

Rainfall-induced shallow landslides in South Sulawesi, Indonesia

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1. INTRODUCTION

Rainfall-induced landslides including shallow landslides have resulted in substantial property damage as well as loss of human lives (Larsen and Simon, 1993). In recent years, the South Sulawesi province of Indonesia has been affected by numerous shallow landslide phenomena caused by particularly intense rains. The danger of these phenomena is related to the difficulty of foreseeing their location and the high risk to people, especially those taking part in farming activities and the people who would cross public roads in areas prone to shallow landslides. The main objective of this study is to analyze the shallow landslides caused by intense rain that took place on 3rd to 4th May 2011 in the province of South Sulawesi, as a representative case of rainfall-induced shallow landslides in Indonesia. The study will provide important information for the development of warning system in the study area.

2. STUDY AREA

The study area was the South Sulawesi province of Indonesia. The South Sulawesi area is located on the western southern peninsula of Sulawesi Island between $0^{\circ}12'$ and $8^{\circ}0'$ South latitude and between $116^{\circ}48'$ and $122^{\circ}36'$ East longitude (**Fig. 1**). The total area is around $46,717 \text{ km}^2$ divided into 24 regencies with total population 8,032,551 in 2010. In general, the configurations of the study areas are ranging from flat to steeply sloped areas. There are two distinct seasons i.e. dry and rainy. The average annual rainfall is distributed from 1,049 to 4,307 mm/year with average temperature 17° to 33°C . Landslides, including shallow soil slides and debris flows that are common in the study area are caused primarily by rainfall.

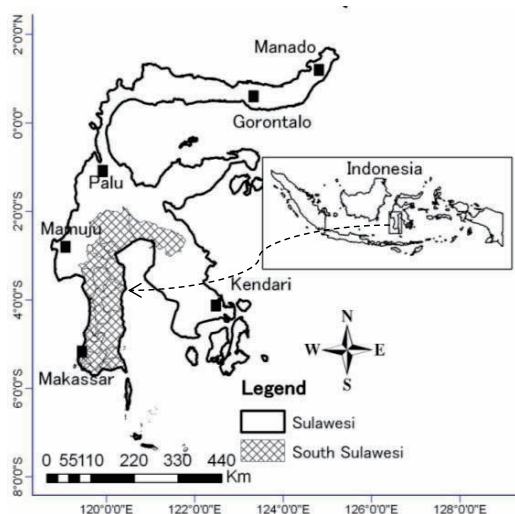


Fig. 1 Study area in South Sulawesi, Indonesia.

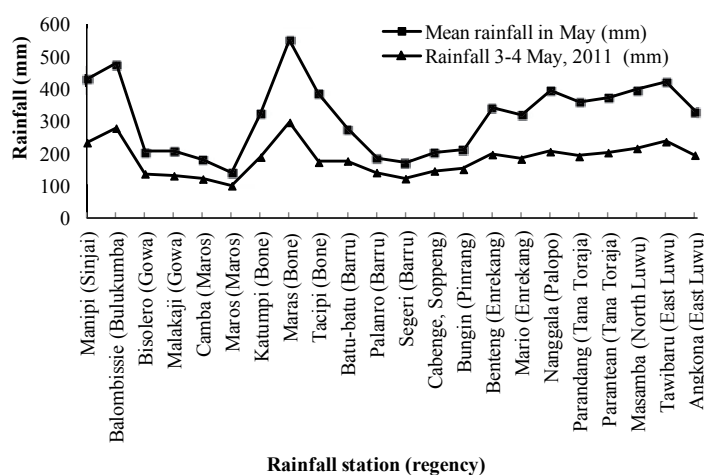


Fig. 2 Intensity of rainfall on 3rd to 4th May 2011 induced shallow landslides in South Sulawesi.

