INTERNATIONAL WORKSHOP ON MULTIMODAL SEDIMENT DISASTERS TRIGGERED BY HEAVY RAINFALL AND EARTHQUAKE AND THE COUNTERMEASURES

March 8 - 9, 2010
Yogyakarta, INDONESIA

Editors
Radianta Triatmadja
Kuniaki Miyamoto
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Daizo Tsutsumi

Universitas Gadjah Mada
Kyoto University
University of Tsukuba
RITSUMEIKAN
International Workshop on Multimodal Sediment Disasters Triggered by Heavy Rainfall and Earthquake and the Countermeasures

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PREFACE

The Hydraulic Laboratory, Civil and Environmental Engineering Department, Faculty of Engineering, Universitas Gadjah Mada, has been established since 1972. Supported by a number of teaching staffs graduated from renowned universities abroad, the hydraulics laboratory is rapidly expanding its capacity through establishment of various networking with not only the other departments in the university, but also other universities in national and international levels. Obviously, the laboratory always tries its best to serve mankind in wider atmosphere, including establishing the integrated merit research involving undergraduate and graduate (Master and PhD) students. Such idea may not be achieved unless frequent exchange views and experiences regarding the state of the art of the related-field researches are conducted. Furthermore, the Hydraulic Laboratory, Civil and Environmental Engineering Department, Faculty of Engineering, Universitas Gadjah Mada in collaboration with three well-known universities in Japan, namely Kyoto University, University of Tsukuba and Ritsumeikan University will hold an international workshop entitled “International Workshop on Multimodal Sediment Disasters Triggered by Heavy Rainfall and Earthquake and the Countermeasures” in Yogyakarta, Indonesia, on 8 until 9 March, 2010.

About 25 papers from Indonesia, Taiwan and Japan of various related topics (multimodal sediment disasters, sediment management at volcanic and/or non-volcanic area, sediment transport hydraulics, sediment resources management, water resource engineering and management, landslides disaster mitigation system, development of monitoring, forecasting, and warning system, flood management and risk analysis, coastal and estuarine disaster management, and community-based and socio-culture approach on disaster risk reduction) were presented and discussed in the international workshop.

The co-organizer of the international workshop are really honored to conduct the international workshop. On behalf of the co-organizing committee of the international workshop, I wish to thank all the participants who have contributed papers, and to all parties who have been involved throughout the implementation of the international workshop, and made the international workshop met a great success.

Yogyakarta, 8 March 2010

[Signature]

Prof. Ir. Djoko Legono, Ph.D.
Chairperson of the Co-Organizing Committee
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A Self-Evacuation Drill Development Program for Community Resilience against Mt. Merapi Disaster

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Abstract

Mt. Merapi is an active volcano in which the occurrence of the eruption is very frequent and produces significant disaster. As a part of disaster mitigation program, evacuation drills become very important not only for raising the community awareness, but also for increasing the community resilience against Mt. Merapi disaster. Various stakeholders from both related governmental agencies in Yogyakarta and Central Java Provinces, and private sectors, have introduced several drills at certain levels, mostly above the village levels. There are still few evacuation drill programs being conducted at the lower levels, in which community should conduct the first action when the disaster occurs. The presence of the facilities provided by the related government agencies would not be effective unless systematic evacuation system at sub-village levels is made available and frequently trained to the community. This paper presents the results of efforts in establishing the self-evacuation drills that are supposed to contribute beneficial in term of community resilience against Mt. Merapi disaster. The selection process of the model area is presented utilizing the community-based approach, so that the accommodated community aspiration may support the sustainability of the program. Three levels of alert that are now recognized by the local community are utilized to develop the program, including process of selecting the small group in charge in order to develop standard operating procedures, evacuation map, poster, and disaster preparedness organization. Method of self-evacuation drills implementation and its evaluation is presented and discussed accordingly, and recommendations for future replication of similar self-evacuation drills is promising beneficial for Mt. Merapi disaster mitigation program.

