# Technology Development and Human Resources Training Supporting Crisis Management in Large-Scale Landslide Disasters

TAMURA Takeshi, Director, Sabo Department

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## 1. Introduction

Based on the changes in the natural environment and social conditions and the actual situation of landslide disasters in recent years, it is thought that the current conditions surrounding research on landslide disasters can be characterized by three environmental changes: 1) More frequent and more intense disasters and changes in the phenomena of their occurrence accompanying climate change, 2) Increased imminence of giant earthquakes, such as the Nankai Trough earthquake, and volcanic eruptions, which are thought to recur with a regular cycle, and 3) Society with a progressively declining population and workstyle reform. I feel that we must conduct our research activities based on these environmental changes.

On the other hand, the 2024 Noto Peninsula Earthquake, which occurred on January 1, 2024, caused a large number of slope collapses and landslides, as well as multiple cases of natural damming of rivers by landslides, and in responding with the cooperation of related organizations, including the Sabo Department, there was a re-recognition of the importance of "efforts to support crisis management for large-scale landslide disasters."

In other words, as efforts to support crisis management carried out by the national government and prefecture-level governments after landslide disasters caused by an earthquake, torrential rainfall, a volcanic eruption, etc. that it would be difficult to respond to with the normal system (i.e., large-scale landslide disasters), a certain effect of efforts by related organizations, including the Sabo Department, was recognized, and the importance of continuing efforts was recognized anew. However, there is also a continuing re-recognition of issues that require continuing study based on the changes in the above-mentioned 2) Increasing imminence of a Nankai Trough earthquake, etc. and 3) Society with a progressively declining population.

This article introduces the efforts of the Sabo Department in connection with large-scale landslide disaster crisis management, the importance of which was recognized anew in the recent Noto Peninsula Earthquake, based on the environmental changes mentioned at the outset.

## 2. Policy of Research and Development Efforts, Etc. Related to Large-Scale Landslide Disaster Crisis Management

There are considered to be several factors that make crisis management by national and prefectural governments difficult when a large-scale landslide disaster occurs. The policy of research and development efforts, etc. by the Sabo Department in response to those factors is shown in the following ① to ④.

① When a large earthquake or other disaster occurs, it is necessary to determine whether serious events have occurred or not quickly over a wide region, including mountainous areas; therefore, the Sabo Department conducts technology development which makes it possible to grasp the condition over a wide region, even at night and in bad weather, for example, by utilizing satellite SAR.

② Because large-scale earthquakes and other disasters are frequently complex disasters, and it is necessary to respond under severe manpower and equipment constraints, the department conducts development of technologies for estimating damage, such as the risk of slope collapse due to an earthquake, etc., so as to develop response plans and arrange the response system in advance.

③ Due to Japan's progressively declining population, it is necessary to respond to disasters with inadequate manpower while also promoting workstyle reform; to address this problem, the department conducts technology development to enable "faster, more accurate and safer" surveys by utilizing DX.

④ Since there are few opportunities to experience actual large-scale landslide disasters, which have a low frequency of occurrence, and it is difficult to secure personnel in a society with a declining population, the department conducts development of technologies for efficiently transferring knowledge and technologies to inexperienced persons by using digital technologies, etc., and conducts human resources training to transfer knowledge and technologies widely, for example, by conducting the Support Program for Training Regional Development Bureau Officials, etc.

## 3. Grasping the Scale of Natural Damming Locations by UAV

This is a concrete example of an effort in connection with the above 2.③.

In emergency surveys based on the Act on Sediment Disaster Countermeasures for Sediment Disaster Prone Areas, the Sabo Department conducts surveys of the position, relative elevation, length of flooding, etc. of natural dams caused by landslides in order to estimate the hazardous area and period of landslide disasters originating from natural damming. As an

alternative or complementary technique to conventional surveys using a laser rangefinder from the ground or a helicopter, we verified a survey technique using a UAV (drone).

