope of the low-flat slope (green-light green). The slope of this incline is in the Tamarundung and Lebang. On contrary, the west of region has a higher slope which has a moderate until steep slope (yellow-red).

The axle routes that link betweenPalopo City and North Torajaplace in a hilly slope that stretches from east to west. The westward of area is, the higher of slopes is. This also causes the region to have a higher potential for landslides.

SUGGESTIONS

To identify landslides prone areas, several other factors such as land cover and settlement are needed to analysis. Therefore, it is necessary to utilize other high-resolution satellite imagery such as Landsat and SPOT satellite imagery.

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