

CRISIS MANAGEMENT DURING THE 2010 ERUPTION OF MERAPI VOLCANO

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ABSTRACT

The last eruption of Merapi volcano which lasted from October until early December 2010 is considered to be the largest since the 1870s. This eruption had revealed a failure in the existing contingency plan. This article aims at analyzing the chronology of the 2010 Merapi crisis, evaluating the roles of different actors of crisis management and to study the community responses to volcanic disaster. Interviews with stakeholders, focus group discussions, questionnaire-based surveys, primary and secondary data collection were conducted before, during and after the 2010 eruptive crisis in the frame of the MIA VITA FP 7 project. The results show that started from November 3rd 2010, the authorities had difficulties to respond the crisis. The main problem occurred on the night of 4th November, when the government decided to extend the safety zone to a radius of 20 kilometers. A contingency plan might fail if the level of disaster exceeds the estimation of impacted area. Thus, contingency planning has to be adjusted for several scenarios.

Keyword: crisis management, volcanic eruption, Merapi

INTRODUCTION

Merapi volcano (2965 m) (Fig. 1) lies 25 kilometers north of Yogyakarta, a city whose population is over 1 million. This volcano is administratively located in two provinces, Yogyakarta Special Region and Central Java, which covers four districts, namely Sleman, Magelang, Klaten and Boyolali. Merapi is one of the most active volcanoes worldwide, with over 70 eruptions since 1548 (Voight, *et.al.*, 2000). During the last two centuries, this volcano has erupted explosively every 8-15 years and more violently every 26-54 years and the repose periods have not exceeded 3.5 years (Thouret, *et.al.*, 2000). The volcano frequently causes disasters with many deaths and loss of the resources (Sutikno and Santoso, 2006).

Crisis management in Indonesia is based on a hierarchical organization (Regulation of President of the Republic of Indonesia No.8 2008). Governments and local governments are mainly responsible for dealing with disasters and considering the roles played by stakeholders (Fig.2). The National Disaster Management Agency (NDMA or *BNPB* in Indonesian), initiated in 1966, is a non-departmental government institution who formulates, stipulates, and coordinates disaster management and its activities, pre-disaster, emergency response, and post-disaster activities. To implement disaster management duties at the Province and

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District/City level, Regional Disaster Management Agencies (RDMA or *BPBD* in Indonesian) have been established.

The 2010 eruption of Merapi lasted from late October until early December 2010. The contingency and evacuation plan prepared by the local government were able to handle the crisis during the first week of the eruption. Due to the strong, persistent activity, the government decided to extend the safety zone to a radius of 20 kilometers on November 4th 2010. Consequently, the crisis management plan was not adequate to overcome this largest volcanic eruption since 1870s. This article aims to explore the chronology of the 2010 Merapi crisis and to analyze the institutional and community responses to volcanic disaster.

