Sediment Delivery of Unusual Sediment Yield in a Mountain Drainage Basin

Akio Yazawa and Takahisa Mizuyama

Sabo Division,Public Works Research Institute
Tsukuba Science City,Ibaraki 305 Japan

ABSTRACT

Japan Islands are in a temperate monsoon climate zone. They have a rainy season called BAIU,which is brought by a stationary front in June and July. They also have two more types of heavy rainfalls when developed low pressure systems and typhoons passing them. The maximum hourly rainfall intensity sometimes reaches more than 100 mm/hour. Those heavy rainfalls cause a lot of debris flows and landslides. More drastic geomorphologic changes,however,are brought by volcanic activities and earthquakes. Though they are very rare natural phenomena,a lot of movable sediment is supplied to river courses. The sediment is transported downstream gradually by large and medium floods. Once these large sediment is produced,the river basin is unstable for successive some decades. It gradually becomes stable as releasing the sediment. In this study a typical devastated mountain basin is picked out to illustrate the processes. A large-scale debris slide occurred about 130 years ago by a sever earthquake there.

INTRODUCTION

Large-scale sediment discharge and long term high sediment discharge are caused by earthquakes or volcanic activities. Most of the processes,however,have not been understood well,beacause of lack of long term data. A new debris avalanche,named Ontake-Kuzure occurred in September,1984 related with West-Nagano Earthquake gave a lot of hints to consider former large-scale landslides.(Tominaga et al.(1985)) Figures 1,2 and 3 show the plan and cross sections of the source area and the runoff course of the debris avalanche.

The example explained here is a large-scale landslide,called Tonbi-Kuzure,which took place by an earthquake of M.6.8 at the upper part of the Johganji River on February 26,1858. Large floods damaged downstream on March 10 and April 26 of the same year. The 128-year old landslide and its successive effects,medium and long term sediment discharge are studied,and the sabo works,erosion control works,is evaluated which has been executed last 60 years.

OUTLINE OF THE JOHGANJI RIVER

The Johganji river has a drainage area of 368.1 km^2. The length of the main stream is 56 km and the mean

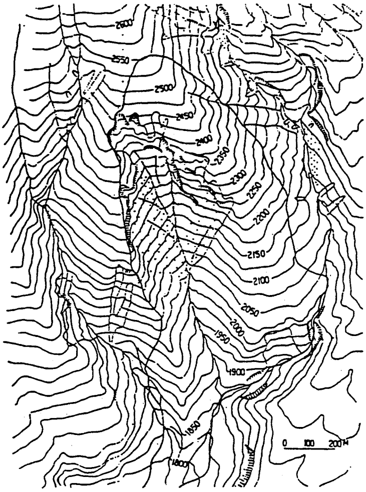

Fig.1 Plane of "Ontake-Kuzure"

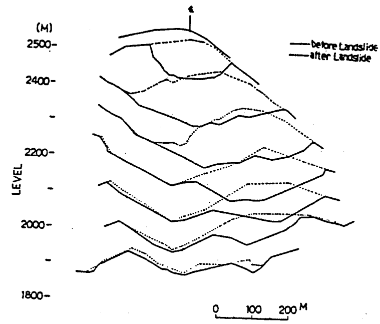

Fig.2 Cross Sections of "Ontake-Kuzure"

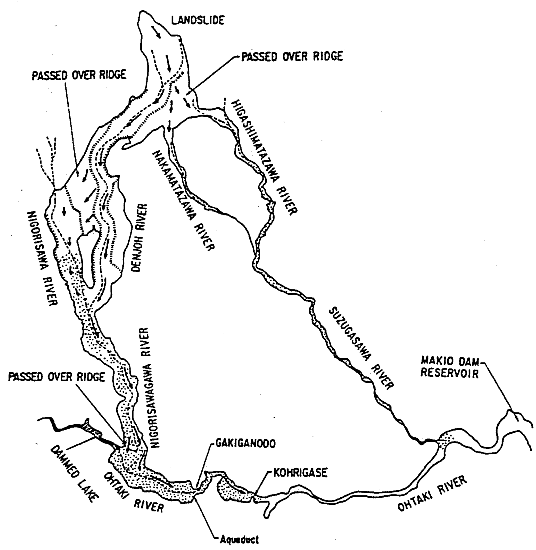

Fig.3 Sediment Runoff from "Ontake-Kuzure" Landslide

channel gradient is around 1/30 on average. It is one of the steepest major mountain rivers in Japan. The geology of the upper basin is volcanic. Weak weathered rocks are easily eroded and yield a lot of sediment. The river is famous for a lot of sediment discharge and its well developed alluvial fan. Figure 4 shows the shape of the basin. Figure 5 shows its longitudinal profile.

