
Disaster Prevention / Mitigation for Devastating Sediment Disasters

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1. Introduction

In recent years, serious sediment disasters have frequently occurred in Japan, including Typhoon No. 19 (2019), July 2018 Heavy Rain, Northern Kyushu Heavy Rain (2017), Kumamoto Earthquake (2016), and Mt. Ontake Eruption (2014). There are more serious sediment disasters may occur because of the impacts of climate change, etc. Given the circumstances, the Sabo Department at NILIM has been advancing studies into identifying the mechanisms of sediment disaster, status of effective infrastructure development, and non-structural measures such as warning, evacuation and monitoring systems, using data on sediment disasters across the country in order to prevent / reduce damage resulting from heavy rains, earthquakes, volcanic activity, etc. This paper describes the main activities of the Sabo Department.

2. Study activities

In recent years, major sediment disasters and floods have caused serious damage in Japan, including Typhoon No. 19 (2019), July 2018 Heavy Rain, and Northern Kyushu Heavy Rain (2017). Furthermore, Typhoon No. 19 of 2019 and the July 2018 Heavy Rain caused widespread and simultaneous sediment disasters in the Eastern Japan and Western Japan. The following introduces part of our study activities based on those situations.

2.1 Prevention / Mitigation of damage caused by sediment / flood

In order to upgrade sediment / flood control measures, it is necessary to improve the predictive accuracy of sediment movement phenomena caused by rainfall, etc. and to advance infrastructure development based on the improved predictability.

The Sabo Department has been continuing research / studies ¹⁾ of sediment / flood and giving technical guidance to offices across the country under its direct control when they plan sediment / flood projects, etc. In addition, results accumulated in the Sabo Department and technical findings obtained through technical guidance, etc. have been documented as Technical Notes of NILIM. ²⁾ The offices under direct control of the Sabo Department that are implementing sediment / flood control measures are now using an analytic method for calculating sediment movement based on river erosion control technical standards revised in March 2019 (Planning Part), in planning infrastructure construction. The Sabo Department is assisting them in technical

matters.

2.2 Utilization of Synthetic Aperture Radar (SAR) images for grasping wide-area sediment disasters

In the event of a wide-area sediment disaster, in order to prevent secondary disasters and take emergency actions quickly, it is necessary to quickly grasp the scope of the sediment disaster, because personnel deployment and the distribution of goods are important components of initial response efforts. As before, helicopters are used immediately after the occurrence of a disaster, but we now are using remote measurement technology in the form of images taken by Synthetic Aperture Radar (SAR) onboard orbiting satellites. These images are available even at night and under bad weather conditions, and utilized when taking initial action. We have been conducting a joint study with the Japan Aerospace Exploration Agency (JAXA) since FY2017 and creating a manual ³⁾ describing the sediment disaster interpretation research method. We also hold training events for the personnel of Regional Development Bureaus, etc. to promote use of this technology.

3. Technical support to local governments, etc. in the event of a sediment disaster

When a large-scale sediment disaster occurs, we dispatch personnel at the request of local governments, etc. to conduct onsite surveys and give technical support including advice to local governments, Regional Development Bureaus, etc. about observation methods, emergency measures, warnings and evacuations, and other critical matters from a viewpoint of preventing secondary disasters. Moreover, when recovery / restoration plans go through the required technical reviews, we provide technical expertise of the actual conditions of the sites.

Particularly, in relation to Typhoon No. 19 of October 2019, we dispatched personnel to Miyagi, Gunma, Kanagawa, and other prefectures where major sediment disasters occurred, in response to the request from local governments, and worked in cooperation with the Sediment Management Study Group of the Public Works Research Institute.

In Marumori Town, Miyagi Prefecture, where the most personnel were dispatched, we conducted sky and ground surveys from a viewpoint of preventing secondary disasters, explained survey results to the town mayor and concerned persons in the town, prefecture, and Regional Development Bureau and gave advice on emergency

measures, warnings and evacuations, and other critical matters. We intend to strengthen such support activities.