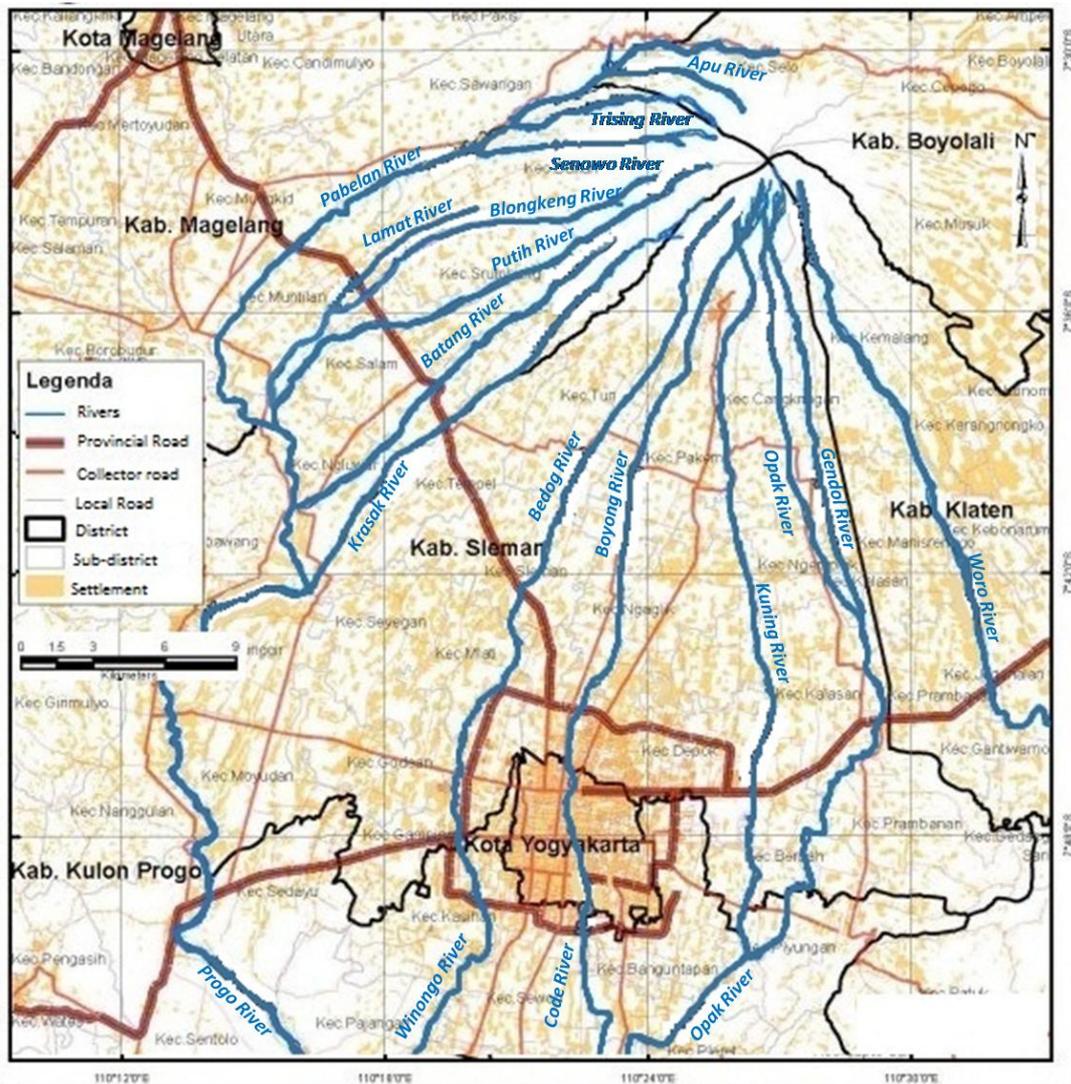


Fig.1. Merapi Volcano, Indonesia

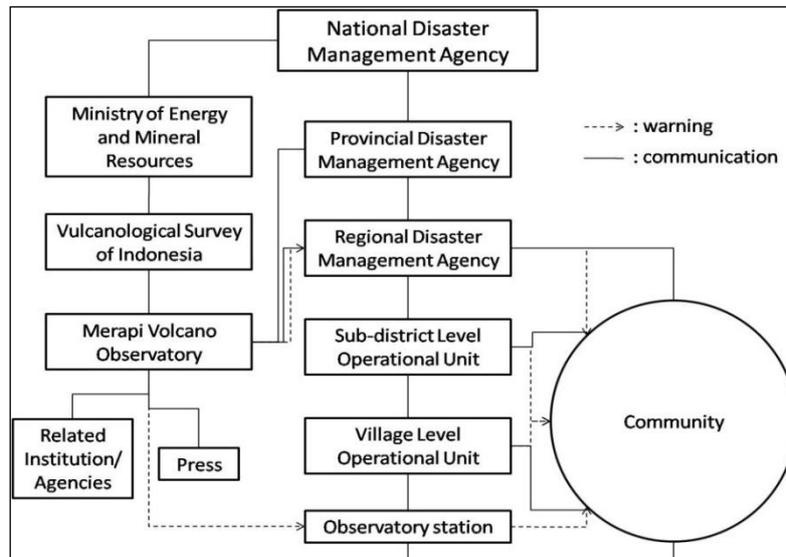


Fig.2. Disaster management in Indonesia

METHODS

Data were collected within four districts before, during and after the 2010 Merapi volcanic crisis. Before eruption, focus group discussions organized in two villages namely Ngargomulyo and Turgo, and semi structured interviews were conducted with key informants; in addition road data and secondary data related to the crisis management were collected since April 2010 until August 2010. Eruption monitoring data collection, questionnaire-based surveys, refugee data acquisition, interviews with stakeholders and key persons were conducted during the crisis. After the crisis, we also carried out surveys of the impacts of the eruptions within 60 villages located in the Merapi's flanks, post eruption focus group discussions in Ngargomulyo, Turgo and Bronggang villages and interviews with key persons, stakeholders and communities at risk. All interviews and surveys were conducted in Javanese and Indonesian languages.

