Policy Analysis for Hitting the Right Target: Risk Communication in Mt. Merapi

Saut SAGALA* and Norio OKADA

* Graduate School of Engineering, Kyoto University

Synopsis

This paper presents a model of macroscopic and microscopic analysis of how people take decision under disaster condition and societal context that governs a preparedness action. In the study area, common risk communication method includes: a distribution of hazard zone maps to the people, information through radio, disaster preparedness brochures, etc. The variety of responses among respondent opinions on risk communication method means some people do not fully understand how to utilize the information into practice. This study suggests policy makers and risk managers need to adjust the risk communication methods and messages with needs and socio-context of the communities.

Keywords: Mt. Merapi, preparedness, policy, risk communication

1. Introduction

Risk is the possibility that people or property could get hurt (Lindell et al., 2007) and thus it must be effectively communicated to the people who are likely to be affected. Tierney et al (2001) argues that an understanding of how and why households prepare for disasters must be based first on an understanding how the public perceives and act on risk information.

Based on their research, Mileti and Fitzpatrick (1993) suggest that successful risk communication, i.e. communication that stimulates action – is based on four general principles. First, risk communication is a process, and the impact of such communications can not be understood unless the risk message is placed in the context along with other such communications. Second, risk communication involves the joint effects of source and message characteristics (e.g. sources credibility, repetition, frequency of repetition, specificity, type and number of channels used to disseminate information) on the one hand and the characteristics of member target audiences on the other hand. Third, risk perception is multidimensional, involving hearing, understanding, believing, and personalizing a risk. Finally, what people do when they receive risk information is not only of the information itself but other activities which people subsequently engage, such as evaluating the risk information that has been provided, seeking additional information from other sources, and discussing the risk information (community participation) with friends, relatives, neighbors, and coworkers (critical awareness).

Risk communication must compete for attention with numerous other types of information that may be much more salient to the public. Tierney et al (2001) asked the following questions: how much time, effort, and money that people are

willing to invest in preparing for disasters.

Therefore, risk communication is often argued to be very important at the core of risk management. Many decision makers, NGO/NPO workers and local champions attempt to educate people in order to increase their preparedness against disaster risks. However, sometimes even after some risk communication is performed people yet are not motivated to effectuate preparedness. This paper presents a model of macroscopic and microscopic analysis of how people take decision under disaster condition and societal context that governs such a preparedness action. In the study area, common risk communication method includes: a distribution of hazard zone maps to the people, information through radio, disaster preparedness brochures, etc. Our observation and interviews from the field suggest that the respondents do not fully understand what the information means, moreover how to utilize them into practice. To investigate this problem, we carried questionnaire surveys and in depth interview in January – February 2008 to communities (N = 322) living at fourteen hamlets in southern flanks of Mt. Merapi, Yogyakarta (figure 1), Indonesia.

This study is carried out based on the previous studies in this study area (Sagala and Okada, *in review;* Sagala et al., 2009; Sagala et al., in review). Taking the communities in Mt. Merapi as the study area, this study propose some policy analyses to be presented if one wants to increase the quality of risk communication.