1. INTRODUCTION

Mt. Merapi is located at the Yogyakarta Special Province and Central Java Province, at approximately 7°32.5'S latitude and 110°26.5'E longitude. The distance from regencies/cities of Yogyakarta, Magelang, Boyolali, Klaten is 30 km, 26.5 km, 17.5 km, and 25 km respectively, and its peak elevation is 2911 m to 2947 m MSL. Frequent eruptions have induced pyroclastic flows due to the collapse of lava dome or lava tip, resulting in tremendous amount of loose volcanic deposit on the
slope of Mt. Merapi and disasters in downstream areas. Once there is a sufficient rainfall, the loose deposit flows as debris flow, endangering the downstream residents’ lives and assets [1]. The foothills of Mt. Merapi have suffered from those volcanic disasters. Densely populated cities including Yogyakarta City extend in the south of Mt. Merapi. According to history, the most frightened danger resulted from Mt. Merapi activity is pyroclastic cloud. The vertical distribution of the pyroclastic cloud is hot/fire ash at the bottom, followed by hot fine ash, and then hot gas mixed with very fine hot ash. Second danger (often called as secondary disaster) arises in the form of debris flow in which the deposited material in some mechanism (often triggered by rainfall) flows down with high concentrated sediment (mixture of boulders, stones, and sand), destroying infrastructures such as bridges, houses, roads downstream.

In almost all cases of disaster occurrence, the public awareness and disaster preparedness of the community is the significant factor that may reduce the number of casualties. This is considered common since the assistance and helps from the outside of the community, i.e. from the regency authorities, may take sometimes and are often too late. Similar condition may also be found in Mt. Merapi disaster, where such awareness and preparedness may not be established within the community unless appropriate evacuation drills are conducted [2, 3]. Through the systematic and frequent self-based evacuation drills, community may recall the previous disaster occurrence, appreciate the importance of appropriate anticipation and action, and enable to save their lives and properties. According to the preliminary observation, the previous trainings of evacuation drills are mostly training of trainers (TOT) so that only few people involved in those activities. It is expected to disseminate more knowledge on disaster management to local communities. The existing standard operating procedures stated that government in regency level has a responsibility to conduct evacuation up to village level whereas responsibility of evacuation from each house to temporary evacuation shelter is managed by village government. Therefore, there is a necessity to conduct a self-evacuation drill and to establish standard operating procedures, evacuation map, poster and disaster preparedness organization.

2. STRATEGY FOR VOLCANIC DISASTER RISK REDUCTION THROUGHH EVACUATION DRILL PROGRAM

In order to formulate a strategy for volcanic disaster risk reduction through self-evacuation drill program, it is necessary to observe the previous related-evacuation drills conducted in the surrounding area of Mt Merapi. It was found that the previous activities were only focused on selected key-person from local community, teachers from primary school through high school, governmental official from regency, district and village level and related parties such as police, army, primary care unit, Red Cross, SAR, TAGANA, SKSB, and NGOs. However, due to some limitation, the local community as the real evacuee was not adequately involved in managing or arranging the evacuation drill. They were positioned as the object to be trained rather than as an active subject that could manage the evacuation independently during the occurrence of disaster.

Regarding the Standard Operating Procedures (SOP) proposed by the local governments [4, 5, 6, 7, 8, 9], it has stated the evacuation procedure from village level through regency level. The evacuation procedure from house level until village level (temporary evacuation shelter) was not clearly explained in these SOPs. Therefore, the village government has the responsibility to conduct evacuation from each house to temporary evacuation shelter. Based on the results of study on public participatory in disaster management [3], almost 70% of 789 respondents from 20 villages within
hazard area never have experience as refugees and many respondents have limited knowledge on disaster mitigation and preparedness. However, most of the respondents think that the evacuation drill is very important to enhance their capacity in volcanic disaster preparedness. They prefer the socialization meeting than other medias to increase people’s awareness of disaster. Furthermore, they are familiar with *kentongan* as a warning sound during disaster occurrence. Based on the study review, it is important to arrange the self-evacuation drill program, which puts emphasis on increasing people’s knowledge and awareness of volcanic disaster, information dissemination through socialization meeting and incorporating the familiar warning sound such as *kentongan* and if possible other medias. Moreover, most of the people think that an organization helping people in time of disaster is very crucial. Therefore, there is a necessity to establish a local disaster preparedness organization at village or sub-village level.

