Field Survey of Typhoon Reming (Durian)-triggered Mudflow Disaster at Mayon Volcano in the Philippines

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Introduction

A damage survey was conducted at the Typhoon Reming (Durian)-triggered mudflow site around Mayon Volcano in the southern part of Luzon Island in the Philippines. The results of this survey are presented in this report.

Mayon Volcano and overview of damage

Mayon Volcano is an active volcano located at the southern end of Luzon Island (Fig. 1). It is a beautiful stratovolcano admired as a sightseeing spot, but it also brought about a number of disasters to the surrounding area. To mitigate damage around this volcano, the PHilippine Institute of VOLCanology and Seismology (PHIVOLCS) prepared a hazard map in 2000. Japanese sabo experts sent to this country in the past by Japan International Cooperation Agency (JICA) also provided a volcanic mudflow monitoring system (telemeter hourly rainfall gauges, wire sensors) to this area.

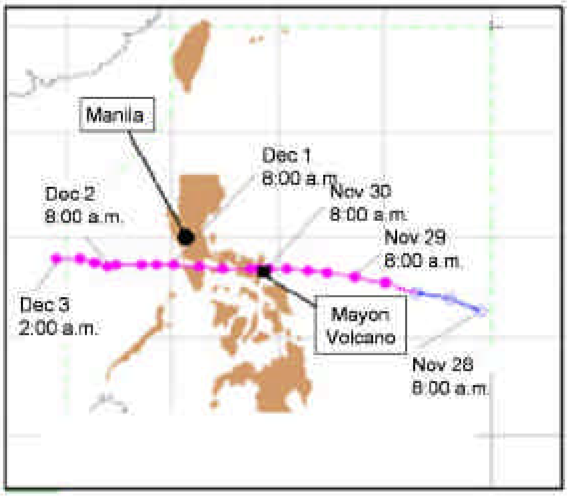

Fig.1 Location of Mayon Volcano and track of Typhoon Durian

On November 30, 2006, a severe typhoon hit the area with a torrential rainfall of 466 mm (Fig. 2), which was far exceeding the past maximum daily rainfall of 370mm recorded in 1967. It triggered a large-scale mudflow over the wide area between the eastern and southern slopes of this volcano (Fig. 3). The resulting damage was disastrous, the dead 620 (734), missing 710 (762), injured 1,478 (2,360), totally collapsed houses 89,474 (228,436), and partially collapsed houses 71,338 (359,601). (The number without parenthesis shows the damage in Albay Province disclosed by the National Disaster Coordination Council (NDCC) on December 16. The number in the parenthesis shows the damage in the entire Philippines. It was confirmed through the hearing of local governments that the most of the damage in Albay Province was caused by the mudflow).