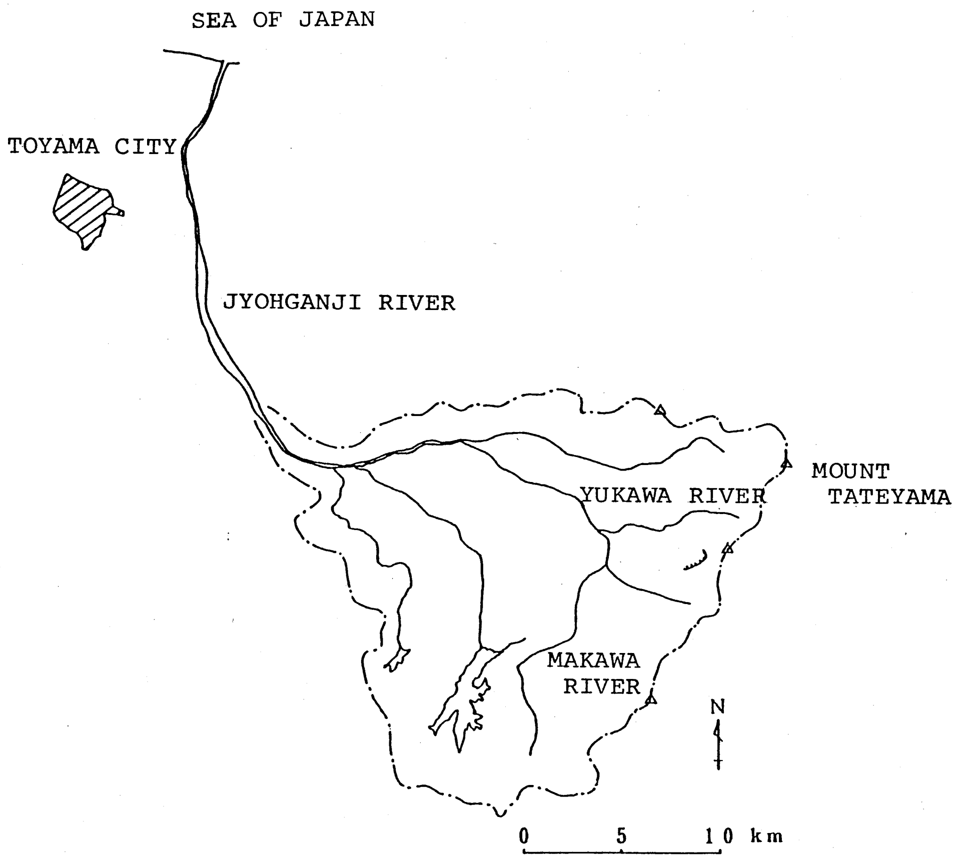

Fig.4 The Jyohganji River Basin

OUTLINE OF TONBI-KUZURE

The earthquake on February 26,1858 caused a large-scale landslide at Mount Kotonbi-yama of Tateyama mountains, at the upper part of the Yukawa River,a tributary of the Johganji River. The landslide is called Tonbi-Kuzure. The landslide mass blocked the Yukawa-dani River. The deposit in the river became the sediment source of the debris flows on March 10 and April 26. The debris flows caused serious damage downstream. The volume of the landslide is estimated $1.5 \times 10^8 m^3$ by our recent field survey. The earthquake also caused many other landslides. Sediment of $1.19 \times 10^8 m^3$ was deposited in the river course including the sediment by those small landslides.

RIVER CHANGE AFTER THE LARGE-SCALE LANDSLIDE

The Johganji River became much wilder than before after the Tonbi-Kuzure in 1858. For a while after the landslide every flood eroded the deposit in the river and transported it downstream. The river bed rose at around the head of the alluvial fan. River terraces developed in the valley.(Fig.5) The phenomenon must