The results of the questionnaire-based survey and refugee data were statistically analyzed. The spatial data such as population distribution, data of the impacts of eruption, road data, and refugee camps distribution were analyzed using geographical information system tools. Whereas descriptive analysis was used to study the roles of different actors of crisis management, the difficulties and success faced by different actors and the community responses to volcanic disaster.

Table 1. Research data acquisition and procession

	Pre-Crisis	Syn-Crisis	Post-Crisis
Field data collection	Population data in 4 districts at hamlets scale (<i>Podus</i>)	Eruption monitoring data collection	Surveys of the impacts of eruption within 60 villages (<i>Surdadu</i>)
	Focus group discussions in Ngargomulyo and Turgo villages	Questionnaire-based surveys (before and after the largest explosion of 4 th -5 th November 2010)	Focus group discussions in Ngargomulyo and Bronggang villages
	Road data collection in 4 districts	Refugee data acquisition	Updating road data collection

	Secondary data related to crisis management during the former eruptions	Interviews with key persons, stakeholders and communities at risk	Interviews with key persons, stakeholders and communities at risk
Data proce	Statistical database (population, refugee data, questionnaire-based surveys, <i>surdadu</i>)		
	Geo-database in ArcGIS platform (road data, population data, refugee data, safe zone data)		
	Descriptive analysis (secondary data related to crisis management, focus group discussion, eruption monitoring data, interviews)		