In general, the proposed self-evacuation drill program needs to put emphasis on the following issues: (1) Evacuation drill program should involve all local community members in the sub-village level; (2) The community should take an active role in managing and arranging the evacuation drill by their own capability; (3) A small group in charge from local community should establish standard operating procedures, evacuation map, poster, and disaster preparedness organization; and (4) The evacuation-related materials and other information should be disseminated through socialization meeting to expedite a valuable discussion and explore the aspirations from the community. The model area needs to be considered carefully based on the needs and necessity of self-evacuation drill implementation. Accordingly, two basic criteria in selecting the model area can be derived, i.e. model area located at Hazard Zone III and the local government agrees to support this program, and at the same time local community are willing to work together in implementing the drill. It is hoped that by establishment of good coordination with the local government and by an active involvement of the local community, the self-evacuation drill could be achieved. By considering the above criteria, Jamburejo Sub-village of Kemiren Village at Magelang Regency, has been selected as a model area for self-evacuation drill development program.

3. IMPLEMENTATION OF SELF-EVACUATION DRILL

3.1. Demographic Profile of Model Area

The self-evacuation drill program should be arranged by considering three important factors, i.e. simple program, small-implemented area and direct benefit to the local community. The Kemiren Village that has been selected as the model area is located in Srumbung District, Magelang Regency. As shown in Figure 1, this village is bounded by Ngablak Village (Srumbung District) in North side, Kaliurang Village (Srumbung District) in South side and Kamongan Village (Srumbung District) in West side. The area of Kemiren Village is 244.61 ha consisting of 47.87 ha for settlements, 196.72 ha for paddy field and 0.023 ha for office building. It has average daily temperature of 23°C and is located at 650 m to 700 m MSL. The number of population in Kemiren Village is 1,131 people that consist of 568 males and 563 females. In accordance with evacuation activities, the vulnerable group and potential group are comprised of 544 people and 587 people, respectively. The vulnerable group includes babies (0-5yrs), children (6-12yrs), pregnant women, elder people (> 55yrs) and handicapped people, while the potential group consists of adolescent (13-16yrs) and mature people (17-55yrs). This village is divided into three sub-villages i.e. Kamongan Cilik, Kemiren and Jamburejo. Majority profession of the people in this village is farmer, whilst almost all of the villagers have livestock surrounding their house. In terms of educational level, the ratio of local people which graduated from
elementary school, junior high school, senior high school and university are 47.5%, 37.4%, 12.7% and 2.4%, respectively. As the targeted sub-village, Jamburejo has the population of 417 people that consist of 202 males and 215 females. The existing transportation facilities for evacuation are 5 trucks, 8 cars and 143 motorcycles.

3.2. Establishment of Evacuation Map

A map of disaster mitigation is important to describe the area of evacuation drill regarding disaster prevention measures. Methodology of mapping for disaster mitigation is implemented by collecting empirical and historical data regarding the previous disaster and geological data, determining the location of the hazard prone areas based on historical occurrence and engineering consideration, and plotting the selected location to a map by utilizing Global Positioning System (GPS).

In order to develop an evacuation map, a small group in charge conducted several informal meetings and field survey under the supervision of Gadjah Mada University. They have to collect and review the existing evacuation map (if any), the number of residents, village map and other information related to the evacuation activities. Furthermore, the small group in charge has to update the data and information i.e. name of the head of household, number of vulnerable people, number of potential group, number of livestock, and number of transportation modes belonging to the local community. In the final stage, they should plot each house location, road and other facilities (mosque, school, office, cemetery, etc.) to a new proposed map. The newly proposed evacuation map in Jamburejo Sub-village of Kemiren Village is shown in Figure 1. Meanwhile, several public consultation meetings have been conducted to discuss the validity of the map, evacuation route, location of alert post and location of assembly point for vulnerable group and for potential group. Moreover, the improvement on evacuation map has been done in consideration with advises and comments from the local community.

