Detection of Landslide Dam Formation by Monitoring Flow Decline

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1. Background

When water flow overtops a landslide dam formed by an earthquake or heavy rain, the result may be a drastic breach that seriously damages the downstream area (photo). To mitigate damage caused by landslide dams, it is essential to detect their formation and take action, including evacuation, as quickly as possible.

2. Objective

If landslide dams form at the stream of a mountain river channel, flow rate sharply decreases (compared with flow during normal flooding) downstream from the landslide dam. It was, therefore, considered that the formation of a landslide dam could be detected by identifying a drastic decrease in flow downstream from a landslide dam. However, there are few studies that have aimed to determine a method and criteria for judging landslide dam formation using flow variation (first issue) or evaluating sections where the landslide dam formation can be detected using flow data (second issue). Therefore, detection and/or confirmation of landslide dam formation using flow rate observation data has not actually been conducted. Therefore, NILIM, in cooperation with the Kanto Regional Development Bureau, proposed a new approach for analyzing these two issues ("proposed approach").

3. Outline of the proposed approach

Regarding the first issue, we proposed that the formation of a landslide dam can be judged by whether the degree of flow decline was larger than given criterion. However, setting a relatively small degree of flow decline as the criterion might suggest that a landslide dam had formed when it had not. To reduce this possibility, we used a flow dataset to clarify the degree of ordinal flow decline, then set the criterion at a point larger than the degree of ordinal flow decline.

Next, for the second issue, we proposed an approach in which we monitor a section of the river where a drastic and large decrease in flow beyond that expected under the above described normal conditions is considered likely if a natural dam is formed. The proposed approach assumed that the degree of flow decrease because a landslide dam is dependent on the ratio of the area of the river basin at the flow observatory to the area of the river basin upstream from the landslide dam, and on the distance from the flow observatory to the landslide dam. Based on these considerations, we proposed an approach in which we monitor the landslide dam formed at the sections where the catchment area is larger than a certain size (the smallest detectable catchment area) and the distance from the flow observatory is less than a certain distance (the longest detectable distance) (figure).

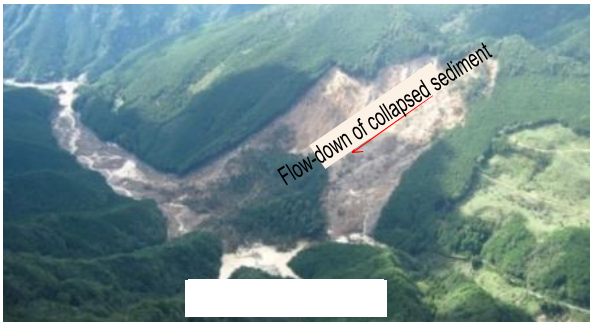

Photo: Example of Landslide Dam Formed in Typhoon No. 12 of 2011

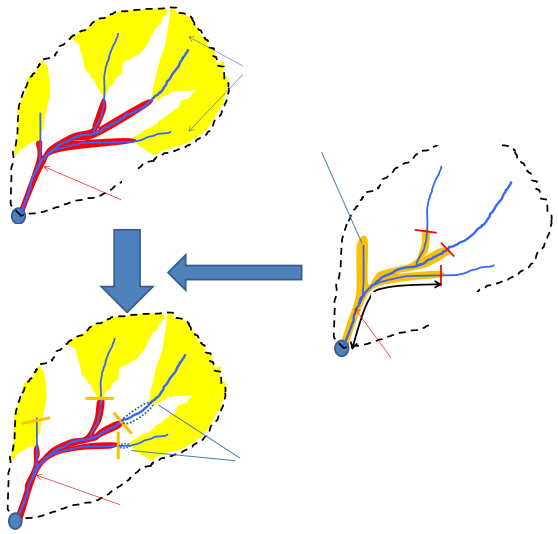

Figure: Diagram of Proposed Approach

[Reference]

"Manual on data analysis for detection of landslide dam occurrence using discharge data," NILIM Document No. 767, Nov. 2013.