4. Implementation of the Regional Development Bureau personnel training support program

The Sediment Disasters Prevention Act was revised in 2010 to stipulate that, in the event of ash fall or river channel blockage by volcanic eruption in excess of a certain level that may produce debris flow, the central government is required to conduct an emergency survey and provide local governments with information on areas and timing where disasters are expected to occur. It is necessary to maintain / improve the technical capabilities of personnel of the Regional Development Bureau who take charge of this duty.

Accordingly, since FY2013, a sabo subsection manager from each Regional Development Bureau has concurrently served at NILIM from April to December. These persons additionally participate in NILIM's lectures, seminars, and on-site training workshops for about two-weeks per year on early detection / measurement of river channel blockage, debris flow flood simulation, watching and observation, emergency works, etc. In FY2019, a total of 9 persons from across the country partook in the program, which included on-site training in the Kii Mountains etc. To date, a total of 56 persons have completed this program. We intend to continue improving this program.

5. Activities by the Technical Center for Large-scale Sediment-related Disaster Countermeasures

In the 2011 Great Kii Peninsula Flood, deep-seated landslides, river channel blockages, and large-scale run-offs frequently occurred in Nara, Wakayama, and Mie Prefectures and caused enormous damage. In response, the Kinki Regional Development Bureau established the "Technical Center for Large-scale Sediment-related Disaster Countermeasures" in Nachikatsuura Town, Wakayama Prefecture in 2014 to promote research and development related to large-scale sediment disasters. For a while after the center was established, personnel from the Sabo Department were deployed to the center to support survey and research activities. Since 2017, a senior researcher has been stationed there to perform research activities in cooperation with the concerned organizations. The Kii Mountains are located in an area with a steep topography and a median dislocation line running on the northern side. Sediment disasters including deep-seated landslides occur frequently in the area. In the area, we are conducting studies on the mechanisms of large-scale sediment disasters including deep-seated landslides, shallow landslides, and debris flow, as well as risk assessment methods by conducting hydraulic / hydrologic surveys, aerial electromagnetic surveys, etc. In addition, we give technical support to the local government, etc. in order to prevent secondary disasters if a sediment disaster occurs in the center's area. We intend to continue activities in cooperation with local communities.

6. Conclusion

For the Sabo Department to properly conduct research activities that lead to the prevention / mitigation of sediment disasters, it is important to accurately grasp social needs and provide specific results. Accordingly, we consider the utilization of research results, such as their reflection in various technical guidelines, in the way we conduct studies. We also use technologies available in other fields and cooperate with other organizations because advanced technologies from other fields, such as information collection technology based on SAR images, and cooperation with other organizations can advance research.

In recent years, the response to sediment disasters has required diverse action and quickness due to the effects of natural phenomena like climate change, earthquakes, volcanic eruptions, social changes like urbanization and depopulation, and administrative activities aiming at more systematic / efficient infrastructure development and improvement / reinforcement of warning and evacuation systems. In research activities for disaster prevention / mitigation, we will strive to grasp future social needs and situations in order to stay on top of things, and to pursue research activities more systematically and efficiently based on objectives and priorities. We will look at both issues that require immediate results and issues that we need to address over the long-term.

☞ See the following for details.

- 1) e.g., Reproduction of Sediment / Flood Cases considering Fine Sediment Behaviors, p. 59
- 2) Technical Note of NILIM No.1048, "Guide (draft) to Study on Sabo (erosion control) Facility Arrangement as Countermeasure for Sediment Flooding / Inundation using River-bed Variation Calculation"
<http://www.nilim.go.jp/lab/bcg/siryoutnn1048.htm>
- 3) Sediment Disaster Interpretation Research Method (Draft) with Synthetic Aperture Radar (SAR) Images, p. 122