RESULTS

Chronology of the 2010 eruptive crisis

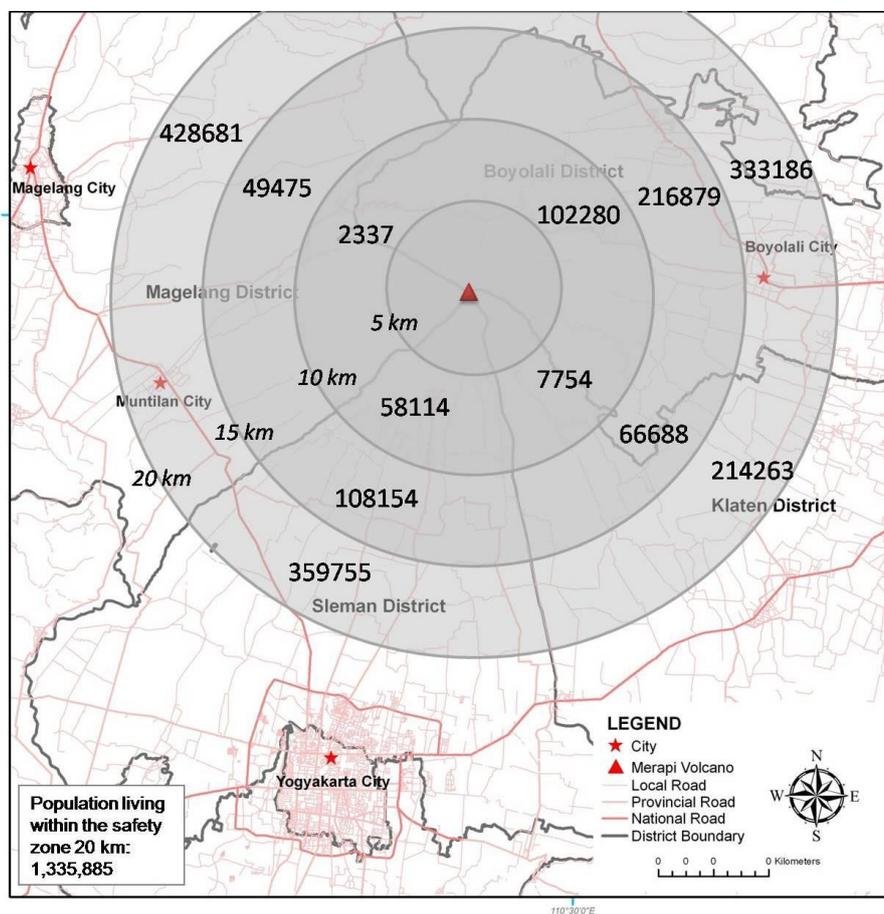


Fig. 3. Population living within the safety zone in the four districts (Sleman, Magelang, Boyolali, Klaten)

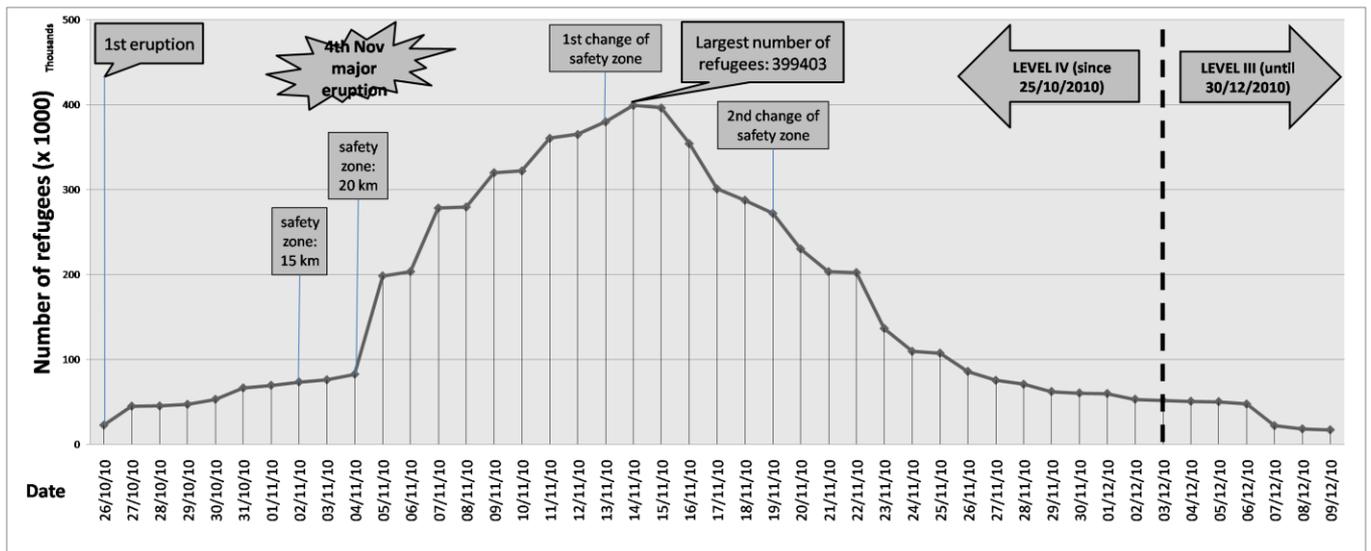


Fig. 4. Number of registered refugees in the four district of Merapi during the 2010 eruption (BNPB, 2010).

On September 20th, authorities increased the alert level from level I (normally active) to level II (on guard), as recommended by the Center of Volcanology and Geological Hazard Mitigation (CVGHM). One month later, the government raised the alert to level III. On October 25th, the alert was raised to its highest level and the government warned community in threatened villages to move to safer grounds. People living within 10 kilometers radius especially those living near the rivers were notified to evacuate.

On October 26th, block-and-ash pyroclastic flows reached the Kinahrejo village, southern part of the volcano, and killed forty people including the gatekeeper of the volcano, namely Mbah Marijan (grandfather Marijan, red.). Most of the refugees fled from their villages during the eruption. Based on the data from BNPB (2010), there were only 22,599 registered refugees during the first day of evacuation. By October 30th, the volcano exploded again, for a longer period and more violently than the previous events. Ashfall were spread as far as 30 kilometres away from the vent, and pyroclastic flows with duration of 22 minutes went to Gendol, Kuning, Krasak and Boyong rivers (Fig.1). On November 3rd, the authorities decided to move the shelters 15 kilometers away from the summit instead of the initial 10 kilometres. Since November 3rd, the local governments could no longer use the contingency plans collectively created by RMDA, MVO and UNICEF in 2009. On November 3rd, there were 76,031 registered refugees spread over four districts.