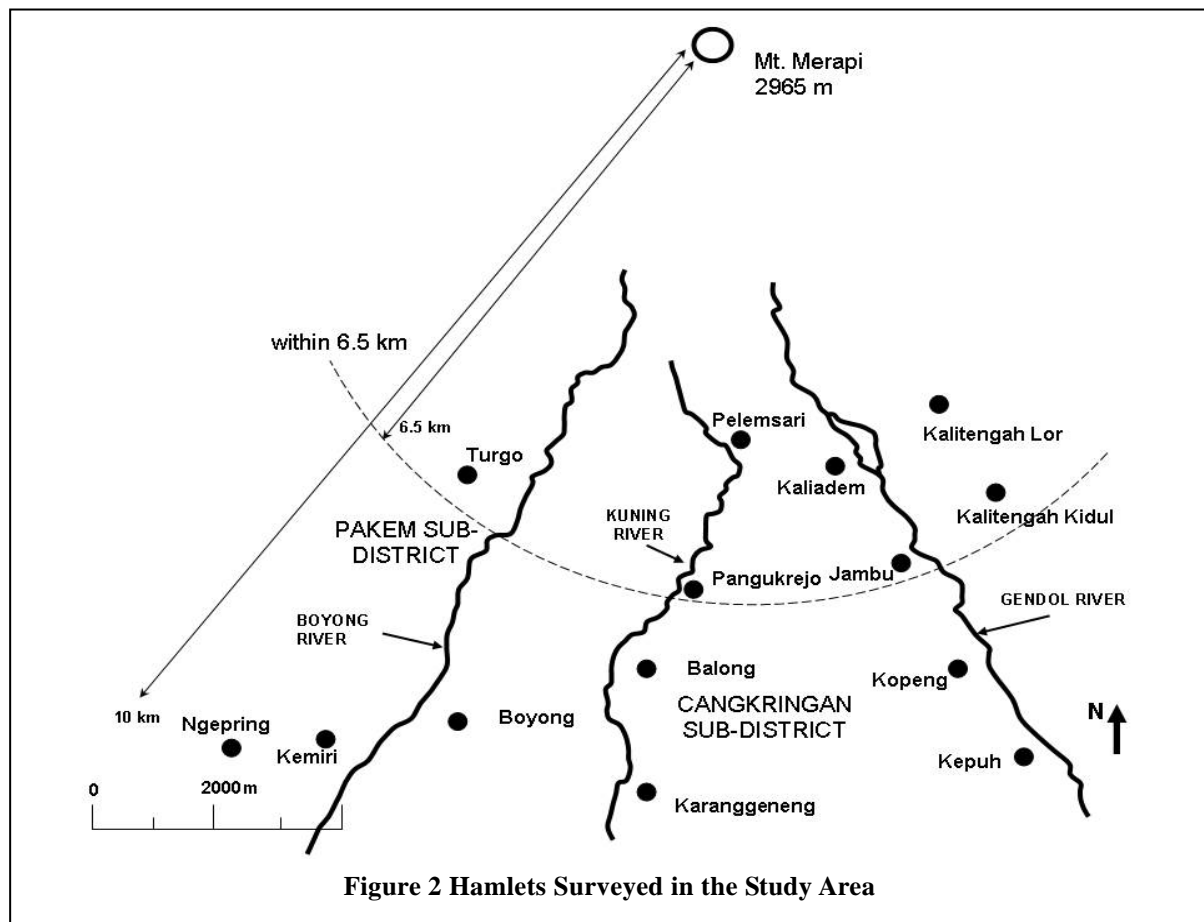Figure 1. Location of Yogyakarta Province

Figure 2 Hamlets Surveyed in the Study Area

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2. Methodology

We carried out the field survey in January – February 2008 at fourteen hamlets at the southern flanks of Mt. Merapi Volcano. We distributed questionnaires to the residents living at this volcano hazard prone area. The total number of respondents that we surveyed in the fourteen hamlets was 322. This study refers to the results obtained in the previous studies.

The survey method was conducted by using the questionnaire survey administered to the communities in Merapi Volcano in January – February 2008 in fourteen hamlets on the southern flanks of Merapi volcano (see figure 2). The questionnaire was intended to collect data on the evacuation decision and factors related to hazards. The respondents for the questionnaire survey were selected randomly. In total, there were 322 respondents interviewed. This number of respondents represented about 10 – 15 percentage of the total households in the hamlets that were selected for the case study area. To make sure the respondents clearly understood our questions, in each meeting we had assistance from 5-6 facilitators guiding the respondents, and each respondent handled four to six respondents.

3. Study Area

Mt. Merapi is located at the north part of Yogyakarta City, the capital of Yogyakarta Province. This mountain has been regarded as one of the most active volcanoes in the world since it erupts very frequently.

The Merapi volcano is located at the northern part of Yogyakarta City (see figure 1) at the border between Yogyakarta and Central Java Provinces. Several inhabited cities and regions, such as Yogyakarta City, Sleman, Magelang, Muntilan, Klaten and Boyolali, are located nearby this active volcano. In total, in these cities and districts there are about 1 million inhabitants.

The study area is located at the southern flanks of the Merapi Volcano, the areas which were affected by the recent 2006 volcanic eruptions. It belongs to the Sleman district and two sub-districts: Pakem and Cangkringan. In total we surveyed 322

respondents from fourteen hamlets. In the study area, the smallest local administrative unit is the village and each village consists of several hamlets. A hamlet, called dusun in Indonesian, was selected instead of village as the unit of analysis here because the hamlet represents the place where a community lives and in many cases it was found that in each community people take action together with other people from the same hamlet.

Merapi has been very active within the last two decades. The records noted that the volcano previously erupted in 1994, 1997, 2001 and 2006 (Ratdomopurbo et al., 2006). In term of numbers of people killed and size of eruption, the eruptions in 1994 and 2006 are among the most dangerous eruptions within the last two decades. The list of all major eruptions in Mt. Merapi was recorded by Thouret et al (2000) as noted in table 1. For example, in 1994 Turgo hamlet has been severely affected by the eruption that at least 63 people died after the pyroclastic flow climbed down to the hamlet (Paripurno et al., 1999). Despite the negative impacts, the eruptions also bring positive impacts to the people. For example, the most recent eruption in 2006 has brought excessive sands and constructions materials that are exploited by the local people and sold to nearby cities for construction development.

