Research Activities in the Field of Sediment-related Disaster Measures

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1. Introduction

In 2015, 788 sediment-related disasters occurred across the country, killing 2 persons in total. As compared with the average data for the past ten years, i.e., about 1,050 disasters per year and fatalities and missing persons totaling about 35 per year, human damage caused by sediment-related disasters in 2015 was rather small. However, destructive damage occurred in some areas, including debris flow in Tarumizu, Kagoshima, in June to July, and the sediment-related disaster in Tochigi-ken caused by the Kanto-Tohoku Heavy Rain in September, and there were also not a few cases where local residents narrowly escaped damage as the result of evacuation based on warning. In recent years, large-scale sediment-related disasters involving many deaths occurred, including the August 2014 debris flow in Hiroshima-shi and the 2013 sediment-related disaster in Izu-Oshima, which gave rise to discussion among society about measures against sediment-related disasters in both structural and non-structural aspects.

Meanwhile, since the eruption of Mt. Ontake in September 2014, which was the most devastating volcanic eruption disaster in recent years, there is a serious social concern about increasing volcanic activities, as seen in the May 2015 eruption in the Kuchinoerabu Island, in which all the island residents were forced to evacuate from the island for more than six months, and the temporary rise in the eruption warning level in Mt. Hakone (June) and Sakurajima (August).

Under such circumstances, the Sediment Disaster Prevention Law and the Law concerning Special Measures for Active Volcanoes have been successively revised, and the NILIM should also be actively promoting technical development including researches and studies that would be helpful in disaster prevention and risk management in case of disaster.

2. Technical support

In case of a large-scale sediment-related disaster, NILIM provides technical guidance in cooperation with the Public Works Research Institute ("PWRI") on the site for prevention of secondary disasters according to request from municipalities, etc. In fiscal 2015, the Sabo Department dispatched a total of 23 experts / day to provide technical advice for safety check after rainfall, emergency measures, etc. from the viewpoint of preventing secondary disasters to the Regional Development Bureaus, Sabo Office under direct control, prefectures, and municipalities that implement measures for preventing sediment-related disasters.

In parallel, the NILIM has started a practical human resource development program, which utilizes the personnel concurrent service system, from last fiscal year in order to support the quality improvement of personnel in Regional Development Bureaus who engage in the advanced measures against sediment-related disasters. In fiscal 2015, a total of 9 persons from local Regional Development Bureaus joined this program, and the personnel of the Regional Development Bureaus in concurrent service have engaged in on-site technical support activities including the debris flow disaster in Serizawa District, Nikko-shi, Tochigi-ken together with the personnel of NILIM and PWRI.

Photo: Debris flow disaster investigation (Nikko-shi, Tochigi)

In view of the fiscal 2014 Hiroshima disaster, etc, the revised Sediment Disaster Prevention Law was enforced in January 2015, requiring the Minister of Land, Infrastructure, Transport and Tourism to endeavor to provide necessary advice, information, and other assistance to prefectures and municipalities. In response, we would like to strive to accumulate and utilize necessary findings and technologies so as to conduct technical support activities more appropriately in case of a disaster etc.

3. Research on large-scale sediment-related disasters

For deep-seated landslides, which may cause natural dams and large-scale debris flow, focused research is

going on, triggered in part by the 2011 Kii Peninsula flood disaster.

The conventional countermeasures against natural dams are focused on emergency measures to be implemented after formation of natural dam, but implementation of such measures before formation is considered to mitigate damage by natural dam. We have therefore started a research for establishment of measures practicable before occurrence of deep-seated landslide from fiscal 2015, such as reduction of the size of natural dams using existing "sabo" facilities in case of a deep-seated landslide.

For sediment-related disasters caused by heavy rain, it is also effective to forecast the effect accompanying sediment movement using the numerical analysis method and implement countermeasures. Therefore, we have summarized points of attention in the Technical Note of NILIM concerning the numerical analysis of sediment movement that reflects the characteristics of the complicated sediment movement phenomenon in mountainous watershed.