By November 4th, Merapi had been erupting for 24 continuous hours, and pyroclastic flows travelled up to 15 kilometres from the vent at around 11.30 P.M. At that time, the safety zone radius was extended to 20 kilometres. The number of population living in the area was 1,335,885 (Fig.3). However, based on the official data of refugees, there were only 399,403 registered refugees (BNPB, 2010). We estimated that there were around 1 million people evacuated from the 20 kilometers safety zone. This estimation lies on the assumption that Boyolali, a city located 18 kilometers from Merapi's summit, has not been evacuated and that there were a number of people who were not in the villages during the crisis period (e.g. overseas workers).

On November 13th, the safety zone was reduced to 15 kilometers from the vent for Magelang, Boyolali and Klaten Districts and 20 kilometers for Sleman District. The highest number of registered refugees was recorded on November 14th (Fig.4). Based on the interviews, the local authorities were not able to record the refugees outside the official refugee camps. By November 19th, the authorities modified again the safety zone: 10

kilometers for Klaten, Magelang and Boyolali Districts. Sleman district was divided into two regions with a radius of 15 kilometers to the east side of Boyong River and 10 kilometers to the west side. Discrepancies of the safety zone in Sleman district due to the fact that the eruptions were mainly directed to the south, between Boyong and Gendol rivers.

Volcanic crisis management: a top-down approach

The volcanic crisis management is basically based on the recommendations of CVGGM. This institution is responsible for assessing and monitoring volcanic hazards. CVGGM provides maps that delineate three danger zones ranking from 3 to 1 (KRB 3, KRB 2, KRB 1). They also provide four warning levels of volcanic activity from I to IV (*aktif normal, siaga, waspada, awas* -- normally active; on guard; prepared; and beware conditions). Stakeholders involved during the state of emergency (level III and IV) are volcanologists (CVGGM), local governments at district, sub-district and village levels, regional disaster management agency (RDMA or BPBD) including army, police, health department, public work department, social department and local authorities at sub-district and village level (Fig.6). The information of volcanic activities obtained from Merapi Volcano Observatory is transmitted to CVGGM and regularly reported to local governments (i.e. head of district). In the case of an emergency situation (level III and IV), the information can be directly reported to the head of district. Thus, the head of district together with BPBD will coordinate each department involved in the crisis management at regional scale. At the local scale, head of village together with the head of sub-villages and local organizations, with the help of army, police, NGOs and volunteer prepare the emergency and evacuation plan. Several disaster risk reduction programs such as evacuation drills were often conducted in Merapi region by different institutions, governmental and non-governmental. The community living in the villages located near to the Merapi’s summit was already prepared to face an eruption of Merapi.