3.3. Establishment of Standard Operating Procedures

Standard Operating Procedures (SOP) is defined as a systematic procedure during the evacuation activities involving local communities, village officer and other relevant institutions. Review on the existing SOPs in four regencies located in the surrounding of Mt. Merapi has been conducted based on Head of Regency Decrees [4, 5, 6, 7] and Governor Decrees [8, 9]. The SOP of evacuation in the regency level to village level is only provided by two regencies consisting of Sleman and Klaten Regency. However, there is no SOP for evacuation activities from each house to temporary evacuation shelter in village or sub-village level. Further, a systematic information flow of disaster occurrence is only explained by Sleman and Klaten Regency Decree. Based on those decrees, information flow of disaster status in Sleman Regency is coordinated by District Disaster Coordination Body (Satlak PB). It does not regulate the information flow of disaster from regency level down to community level. However, Klaten Regency decree shows regulation of coordinating, controlling and reporting of disaster and evacuees management from regency level until village level.

The SOP was developed based on three different status of Mt. Merapi i.e. WASPADA (caution), SIAGA (warning) and AWAS (evacuation), whereas each level of status has a different type of activities. The main activities listed in the SOP comprises information flow, group in charge coordination, information dissemination, data updating, and evacuation of vulnerable group and potential group from each house to assembly point and then to the temporary evacuation shelter.
Fig. 1: Evacuation map of Jamburejo Sub-Village of Kemiren Village Magelang
The movement of evacuees from the temporary shelter to final evacuation shelter is not covered in this newly proposed SOP, since it has been stated in the existing SOPs made by local governments and Forum Merapi. The SOP of self-evacuation was developed through a series of informal meetings with group in charge and village or sub-village officers. It took about two months to establish SOP at one model area. In addition, the SOP should be comprehensive but simple and easily understood by local community. The main content of SOP at model area is described in Table 1. The difficulty was emerged when the local community thought that the security of their livestock during evacuation needed to be considered and stated in SOP. After having series of focus group discussion, the community realized that livestock could not be evacuated to the evacuation shelter. Only security and data update of livestock at a place near the village office is necessary to be mentioned in the SOP.

<table>
<thead>
<tr>
<th>Status</th>
<th>Procedures</th>
<th>Group in charge</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>WASPADA (Caution)</td>
<td>Coordination of group in charge</td>
<td>PIC, Linmas, RT/RW, LYO</td>
<td>Evacuation preparation and task demarcation</td>
</tr>
<tr>
<td></td>
<td>Data update of the evacuees</td>
<td>PIC, Linmas</td>
<td>Updating family member, preparing for necessary goods to bring</td>
</tr>
<tr>
<td></td>
<td>Information Dissemination</td>
<td>PIC, Linmas</td>
<td>Informing the status change</td>
</tr>
<tr>
<td></td>
<td>Information on status update of Mt. Merapi</td>
<td>PIC, Head of RT/RW</td>
<td>Looking for information, visual observation</td>
</tr>
<tr>
<td></td>
<td>First aid and logistic preparation at Assembly point and shelter</td>
<td>PIC, LYO</td>
<td>Preparing sedan chairs, stretchers, food and drink</td>
</tr>
<tr>
<td>SIAGA (Warning)</td>
<td>Data update of the evacuees</td>
<td>PIC, Linmas</td>
<td>Ensuring the evacuees’ preparedness of evacuation and house security</td>
</tr>
<tr>
<td></td>
<td>Evacuees preparation check</td>
<td>PIC, Linmas</td>
<td>Moving to assembly point, reporting and move to shelter</td>
</tr>
<tr>
<td></td>
<td>Vulnerable group evacuation to the temporarily shelter</td>
<td>PIC, Linmas, RT/RW</td>
<td>Checking vulnerable group</td>
</tr>
<tr>
<td></td>
<td>Data update at evacuation shelter</td>
<td>PIC, RT/RW</td>
<td>Three shifts per day</td>
</tr>
<tr>
<td></td>
<td>Patrol guard shift at the Village</td>
<td>PIC, Linmas, LYO</td>
<td>Updating livestock data</td>
</tr>
<tr>
<td></td>
<td>Livestock arrangement</td>
<td>PIC, Linmas, LYO</td>
<td>Kentongan sound: “gobyok”</td>
</tr>
<tr>
<td></td>
<td>Preparation of Kentongan Point</td>
<td>PIC, Linmas</td>
<td>Any returning inhabitants must get the permission from Head of Sub-village</td>
</tr>
<tr>
<td>AWAS (Evacuation)</td>
<td>Evacuation of all villagers to the temporarily shelter</td>
<td>PIC, Linmas, RT/RW, LYO</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Data update at temporarily shelter</td>
<td>PIC, Linmas, RT/RW</td>
<td></td>
</tr>
</tbody>
</table>

