Study on Sediment Disaster and Resources Management in Mt. Merapi Area

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1. INTRODUCTION

Among of the volcanoes in Indonesia, Mount Merapi shown in Figure 1 is one of the most active volcanoes. The volcano that stands 2,968 m is located in Java Island along $7^0$32'26.99''S latitude and $110^0$26'41.34''E longitude. In the last 50 years, Mt. Merapi erupted once 3 years, and major eruptions occurred at intervals of 9 years. Mt. Merapi eruptions have produced huge sediment deposit on the slopes. The deposited sediments cover 286 km^2 on the surrounding of the volcano. In addition to causing the disaster, the deposited sediment is used by local people as sediment resources through sand mining activity. In this paper, we discussed about related sediment disaster mitigation and sediment resources management in Mt. Merapi area.

2. CURRENT SITUATION OF SEDIMENT DISASTER MANAGEMENT

(a) Sediment related disasters

Thus far, Mt. Merapi still produces huge sediment, threatening inhabitant with sediment related disasters. At least 1.1 million inhabitants live on its slopes and 440,000 people live in areas with high risk of pyroclastic flows, pyroclastic surges, and debris flows.

Pyroclastic flows have occurred during the last eruption toward all directions of the tributaries in surrounding the Mt. Merapi, and caused tremendous damages. On November 22, 1994, the pyroclastic flow occurred through Boyong River, burning Turgo village and causing 66 casualties. In 1998 and 2001, some pyroclastic flows took place and inhabitants had to evacuate. During the eruption in June, 2006, the local government evacuated 44,500 people who lived around the risky zone. On June 14, 2006, pyroclastic flow occurred toward Gendol River and burned Kaliadem village. Two men lost their lives. **Figure 2** shows the condition nearby Kaliadem village after a pyroclastic flow.

In addition to the hazard of the phyroclastic flows, the local residents are also threatened by debris flows. In Mt. Merapi area, debris flow starts on the upper slope between the elevations of 1,000 and 2,000 m. Debris flows have frequently happened just after eruptions because pyrolastic flows pile up a huge quantity of loose sediments and ashes in the river basin of the volcano. The debris flows have caused serious damages in property and assets.

(b) Countermeasures of sediment related disasters

To mitigate the sediment disaster due to deposited sediment of Mt Merapi, the combination between two managements are used, that is structural and non-structural measures. By 2001, 50 check dams, 101 consolidation dams, and 12 km dykes were built to countermeasure the sediment related disasters. The debris flows were recorded 64 times since 1981, but the disasters were only counted 2 times. It indicates that the sabo facilities are effective to mitigate the sediment disasters and have provided the high safety of disaster prevention for local people. According to the survey by JICA (2004), it shows that prior to the project implementation almost half of the respondents were worried about debris flows. After the project implementation, none of the respondents worried about debris flows and 65 % of them said that they had no fear and lived there peacefully.

However, the other problems have occurred, such as river incision or morphological change that causes negative affects to ecosystem and river structures in downstream area such as pier collapse and no function of water intakes. Moreover, development provided by the Sabo work, like as transportation access, irrigation and the sense of safety have encouraged people to move to the mountainous area to use the land and other resources as well as the deposited sand. The situation raises new problems of related sediment disasters in the area, such as increasing population in disaster prone area and excess of sediment utilization.

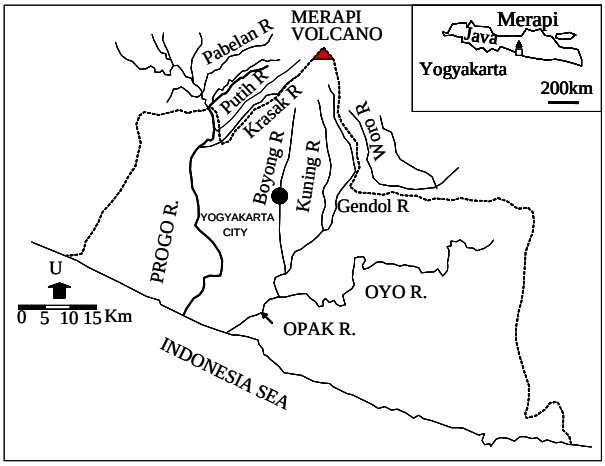

Fig. 1 Location of Mt. Merapi

Fig. 2 Kaliadem village after the pyroclastic flow

Key words: sediment, production, disaster, resources, Mt. Merapi
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3. SEDIMENT RESOURCES MANAGEMENT

