Policy of Large-scale Landslide Dam Countermeasures Caused by Typhoon No.12 (TALAS) in Kii Mountain System, 2011

Gengo YOSHIMURA[1] and Hiroaki SUGAWARA[1*]

[1] Kii Mountain System Sabo Office, Kinki Regional District Bureau, Ministry of Land, Infrastructure, Transport and Tourism, Japan
[*]Corresponding author. E-mail: yoshimura-g2xj@mlit.go.jp

INTRODUCTION

Typhoon No.12 (TALAS) hit Japan from Aug.30 to Sep.5, 2011 causing heavy rainfall. The rainfall caused a great number of large-scale sediment related disasters in Nara, Wakayama and Mie prefectures which are located in Kii Peninsula. The disaster is characterized by a deep-seated landslide, landslide dam, debris flow and flood. Landslide dams occurred at 17 areas and at five of these as Akadani, Nagatono, Kuridaira, Kitamata and Iya, the damage was so severe that the landslide dams reached dozens of meter that was filled up by river water. The erosion and sediment control countermeasures are currently being undertaken by the Kii Mountain System Sabo Office, MLIT. The basic policy of countermeasure, sediment disposal plan and the sabo facility plan were discussed at "Study Committee for Measures against Landslide Dam" (headed by Emeritus Professor Takahisa MIZUYAMA at Kyoto University). At present, the emergency work of installing basic sabo dams and temporary overflow channels for erosion control of the landslide dam has been completed, so that groundsels group, reduction the height of landslide dam, re-filling the flooding reservoir and other sabo works are implemented. In this paper we introduce the policy for the countermeasures for landslide dam depends on the time changes of the sediment movement and the construction condition. And we consider effective countermeasure for landslide dam.

TIME CHANGES OF COUNTERMEASURES AND SEDIMENT MOVEMENT

Emergency sabo work began immediately after the landslide dam occurrence. We installed the temporary overflow channel with pumping drainage during the construction period for reducing water discharge to prevent damage by overflowing and resulting erosion of the landslide dam. With the intent to complete the work before the next year's deluge the structure of temporary overflow channel was designed for using local material such as gabion and sabo soil cement.

After Typhoon No.12 in 2012, some heavy rainfalls hit until 2015 such as Typhoon No.15 (ROKE) in 2011, Typhoon No.4 (GUCHOL), No.5 (TALIM), No.16 (SANBA), No.17 (JELAWAT) in 2012, Typhoon No.11 (HALONG) in 2014 and Typhoon No.11 (NANGKA) in 2015. These events caused 1) landslides occurred in and around the head of the ordinary landslide area, 2) landslide dam was formed again, 3) heavy erosion at the landslide dam was caused and it damaged the countermeasures partially and supplied huge amount of sediment to downstream.

The following addresses in particular in Akadani and Kuridaira areas, which suffered heavy damage by the sediment movement. In Akadani area, after Typhoon No.4, 17 in 2012 and Typhoon No.18 in 2013, the temporary overflow channel was buried by collapsed sediment. Meanwhile, water was discharged from the flooding reservoir through an underground culvert below the temporary overflow channel bottom. Furthermore, after Typhoon No.11 in 2014, a large-scale landslide again occurred. Collapsed sediment reached the opposite bank of the landslide, and buried the temporary overflow channel again and brought damage to the sabo dam installed right below of the landslide dam. However, although the left wing of the sabo dam were damaged, the sabo dam

prevented the erosion of the riverbed and landslide dam. At present, basic sabo dam has been installed downstream of the landslide dam. In Kuridaira area, after Typhoon No.4, 5 in 2012, the channel/chute end was scoured by the overflow discharge. Moreover, after Typhoon No.16, 17 in 2012, heavy erosion caused at the end of the landslide dam that two-third of the temporary overflow channel with an overall length of 576m was discharged. In order to alleviate and stabilize the water discharged from the flooding reservoir, the culvert was installed before the countermeasures are completed. However, after Typhoon No.11 in 2014, the temporary overflow channel and the culvert was completely discharged and crest of the landslide dam decreased 15m for this typhoon. At present, basic sabo dam has been installed 1.5km downstream of the landslide dam.

Table 1 The status of Akadani and Kuridaira area

	height of landslide	height of landslide dam	amount of collapsed sediment
Akadani	850m	67m	about 11,000,000
Kuridaira	450m	100m	about 24,000,000

POLICY OF LARGE-SCALE LANDSLIDE DAM COUNTERMEASURES

The goal of the countermeasures for the landslide dams is to control the damage caused by seepage, overflow and erosion of the dam body, and to avoid debris flows and flooding downstream. Through the countermeasures, we can show the policy of landslide dam countermeasures as follow:

- To alleviate the impact of water discharged from flooding reservoir, it is important to reduce the elevation of the overflow, and back-fill water storage to prevent the erosion and the outburst of the landslide dam.
- It is important to install both the temporary overflow channel and the sabo dam simultaneously in the initial phase of emergency sabo works. The sabo dam should be built at the terminus of the slope downstream of the landslide dam for the purpose of preventing scour at the foot of the landslide dam and stabilizing the landslide dam.
- When the slope downstream is less steep and the height of the dam is low, a series of groundsels is installed. However, it is steep and high an overflow channel with chute is adopted to solve the difficulties of excavation and transport of a great amount of excavated soil.
- The surface of the overflow channel must be covered by concrete to prevent abrasion and erosion. Furthermore, the structure of the channel should be considered that not washed away if damaged (fail-safe system).
- Using the excavated soil, to bury the reservoir to reduce the storage, and make the downstream bed slope of the landslide dam more gentle to prevent the erosion.
- The policy for the countermeasures to be taken at the landslide dam depends on the time changes of the sediment movement and the construction condition.

CONCLUSION

Although we show the policy of large-scale landslide dams, we need more research. Because there are not many case of the landslide dams. Regarding institution of countermeasures of landslide dams, those not related to the concept of conventional erosion control are also needed. It is also important to plan countermeasures suitable for a particular field condition, while also considering application of civil engineering technologies intended for purposes other than erosion control for example pipe-jacking method.

Keywords: large-scale landslide, landslide dam, countermeasure, sediment movement