For the Prevention of Sediment Disasters

NISHI Masato, Director
Research Center for Disaster Management

Keywords: sediment disaster, deep-seated landslide, crisis management, technical support

1. Introduction

The Sediment Disaster Prevention Department will be launched on April 1, 2014. This new department has been organized by the former Erosion and Sediment Control Division of the Research Center for Disaster Management, the newly established Research Coordinator for Deep-seated Landslide Prevention, and the former Sediment Disaster Prevention Division.

The Erosion and Sediment Control Division had been studying causes of sediment disasters and planning and formulating countermeasures therefor and standards for warning and evacuation. It was, nevertheless, decided to strengthen the study of erosion and sediment control by launching a new organization in order to establish effective measures for major sediment disasters, including the deep-seated landslide that occurred on the Kii Peninsula.

The Erosion and Sediment Control Division was mainly in charge of structural measures including erosion and sediment control planning and infrastructure design methods, while the Sediment Disaster Prevention Division mainly engaged in non-structural measures including warning and evacuation systems and remote sensing technology, and the Research Coordinator for Deep-seated Landslide Prevention directed the focus of their studies on deep-seated landslide in coordination with both divisions.

2. Issues on recent sediment disasters

Sediment disasters occur repeatedly every year and cause loss of human lives and property damage, totaling about 1,000 cases on average and killing dozens of people every year. In recent years, Typhoon No. 12 in 2011 caused serious damage to the Kii Peninsula, heavy rains in July 2012 including the Kyushu Heavy Rain caused disasters, and the Great East Japan Earthquake in 2011 caused large-scale sediment disasters in many places including Shirakawa in Fukushima Prefecture. As a volcanic disaster, Mt. Shinmoe in Kirishima erupted in January 2011 and many residents around the mountain were forced to evacuate. Furthermore, still fresh in our memory is Typhoon No. 26 that hit Izu-Oshima in October 2013 and caused large-scale mudflows and serious damage including 39 people dead or missing.

Looking back on these disasters, many of them were caused by record-high rainfalls. The continuous rainfall caused by Typhoon No. 12 in 2011 reached about 1,800 mm, the largest rainfall ever observed in Japan, and the 24-hour rainfall of 824 mm observed in Izu-Oshima in 2013 was also the highest as an observation point value since 1938. There is concern that climate change may lead to frequent occurrences of abnormal weather. Accordingly, we have to think that the trend of large-scale sediment disasters will continue under intense weather conditions.

Furthermore, in hilly and mountainous areas, which are prone to sediment disasters, resistance against natural disasters is declining due mainly to a progressive low birthrate and aging, while the development of erosion and sediment control infrastructure is limited due to financial constraints. Thus, disaster prevention projects are faced with a difficult situation because of social factors.

Under such circumstances, in order to prevent sediment disasters and ensure the safety of people, multiple measures should be promoted in both structural and non-structural aspects, including efficient development of erosion and sediment control infrastructure and the advancement of warning and evacuation systems. Also, to enhance the effectiveness of such measures, it would be necessary to conduct technical reviews. This paper introduces the direction of research and studies into the aforementioned issues by Sediment Disaster Prevention Department.

3. Erosion and sediment control plan for deep-seated landslides, etc.

The slope failure that occurred on the Kii Peninsula was very large in scale and resulted in the formation of a huge natural dam, so it was necessary to take different actions from that of the past. For this reason, in order to formulate a method for drafting an erosion and sediment control plan in consideration of the debris flow resulting from this deep-seated landslide, the study is proceeding by identifying locations vulnerable to deep-seated landslides, external force settings for infrastructure, etc.

We will also continue to study methods of long-term assessment of sediment discharge to the downstream after large-scale collapses.

Not only deep-seated landslides but also simultaneous frequent occurrence of shallow landslides could cause a major disaster as occurred in Izu-Oshima. In response to this Izu-Oshima disaster, the Erosion and Sediment Control Department of the MLIT held its first meeting of the "Workshop for Strengthening Sediment-related Disaster Prevention Measures" in December 2013, in order to reinforce structural measures for phenomena not contemplated in existing plans and for large amounts of debris, as well as non-structural measures including warning and evacuation measures. The workshop identified some new issues, including measures for areas without clear valley topography, such as volcano areas, and measures for debris, which increases the damage of sediment disasters, and is urgently discussing these measures.

It is also a major issue to establish strategic maintenance approach for existing erosion and sediment control infrastructure. Conventionally, maintenance of existing infrastructure has not been of a satisfactory level mainly because sites are separately located in mountainous regions, so we plan to study ways to strengthen management in order to utilize existing facilities effectively.

4. Crisis management in major disasters

There is concern that an earthquake in the Nankai Trough or directly under Metropolitan Tokyo would cause catastrophic disaster across a wide area. To minimize damage in such cases, it is necessary to act appropriately. Since sediment disasters often occur in remote isolated locations, it is important to grasp the whole picture of a disaster including the location and scale at an early stage.

Individual disasters were conventionally grasped by reporting or patrols, but the conditions of area-wide disaster are understood using helicopters deployed to each Regional Development Bureau. Moreover, in verifying the damage in the Great East Japan Earthquake, Typhoon No. 12 of 2011 and other disasters, attempts were made to obtain pictures and information collected by synthetic aperture radar from an airplane or satellite and use them for addressing disasters. This approach achieved a certain level of success.

In addition, the development and utilization of technologies that contribute to crisis management are proceeding, including efforts to develop a seismograph for instant pinpointing of the location of large-scale collapses, efforts to estimate collapse-prone areas from seismic intensity distribution, efforts to estimate upstream channel blockage from water gauge data, and systems to collect information from residents using SNS. Thus, study is underway to grasp of large sediment migration phenomena in real-time.

In the future, we are going to improve the accuracy of such information and study the development of information transfer systems to support resident warning and evacuation systems. The findings from the aforementioned studies are used not only for crisis management in disasters but also for long-term land monitoring through constant monitoring of mountainous areas and the logging of that data.

5. Technical support in sediment disasters

Sediment disasters frequently occur in Japan, but local governments have few technical experts with thorough knowledge of sediment disasters. In the event of a sediment disaster, personnel of NILIM and PWRI often provide technical advice, as experts, at the site since it is urgently required to prevent secondary disasters in search activities, etc., ensure the safety of residents, and take emergency measures. In fiscal 2012, a total of 12 persons were dispatched from NILIM to 10 disaster stricken areas, and 8 persons were dispatched as Tec-Force in fiscal 2013 to Izu-Oshima to support the activities of Tokyo and Izu-Oshima.

Regional Development Bureaus also need personnel familiar with disaster response in order to provide active support to local governments in the event of a disaster. In order to support the development of such personnel, the Erosion and Sediment Control Division has been receiving personnel from the Regional Development Bureaus since fiscal 2013, who concurrently serve both organizations. We provide such personnel with opportunities to study and discuss issues on disaster response and support them in acquiring the required capabilities, including how to grasp the flow of on-site response and technical viewpoints, by introducing our know-how when they accompany us on visits to provide technical guidance on disaster response.

We would like to continue efforts to reflect the findings of our division in the policies on sediment disaster prevention measures, to contribute to the improvement in disaster response capability of MLIT in general, and to eliminate disasters.