(a) Current situation of sand mining

Recently, the total amount of the sand mining production has been increasing rapidly due to some reasons. The first reason is the deposited sediment has good quality for construction material. The specific gravity of the deposited sediment is between 2.65 and 2.70, and the content of silt is 0.06% to 1.40%. The other reason why the sand mining volume increases is the poverty due to the impact of the economic crisis, which began in mid-1997. The poverty in Indonesia has increased very significantly from 16.6% in 1996 to 27.2% in 1999. In Yogyakarta Special Province, the poverty increased from 16.2% in 1996 to 26.9% in 1999. The people need the additional income to survive under this condition, and look for a new income source, such as sand mining activity. The sand mining is a good cash income for the rural people in Mt. Merapi area as the agriculture endures the low productivity, because the irrigation infrastructure did not function and there are some unfavorable economic conditions. **Figure 3** shows the estimated sand mining production volume in the districts surrounding Mt. Merapi, which was estimated based on the sand mining tax collected by the local governments. **Figure 4** shows the sand mining activitiy in slopes of Mt. Merapi

(b) Sediment resources management in Mt. Merapi area

The volume of sand mining has increased significantly since 1999; when the regional government has been given broaden autonomy including its financial by the law Number 22/1999 and Number 25/1999. Based on these laws, the proportion of tax income allocation between Central and Regional Governments is 20% and 80% for Central and Regional Governments, respectively. The sand mining tax income has tremendously increased since 1999. For instance, the sand mining tax of Magelang district in 1998 was 264 million rupiah, but in 1999 the sand mining tax was 868 million rupiah or about 3.29 times of 1998. Hence, the both laws have motivated local government to increase tax incomes as well as sand mining tax income. Based on the description above, when viewed from the interests of the resources, people tend to mine the sand as much as possible, although sometimes ignore the interests of the environment. Consequently, sand mining causes the negative impacts on the environment such as unstableness of river structures, riverbank stability and so on. To overcome the problem of negative effects of sand mining on the environment, government and non-government organizations have discussed the above issues. Moreover, there are some regulations to be used, i.e. Public Work Decree No. 458/KPTS/1986. The decree is intended for river protection against sand/gravel mining exploitation. However, its impact in controlling sand mining is very limited due to the lack of integrated management.

4. CONCLUSIONS

As described in above, it is clear that people in upstream area are still threatened by sediment disasters, besides they also use it as a resource. So far, the management of sediment still tends to separate between sediment disaster management and sediment resources management, and between sediment management in the upstream and downstream areas. While sediment management for the purpose of certain interest will affect the other interests, management of sediments in the area will affect the downstream area. Based on the issues in upstream and downstream areas, the policy of sediment management is proposed as follows:

a. Due to Mt. Merapi eruptions, it is necessary to provide available volume of sabo works to against the excessive sediment discharges.
b. Sand mining is still needed to support regional development and to empty the sabo works as part of disaster management of sediment. However, it is proposed to be control strictly.
c. To stabilize riverbed and make countermeasures for riverbed degradation in downstream area, consolidation works would be proposed to be installed, as well as some sediment should be flowed into the area.

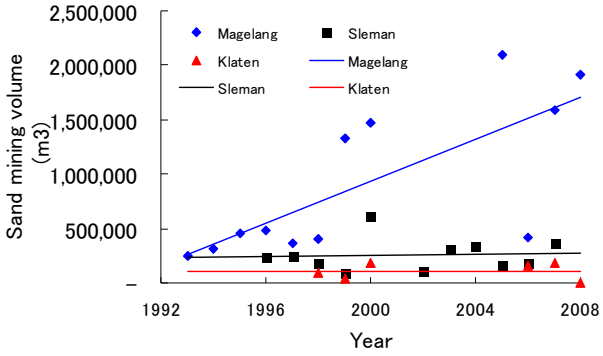

Fig. 3 Sand mining volume in the districts around Mt. Merapi

Fig. 4 A sand mining activity in Mt. Merapi

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