In the 2006 eruption, the Sleman District Government prepared the evacuation shelter located far further down on the southern parts of the volcano. The distances from the evacuation shelters to the volcano vary from 10 – 14 km.

During an emergency, demand for information is intense and this demand places a strain on all responding agencies (Ronan and Johnston, 2005). It is recommended to prepare plans and public information in advanced, prior a disaster occurrence. Okada (2008) proposes the use of "disaster clock" to understand this concept. In this concept, it is assumed that a disaster occurs at 6 o'clock. Prior to that time is a preparation stage, which includes the right time to disseminate information to the public.

Table 1 the List of Major Eruption in Mt. Merapi (Thouret et al 2000)

| Eruptive Events	Type of Eruption	Casualties PF / DF	Affected Villages
1672	Ex, PF, DF	3000	
1822-1823	Ex, PF, DF, D	100	
1832-1835	Ex, PF, LF, D	32	
1849	Ex, PF, LF	Hundreds	
1871-1872	Ex, Tf, PF, LF	200	
1902-1904	Ex, D, LF, PF	16 (PF)	3
1920-1921	Ex, PF, D, DF	35 (PF)	1
1930-1931	Ex, PF, LF, D, ps, DF	1369 (PF + DF)	42
February 1932	Ex, sec. DF	DF	1
1953-1954	Ex, PF, Ph, LF, D	64 (PF)	6
1961	Ex, PF, D, ps, sec. DF	6 (PF + DF)	10
January 1969	Ex, PF, LF, ps, sec. DF	3 (PF + DF)	26
1972-1975	Ex, PF, LF, D, sec. DF	9 (DF)	Several tens
November-December 1976	LF, PF, sec. DF	29 DF	Several tens
22 November – 7 December 1994	Ex, PF, ps, DF	66 (PF, ps)	Several
14-18 January 1997	Ex, PF, D	6 missing, several injured	
April – June 2006	PF	Two died	
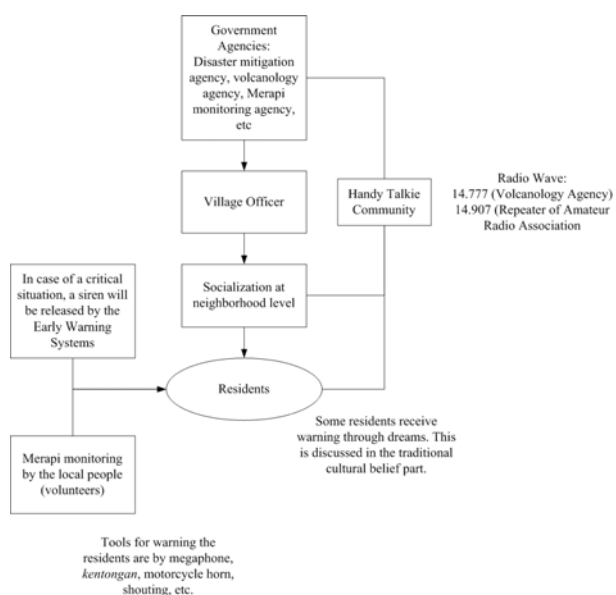
Figure 3 Information flow during a volcanic crisis in Mt. Merapi

Figure 3 describes how the information flows during a volcanic crises in Mt. Merapi. The main information is, of course, coming from government agencies (disaster mitigation agency, Volcanology agency, Merapi monitoring agency, etc). However there is a relay of this information by radio wave provided by Volcanology agency and some amateur radio association. In each hamlet, people obtain the information through the radio and distributes to the others in their hamlet.

Another means of communication made by the local people includes the development of local siren systems.

4. Results & Discussions

The macroscopic analysis, model of social resilience, comes up with community variables (community participation and collective efficacy) that determines people action in intention to carry out disaster preparedness. It is then followed by institutional variables (empowerment and trust) that support the communities with information and capabilities prior taking a preparedness action.

