TWO LARGE-SCALE LANDSLIDE DAMS AND OUTBURST DISASTER IN THE SHINANO RIVER, CENTRAL JAPAN

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INTRODUCTION

Major flooding damage may occur in the downstream area, if a large-scale landslide dam bursts due to the built-up of water behind the landslide dam. Researchers such as Schuster (1986) and Tabata et al. (2002) have collected data on landslide dam cases and performed related analyses. As a recent example in Japan, large-scale landslide dams were formed in the Imo River, tributary of the Shinano River, when the Niigata-Ken Chuetsu (Mid-Niigata) Earthquake occurred on Oct. 23, 2004. Various measures were taken to prevent the bursting of these dams.

Large landsides or debris flows due to heavy rainfall, earthquakes often block mountain rivers to form landslide dams. Dammed water inundates the upstream area and the downstream area is flooded by surges when the landslide dam breaks. As many as 19 landslide dams have been formed in the last 500 years in the northern region of Nagano Prefecture in central Japan, all except one having broken. Seven were formed when the Zenkoji Earth-Quake occurred in 1847. This abundance is likely because of the geotectonic background of this area which is located at the western end of the major tectonic line, "Fossa Magna".

In the midstream and upstream areas of the Shinano River, two large-scale landslide dams were forms about 160 and 250 years, respectively. The Tobata landslide occurred June 24, 1757 due to heavy rain. The Mt. Iwakura landslide occurred May 8, 1847 due to the Zenkoji Earthquake. Information on the formation and subsequent bursting of these landslide dams remains in detail in historical records such as old documents and picture maps.

LANDSLIDE DAM FORMED IN 1757

At the Azusa River, three dams – the Nagawado, Midono, and Inekoki Dams – were completed in 1969 by a power generation company and have since been producing hydropower. The Nagawado Dam is an arch dam, 155 m high, having Lake Azusa with a total storage capacity of 123 millions m^3 as the dam lake.

In the early morning of June 24, 1757, landslide occurred on the left bank of the Azusa River due to torrential downpours in the rainy season (estimated sediment movement: 10 millions m^3), forming a landslide dam in the river. From the historical records, old maps,

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And aerial photos, it is estimated that the water height and water volume reached 150 m and 98 millions m^3, respectively. This landslide dam subsequently collapsed approximately two days (actual time: 54 hours) later, flooding the Matsumoto-Daira area in the downstream section. As the Zousui Bridge (height from water level 14.4 m; length 34.2 m) located 12 km downstream was carried away by the flood, it is estimated that the flood height and the peak flow were 20 m and 27,000 m^3/s, respectively.

The lords ruling the areas (Matsumoto feudal clans) at the time and local people collaborated together to watch, report, and quickly evacuate from the site. Although houses and arable land were carried away, casualties were not many because people evacuated to a safe place quickly.

LANDSLIDE DAM FORMED IN 1847

Due to the Zenkoji Earthquake on May 8, 1847, a large-scale landslide (estimated sediment movement: 20 millions m^3) occurred at Mt. Iwakura at the midstream section of the Shinano River (Sai River) and a large landslide dam was formed due to the blockage of the river. Although the river blockage height was 70 m, the water build-up reached as much as 300 millions m^3, making it the largest landslide dam recorded in Japan.

The water level reached its maximum on the 16 days after the landslide, because of abundant water supply from snowmelt (average flow rate: 254 m^3/s). The water gradually began to overflow from the dam top, eroding the 1000 m long debris masses. The landslide dam finally collapsed on the 19 days. The resulting flood flow, reaching a height of 21m and a peak flow of 34,000 m^3/s, caused serious damage to areas in the downstream section which are known today as Nagano City (Zenkoji-daira) and Iiyama City.

Immediately after the earthquake, Yukitsura Sanada who was lord of the Matsushiro feudal clan at the time, ordered his men to draft a “Large-Scale Earthquake Disaster Map” and reported the state of damage to the Edo feudal government that was ruling Japan at that time. With support from this feudal government, the Matsushiro clan started a disaster retrofit effort. Two years later, the lord himself made an inspection tour of his territory and ordered the renowned painter Sekkei Aoki to make 67 sketches of the earthquake damage. After about four or five years later when the first stage retrofit work ended, the lord also ordered the preparation of a land survey map, and eight large-size maps (scale: 1/6000) collectively called the “Survey Map of the Matsushiro Territory” were completed.

In our report, the formation and bursting of the two landslide dams and the resulting flooding, which were vividly depicted in the aforementioned maps and drawings are very introduced. Historical records on landslide dams and associated floods will be connected more and they will be documented. These information are taken into account when disaster prevention plans or warning and evacuation system are made in each area.

Keywords: Shinano River, Landslide Dam, Tobata Landslide, Zenkoji Earthquake, Mt. Iwakura Landslide, Old Documents, Picture Maps