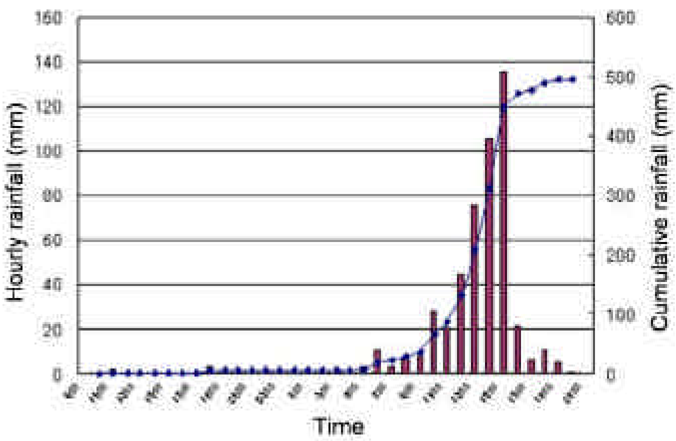

Fig.2 Rainfall at Legazpi City

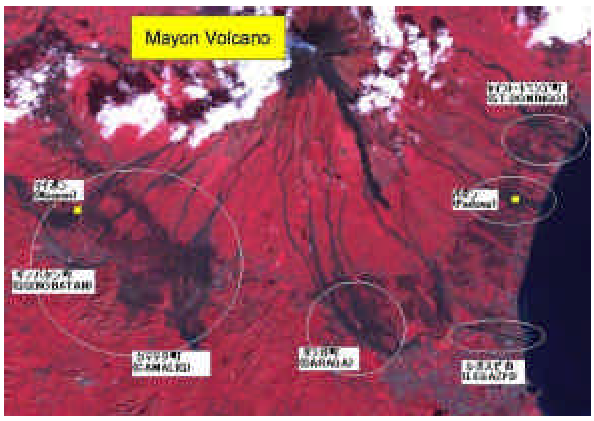

Fig.3 Mudflow(debris flow) at the foothills of Mayon Volcano(The flooding areais shownin black)

Dispatch of a survey team

To conduct a damage survey, a three-member team was dispatched from Japan, consisting of Director-General Tsunaki of the Research Center for Disaster Risk Management at the National Institute for Land and Infrastructure Management; Deputy Leader Sakurai of the Volcano and Debris Flow Team of the Erosion and Sediment Control Research Group at the Public Works Research Institute, both representing the Ministry of Land, Infrastructure and Transport; and Director Manzen of the Planning Division of the Sabo Technical Center (STC). Joined with them from the Philippines were Tokunaga (JICA expert leader) and Mitsunaga (myself) who were working at the Flood Control & Sabo Engineering Center (FCSEC) as the JICA long-term experts, as well as two counterparts of the Philippines.
The joint team conducted a field survey on four days from Dec. 11 to 14, 2006. On Dec.15, the Japanese survey team submited a survey report and recommendations to the Assistant Secretary Bonoan of the Department of Public Works and Highways (DPWH) of the Philippine Government.

Overview of the survey

When the survey team entered the disaster site, national roads were open to traffic although some lanes were restricted. The electricity and telephone services were cut off in all areas, including the provincial capital of Legazpi City, because most of service poles fell down due to strong wind. Administrative organs, hotels, restaurants, etc., were using electricity from their emergency generators. Although the line condition was not good, cellular phones were usable excluding some areas, thanks to the emergency installation of temporary antennas.
At the disaster site on the foothills of Mayon Volcano, some villages could escape from damage owing to the training dike installed in the past (Photo 1), but other villages such as Padang on the eastern foothills, Busay on the southeastern foothills, and Maipon on the southwestern foothills were covered with a 2 m-deep mudflow over the width of several hundred meters. In these villages, only the roofs of houses remained above the debris and it was like “The entire village was swallowed by the mudflow and the former landscape is unimaginable” as one villager grieved. Large sized boulders, 2～3 m in diameter, were found in the deposited debris (Photos 2～7).

Photo.1 Damage was alleviated by training dike.

Photo.2 Damage at Padang Village(1)

Photo.3 Damage at Padang Village(2)

Photo.4 Damage at Maipon(1)

Photo.5 Damage at Maipon(2)

Photo.6 Damage at Daraga Town(1)

Photo.7 Damage at Daraga Town(2)

People in Padang Village never thought of being involved in a debris flow, because their village was 300 m away from the river and the lower part the river channel was covered with a concrete revetment. However, the debris flow which flooded in the upstream attacked this village directly, giving no time of evacuation as one villager accounted “We saw water coming, and the debris immediately hit us”. In Maipon, a mudflow run down the area where “there was no river around here before” (villager) and caused serious damage to the village.

During the helicopter survey, no gullies or large-scale collapses that might provided debris for the current mudflow were found around the top section of the volcano. However, when we surveyed the southern and southwestern foothills about 8 km from the crater in a concentric manner, several large-scale gullies were found. The depth of the largest gully was about 10 m and the width was as large as 50〜200m (Photo 8). It was found that some of those gullies were developed at locations where a gully had never existed before.