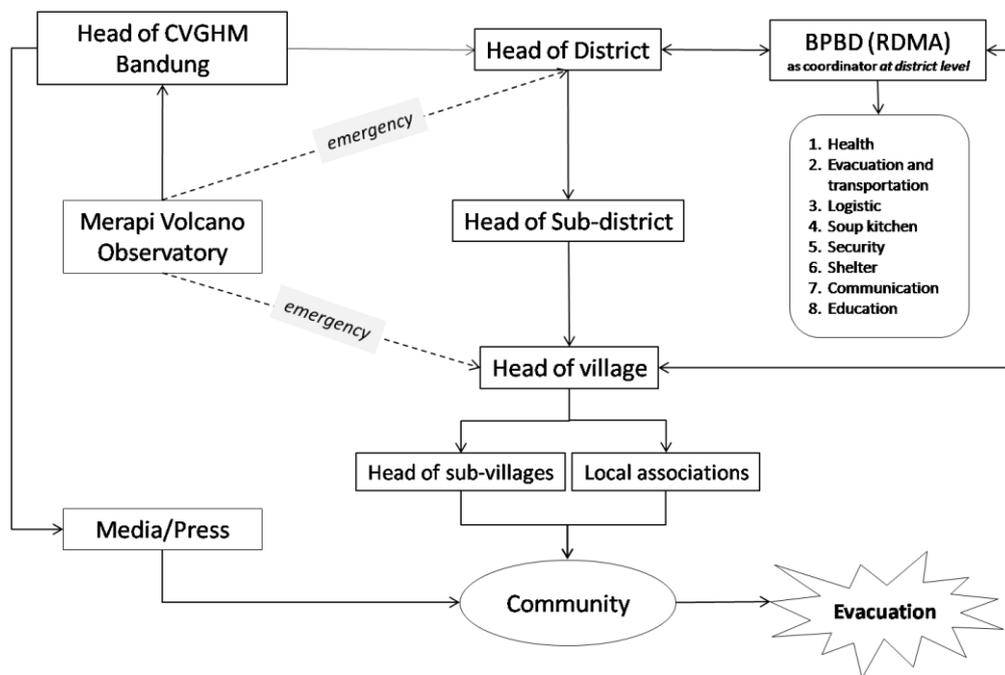


Fig.5. Crisis management organization

During the 2010 Merapi eruptive crisis, the local authorities have well managed the crisis until the main eruption on the night of November 4th. After the extension of safety zone

up to 20 kilometers from the summit, the local authorities were overwhelmed by the scale of disaster and the number of people to be evacuated. Difficulties were not only faced by the local governments but also by the volcanologists, several due to the destruction by pyroclastic flows of several monitoring tools since the first eruption on October 26th. Thus, the information for decision making purposes was not fully adequate. The local governments could no longer use the contingency planning because it was not prepared to anticipate such a big eruption of Merapi volcano. After a large-scale evacuation of people living in a radius of 20 km on November 4th, the communities from non-impacted areas and local organizations played a crucial role on crisis management.

Community responses in crisis management

Based on the interviews conducted in Ngargomulyo and Turgo villages, most of the refugees evacuated on October 26th when the first pyroclastic flows were reported. The evacuation order was mostly given by the head of village directly to the villagers. Technologies such as mobile phone and talkie-walkies as well as traditional tools such as wood gongs (*kentongan*) were utilized to inform the villagers. Trucks, motorbikes and cars were the main vehicles used for evacuations. Trucks were the main transportation tool because the evacuation process was organized by the authorities before November 4th. After this date, most of the people fled during the night by local means of transportation.

Before the peak of the eruption, most of the villagers opted to return home during evacuation period at daytime in order to survey the condition of their houses, to take a bath and to feed the cattle. People worried about leaving their livestock, who need to be fed and may be stolen as well as their properties left at home. In Merapi's flanks, cattle are the main resource for most of the villagers, and the only way of savings. Considering the number of cattle on the Merapi's slope, on November 1st, the local governments together with NGOs and academic institutions constructed some evacuation shelters for livestock, apparently for the first time at Merapi.

When the safety zone was extended up to 20 kilometers from Merapi's summit, there was no refugee camp prepared to accommodate the refugees away from this new radius. People started to evacuate from the new safety zone at 11.30 PM on November 4th. At that moment, either people or local government did not know where they had to evacuate. The local authorities of Sleman district prepared a new refugee camp in Maguwoharjo football stadium on November 5th at 5 A.M only. This site became the largest official refugee camp in Sleman district which accommodated more than 21,900 evacuees. However, due to limited space at the stadium, many refugees moved to smaller refugee camps managed by local communities, local institutions (community-based shelters) or moved to relative-based shelters. During the crisis situation, support on aids, food, clothes, medicine and other basic needs were granted by local communities from non-impacted areas, local institutions and organizations, e.g. each family living near Maguwoharjo stadium prepared five meals per day for the refugees during the first days of crisis.

The role of local associations was not only limited to aids distribution but also for crisis communication, as exemplified by the actions of Jalin Merapi, a local association supported by several NGOs working in Merapi's flanks. This association established in 2006 was initiated by three community radio stations in Klaten, Boyolali and Magelang districts. During the emergency response period in 2010, Jalin Merapi used various media to quickly and accurately convey important information and data to support the decision making process. It could be accessed through website, social networking such as Twitter and Facebook, SMS, radio communication, telephone and the post information in the field who was managed by a voluntary network that runs 24 hours a day.