Note: PIC = Person in Charge  RT = Lowest administrative unit  LYO = Local Youth Organization
Linmas = Social Protection  RW = Consist of 3 to 5 RTs (Karang Taruna)

3.4. Establishment of Poster

The poster provides information about the instruction flow for evacuation, priority person to be evacuated first (vulnerable group) and important things to bring by the evacuees. The draft of poster has been discussed with the local community in Kemiren Village to get some comments and advice so that the information in the poster can be understandable and the layout will be more attractive. The proposed poster for self-evacuation drill program is shown in Figure 2.
3.5. Establishment of Disaster Preparedness Organization

In order to sustain the community disaster mitigation and management in hazard prone area, a community task force need to be established as a key driving force in conducting the village disaster management program [10]. This community task force team may include the head of the village as the team leader or advisor, the representatives from local community groups, and the young leaders. Disaster preparedness organization of Kemiren Village was established at the end of 2009 (Fig. 3). The evacuation coordinator is supported by a deputy coordinator and assisted by five coordinators i.e. coordinator for data updating, security, transportation, logistics and first aid. Most of their daily job is as a farmer. The purpose of this organization is to provide a clear task demarcation among the group in charge and to increase the motivation and confidence to conduct the evacuation by their own capability. In case of the absence of the head of sub village or evacuation coordinator, the other members could take necessary action to evacuate all villagers under the guideline stated in the SOP. By establishing this organization, it is hoped that sustainability of community-based disaster preparedness will be achieved.

Fig. 2: Evacuation poster
3.6. Drill Implementation

Simulation of WASPADA status had been conducted from 23 July 2009 until 1 August 2009. The activities during WASPADA are coordination (Figure 4a and 4b), data update of the evacuees, information dissemination, info on status update of Mt. Merapi, and first aid and logistic preparation. These activities were accomplished during the time of 15:30 until 19:45 pm on 23 July 2009. The person in charge has generally tried to do their task properly. They could disseminate the information on Mt. Merapi status change, ask the villagers to prepare for evacuation and inform the location of assembly point and evacuation route. Meanwhile, they have updated the data of family member in each house.

Simulation of SIAGA status was carried out on 1 August 2009 from 17:00 until 19:14 pm. The activities are updating data, ensuring preparedness of the local people, evacuating vulnerable group (Figure 4c), updating data at temporary evacuation shelter, determining patrol guard shift, preparing livestock evacuation camp and determining kentongan point. The AWAS Status directly continued the SIAGA Status. Simulation of AWAS status was done on 1 August 2009 from 19:15 until 21:00 pm. The activities during AWAS Status are evacuation of all inhabitants, data update at temporary evacuation shelter and evaluation of drill implementation.

AWAS Status is arranged in the evening time that has a higher difficulty compared to the day-time. This time setting is arranged based on the internal meeting with group in charge who wants to have an experience of managing the evacuation drill during the evening time. The activities ran smoothly, with
good coordination among the group in charge, village officers, police, army, primary care unit, and SAR team. AWAS status was ended by an evaluation session (Figure 4d). All parties generally realized the importance of this program and had willingness to improve the implementation of evacuation drill in the future. The head of village representing his residents declared that Kemiren village would keep using the SOP, evacuation map and poster established during this activity. Moreover, they will maintain the sustainability of disaster preparedness organization in Jamburejo Sub-village.

