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Recovery Works from Landslide Dams Caused by Typhoon Talas 2011

Yoshiaki NANAMI
Director, River Department ,Kinki Regional Development Bureau
Ministry of Land, Infrastructure, Transport and Tourism, Japan
nanami-y2qp@kkr.mlit.go.jp

ABSTRACT:
From September 1st to 5th, 2011, Typhoon Talas brought a record-breaking precipitation on Kii Peninsula, causing a lot of catastrophic torrential floods and debris disasters.
The debris flows blocked river courses and formed 5 landslide dams which had risk of secondary disaster due to dam outburst flood. Just after the dams' emergence, Ministry of Land, Infrastructure, Transport and Tourism(MLIT) Kinki had started an operation of urgent investigations and countermeasures based on Sediment Disaster Prevention Act.
This article summarizes the landslide dams and the recovery works.

Keywords: *landslide dam,* *Typhoon Talas*

1. FLOOD AND DEBRIS DISASTERS CAUSED BY TYPHOON TALAS

Typhoon Talas had developed around the Mariana Islands on August 24th, 2011, and started growing larger and moving northward in a slow speed. On September 1st, it approached Kii Peninsla and brought a record-breaking precipitation all over the peninsula up to 5th (Fig.1).

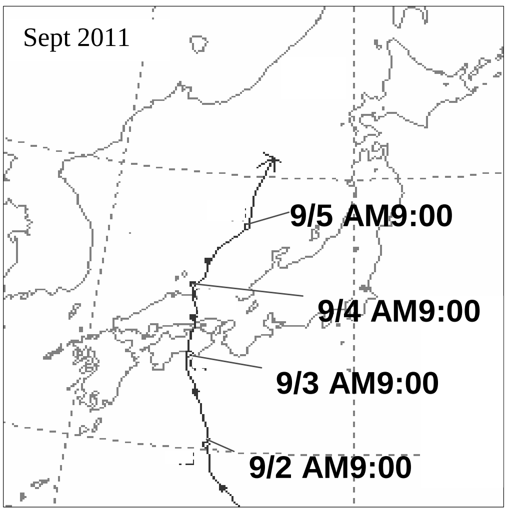

Figure 1. Trace of Typhoon Talas

The sequence of rainfall reached 60% of annual precipitation and the watershed average rainfall over Kumano River attained 1,400mm. In Nara Prefecture, especially, total rainfall exceeded 1,800mm at Kitayama Village and 2,400mm at Ohdaigahara Highland(Fig.2). The extraordinary rainfall caused unexampled flow discharge of 22,000 m^3/s on Kumano River.

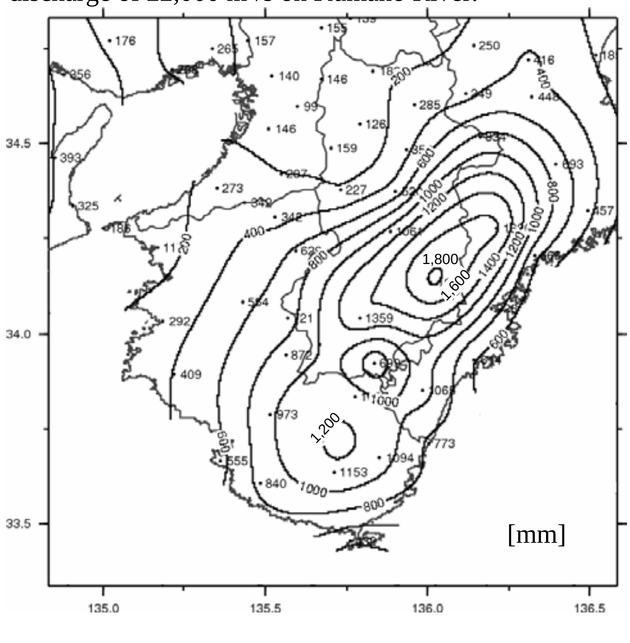

Figure 2. Isohyetal map of total preupitation (2011/8/30-9/5) in Kii Peninsla

Consequently, a lot of serious flood and debris disasters occurred mainly in Nara and Wakayama Prefecture, shutting off road network, isolating remote communities and inundating, washing out residential buildings. It was a serious calamity to count 94 dead and missing.

