

The Study Of Landslide In Tomohon Manado Road Path

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Abstract. The route of Tomohon-Manado almost every year in the rainy season, landslides occur, because it is supported by the physical condition of the land with a rough topography that appears from the steep slope, the building material is Lokon volcano material which is classified as young gungungapi so the material is not compact and vulnerable to landslides. In addition to the physical condition of the land, the Tomohon-Manado route is the main transportation route that connects Manado as the capital of North Sulawesi Province and several Regency Cities such as Minahasa Regency, South Minahasa Regency, South east Minahasa Regency and even to Bolaang Mongondow Regency. On the other side of the Tomohon-Manado route also takes place the economic activities of the population such as fruit trade, restaurants and there are also lodging which strongly supports the economy of more specialized residents who live on the Tomohon-Manado Line. In this regard, it is very important to study the problem of landslides in the Tomohon - Manado route with the following problem formulation: What are the conditions of landslides in the Tomohon-Manado route. The purpose of this study is to examine the condition of landslides in the Tomohon - Manado route. The method used includes the interpretation and analysis of photographs / images, field observations and measurements, laboratory analysis and the value of terrain parameters to determine the level of landslide hazards. The results showed based on the value of the terrain parameters, the landslide hazard in the Tomohon-Manado route was subject to three levels of landslide hazards in the Tomohon-Manado river, which were subjected to low, medium and high hazard levels. Landslide events were found both on slopes to steep slopes, types of landslides in the Tomohon-Manado route include slide and slope types and after the 2014 flash flood event in Manado, landslide conditions in the Tomohon-Manado route experienced an increase in the number of landslides and the amount of material that moved and had an impact for the closure of the Tomohon - Manado route in quite a long time and the existence of fatalities and damage to housing in the Tomohon - Manado route.

Keywords. Study, Danger, Landslide

1. Introduction

The route of Tomohon-Manado is the main road that connects Tomohon City, Minahasa Regency, Mitra Regency with Manado City. Tomohon-Manado Line is almost a rainy season during the rainy season. Based on the land use direction map of the Directorate of Geology of Environmental Planning (1977) the Tomohon-Manado route is included in category B which is directed to local only agriculture which is developed for rural growth centers with regard to morphological conditions and does not occupy areas prone to disasters.

The reality that is often in the pathway affected by landslides is used for fruit, home, food and lodging trade routes. This condition is caused in terms of the economy which strongly supports the economy of the villagers who live near the Manado-Tomohon road and contributes positively to the development of Tomohon City and Minahasa in the Tourism and Tax sector. Based on the map of the Earth Map of Manado (1991) issued by Bakosurtanal Scale 1: 50,000 the Tomohon-Manado path with a rough topography can be seen from the level of density of the contour line where the rough topography is a reflection of the steepness of the slope where the steep slopes are very supportive of the occurrence of landslides. From the geological aspect based on the geological map sheet system Manado Scale 1: 250,000 (Effendi, 1976). The Tomohon-Manado route is covered by young volcanic rocks consisting of lava, bombs, lapilli and ash where these rocks are classified as loose rock / unconsolidated rocks that are prone to landslides. Besides the topography and lithology factors of the Tomohon-Manado route, the central part of the volcano is one of the active mountains in North Sulawesi where the middle slope is cut and made into the Tomohon-Manado road. According to Varnes (1978) in Sulastoro (1994) cliff cutting and increasing slope angles, volcanic processes and car vibrations are among the triggering factors for landslides. Based on the results of the Tewal Research (2006) using terrain units as a unit of analysis of the level of landslides in the Tomohon-Manado Line consisting of low, medium and high levels of landslides and those that dominate are moderate levels of danger. Based on the occurrence of disasters in 2014 together with the occurrence of disasters flash floods in the city of Manado, the Tomohon-Manado route experienced a landslide which was quite severe, namely the interruption of the transportation route, the Tomohon-Manado, so that the road had to be diverted to several alternative roads, even claimed human lives, and impacted on economic and office activities and other activities included for UNIMA residents who work the Tomohon-Manado route every day. In addition, in December 2017 (December 24, 2017) the latest landslide events in the Tomohon-Manado road where the slope level that is not so steep ie around the dam occurred landslides-with a number of landslides which are quite a lot including in the Warembungan Pertamina location. The increasing number of landslide points / events in the Tomohon-Manado road or the increase in landslide points in the Tomohon-Manado road from year to year and with the presence of victims due to landslides in the Tomohon-Manado road and supported by unconsolidated geological conditions and topographic conditions that are generally steep and the Tomohon-Manado road as a transportation route that is classified as dense, it is very important to continue to study the condition of landslides in the Tomohon-Manado lane considering that on the other hand this road is widely used as a source of community economy because quite a lot is used for trade in fruit, restaurants and lodging where this, besides supporting regional income in the form of taxes, also supports the fulfillment of the needs of the people who are doing economic ventures on the Tomohon-Manado road. In connection with the many activities and communities that utilize the Tomohon-Manado road, the safety and comfort of the community is very important to be considered and one of them is safety from landslides. In this connection it is very important to assess the condition of landslides in the Tomohon - Manado.online. In connection with this the research problem was formulated as follows: What are the Conditions of Landslides in the Tomohon - Manado Road, with Research Objectives: Assessing Landslide conditions on Tomohon - Manado Road.

