Sediment hazards and SABO works in Japan

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This issue launches the publication of English language journals of the Japan Society of Erosion Control Engineering, which will be distributed through the internet as e-journals. The society intends to disseminate information on sediment hazards and SABO works, new SABO research and SABO technologies, and exchange SABO information in various places around the world. Thus, in this first issue, I review and introduce sediment hazards and SABO works in Japan.

1. NATURAL CONDITIONS OF JAPAN

Seventy per cent of the Japanese archipelago is mountainous. About 120 million people live on densely populated plains, alluvial fans, slope foothills, and slopes. The mountains are high and the rivers draining these are short with steep gradients. Flood waters are therefore fast moving. Japan has a summer rainy season in June and July called the Baiu season, and an autumn rainy period in September and early October characterized by tropical low-pressure systems (typhoons). These rains supply the water needed for growing rice and other crops, but sometimes their intensity causes damaging debris flows and landslides. SABO is a Japanese term that means erosion and sediment control works. The Japanese style of SABO erosion control works is more intensive than Western erosion control works. The term SABO is known internationally, and is used both in and outside Japan.

2. PAST SABO WORKS FOR EROSION AND SEDIMENT HAZARDS

Japan has a civilized history of more than 2000 years. In the past, trees on mountain slopes were cut for firewood and building houses, other structures, shrines, and temples. Annual average temperature is 15°C and annual precipitation about 1850 mm in western Japan. Forests regenerated naturally after cutting thanks to the moderate climate in most areas of Japan. However, forests did not recover in weathered granite areas and erosion accelerated. Some regulations to prohibit forest clearance were then issued. Erosion control works, reforestation, and construction of SABO dams and check dams have been carried out during the past 200 years. Intensive hillside SABO works, such as terracing and reforestation, began 120 years ago in the Meiji Era. These works were successful in most areas thanks to a mild wet climate and hard work. Slope surfaces were covered with trees that controlled surface erosion remarkably well. An example of successful application of hillside SABO works on Tanakami Mountain, Shiga Prefecture is illustrated in Photo 1.

3. CONTEMPORARY SABO WORKS

By 1960, denuded mountains in Japan had been mostly covered with vegetation. Other large scale SABO works started before World War II, including erosion and sediment control works to prevent erosion on large landslide areas, and relatively high (15 meters; Photo 2) SABO dams to control sediment discharge from the landslide areas. Since around 1970, debris flow hazards were recognized. These were triggered by heavy rainfall and destroyed many houses, jeopardizing human life. Closed-type SABO dams as shown in Photo 2 have been used to trap or control debris flows. Steel pipe open-type SABO dams (Photo 3) have been constructed upstream of a closed-type SABO dam to check large rocks contained in debris flows. The steel pipe open-type SABO dams (Photo 4) with narrow openings have been formally adopted as major debris flow control structures since March 2007, because they do not change the natural condition of torrents, and because of their low

