Sediment Control Works to Prevent Deep-seated Slope Failure in the Tachiyazawa River Basin

Toshikazu KUBOTA[1*], Tateo MITSUNAGA[1], Hirokazu YAKURA[1] and Satoko KASAHARA[1]

1 Shinjo Office of River, Tohoku Regional Development Bureau, MLIT, Japan
*Corresponding author. E-mail: kubota-t82ac@mlit.go.jp

INTRODUCTION

In 2011, a deep-seated slope failure occurred at Ikenodai in the Nigorisawagawa River basin, a tributary of the Tachiyazawa River (**Fig. 1**). It involved 1.9 million m^3 of sediment, which did not make landslide dams, but moved in a sediment outflow reaching a distance of 1.5 km. The sediment deposits were 15~20 m thick. The volume of the sediment outflow was so large that it exceeded the amount of sediment of the Sabo Master Plan. The 1.5 km area between the landslide and Nigorisawa Sabo Dam No. 5 caught most of the bed load. However, the sediment outflow damaged the wing sections of the sabo dams in the Nigorisawa River basin.

EFFECT OF SABO DAMS ON CATASTROPHIC SEDIMENT OUTFLOW

Immediately after the Ikenodai landslide, the effects of the sabo dams on capturing the sediment debris flow were as follows: (1) Part of the landslide was disturbed and 1.1 million m^3 of debris was deposited in the Nigorisawa River. (2) The wing sections of Sabo Dams No. 4 and 7 were damaged by the high-impact force of the debris flow. (3) Sabo Dam No. 5, which had a 200,000 m^3 pocket for sedimentation, caught the sediment outflow and suspended load. This Sabo Dam is located in a section where the river bed gradient changes and the width of the river changes from 60 to 120 m. (4) Sabo Dam No. 5 caught 35% of the outflow.

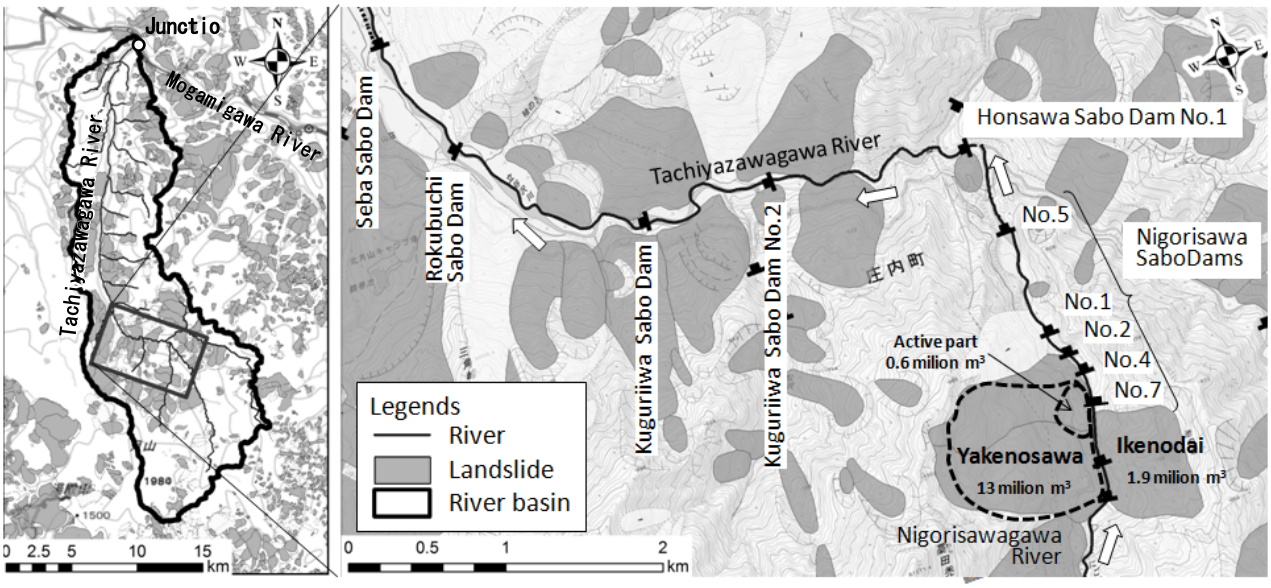

Fig.1 Locations of the Sabo dams and landslide

SEDIMENT CONTROL FOR CATASTROPHIC SEDIMENT OUTFLOW

Catastrophic sediment outflows, like that of the Ikenodai landslide, occur frequently in the Tachiyazawa River basin. Catastrophic sediment outflows are thought to occur there because of the geology and topography, and it is heavy snowfall region. A current risk is the active Yakenosawa landslide.

