Research and Study Supporting Disaster Prevention / Reduction in the Water Field

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1. Introduction

In 2019, Typhoons Nos. 15 and 19 and other storms caused enormous damage across Japan. In July of the previous year, the heavy rains caused serious damage across West Japan. For the first time, the Meteorological Agency blamed this heavy rain on climate change.

With regard to climate change, the Panel on Infrastructure Development ("PID") issued a report in August 2015, titled "Interim Report on Climate Change Adaptation Measures in the Flood Disaster Field," in which it indicated that (i) infrastructure should be built to the planned scale; (ii) proper maintenance and upgrades are necessary to ensure infrastructure functions as expected and (iii) water disasters can be prevented and mitigated by ensuring the foregoing efforts, devising operating and maintenance procedures for infrastructure, promoting, as proposed, community and regional development in consideration of likely disaster risks and improving preparedness in terms of orderly evacuation, smooth emergency response, business continuity, etc.

Furthermore, in the "Flood Control Plan for Climate Change" proposed on 2019 by the Engineering Workshop on Flood Control Planning for Climate Change, a major proposal was made to "change the basis of flood control planning from the actual precipitation to the future precipitation predicted from climate change".

The "Flood Control Measures for Mitigating Large-scale Flood Hazards" -- a report issued by the PID after heavy rains hit the Kanto and Tohoku areas in September 2015 -- decried the need to make society "aware of waster disaster prevention" and indicated that local governments, local communities, residents, businesses and river administrators should be aware that "infrastructure has its limits and unpreventable large-scale flooding is bound to occur" and that non-structural measures that aid the evacuation of residents should be ensured part and parcel to structural measures for flood prevention. In response, MLIT launched a "Vision for Making Society Aware of Waster Disaster Prevention" and proposed an emergency action plan in order to realize this vision. Measures have been promoted under the plan, which has been modified because of the heavy rain disasters that occurred after the plan's inception.

As presented in the PID's proposal in August 2015, in order to prevent / reduce damage by rainstorms and other events, including the impact of climate change, it is important to develop and continually maintain various infrastructure that protects communities (e.g., river / coastal levees, dams, etc.). Systems for inspecting and assessing infrastructure are being established, but it is nonetheless important to improve the efficiency of maintenance activities for existing infrastructure with limited financial and personnel resources.

2. Disaster prevention / reduction measures for flood damage

In light of the circumstances stated above, it is necessary to make society aware of water disaster prevention and conduct studies into flood control measures from various aspects in consideration of climate change.

NILIM has proposed a new flood control framework [1)] for reducing water disasters, which promotes disaster prevention / reduction in a seamless and comprehensive manner by combining a reduction in flood frequency (disaster prevention by river development, etc.) and post-flooding damage control (disaster reduction or risk management) after predicting changes in heavy rainfall due to climate change and subsequent changes in river flow. In order to promote this approach, it is necessary to examine quantitative methods for measuring the effects of various measures on flood damage risk and uncertainty, as well as specific measures.

<Viewpoint of disaster prevention> In river development, it is important to improve river channels to ensure flow of river water, and to build levees. Specifically, we promote the study of river improvement methods to control sediment re-deposition after channel excavation and re-growth after cutting trees (See Fig. 1).

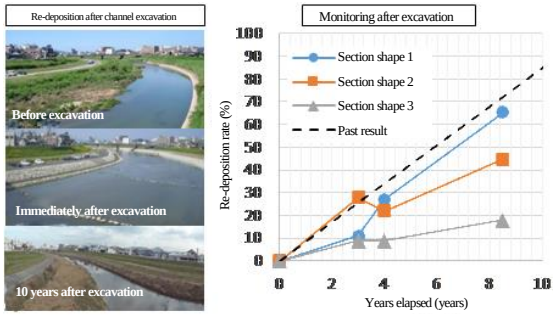

Fig. 1 Analysis on sediment re-deposition after channel excavation

In addition to levees, dams are another important piece of flood control infrastructure and, due mainly to a decrease in suitable sites for new dam construction, effective use of existing dams and dam upgrades are critical flood control measures. For this purpose, there are both non-structural and structural technologies. In the field of non-structural technologies, we are conducting a study into utilizing a dam's flood set function more effectively using precipitation forecast information. In terms of structural technologies, we are raising levees, expanding discharge gates, and addressing reservoir sedimentation with existing dams and studying methods for choosing the most appropriate technologies and supporting their application to individual dams.

<Viewpoint of disaster reduction> An ongoing study at NILIM is mapping the potential spatiotemporal variations in river water level in a flood as "Flood Damage Risk Lines" (See Fig. 2). In addition, technical development and social testing are underway for a system that predicts the occurrence of inundation by rainfall in urban areas and transmits information to local residents, etc. (see Fig. 3). For the foregoing studies, we continue to advance system development with the aim of expanding the scope of application and upgrading information in ways that provide a stronger basis for deciding on evacuations and promote effective / efficient flood prevention activities.

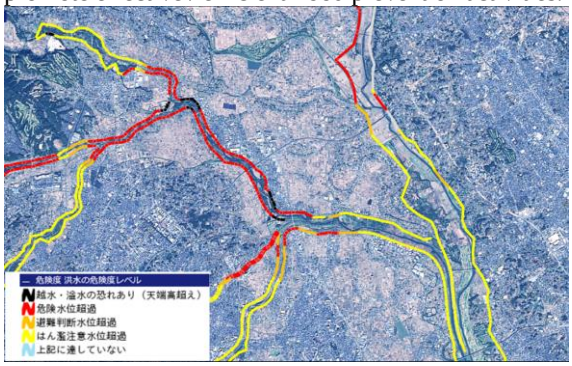

Fig.2 Example of flood risk line indications

Fig. 3 Inundation forecast system

3. Activities for infrastructure maintenance

Regarding the maintenance of river infrastructure, a study is proceeding on a new approach for detecting deformation, etc. using satellite imagery, laser survey data, etc. and is expected to enhance administration efficiency. For river channels, we are studying simple and low-cost ways to measure discharge capacity in small and medium-sized rivers, while, for levees, we are studying a method for screening locations we should inspect based on laser survey data, etc. As for dams it is generally difficult to apply deformation detection methods of other structures because dams are huge structures, but we are developing technologies to inspect the inside of the dam body in a manner suitable for the characteristics of dam materials and structures (non-destructive / semi-destructive method). In the coastal field, we are studying a method for mapping wide sections of the submarine topography along sandy beaches using satellite imagery, laser survey technology, etc. and a method for measuring coast lines efficiently and continuously (see Fig. 4).

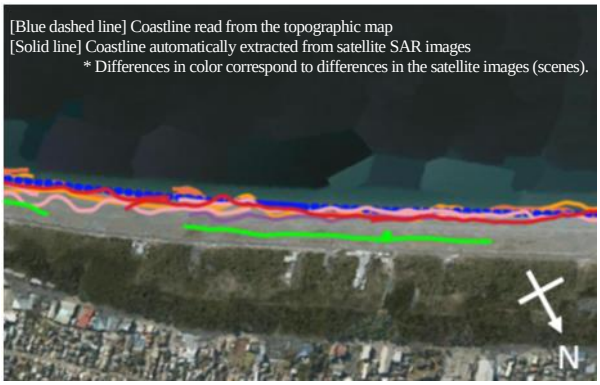

Fig. 4 Example of coastline extraction with satellite SAR images

☞See the following for details.

1) NILIM Project Report No. 56, 2017
http://www.nilim.go.jp/lab/bcg/siryou/kpr/prn0056.htm