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2010 Merapi Volcano Eruption: A Study of the Role of Geomorphology for Spatial Planning

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ABSTRACT

Merapi volcano can be viewed as a volcanic ecosystem which has several specific characteristics: (a) it is one of the most active volcanoes in the world with unique properties of eruptions, (b) although it often causes natural disasters, its surrounding areas are densely populated, and (c) most of these areas have been used for various purposes that are growing dynamically. In addition to its abundant potential natural resources, Merapi volcano is also well-known as an active volcano with specific nature of eruptions occurring periodically. When it erupts, incandescent lava, hot clouds (nuess ardente), or lava flow can be erupted.

In its eruption from October to November 2010 the amount of rocks and molten lava coming out of its crater, followed by spewing hot clouds, completely destroyed Kinahrejo village and other residential areas surrounding the village. Even further, headwaters areas of the Kuning River, Gendol River, and Woro River were devastated. Even worse, the Gendol River was filled with these volcanic materials up to about 18 kilometers into Cangkringan sub-district. Because of this disaster, more than 300 people and thousands of livestock were killed. In addition, properties, infrastructures, and farmland were completely destroyed. The writers have made this devastating disaster the background of this study. The objectives of this study are: (a) to assess the geo-morphological conditions of Merapi volcano and its surroundings, (b) to assess the distribution of pyroclastic (hot-clouds) deposits and lava flows of Merapi volcano (1911-2010), and (c) to prepare a regional spatial pattern of Merapi volcano through morphological approach and with the results of geo-morphological processes based on the history of Merapi eruptions from 1911 until 2010.

The results of this study show that firstly, geo-morphological processes from the past up to the present have shaped the typical characteristics of Merapi volcano's landscape, which can be grouped into morphological units, namely: Old Merapi lava domes, volcanic cone, volcanic slope, volcanic foot, volcanic foot plain, and fluvio-volcanic plain. Secondly, viewed from the history of its eruptions from 1911 until 2010, the distribution pattern of hot clouds and lava flows of Merapi volcano formed a relatively regular pattern and repeatedly around the cone morphology and volcanic slopes and constantly followed the flow of rivers, namely: the Apu River, Tlising River, and Senowo River which coalesce into the Pabelan River; Blongkeng and Putih Rivers, Batang and Bedog Rivers which in turn coalesce into the Krasak River; Boyong-Code River, Kuning River, Gendol River, and Woro River. These geo-morphological volcanic processes will continue to occur in a certain cycle period although the intensity may not always be similar, and their spread will follow the previous paths. Thirdly, based on the distribution pattern of hot clouds and lahar flows, it is suggested that the volcanic materials erupted and the areas affected will always follow the existing pattern, with a certain cycle period and intensity that is not always similar. These natural phenomena which relatively follows a consistent pattern is highly likely to be the main factor and a strong base in formulating spatial planning policies in disaster-prone areas of Merapi volcano, which is dynamic and elastic.

Keywords: eruption, hot cloud, lahar flow, landscape, morphology, spatial planning