We considered the influence of debris flow from the Yakenosawa landslide in a numerical calculation. We calculated two type of debris flow discharge: one was the active part of the Yakenosawa landslide, with total debris flow volume of 0.6 million m^3 (peak discharge 14,228 m^3/s), and the other was the largest failure in the past 70 years, which had a total debris flow volume of 8 million m^3 (peak discharge 123,480 m^3/s). The other settings conformed to those in PWRI technical note No. 4240.[1)] We calculated the cases before and after reconstruction of the Sabo dams to evaluate the effects of enlarging Kuguriiwa Sabo Dam No. 2 and increasing the sediment trap capacity of Honsawa Sabo Dam No. 1.

The 0.6 million m^3 simulation showed that the amount of sediment outflow could be greatly reduced in the area near Kuguriiwa Sabo Dam No. 2, which is located 4 km from the Yakenosawa landslide (**Fig. 2c**). Therefore, we proposed a sediment control plan that involved reconstructing Kuguriiwa Sabo Dam No. 2 and increasing the sedimentation capacity in the Tachiyazawa River basin. The simulation results at a location 8 km from the Yakenosawa landslide showed that the sediment outflow would decrease from 230,000 to 30,000 m^3 as a result of the improvements (**Fig. 2c**). In the simulation of the maximum volume landslide, the sediment outflow was reduced; however, the amount of the reduction was insufficient (**Fig. 2d**).

CONCLUSION

In the Tachiyazawa River basin, the Sabo Master Plan should consider the possibility of large volume sediment outflow resulting from deep-seated slope failure. Based on a simulation of the debris flow from the Yakenosawa landslide, we propose a plan involving reconstruction of the Sabo dams.

To control debris flow in the Nigorisawa River basin, it is necessary to reinforce the sabo dams along the Tachiyazawa River, which are located far from the landslide. However, any prevention work should consider the estimated costs and work schedule. Another control method may be necessary to deal with a large deep-seated slope failure, such as landslide prevention work.

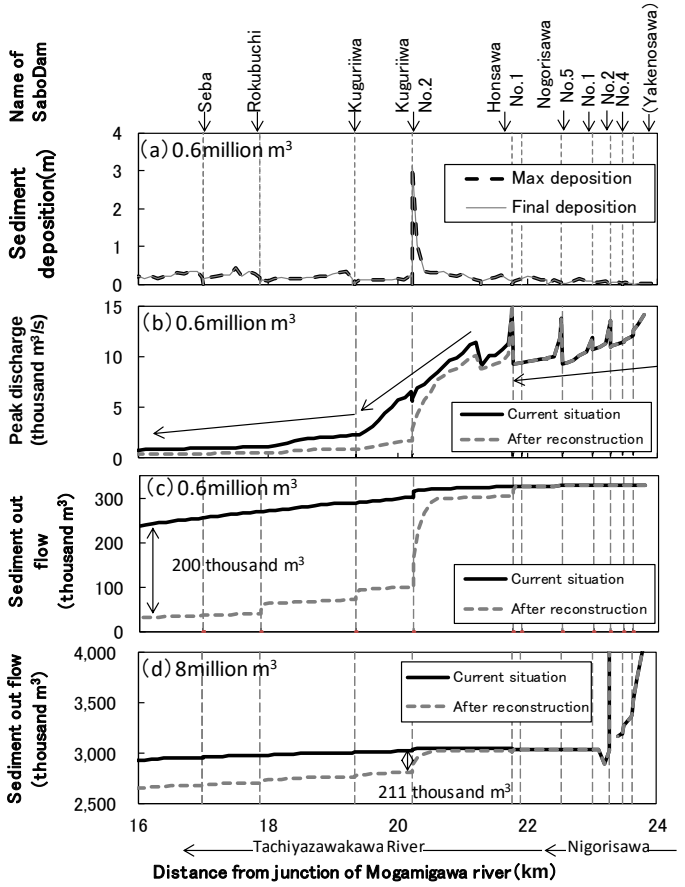

Fig.2 Result of simulation

1) Erosion and Sediment Control Research Group Volcano and Debris Flow Research Team Public Works Research Institute (2012) Run off and flood computation manual for debris flow result from deep-seated slope failure, PWRI technical note No. 4240 September 2012.

Keywords: Deep-seated slope failure, debris flow simulation, sediment control work