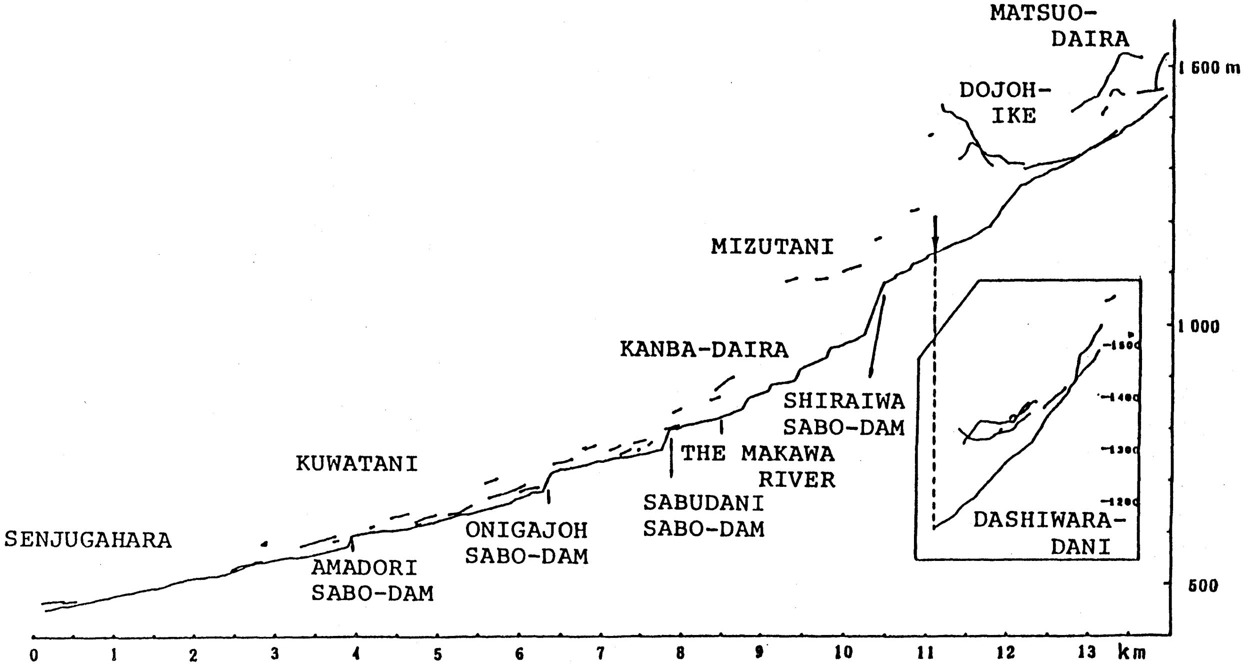

Fig.5 Longitudinal profile of the upper Johganji River and terraces

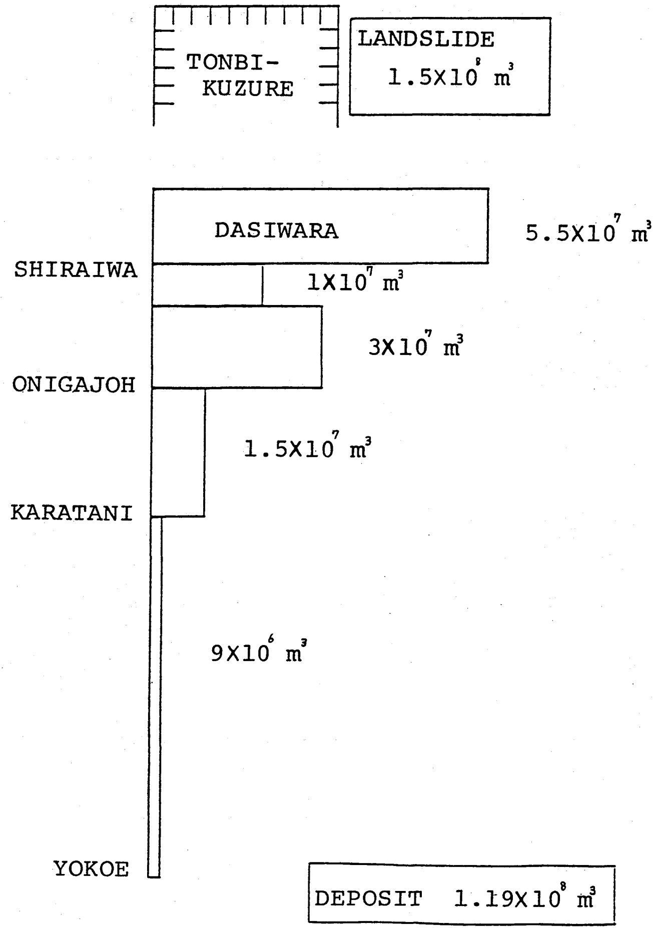

Fig.6 Sediment balance of Tonbi-kuzure

have been remarkable just after the landslide and it must have slowed down gradually as time passed. The present situation is still on the way from geomorphologically unstable to stable condition. A large flood occurred in 1969,which buried low terraces recognized in the aerophotos in 1955. Since then no major flood was reported. The river bed of the upper part from Karatani have been eroded and new low terraces have been formed.