Further, the NILIM has participated in the Research Organization for Large-scale Sediment Disaster Countermeasures, centering on the Technical Center for Large-scale Sediment Disaster Countermeasures, Kinki Regional Development Bureau, to continue researches and studies, technical development, etc. concerning mechanism identification and countermeasures for deep-seated landslides and large-scale debris flow by academia-government collaboration.

4. Effort for early detection of sediment-related disaster

The successful launch of "DAICHI-2," JAXA's Advanced Land Observing Satellite (ALOS), in May 2014 has enabled "regular health check (routine observation)" and "emergency diagnosis (urgent observation)" using the Panchromatic L-band Synthetic Aperture Radar (PALSAR-2). We aim to develop technologies for locating the sites of deep-seated landslides and natural dams by monitoring areas vulnerable to landslide or deep-seated landslide at "ordinary times" and grasping signs (slope movement) of landslide etc. from the data observed by PALSAR-2 to be able to undertake countermeasures quickly in case of detecting abnormality, and by conducting emergency observation quickly and efficiently in combination of aircraft-mounted SAR (synthetic aperture radar) etc. with PALSAR-2 at the "first response stage" of a large-scale sediment-related disaster caused by heavy rain or earthquake.

Additionally, it has become possible to detect precursory phenomena of sediment-related disasters, which are important criteria for judging warning and evacuation from sediment-related disaster but were difficult to collect and share among the local community, by analyzing "twitter" information posted unintentionally on the network. We would like to advance the development of technologies that support determination to evacuate in "urgent stage" by complementing the information issued by users of SNS (Social Networking Service), which is also called "social sensor," with the rainfall observed by radar such as XRAIN etc. to enhance reliability.

Meanwhile, since the early detection method using a physical sensor is considered effective, we have newly started a study on the method, as a new challenge, for forecasting sediment-related disasters with high accuracy using real-time observation / monitoring data from fiscal 2015. This study examines the method for setting up standard values to determine the urgency of a sediment-related disaster using the monitoring / observation information on flow rate, sediment discharge, etc. that would be effective to determine the urgency of a sediment-related disaster. In fiscal 2015, we conducted a fundamental study for using observation results as reference, including specification of relations between changes in the sediment flow environment in basins and observation values by analyzing the observation results of sediment discharge in sediment movement including debris flow.

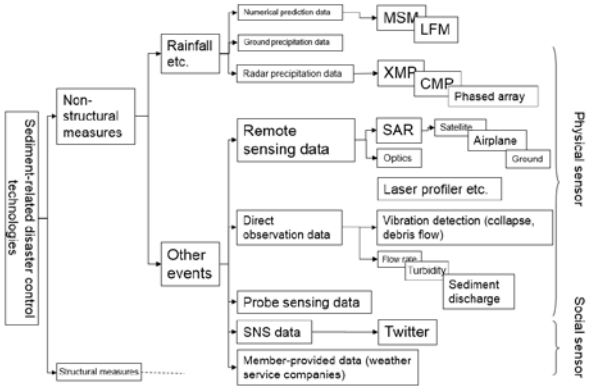

Figure: Various information available for early detection of sediment-related disasters

Ultimately, our policy aims to be able to provide the information concerning the risk of occurrence of sediment-related disaster, which has higher forecast accuracy and communicates urgency more easily by joint use with the conventional approach based on rainfall information.

5. Conclusion

In accordance with the increasing social concern about sediment-related disasters, relevant technical field is wide and expanding its base. As a state-run research institution, in collaboration with universities, government and private research institutions, etc., we will advance researches and activities with a sense of speed and respond appropriately to request and expectation from society.

☞See the following for details.

1) 2015 Sediment-related Disasters in Japan (Sabo Department, MLIT)
http://www.mlit.go.jp/river/sabo/jirei/h27dosha/H27_dosyasaigai.pdf