

A. INTRODUCTION

Indonesia is one country in Southeast Asia, which has a high vulnerability of natural disaster both geology and hydro-meteorology. This vulnerability mainly caused by the high density of population (Hadmoko et al, 2009; Fathani et al., 2009) and infrastructures located in the disaster prone areas. Furthermore, there is a relation with geographical condition and geological – geomorphological setting, Indonesia laid in zones largely affected by volcanic activity, seismicity, cyclone etc. As one of the developing country, Indonesia has a poor condition of the economic, social, political and cultural, which simultaneously increase the vulnerability to natural disasters.

B. LANDSLIDE DISASTER IN INDONESIA BASED ON HISTORICAL DATA

Hydro-meteorological disaster dominates natural disaster in Indonesia every year, approximately 80% of total disaster, only 20% is a geology disaster (**Fig. 2**). Indonesia have experienced 517 occurrences of hydro-meteorological disaster in 2010 about 71% of total, geological disasters such as earthquakes, tsunami and volcanic eruption occurred respectively 13 times (2%), 1 time (0.25) and 3 times (0.5%). However, geological disasters are relatively infrequent in Indonesia but has caused more fatalities (91.8% of total).

Landslide is one of geological disasters, which is the most frequently occurring disaster in Indonesia, and the number of occurrences has sharply increased from 2000 to 2009 (**Fig. 3**). Hansen (1984) explained that the 95% incidence of landslide disasters in developing countries dealing with fatalities. This phenomenon also happens in Indonesia due to some communities which economically and socially marginalized are forced to occupy the most hazardous slopes in rural and urban areas. They characterized as a society strongly influenced by natural such as climate, however, have a limited capacity to respond to and recover from disaster event.

In the year 2005, there was a number of landslides occurred in several regions in Indonesia, among others : West Java, East Java, Aceh, North Sumatera and West Sumatera; caused 243 died (<http://www.scribd.com/doc/38301642>). Incidence of landslide in 2005 tended to decrease compared to two years before but, the number of death is relatively high even increased sharply (**Fig. 3**). In that time, implementation of disaster management in Indonesia were based on emergency response so that government and community tend to ignore the disaster mitigation, which it can reduce casualties and damaged caused by disaster (Paripurno, 2008). The paradigm of disaster management in Indonesia has changed since the Act Number 24 of 2007 on Disaster Management; disaster management activities more focus on mitigation efforts (preventive paradigm). It has succeed in reducing deaths of landslides, while the number of incidence increased sharply from 2007 to 2009.

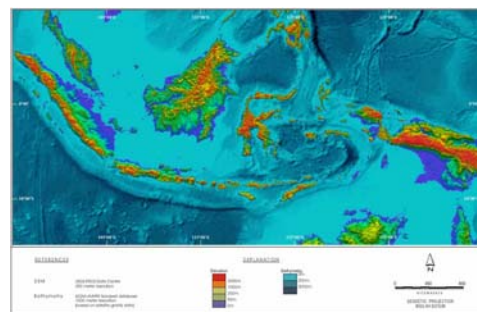


Figure 1. Topography of Indonesia

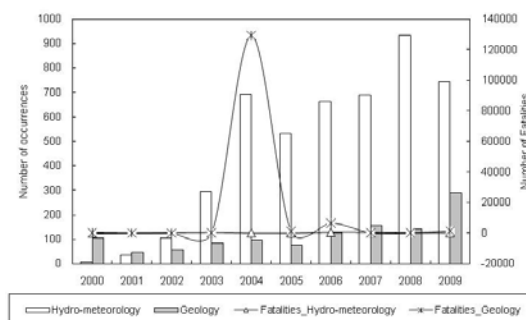


Figure 2. Number of occurrences as well as fatalities by natural disaster

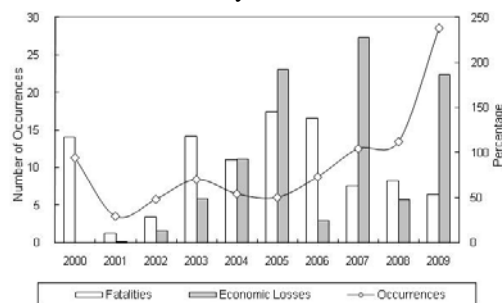


Figure 3. Trend of occurrences, fatalities, and economic losses by landslide disaster

Fathani et al., (2009) confirmed the natural factors triggering landslides in Indonesia. First, a more than 60% of Indonesian region are covered by the mountainous and hilly areas of weathered volcanic rocks which are intersected by faults and rock joints. Second, high annual rainfall can exceed 2000 mm to 3000 mm and frequent earthquake vibration cause the occurrence of landslide frequently increase recently. Paimin et al (2008) confirm that land use change, deforestation, alteration of slope geometry for various purposes, such as : mining; housing; roads; without regard to carrying capacity of the terrain has increase the vulnerability of the Indonesian territory of the landslide. Suryolelo (2005) contend that landslide in Indonesia is mostly due to the disruption of existing drainage systems particularly by road construction.

C. THE IMPORTANCE HAZARD STUDY AND ITS CHALLENGES IN INDONESIA

The impact of natural disasters can be reduced by mitigation efforts either by way of structural (slopes, rock butters, drainage tunnels, stone columns, retaining wall etc) or non-structural such as avoiding the disaster area for buildings. Because of limited financial resources, developing countries, like Indonesia, have difficulties to build the facilities or constructions to protect an area from natural disaster. Furthermore, efforts in relocating of residents to a safe area is also very expensive and impracticable also faced non-technical problems. Therefore, hazard study is very important and useful to inform the public about disaster-prone locations with the probability of the occurrence. It is going to produce maps of potential disaster that is very important for designing the early warning system and preparedness activity, the other element of mitigation.

Landslide hazard is a particular case of natural hazard as “the probability of occurrence within a specified period of time and within a given area of a potentially damaging phenomenon” (Varnes, 1984). This definition includes temporal and spatial aspects. Hadmoko et al (2009) underlined that the temporal factor of landslide is difficult to be included in most of hazard maps due to absence of multi-temporal data of landslide events as well as heterogeneity of the subsurface conditions. Indonesia as well as other developing countries have a problem about scarcity data of geology, hydrology, meteorology and or geomorphology for assessing landslides hazard. Consequently, the most of the hazard maps have only presented the spatial information of landslide hazard and do not provide an estimate of time “when” the landslide may occur, whereas this is key in mitigation effort. However, Indonesia has a great opportunity to estimate the landslides probability by exploring remote sensing data from internet. Currently available remote sensing data with high resolution even it is free to be taken which can be used to generate data geology, hydrology, meteorology and geomorphology as input data in hazard assessment. The remote sensing technology is integrated with Geographic Information System (GIS) and a little bit of field work transform the landslide hazard assessment is more possibly could be done in developing countries like Indonesia.

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