Besides, huge-scale collapses of mountain mass, so called deep seated landslides, fell down to block valleys and build landslide dams.

2. APPEARANCE OF LANDSLIDE DAMS

Because of uncountable fracture zones induced by fault movement including Median Tectonic Line in Kii Mountains, a number of deep seated landslides occurred in the history.

Among them, Totsugawa Disaster was serious and suggestive. In 1889 August, over 1,000 huge-scale debris flows, must be deep seated landslides, occurred and built over 50 landslide dams. After the rainfall, dam outburst floods triggered further damage on downstream villagers. A local history book tells us 200 people were dead during the disaster series.

Typhoon Talas also caused many landslides. An aero-figuregraphic interpretation found 3,000 landslides and a sediment volume of major 70 collapses was over 100 thousand cubic meters in each site(Fig.3). Total amount of collapse sediment was estimated to 100 million cubic meters and it became the largest rain-induced landslide disaster after the World War II.

Figure 3. Landslides on Kii Peninsula

Later on, an aerial survey after rainfall found 17 landslide dams in Kii Mountains. Because 5 dams had been intact and blocked river flows, MLIT Kinki has been conducting urgent field investigation and recovery works up to now(Fig.4-Fig.9, Table 1).

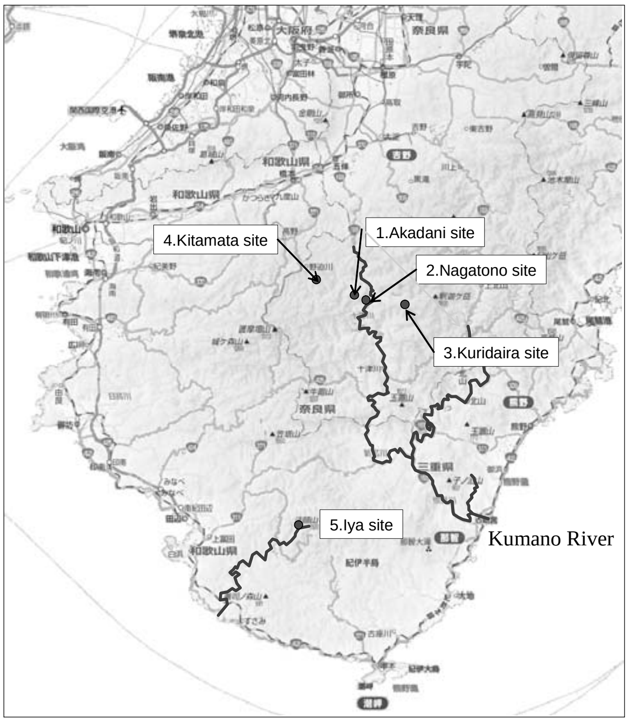

Figure 4. Location of 5 landslide dams

Table 1. Specifications of 5 landslide dams

	Land slide dam		Reservoir	Catchment
	Height (m)	Collapsed Volume (× 10^3m^3)	Capacity (× 10^3m^3)	area (km^2)
Akadani	85	9,000	5,500	13.2
Nagatono	80	6,800	2,700	4.5
Kuridaira	100	13,900	7,500	8.7
Kitamata	25	1,200	40	0.4
Iya	60	4,100	600	1.2

Figure 5. Akadani site

Figure 6. Nagatono site

Figure 7. Kuridaira site

Figure 8. Kitamata site

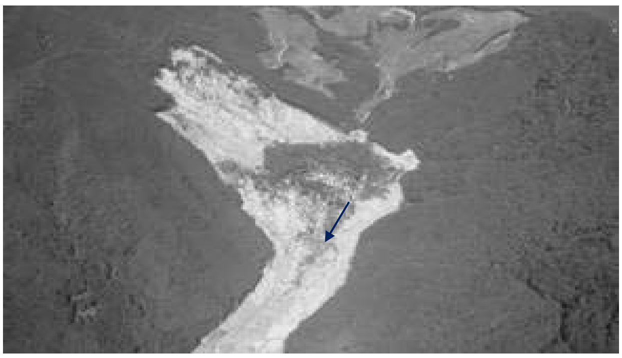

Figure 9. Iya site

3. LANDSLIDE DAM MONITORING

A landslide dam, which blocks natural river course by large-scale soil mass, has risk of secondary disasters toward downstream, such as dam outburst debris disaster. The dam outburst has mainly 3 principle mechanisms as; overtopping erosion, slip failure and progressive piping. Overtopping erosion was the most typical reason in past cases(Tabata et al.,2002), so that it is important to monitor water level of the dammed-up reservoirs.