Fig. 4: The activities during self-evacuation drill in evening time

4. RESULTS AND DISCUSSIONS

The assessment by pre and post test had been performed in order to evaluate the change in perception and knowledge of local community concerning the disaster risk awareness due to the implementation of self-evacuation drill program. Data collection by purposive random sampling was done to 20 respondents, in which 19 respondents have ever experienced volcanic eruption, and 16 respondents have attended the disaster mitigation training. The respondents who ever lived in evacuation shelter are 17 people. Figure 5 and 6 shows the change of respondents’ knowledge on volcanic disaster and disaster preparedness in Jamburejo Sub-village of Kemiren Village, Magelang.
Respondents' knowledge about volcanic disaster before the implementation of self-evacuation drill program can be categorized as average. The distribution of respondents' knowledge about volcanic disaster is not even. It may be because the previous drills did not widely reach all community. After the implementation of the drill, respondents' knowledge about volcanic disaster increases. The increment occurred in volcanic activity status and in how they evacuate when there is volcanic eruption risk. The knowledge of respondents on how to get information of volcanic activity status is still not good, either before or after the drill. However, for some respondents, it increases. Lack of knowledge about volcanic activity information might be caused by limited access to the source of information.
The respondents' knowledge about volcanic activity status increases significantly on who should evacuate and when to evacuate at the time of volcanic eruption. Value variation in the increase of respondents' knowledge may happen due to variation in cognitive ability, particularly in its relation with organization matter. Villagers' data update, monitoring on volcanic status change and task demarcation in preparing evacuation are not able to be comprehended by some respondents.

After the drill, knowledge of evacuees about evacuation procedure increases significantly. This happens to the procedure to reach the assembly point and the use of vehicle to evacuate. Meanwhile, kinds of equipment should be brought during the evacuation is already well-known by respondent, which shows the effectiveness of proposed poster. From the interview with local community, livestock is important for some respondents, while according to SOP, livestock is not allowed to bring in evacuation. Based on the questionnaire results, almost all of the respondents think that the facilities regarding shelter cleanliness/comfort and education was not sufficient. In addition, 18 out of 20 respondents considered that food for livestock should be provided in the village although it was not primary needs for human living. Almost 70% of the respondents suggested that it is necessary to provide more attention to the shelter security.

Based on the overall evaluation on self-evacuation drill in Kemiren Village, several issues can be highlighted. The major issue is the person in charge should have sufficient understanding on standard operating procedures, the role of evacuation map and poster. Their sufficient knowledge on the spirit of self-evacuation will strongly encourage the evacuees to follow their instruction. Moreover, data updating of villagers have to be accurately performed prior to the evacuation drill, therefore, it is necessary to conduct regular data updating. In addition, the coordination and management of evacuation drill should be improved among the local government, group in charge and communities. The evacuation drills provide benefit to local people living in hazard prone areas particularly for improvement of community knowledge and skills on volcanic disaster preparedness management. Society resilience and human security can be improved through the implementation of regular self-evacuation drill program, through public education and community empowerment in establishing the Standard Operating Procedures (SOP), evacuation map, poster and disaster preparedness organization surrounding Mt. Merapi area. Small group in charge were trained within the community unit (sub-village) and left to teach their own society. In this way, welfare is improved and risk is changed into sustainable development.

5. CONCLUSIONS

The effectiveness of volcanic disaster risk reduction was mainly driven by the community empowerment for disaster prevention and mitigation at the village or sub-village level. The potential volcanic disaster can be reduced with more emphasis on the management of social vulnerability. The social approach should be mainly directed for the capacity development of local community. Through all of those strategic approaches, community resilience in disaster-prone area at village level can be effectively improved. Furthermore, support from local governments (provincial level to village level) and community willingness are the key points to ensure the evacuation drill implementations. Coordination among the local government in village level and sub-village level, local community and other relevant government agencies are supposed to be enhanced to facilitate the evacuation activities.

The community and civil society organizations have a key role to play in achieving the goals on disaster risk reduction. To maintain the sustainability of Mt. Merapi disaster preparedness, existing
local organizations have to be listed and encouraged to participate in those activities. Besides, the existence of small groups in charge for evacuation in sub-village level contributes easier implementation on evacuation drills and make the evacuation more convenient for local people. A main problem of real evacuation is the lack of awareness of local community, not only the vulnerable group but also potential group, to do evacuation during the disaster. For the existing evacuation procedures, local government through Satgas, Satlak, Satkorlak, SAR and village officer are dominant to organize and arrange the evacuation. This method does not seem appropriate for real evacuation, so that it is necessary to modify the evacuation procedures. It is expected that there would be effective evacuations and deep impact for local people awareness by conducting evacuation activity that is managed and arranged by local community themselves. In this recent time, without any support from other parties, self-evacuation is still difficult to be maintained its sustainability. In the future, self-evacuation has to be implemented where local community is able to conduct their activities without any support from outside parties.

6. REFERENCES


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