RIVER BED CHANGE

The river bed has been surveyed since 1924,almost every year since 1951. Longitudinally averaged river bed elevation changes are shown for 9 divided reaches from the river mouth to Shiraiwa Sabo-dam.(Fig.7) Large aggradation is observed in the upper reaches

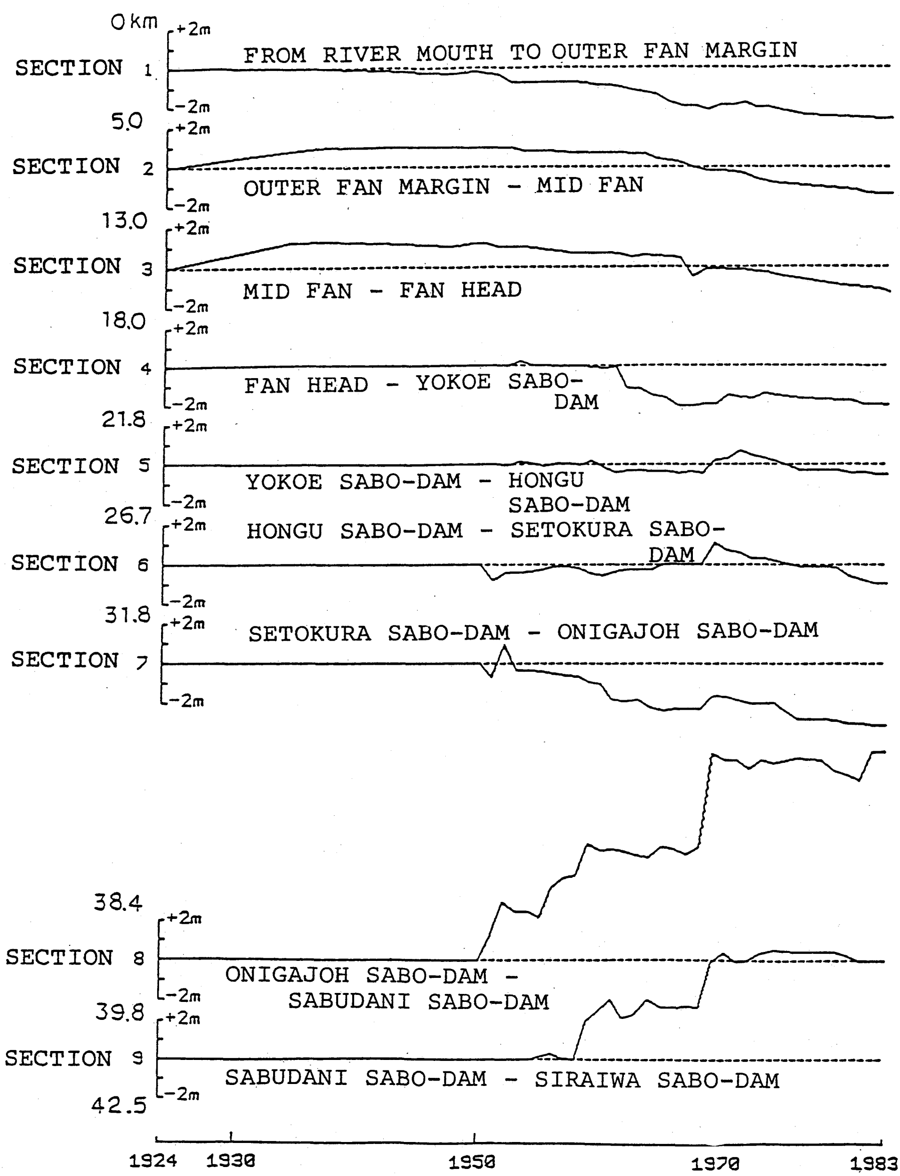

Fig.7 Longitudinally averaged change of river bed elevation for divided reaches

from 1968 to 1969. This is because new landslides and debris flows took place by the storm in August,1969. Most landslides by the storm occurred on the slopes close to the river course. No deposition was observed in the river course of the lower reaches on the alluvial fan,downstream from Yokoe dam. Similar change is found from 1951 to 1952. Some damage was reported by a flood in 1952.

Gravel mining was popular in the lower reach of the Johganji River since after the World War II,1945. The effect of the gravel mining appears the river bed change data. The effect is ,however,estimated only 0.078 m and 0.014 m per year in the upper and lower reaches of the alluvial fan respectively. It can not explain large degradation in 1969. The degradation should be explained as follows;newly produced sediment stopped at the upper reach in the valley. The deposition near the river mouth from 1968 to 1969 is understood the fine part of the newly produced sediment. The volume is estimated 6.6×10^5 m^3 including the estimated volume of the gravel mining,which is about 37 percent of the estimated total suspended discharge of the flood,$1.8 \times 10^6 m^3$.

REFERENCE

Tominaga,T.et.al.(1985)Landslides and Damages due to the Naganoken-Seibu Earthquake of September 14, 1984,17th Joint Meeting,U.S.-Japan Panel on Wind and Seismic Effects UJNR,Tsukuba,May 21-24