However, the latest landslide dams locate at inapproachable mountainous area or had only a road shut-out by sediment. Because of the difficult road accessibility, MLIT Kinki called out helicopters to set up water-gauges on the dam reservoirs. And at the downstream of the risky dams, MLIT Kinki installed CCTV cameras and wired censors to check a contingent debris flow for 24hours a day.

At the same time, MLIT Kinki implemented damage simulation of possible dam outburst flood and called for the highest attention of municipalities and residents in downstream area. Based on the information, municipalities set off-limits zones on 150 houses in downstream area.

Through the MLIT monitoring, up to now, 2 small overtop erosions have been confirmed at Akadani and Iya among the 5 dam sites.

4. RECOVERY WORKS FROM LANDSLIDE DAM

In order to prevent overtop erosion from the large-scale reservoir at Akadani, Nagatono and Kuridaira, MLIT Kinki has urgently constructed a temporally spillway protected by gabion mattress on the dam body, which is designed to ensure the safety against a 2-year return period rainfall.

The spillway construction has been operated under the safety-first principle. Firstly drainage pumps started running to lower the reservoir’s water level to reduce overflow risk not to interrupt earthwork on the dam. After securing enough working area, the soil excavation and the gabion work were completed within the shortest work period(Fig.10 , Fig.11).

Construction machines and drainage pumps were airlifted by a helicopter for these emergency recovery works, because some landslide dams locate at unapproachable mountainous area by road.

Figure 10. Recovery works at Nagatono site

Figure 11. Temporary spillway at Nagatono site

In the case of Iya and Kitamata, MLIT Kinki has filled up the relatively small reservoir by soil to eliminate water pool from the landslide dam(Fig.12).

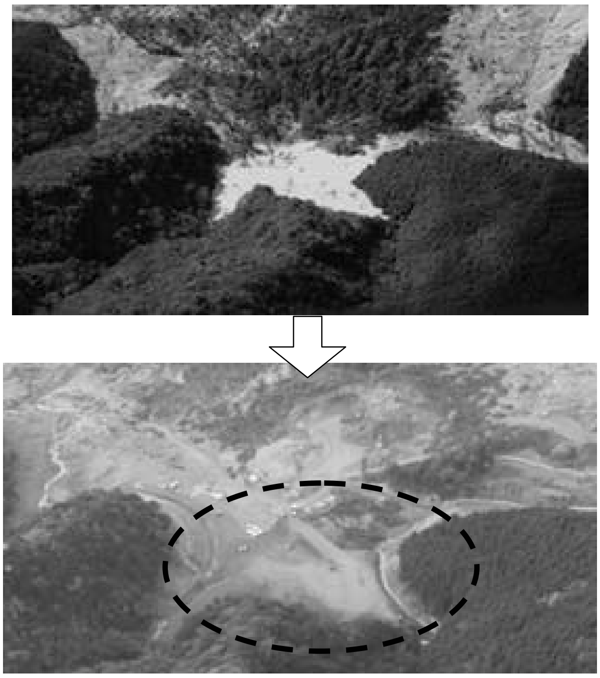

Figure 12. Filling-up work at Iya site

By these recovery works, MLIT Kinki has succeeded to reduce risk of the secondary debris disasters. According to the progress of the works, off-limits zones set by the municipalities was diminished step by step. The last off-limits was called off on February 8th, 2012.

5. CONCLUSION

MLIT Kinki has been conducting the urgent recovery works since last September and plans to complete all of them until June 2012, before the next rainy season.

As for the permanent recovery, MLIT Kinki has a plan to widen of the spillways, build new debris flow control dams, stabilize collapsed slopes to prevent further erosion. The higher security of the landslide dams will be assured in coming 5 years.

REFERENCES

Tabata, S. and Mizuyama, T. and Inoue, K. (2002): Landslide dams and disasters, p.53.