When the accuracy of the 3-dimensional point group data measured by UAV photogrammetry (photographic surveying) was checked by comparison with the LP (Laser Profiler) data surveyed in the past fiscal year, it was found that topographical maps showing collapsed slopes and blocked river channels can also be created with high overall accuracy by UAV photogrammetry.

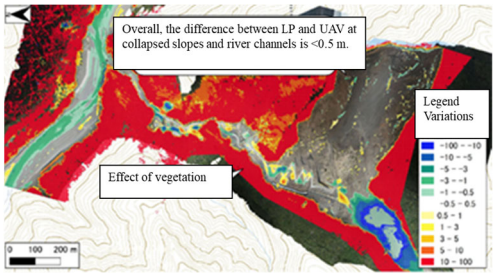


Fig.-1 Difference of UAV photogrammetry and LP data

## 4. Transfer of Disaster Response Technology Utilizing BIM/CIM Models

This is a concrete example of effort in 2.④.

As will be described below in 5., in practical training in measurement of natural dams in the training support program for staff of Regional Development Bureau Officials, Etc., the trainees could easily and visually understand the points to note in natural dam measurements when staff who had actually participated in emergencies surveys provided guidance on those points by displaying the results of natural dams measured by the trainees on 3-dimensional BIM/CIM models.

As this example demonstrates, 3-dimensional visualization of actual disaster sites by BIM/CIM models is also effective for transfer of disaster response technologies.

Photo-1 Measurement of a natural dam
(Left: measurement from helicopter,
right: measurement by UAV)

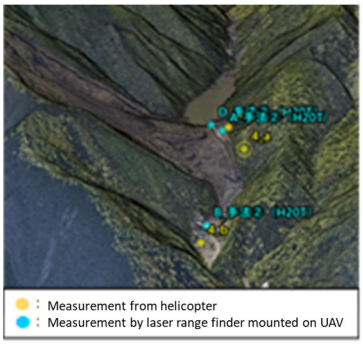


Photo-2 BIM/CIM model displaying results of natural dam measurement

## 5. Support Program for Training Regional Development Bureau Officials, Etc.

This is a concrete example of efforts in 2.④.

Since FY 2013, the Sabo Department has conducted this program in cooperation with the Public Works Research Institute (PWRI) and the Technical Center for Large-Scale Landslide Disaster Countermeasures of the Kinki Regional Development Bureau for staffs of the River Departments of all Regional Development Bureaus, etc. (including the Hokkaido Regional Development Bureau). (Since FY 2018, the objects of part of the program have been expanded to include the staffs of Road Departments).

The period of the program during each fiscal year is April to December. Under curriculum established for this program, trainees normally gather 4 times, and staff members who have mastered the response to crisis management of large-scale landslide disasters are trained through acquisition of landslide disaster emergency survey techniques, mainly for natural dams, and knowledge and research results that can be used in TEC-FORCE dispatches, and exercises related to emergency surveys and emergency countermeasures, etc.

## 6. Progress of Technology by Accumulation of Cases

Since the object of countermeasures for landslide disasters is nature, there are many cases where new techniques and knowledge are born from verification and experience of the actual phenomena.

In talking about large-scale landslide disasters, we use the single term “natural dam.” However, if the place, time, triggering factors, etc. are different, the characteristics in the phenomenological aspect and the response required in crisis management will also be different.

Accordingly, as the Sabo Department, in addition to promoting research, development, etc. which we have already begun, we hope to contribute to the progress of large-scale landslide disaster countermeasure by collecting not only knowledge gained by surveys and experience by our own staff when a new disaster occurs, and also the knowledge and experience by other organizations, and accumulating those cases.

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☞For more information:

1) Website of the Technical Center for Large-Scale Landslide Disaster Countermeasures: https://www.kkr.mlit.go.jp/kiisankei/news/pdf/topic_20231107_02.pdf

2) Yamakoshi Takao: Support Program for Training Regional Bureau Officials Engaged in Advanced Landslide Countermeasures, Rivers, No. 910, pp. 53-55, 2023