2. Research Method

This study uses a geomorphological approach with a terrain as a unit of analysis. The research methods used included map analysis, interpretation of aerial photographs / images, observations, field measurements to obtain physical data as well as laboratory analysis of soil samples. To get a landslide hazard map scale of 1: 50 000 is done by respecting the terrain parameters.

Research flow chart:

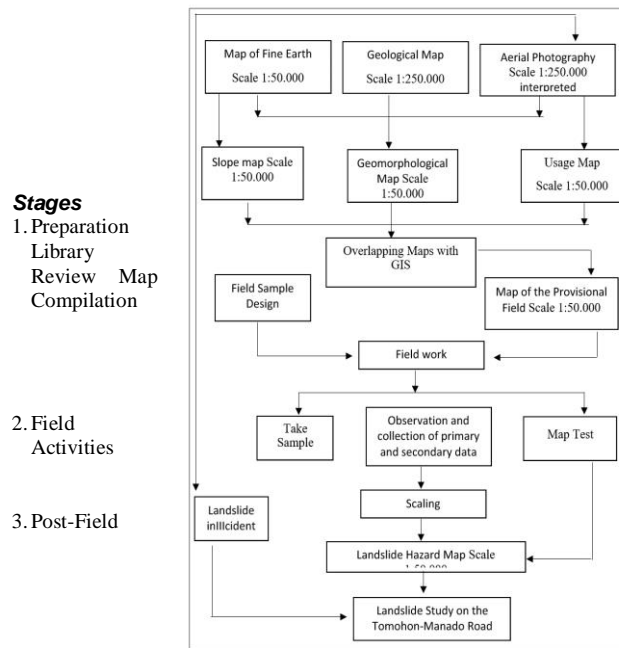


Figure 1. Elements of Commercialized Geotourism Product Package.

3. Result and Discussion

Landslides in the Tomohon - Manado route, through the value of the terrain parameters consisting of slopes, texture, permeability, soil solum thickness, rock weathering, steep wall conditions, vegetation density, internal drainage and outside drainage, as in Table 1 shows that landslides in the path Tomohon - Manado consists of three categories of hazard classes namely low, medium and high landslide hazard classes and based on the landslide distribution maps are also included on three landslide hazard levels namely low, medium and high hazard levels dominated by moderate landslide hazard levels (Figure 1). This category of landslide hazard level is similar to the level of landslide hazard in Manado City after the 2014 Manado flash flood (Selvana IJST 2018). The category of high landslide hazard levels that occur in the Tomohon - Manado route is supported by terrain parameters namely slope conditions, permeability and soil texture as well as the thickness of the soil solum and rock weathering levels which are generally categorized as further weathering besides that also due to the supporting factors of landslides namely rainfall height and land use with various designations such as settlements, dry fields, clove plantations as well as coconuts, all of which support the opening of land which although there is still forest in certain places but generally on land with steep slopes.

Landslide conditions in the Tomohon-Manado route are also classified into three hazard level categories, based on research / observation based on two types of landslide types, namely slide type landslides that occur at locations with steep slope slopes and slump or sloping types which this phenomenon occurs at locations with slope and sloping (Figures 3 and 4) and also the point of landslide occurring in the Tomohon - Manado route was found both on the slope of the steep slope to the sloping land (Figures 2 and 5)

Also based on research landslides along the Tomohon - Manado road were found

also on clove plantations and on talud roads even at the same time as the occurrence of flash floods in Manado City in 2014, on the Manado - Tomohon Strip there was a large landslide where a lot of material moved and had an impact on the closure of the Tomohon - Manado road lane in quite a long time, the loss of human lives and houses buried in land and Easter flash floods, the condition of the number of landslide points increased, even on the sloping slopes were found the occurrence of landslides.

The existence of this phenomenon shows how important it is to assess the condition of landslides on the Tomohon-Manado road as one of the main transportation routes in North Sulawesi Province.

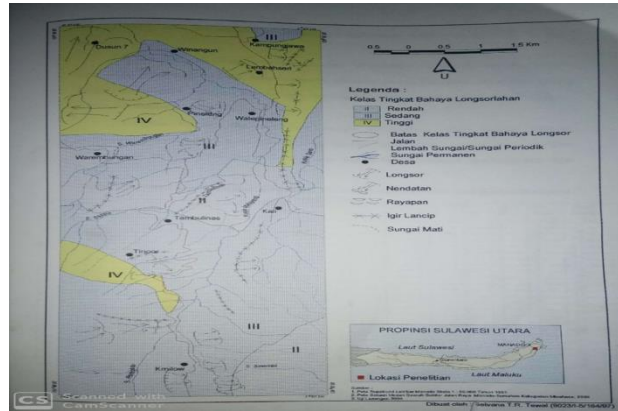


Figure 2. Landslide Distribution Map of the Tomohon-Manado Route



Figure 3. Landslide on a gentle slope



Figure 4. Slide Type Slide.



Figure 5. Slump / Slash Type Landslide

4. Conclusion

1. Level of landslide hazard in Tomohon - Manado based on the level of field parameters, there are three classes of hazard levels, namely medium and high level of landslide hazards with slide and slump types
2. Landslides in the Tomohon - Manado route were found at slopes to steep slopes and there were additional points of landslides.
3. There is a tendency for an increase in the number of landslides and the extent of landslides in the Tomohon-Manado road so conservation is needed to minimize landslide hazards
4. The use of land in the Tomohon-Manado road is strived to minimize slope cutting so as not to cause slope instability and material

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