Promotion of Research and Technology Development to Support Sabo Engineers

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Keywords: grasp of environmental changes in mountain basins, UAV, synthetic aperture radar (SAR), NILIM Sabo Training

1. Mountain basin environments continue to change

Often the target of Sabo, mountain basins are continuously changing due to weather, geological conditions, and human activity. Rain, snow, earthquakes, volcanic eruptions, deforestation, and wildfires directly and indirectly cause various changes in mountain basins, including slope failure, landslide dam formation, sediment discharge, and sediment accumulation in mountain riverbeds. When such changes occur, sediment disasters may occur or may have long-term effects on our lives, such as repeated slope failures and sediment discharge due to subsequent rainfall. Therefore, it is necessary to continuously monitor changes in mountain basin environments on site and respond to such changes.

For example, the Sabo Department of the Water and Disaster Management Bureau of MLIT and the Japan Meteorological Agency jointly establish and implement a provisional standard that lowers the thresholds for the release of Sediment Disaster Alert[1] for municipalities where an upper 5 seismic intensity or higher is observed. As of the end of December 2021, 80% of the normal threshold was set as a provisional threshold for Toshima Village (Dec. 9 earthquake near the Tokara Islands), Kawaguchi City (Oct. 7 earthquake in northwestern Chiba Prefecture), and Hashikami Town (Oct. 6 earthquake off Iwate Prefecture), where a maximum seismic intensity of an upper 5 was observed. Whether to return the provisional threshold to the normal threshold will be determined after the relevant Regional Development Bureau and prefecture investigate post-earthquake rainfall, slope failure, and other conditions.

The reason for implementing the provisional threshold for Sediment Disaster Alert is as follows. Since the ground in the mountain basin is likely to be vulnerable due to seismic motion[2], the risk of sediment disasters due to expansion by rainfall of slope failure or due to the occurrence of a new slope failure,[2] is higher than before the earthquake for some time after the earthquake.

2. Greatly improve the efficiency of survey, inspection, and observation methods in mountain basins and ensure the safety of personnel

Various new technologies in recent years have enabled “faster, more accurate, and safer” surveys, inspections, and observations in steep and forested mountain basins. With support from the Regional Development Bureau and cooperation from research institutes of other fields in Tsukuba City, the Sabo Department is engaged in research and technology development for the following: emergency surveys of landslide dams and grasping of damage conditions using autonomous UAV flight,[4] identification of the locations of sediment disasters using synthetic aperture radar (SAR) images,[5] estimation of more accurate rainfall intensity using surveillance cameras already installed in mountain basins,[6] etc.

The results obtained to date have been published in Civil Engineering Journal and other academic journals, etc. and organized and issued as Technical Note of the NILIM and guidelines to the engineering officials of prefectures and Regional Development Bureaus in charge of Sabo.

3. Deliver necessary technology to Sabo engineers at the *front-line*

Two examples are introduced as follows.

3.1 Emergency surveys of natural dams and grasping of damage conditions using autonomous UAV flight[4]

As a method for acquiring clear images of collapsed slopes that are not visible from the takeoff point, the Sediment Disaster Prevention Technology Center of the Kinki Regional Development Bureau, where one senior researcher from the Sabo Planning Division is stationed along with Bureau officials, enabled investigation and inspection by autonomous flight under Level 3 flight by flying two UAVs simultaneously, which are responsible for photography and radio relay, respectively to stabilize the control and communication strength during flight (Fig. 1). With this method, it is possible to greatly improve the efficiency of surveys and inspections, and ensure the safety of personnel involved in field surveys and inspections, both in the event of a disaster and in ordinary times. The results are published as "Guidance." [4]

The Level 3 flight of UAV was the first case in the country and was covered by local and national media.

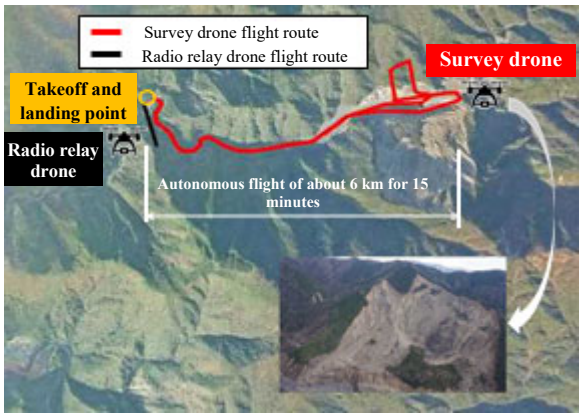

Fig. 1: UAV flight route (Kuridaira area, Totsukawa Village, Nara Prefecture)

3.2 NILIM Sabo Training

Since FY 2013, the Sabo Department has sponsored the NILIM Sabo Training for engineering officials from the Regional Development Bureaus with the aim of "promoting capacity building of engineers of Regional Development Bureaus with high competence required for surveys of sediment disasters". The members of the Sabo Department serve as lecturers to directly introduce research results and field survey methods.

Figure 2 shows the content of this training. The officials from the Regional Development Bureaus in charge of Sabo have been participating in this program from the beginning, and the officials in charge of road disaster prevention have been participating since FY 2018. As of FY2021, 101 trainees (74 for Sabo and 27 for roads) had completed the training, and were engaging in TEC-FORCE activities, etc. in the event of a sediment disaster.

In FY2021, we took a collective approach as much as possible to hold the training while striving to prevent COVID-19 infection. In the field training, with the cooperation of the Kii Mountain Sabo Office of the Kinki Regional Development Bureau, we conducted a field survey of torrents prone to debris flow (Photo 1) and boarded the helicopter "Kinki" to confirm the scale of the deep-seated rapid landslide and landslide dams. (**Photo 2**).

In FY2022, we will continue to implement the training, while incorporating new findings obtained from the research.

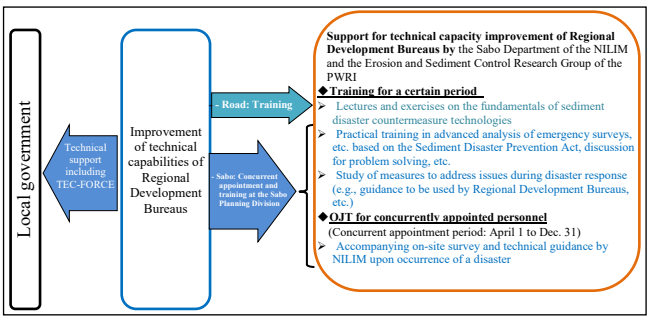

Fig. 2: Main contents of the training program for engineers responsible for advanced investigation and technical support in the event of a sediment disaster

Photo 1: Practical training on a field survey of torrents prone to debris flow

Photo 2: Confirmation of deep collapse and natural dams from helicopter

4. For rapid post-disaster recovery / reconstruction and the following maintenance of a safe living environment for the region

Sediment disasters directly affect human lives. In addition, evacuation may be prolonged if houses are damaged or infrastructure such as roads and water and sewage facilities is severely impacted. It is important not only to prevent disasters in advance, but also to rehabilitate and maintain the living environment to prevent secondary disasters.

To keep the living environment in the region safe, we will continue to conduct research and technology development on the construction and maintenance of Sabo facilities in accordance with changes in mountain basins, the development of technologies that contribute to sediment management, and the ideal form of Sediment Disaster Alert.

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