

# **WARNING AND EVACUATION IN RESPONSE TO SEDIMENT-RELATED DISASTERS**

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Sediment-related disasters commonly occur in association with flood disasters. On July 19th, 2006, several such disasters occurred in Okaya City, Nagano Prefecture, Japan. In Okaya, two debris flows killed eight people, but Suwa City located next to Okaya was voluntarily evacuated before it was struck by a debris flow.

The law concerning the “promotion of measures for sediment-related disaster prevention in a restricted area” requires cities in area specified by the prefecture to develop a warning and evacuation system for sediment-related disasters. Unfortunately, Okaya was not designated a sediment-related disaster warning area, as no sediment-related disasters had occurred there in recent history, whereas Suwa was prepared and avoided the loss of lives.

In this paper, we propose an effective warning and evacuation system for sediment-related disasters based on what we learned from disaster-prevention personnel in Okaya and Suwa.

## **THE SITUATION IN OKAYA CITY WHEN THE DISASTER OCCURRED**

In Okaya, sediment-related disasters occurred in 14 places beginning at approximately 3:00 am or shortly thereafter on July 19th. Debris flows that struck at 3:50 am in Shibirasawa and 4:40 am at the Odaisawa killed eight people. No evacuation had taken place for the following reasons.

- Both the disaster-prevention personnel and the inhabitants of Okaya were prepared for flood disasters, but not for sediment-related disasters.
- Although a map showing danger spots for sediment disasters had been distributed to all the houses in Okaya, neither the disaster-prevention personnel nor the inhabitants of Okaya were sure which areas were hazardous.
- The disaster-prevention personnel in Okaya were overwhelmed with information on flood damage and sediment-related disasters, and could not cope with all of the information.
- The disaster-prevention personnel in Okaya could not get the information they desired, such as where, when, and how large disasters occur.

## **EVACUATION OF THE VULNERABLE POPULACE**

At around 4:00 am on July 19th, a debris flow struck behind a retirement home at Osachidehaya, in Okaya. At that time, a staff member looked outside and saw a debris-flow deposit. At 5:30 am, the residents of the first floor were evacuated to the second floor using the elevator, as advised in an evacuation advisory developed by Okaya City. This took 15 minutes. The residents were unable to leave the house because a debris-flow deposit already covered the access road and they had not secured cars for the move. Under certain circumstances, they might not have been able to evacuate to the second floor, because the

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elevator was on the side of the building facing the slope, and the generators used in the case of a power failure could not supply sufficient electricity.

## **THE VOLUNTARY EVACUATION IN SUWA**

At Nakanosawa, in Suwa, the head of a ward noticed muddy flow in a stream that he was monitoring and evacuated the inhabitants by calling on all of the houses in the ward. This was completed before 10:00am on July 19th, when a debris flow struck Nakanosawa.

Suwa, located in Nagano prefecture, was designated a sediment-related disaster warning area and a special sediment-related disaster hazard area under a law enacted in 2005. The inhabitants of Suwa were educated about sediment-related disasters. Consequently, both the disaster-prevention personnel and the inhabitants understood the warning signals of a debris flow and knew which hazard areas needed evacuation. The following factors affected the evacuation.

- The disaster-prevention personnel in Suwa had trained for disaster prevention using role playing. When the actual sediment-related disaster occurred, most of them remembered what they had learned during the training.
- A mutual reporting system was used to relay information on the sediment-related disaster between the officials and inhabitants of Suwa, with three personnel designated to operate the system.

## **WARNING AND EVACUATION DURING SEDIMENT-RELATED DISASTERS**

To prevent sediment-related disasters, we need to adopt the following measures.

- Create an information system that assumes multiple disasters can occur at nearly the same time. This system should then automatically manage information, develop a method of selecting information, and be able to be used by several cities.
- Designated specific sediment-related disaster warning areas by law.
- Examine construction methods to minimize the damage in disasters, such as developing an inexpensive way to reinforce buildings.
- Maintain vigilance by keeping alert, improve ways to share disaster experiences, provide training to prevent disasters.

## **CONCLUSIONS**

Sediment-related disasters often follow heavy rainfall and earthquakes, and can occur at the same time as other disasters, such as floods. Therefore, it is necessary to consider an information system for gathering and spreading information about sediment-related disasters. The law on the “promotion of measures for sediment-related disaster prevention in a restricted area” was useful for promoting warning and evacuation methods. Nevertheless, other measures are needed. Evacuation is an efficient way to minimize the loss of life during disasters, but we need new techniques to predict the occurrence of disasters to avoid relying solely on evacuation.

It is difficult to evacuate the residents from their houses. To protect those living in dangerous areas, we must be able to evacuate houses during an electric power failure, without requiring outside assistance.

**Keywords:** Sediment-related disaster, Warning and evacuation, Vulnerable populace