The microscopic analysis, analysis of evacuation decision, indicates the differences among people when receiving information to evacuate. Some people take their decision on the basis of their disaster experience while some others take their decisions on the proximities to hazard sources. However, there is a unique case where people in a hamlet take their decisions due to their cultural beliefs. The findings on the microscopic analysis illustrate heterogeneity.
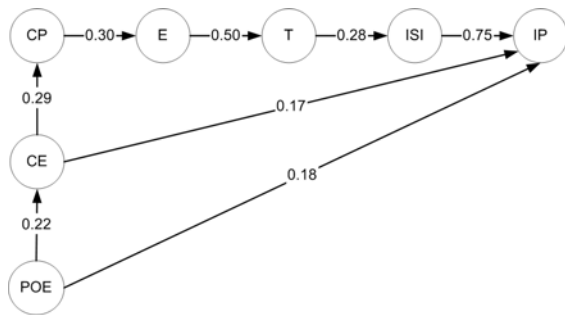
Figure 4 Social Resilience of Communities in Mt. Merapi (source: Sagala et al *in review*)

Study on social resilience indicates the following model (figure 4). This model is based on the interaction between individual, community and institutional factors that affect the "intention to prepare" against volcanic hazards.

In the analysis of social resilience of communities living in the southern flanks of Mt. Merapi Sagala et al (2009) found the following model that describes how "intention to prepare" is predicted by the other factors (see figure 5). The model describes what factors that contribute and motivate people to have "intention to prepare". The model found that some collective and institutional factors that contribute to intention to prepare. For example, factor collective efficacy contributes a lot to the intention to prepare.

In other study, Sagala and Okada found the factors that are associated with the household evacuation decisions (Sagala and Okada, *in review*). They found several factors that are correlated with the household evacuation decisions (see figure 5). Figure 5 explains that the evacuation decisions are correlated negatively with the distance to the sources of hazard (to the volcano and the river). This means the further the residents live from the volcano or far from the river, the smaller is the willingness to evacuate. On the other hand, the closer the distance to the volcano, the higher is the willingness to evacuate. The relationship between evacuation decisions and disaster experience shows a positive correlation. Those who had earlier experience tend to be more willing to evacuate than those who did not have experience. The relationship between natural signals and the evacuation decisions also show a positive correlation but with a less significant value of the correlation.
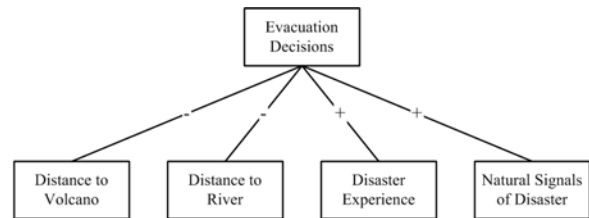

Figure 5 Relationship between evacuation decisions and hazard-related factors

We asked the respondents whether they understand that they live in hazard prone area. We asked this to the respondents who lived in hazard zone 3 and hazard zone 2. About When the respondents asked whether they understood the meaning of the hazard zone, most of them just knew that it is a dangerous place (figure 6).
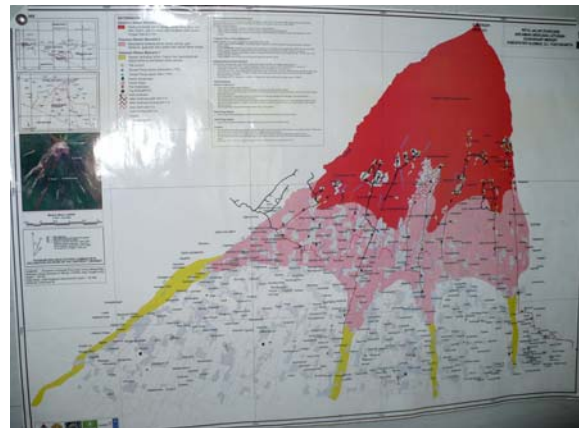

Figure 6 Map of Hazard Zone in a respondent's house

However, to a deeper extent like what are the meaning of the legends (colors and symbols) in the map, they did not understand that clearly. There are some possible reasons for this lack of understanding. First, it could be due to lack of further explanation by the authority during the distribution of the map of hazard zone. When we asked the respondents how he / she received the map, they said the map was simply distributed by the local leaders without any further discussion or guidance on the meaning of the hazard zone. The special findings, such as roles of cultural beliefs in evacuation and commuting evacuation, contribute to a special context which may merely occur in developing country. This information is vital in creating a more adaptive risk communication way and emergency process.