3. RAINFALL EVENT AND ASSOCIATED SHALLOW LANDSLIDES

On 3rd to 4th May 2011, a high intensity rain episode hit thirteen regencies in the South Sulawesi province of Indonesia. The high intensity rainfall triggered about 40 shallow landslides in the regency's area. The rain gauge located between two to five kilometers from the shallow landslide areas, measured 101 to 298 mm of rain in 2 days. High intensity rainfall ranges from 41 mm/hr to 79 mm/hr with short durations. In this area the rainfall over 50 mm by hour caused shallow landslides. Maximum damage and disruption occur at several sites along the transportation network, especially in Gowa regency, Bone, Palopo, North Luwu and East Luwu. The shallow landslides resulted in 2 fatalities and several injured people. Data from twenty two meteorological stations illustrate the significance of this rainfall event by comparing the precipitation of May with other mean monthly records. The mean monthly precipitation is 314 mm, whereas the cumulative value of the two most intense days from 3 to 4 of May was 184 mm. In other words, the storm corresponded to 61% of the monthly average in only two days (**Fig. 2**). In the other hand, the high intensity of rainfall on the 3rd to 4th May 2011 caused the flooding of several places in the area. The distribution of shallow landslides in South Sulawesi province, soil types, geology, elevation and rainfall condition are shown in **Fig. 3**.

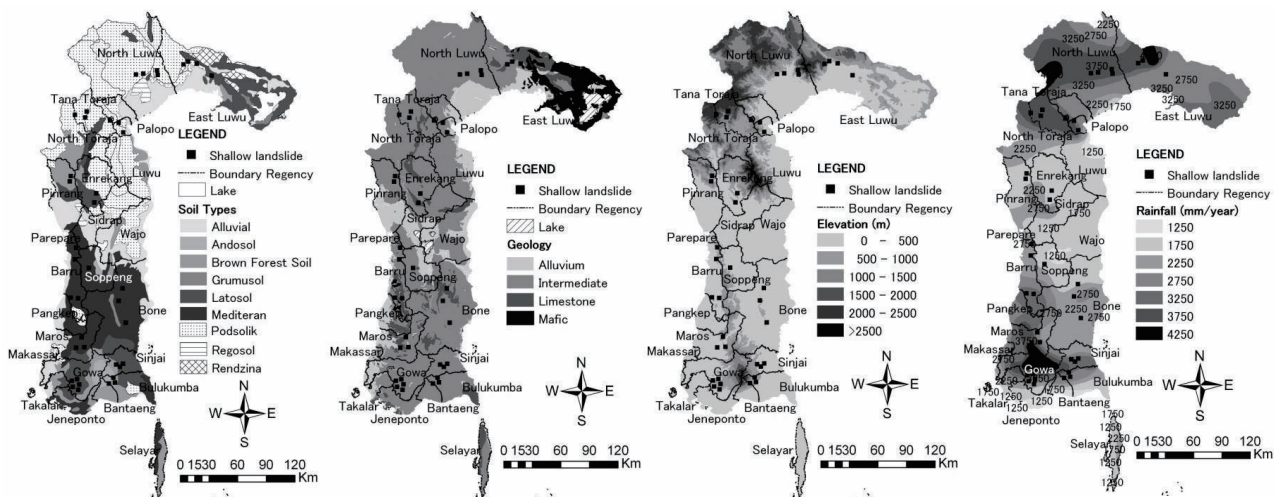


Fig. 3 Distribution of shallow landslides, soil types, geology, elevation and rainfall conditions in South Sulawesi.

4. CONCLUSION

The present study shows that short-duration rainfall with high intensity rainfall events triggered about 40 shallow landslides in South Sulawesi province on 3rd to 4th May 2011. In this area we could observe that the rainfall intensity over 50 mm/hr may cause shallow landslides that could cause damage to property including loss of human lives. The development of a warning system should have a priority for areas prone to shallow landslides.

Keywords: shallow landslide, rainfall intensity, damage, warning, South Sulawesi

Reference

Larsen, M.C., Simon, A. (1993): A rainfall intensity-duration threshold for landslides in a humid-tropical environment, Puerto Rico, Geogr. Ann., Vol. 75 A (1-2), pp.13-23.