Mayon Volcano is made of very fragile geology, and it was presumed that a large amount of rainfall was concentrated into the gullies and it eroded the fragile ground, causing damage to the downstream areas. It was also found that development of gullies at this site was very drastic – they were caused only by half-day rainfall.

As to the run-off time of the debris flow, a Maipon resident said "It occurred around two o'clock when the rain was so strong". Therefore, it is known that the debris flow occurred in about an hour after the rain became intensified.

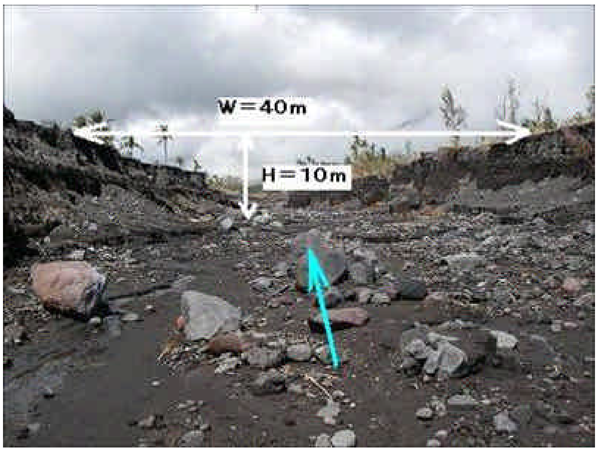

Photo.8 Gully caused by the mudslide

At the time of the disaster, the volcanic mudflow monitoring system provided from Japan was not functioning properly because of insufficient maintenance. Although the rainfall data had been outputted at the local offices of DPWH, they also had not been utilized for disaster prevention.

Maipon and other villages were indicated as mudflow danger areas in the hazard map prepared by PHIVOLCS, but the hazard map itself had not been utilized satisfactorily. As a result, most people did not evacuate without considering a mudflow possibility and the resulting damage became so extensive.

To add to this, officials who understood the importance of an hourly rainfall in the trigger of a mudflow were quite few. Also, a system that can properly utilize the data obtained by organizations such as the Philippine Atmospheric Geophysical and Astronomical Service Administration (PAGASA) was either not existing or not functioning at the time of the disaster.

In the Philippines, strong voices are often raised on the need of proper care of disaster-affected people, but when it comes to the need of disaster prevention measures, it often ends with the words "the budget is not available". To promote disaster prevention measures hereafter, what is vital is the establishment of an organizational structure that can work for continuous collection of data and effective utilization of the obtained data.

Submission of recommendations

Based on the survey results, the survey team submitted the following recommendations.

1. Strengthening of an organizational structure for disaster prevention
2. Update of hazard maps
3. Collection and utilization of meteorological and hydrological information
4. Implementation of emergency prevention works
    - 4.1 Construction of training dikes (ring dikes)
    - 4.2 Raising of refuge areas
    - 4.3 Improvement of evacuation facilities
5. Renewal of sabo plans

At present in the Philippines, PHIVOLCS is renewing hazard maps and PAGASA is planning an installation of Doppler radar rain gauges with assistance from Japan and other countries. It is also reported that PAGASA is inviting additional donors to complete rain gauge installations by 2010.
However, as a personal note, I am skeptical about the present situation here that nothing has been discussed on the retrofit of disaster prevention facilities other than roads.

Concluding Remarks

At the end of this report, I would like to express my deep gratitude to the Ministry of Land, Infrastructure and Transport of Japan for sending an urgent survey team, as well as to those of the survey team and organizations such as Office of Civil Defense (OCD) which kindly provided convenience for our survey. At the same time, I would like to offer my deep sympathy to the affected people and hope that their areas are recovered as early as possible.

P.S.
A small-scale eruption occurred at Mayon Volcano in June 2006. Although local people evacuated from the area temporarily, they returned home at the end of October as the eruption subdued. Some considered this eruption might have affected, but it was judged that its effect on the current mudflow was extremely small, in view of the fact that the ashfall amount was very small and the ashfall area governed by a wind direction was different from the current disaster area.