Table 2 The classification of the hamlets based on the evacuation decision analysis

	Type	Hamlet	Influenced by
A	Respondents who experienced disaster and held beliefs are likely to trust more on their disaster experience	Turgo	Hazard-related factors: disaster experience
B	Respondent who reside in the key-holder hamlet tend to trust on cultural beliefs	Pelemsari	Cultural belief factor
C	Respondent who did not experience disaster but resided close to the sources of hazards.	Kalitengah Lor, Kalitengah Kidul,, Kaliadem, Kopeng, Jambu, Kepuh and Pangukrejo	Hazard-related-factors: hazard proximities and natural signals
D	Those who stayed far from the volcano (8-10 km) and far from the key-holder did not evacuate	Ngepring, Kemiri, Boyong, Karanggeneng and Balong	Hazard-related factors: Hazard proximities

For example, the commuting evacuation needs a further investigation of how to provide an optimal time and cost for commuting. Similarly, the finding on cultural beliefs suggest that the cultural leader needs to be heavily involved in the process of risk communication. The fail of persuasion to some people might occur because they trust more to cultural leaders as compared to the local government.

5. Conclusions

This study suggests policy makers and risk managers to adjust the risk communication methods and messages with needs and socio-context of the communities. Ultimately, this study argues that the communities have different characteristics in dealing with disasters. Thus, disaster education program should be adjusted to the needs of each community. For example, for communities where there is much influence of cultural beliefs, it is important to educate the people on the potential of imminent disaster, such as pyroclastic flows. That the past pyroclastic flow did not reach into their hamlet does not mean that there is no possibility in the future. As the role of cultural leader (key-holder) is prominent in this hamlet, it is important to approach the message from the key-holder. For the hamlets where hazards related factors play a significant role, it is important for the emergency manager to remind people to keep their level of awareness. Further detailed information of

how pyroclastic flow might occur should be conveyed to people living in these hamlets so that they understand how dangerous the pyroclastic flow is.

Findings in this study are important in developing a suitable risk communication for communities in Mt. Merapi and other communities facing similar condition. The findings suggest right messages should be communicated through risk communication method which is adjusted to the level of understanding of the communities. For example, to the people in Vanuatu, Solomon Islands, Cronin et al (2004) suggested to include the cultural symbols and simple hazard maps to communicate with the local people. Similarly, for people who hold cultural beliefs it is important to take into consideration their cultural beliefs in such a way to increase their preparedness against the volcanic risks. Noteworthy is to approach and to include the cultural leader (key-holder) for disaster education to the residents.

The findings confirmed that, in members of a collectivistic society, preparing is a process that is carried out collectively, with factors such as "community participation" and "collective efficacy" derived from everyday life being particularly important. These findings imply that community-based approaches to risk management in Indonesia (and in other collectivist societies) will be more effective than those targeting individuals.

The literature provides many examples of community based disaster management in the

developing countries (Allen, 2006; Luna, 2001; Purnomo & Mendoza, 2004; Suyanto, Applegate, & Tacconi, 2001). So-called community based activities are commonly initiated by either local champion in a community or by organizations in the form of NGO, either local or international. The findings from the present study can be used to inform how these agencies work with communities. It allows them to target their intervention (e.g., ensuring hazard issues are identified and discussed in community groups, providing risk management activities in ways that increase collective efficacy). However, evidence suggesting that individual beliefs do play a role suggest that some attention should be directed to this level of intervention. Identifying the contents of intervention at this level must, however, await additional work.

Currently, public hazard education and risk management promotion are carried out on a project basis or soon after a disaster occurs. Because this approach defines disaster preparedness as a process that is separate from people's daily activities, it lacks the condition necessary to facilitate community members' ability to identify and discuss hazard issues in the context of normal community activities. Thus, after a program or campaign, people are not motivated to apply the information into disaster preparedness. Our findings suggest, it is important to integrate risk management and community development for improving disaster preparedness in more collective society. The inclusion of risk management program in community daily activities will significantly increase their capabilities (e.g., collective efficacy) and relationships (empowering) within the communities. Our findings also highlight the roles of institution (local government, emergency managers) to empower the communities. Appropriate coordination between local institutions and communities will increase trust and subsequently motivate people to search for information and carry out preparedness.
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Acknowledgements

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住民の防災行動を促すための政策分析：メラピ山におけるリスクコミュニケーション

Saut SAGALA*・岡田憲夫

*京都大学工学院研究料

要　旨

　本研究は災害時や防災を掲げる社会における住民の意思決定をマクロ・ミクロの両観点から分析した。一般的なリスクコミュニケーション手法には，住民へのハザードマップの配布，ラジオを通した情報提供、防災パンフレットの配布などがある。リスクコミュニケーションに関する様々な意見を見ると，情報を行動に結びつける手法が確立していないことが分かる。本研究では，政策立案者とリスク管理責任者がリスクコミュニケーション手法や地域社会におけるコミュニティの調整を行う必要性を提言する。

キーワード: メラピ山，防災，政策，リスクコミュニケーション