DISCUSSION

The importance in planning and coordination

Contingency planning has to wrap a forward management process to establish arrangements and procedures to respond to a potential crisis or emergency. This includes developing scenarios, determining the objectives of all actors involved in this situation, information process, and operational arrangements for specific actors at times of need and defining what will be needed to reach those objectives (Vidiarina, 2010). Planning for volcanic contingencies is a difficult task, requiring urgent attention in view of the results of volcano surveillance and historical eruption history (Mckee et al., 1985). During the 2010 eruptive crisis, several monitoring tools in Merapi were destroyed by pyroclastic flows. The information of volcano surveillance was not fully adequate for emergency decision making purposes. A contingency plan might fail if the level of disaster exceeds the estimation of impacted area, as happened in Merapi volcano. The last contingency plan of Merapi was created collectively in 2009 by the Merapi Volcano Observatory (MVO), Governments of Klaten, Boyolali, Magelang and Sleman Districts, UNICEF, and several non-governmental organisations. Unfortunately, this contingency plan was not adequate to overcome the crisis, because the coverage area of the safety zone was smaller than the areas to be evacuated during the 2010 eruptive crisis. The plan needs to identify all resource requirements. All agencies involved in the evacuation management must also have a clear understanding of their roles and responsibilities. The main problem during the November 4th evacuation was the underestimation of the coverage area of emergency plan in all regencies. Thus, the emergency plan should be tailored to local discourse and consider the needs and resources of the region.

Including everyone in community participation

Communities should be included in disaster management programs, in order for government and communities to play complementary roles in coping with volcanic disasters (Paton *et al*, 2008). Community together with NGOs and local institutions had proven that they can response the crisis by working collectively when the local authorities were overwhelmed to cope with disaster. After the 2006 eruption, efforts have been made by the local authorities together with MVO-CVGHM, academic institutions and NGOs to create Forum Merapi. This Forum's goal was to create a more comprehensive and participative disaster risk reduction program on the Merapi volcano. Since 2006, several programs on volcano-related disaster management were conducted under the forum's umbrella, e.g. participative volcanic hazard mapping, community evacuation simulations, and compulsory training programs for hazard mitigation. Consequently, residents in the villages located close to the summit were already prepared to face an eruption of Merapi. The gatekeeper's death during the first day of the eruption also affected people's perception of volcanic risk. People used to put their trust on the gatekeeper, although they were exposed to the danger. Yet, the villagers increasingly believe in the authorities and scientists, notably the volcanologists and their chief, Dr Surono (sometimes called the new gatekeeper of Merapi by the journalists and even the population). However, there was a lack of community awareness and education for villages located between 10 and 20 kilometres from the summit, where the evacuations were unplanned. More than 80 % of the victims of the November 4th eruption were living in villages located outside the 10 kilometres radius. Therefore, in the future, community awareness and education should also be held in all volcanic hazard prone areas.

The role of media in crisis situation

Information and knowledge are important, but the public's views and reactions are decided by different things, such as the fact that people choose what they read and believe in (Attersam, 1995). A problem of crisis communication occurred on November 7th during the emergency period, it happened when a national television station broadcasted an issue that the pyroclastic currents could reach 60 kilometers away from the Merapi's summit and therefore could destroy Yogyakarta city. As a result, many people panicked and fled far away from their previous refugee camps. Mass communication is inextricably entwined with disasters (Rattien, 2005). The role of the media is very important in transmitting information to public (De Belizal *et al.*, 2011b) if the information is accurate and reliable.

CONCLUSION

The main problem during the November 4th evacuation was the underestimation of the coverage area of contingency plan in all regencies. A wider range of volcanic hazards accompanying different scales of eruption must be considered for evacuation and contingency planning in Merapi. Institutional response to minimize risk is not as effective as when the community is involved. Working with the community is an ideal solution to minimize the gap between the government, scientists, non-governmental organizations and the community itself. Community together with NGOs and local institutions had proven that they can response the crisis by working collectively when the local authorities were overwhelmed to cope with disaster.

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