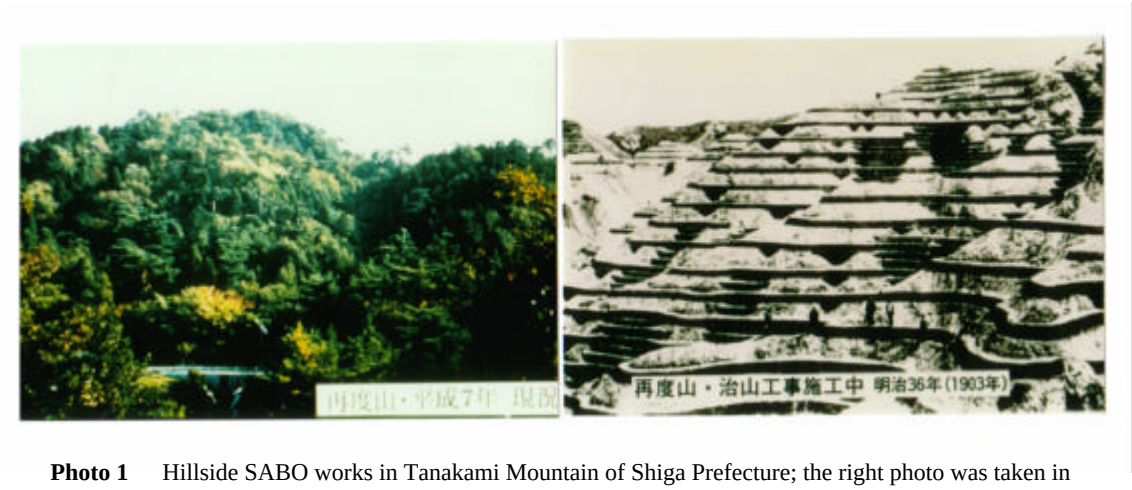

Photo 1 Hillside SABO works in Tanakami Mountain of Shiga Prefecture; the right photo was taken in 1903 and the left one in 1995.

Photo 2 Concrete SABO dam (closed type)

Photo 3 Steel pipe SABO dam (open type) trapped large rocks of debris flow at Rishiri island in 2007.

maintenance. The concrete slit open-type SABO dams once constructed are not built now, because debris can flow through the slits. Existing slit SABO dams were improved by installing iron bars over the slits. Photo 5 illustrates a slit SABO dam at Hakone in which steel bars were installed to prevent debris passing through the slit.

At present, SABO works protect against not only surface erosion and sediment transport in mountain rivers, but also against shallow and deep-seated landslides and snow avalanches. SABO works also protect against

Photo 4 Steel pipe SABO dam as downstream end structure of debris flow torrent. Its opening is small, almost equal to a diameter of the rocks transported at the front part of debris flow.

Photo 5 Concrete slit SABO dam. Steel bars were installed at the slit after debris flow passed through the slit.

many volcanic hazards, including: (1) volcanic mud flows (also called lahars), a type of debris flow that occurs after ash fall from volcanic eruptions; (2) lava flows; and (3) pyroclastic flows. Countermeasures against sediment transport by wind on beaches and at the margins of deserts are also part of SABO works, although there are no deserts in Japan. Research on SABO control measures has been conducted to support these SABO works.

4. ADMINISTRATIVE ORGANIZATIONS ENGAGED IN EROSION AND SEDIMENT CONTROL

Erosion and sediment control works are administered and conducted under the authority of two governmental organizations: (1) the erosion department of the Ministry of Land, Infrastructure and Transport, formerly the Ministry of Construction; and (2) the Forestry Agency of The Ministry of Agriculture, Forestry and Fisheries. The former is responsible for erosion and sediment control mainly related to rivers, while the latter agency focuses on erosion control to conserve forest lands. There are 47 prefectures in Japan; in each prefecture, the Agriculture and Forest Department and the Sabo Section of the Public Works Department are responsible for erosion control works.

5. COUNTERMEASURES ADOPTED IN THE SABO WORKS

Structural measures and nonstructural measures are applied to mitigate sediment hazards, termed ‘hard’ and ‘soft’ measures, respectively, in Japan. Hard countermeasures include construction of SABO dams, channels and hillside works, and restoration of vegetation. Soft countermeasures include conservation land-use practices, warning systems, and preparedness, such as emergency planning and evacuation measures.

Current research and development of SABO works in Japan includes:

1) Mechanisms of rainfall runoff, debris flows, landslides, sediment transport, lava flows, and snow avalanches.
2) Sediment control planning at the river basin scale
3) Sediment management from mountains to coastal zones
4) Debris flow control structures; open-type SABO dams
5) Prediction of debris flow occurrence, including the location, time, and magnitude of the event, as well as effects on the impacted area
6) Prediction of landslides, including the location, time, and magnitude of the event, as well as effects on the impacted area
7) Analysis of critical rainfall characteristics that trigger debris flows and landslides
8) Landslides triggered by earthquakes
9) Natural landslide dams and their outburst
10) Development of SABO structures and works, taking into consideration natural environment preservation in mountains and mountain torrents; for example preserving fish, animal, and insect populations along rivers prone to torrents.
11) Countermeasures against shallow and deep-seated landslides

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http://www.jsece.or.jp/indexj.html.
Additionally, English information on Japanese laws related to natural disasters, as well as recent disasters in and outside of Japan, can be viewed at
http://www.sabo-int.org/.
SABO (Erosion Department, the Ministry of Land. Infrastructure and Transport);
http://www.mlit.go.jp/river/sabo/
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