NILIM's Activities for Improvement of Planning and Preparation Methods for Landslide and Flood Countermeasures

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1. Introduction

Landslides and floods are a phenomenon where flooding of sediment and muddy water or of muddy water occurs, caused by the rise of a riverbed or a river blockage due to an accumulation of large volume of sediment generated by landslides and debris flow at a point downstream rather than the basin outlet. Fooling damages a much wider area, compared to debris flow (Figure-1). Landslides and floods have frequently caused substantial damage, having a tendency to occur more frequently since the beginning of the 2000s. [*1)] It is thought that this has been caused by the increased frequency of extremely heavy rains producing both a lot of sediment due to frequent landslides, and by floods carrying a large amount of sediment downstream. Both are impacted be high rainfall intensity and a high volume of total rainfall due to climate change.

MLIT has already identified river basins that have high landslide and flood risk all over Japan and is determined to accelerate landslides and floods countermeasures as preventative and efficient disaster prevention measures. The NILIM's Sabo Department is engaged in studying survey details and planning preparation method for countermeasures required for such a contingency.

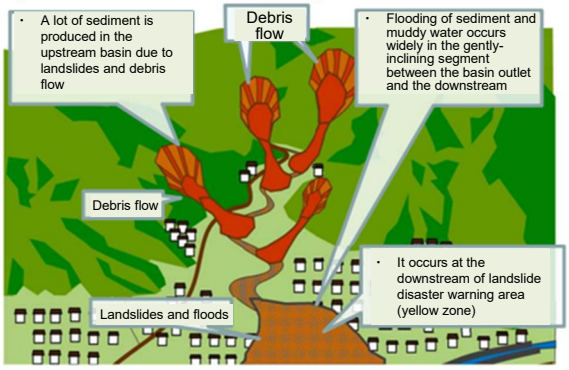

Figure-1 Image of landslides and floods

2. Difficulty in making plans for landslides and floods countermeasures

To prepare a strategic plan for Sabo facilities (planning for landslides and floods countermeasures) as landslides and floods countermeasures, it is necessary to predict a series of sediment movement phenomenon and potential damage caused. Furthermore, to predict how such a phenomenon would change by placing Sabo facilities, understanding where in the river basin and how much volume and quality of sediment would be produced and moved into river against the predicted level of rainfall, how the sediment would move down the river is difficult. Having ever-changing slopes and river width from the upstream to the downstream causing riverbed changes due to erosion and accumulation, from which part of river the flooding starts and how much damage is given to surrounding houses are all variables. We make such predictions based on these variables by creating a numerical simulation model. However, it is not easy to create a model that can be used for practical planning preparation that fits an actual river basin, as the river basin area as well as the river length subject to study are so large, the boundary conditions set are so diversified and the flow forms are so complicated.

As for the planning preparation method for landslides and floods countermeasures, the basic concept has been streamlined in the river and Sabo technology standards and NILIM's documents [2)], however, as those methods are adapted at each place and practical plans are studied, we need to consider such issues as accumulation of data on input conditions substantially affecting the calculation or way of considering various uncertainties such as sediment supply sources for calculation. It is necessary to further improve the planning preparation method so that the regional development bureau and prefectures can smoothly implement the planning preparation.

3. Contribution as a hub for study structure coordinating related institutions

To improve the preparation method for landslides and floods countermeasures planning, a study structure coordinating related institutions has been created as shown in Figure-2.

We have 37 river systems for which we study landslides and floods countermeasures. For planning the river systems we have direct Sabo projects and we have placed technical study meetings consisting of academic experts, MLIT's Sabo Department, NILIM's Sabo Department, regional development bureau and responsible offices. At this research meeting, the appropriateness of our study results are evaluated at each study stage and useful knowledge and issues are identified. We had 13 technical study meetings held during FY2024 and NILIM's Sabo Department

participated in all of them and gave detailed technical guidance, on how to prepare to regional development bureaus and responsible offices.

To summarize and streamline the knowledge and comments obtained at technical study meetings for each river system and to improve the planning preparation method for landslides and floods countermeasures, we have an additional opportunity (technical discussion meeting) to have opinions from academic experts who also participate in technical study meetings (basically held once a year). NILIM, as a secretariat, prepares, administers the meeting and streamlines the direction utilizing the opinions heard.

Utilizing the opinions obtained at the technical discussion meeting, NILIM's Sabo Department issues technical documents and engages in communication with other related institutions, such places as regional development bureaus. Feedback and new issues are identified there and then they are discussed at technical study meetings.

The technical discussion meeting connects the on-site practices and identification of issues with the improvement of planning preparation method for landslides and floods countermeasures at related institutions. NILIM's Sabo Department, as a secretariat, works as a hub within the study structure coordinating related institutions.

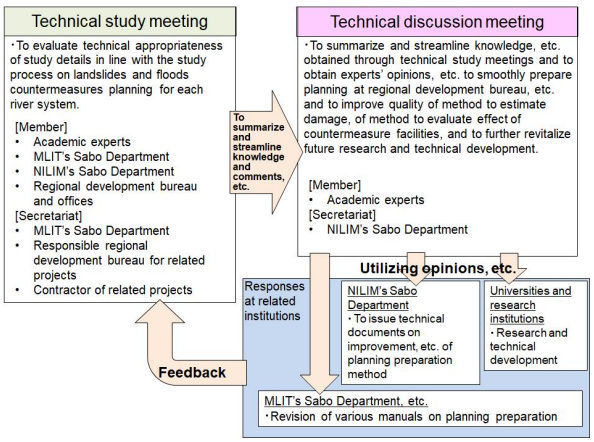

Figure-2 Structure to study landslides and floods countermeasures planning

4. Examples NILIM has as research theme

There is research and development NILIM's Sabo Department has as its own research theme utilizing opinions of the technical discussion meeting. I will explain three examples as follows.

Regarding the issue that the riverbed change calculation model cannot properly reproduce the phenomenon identified in actual landslides and floods (in particular, it cannot reproduce phenomenon such as sediment having a wide variety of particle sizes including minute particles that are carried down to the area having small riverbed slopes). We engage in research in order to improve the calculation model. As the initial stage approach for this research, we describe the research results while conducting hydraulic model experiment, as an article in this document. [3)]

As for the slope collapse sediment volume flowing into the river at the time of planned rainfall, we engage in research on its verification method. Currently, we use a method to empirically estimate the volume based on the actual data from past heavy rainfalls, however, we also consider a response to extremely heavy rainfalls that we have never experienced before due to climate change. We engage in research on methods to embedded-analytically estimate a physical model for slope collapse.

In addition, as for the housing damage estimation required for studying landslides and floods countermeasures planning, we engage in actual situation surveys to study the relationship between the sediment depth and the housing damage. Research into the relationship between the flow speed and water depth is reproduced by numerical simulation and actual housing damage.

5. Conclusion

As explained above, NILIM's Sabo Department continues to ensure improvement in the planning preparation method for landslides and floods countermeasures, contributing as a hub for study structure and making its own research and development.

☞Detailed information is as follows.

1) FY2023 summary of Sabo technology study meeting considering climate change, March 2024, p4 https://www.mlit.go.jp/river/sabo/committee_kikohendo/231225/r5torimatome.pdf

2) NILIM document No. 1048, November 2018 https://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn1048.htm

3) Development of the calculation model to accurately predict sediment accumulation at the time of occurrence of landslides and floods, pages 58 ~ 59 of this document