Formation and Development of SABO Philosophy in Japan: Focusing on Sediment Control Planning

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INTRODUCTION

Japan is located within one of the world's most active tectonic zones and has developed under conditions of abundant rainfall and intensive land use. As a result, the need to mitigate diverse sediment-related disasters has been a constant challenge, leading to the development of a unique concept of Sabo.

In Japan, sabo can be understood in two ways. In its narrow sense, Sabo refers to Erosion and Sediment Control, focusing on controlling sediment production, transport, and deposition through erosion control works like Sabo dams. In its broad sense, SABO refers to Sediment-related Disaster Risk Reduction (SDRR), an integrated basin-scale approach that combines sediment source management, sediment control, and the protection of downstream communities. The evolution of Japanese Sabo can be understood as a transition from hazard reduction to comprehensive risk management, encompassing not only the reduction of sediment hazards themselves but also the reduction of exposure and vulnerability. In this sense, modern SABO has evolved into a framework for managing sediment-related disaster risk at the basin scale.

This presentation reviews the formation and evolution of Japan's Sabo planning philosophy, with particular emphasis on sediment control planning, and discusses its implications for disaster risk reduction under a changing climate.

FORMATION AND DEVELOPMENT OF SABO PHILOSOPHY

The origins of modern SABO administration in Japan can be traced back to the seventeenth century. Following the introduction of European engineering techniques during the Meiji era, Sabo technology evolved in ways that reflected Japan’s distinctive natural and societal conditions. Japanese rivers are generally short and steep, allowing sediment produced in upstream mountain catchments to reach downstream areas rapidly, causing riverbed aggradation and increasing flood risk. At the same time, populations and assets are concentrated on alluvial fans and floodplains, where land use is highly intensive. Consequently, Japanese sabo has developed not only as a means of mitigating sediment disasters in mountainous areas but also as a system for managing sediment throughout entire river basins, including downstream channels and flood-prone areas.

Until the nineteenth century, Sabo works mainly consisted of hillside stabilization and reforestation projects aimed at restoring degraded slopes and suppressing sediment yield. In the early twentieth century, however, European concepts emphasizing torrent stabilization were introduced, leading to a shift toward controlling sediment transport and deposition processes themselves.

During the early twentieth century, Masao Akagi emphasized the control of sediment production systems in upper watersheds to stabilize downstream river channels, whereas Makoto Kaba focused on achieving rapid protective effects through sediment-control measures immediately upstream of protected areas. Although their approaches differed, both sought to protect downstream communities from sediment-related disasters. These philosophies were integrated in the Joganji River basin, where

sediment source management and downstream protection were pursued within a basin-wide framework, laying the foundation for modern Japanese SABO.

In 1938, under Akagi's leadership, the Ministry of Home Affairs published *Sabo Engineering Works*, Japan's first official technical manual for Sabo projects. This publication codified the concepts and practices developed through projects such as those on the Joganji River into a nationwide technical framework. The Joganji River project therefore represents the clearest and most comprehensive early implementations of integrated sediment management and can be regarded as the prototype of modern Japanese Sabo planning.

QUANTIFICATION AND SYSTEMATIZATION

Following World War II, Japanese Sabo evolved from experience-based practices to quantitative planning methodologies. In 1951, Kotaro Kimura established a planning framework based on sediment budget analysis, enabling quantitative estimation of sediment production and transport within river basins. This approach transformed basin-wide Sabo concepts into a measurable and systematic planning methodology.

Subsequently, the establishment and continual revision of the Technical Standards for River and Sabo Works provided a comprehensive planning framework ranging from sediment source control to sediment regulation by Sabo dams. Through this process, Japanese Sabo developed into a nationally standardized planning system characterized by integrated sediment management at the basin scale, quantitative sediment control based on sediment hydraulics, and the coordination of upstream and downstream measures. Furthermore, the framework expanded to include non-structural measures such as early warning systems and land-use regulation.

The scope of Sabo planning gradually expanded beyond the mitigation of mass movement hazards (landslides, debris flows and slope failures) to include the reduction of sediment-laden flooding (aggradation-induced flooding, fan flooding and overbank sedimentation) and associated impacts on alluvial fans and floodplains. As a result, the focus of Sabo evolved from controlling sediment hazards themselves to managing sediment-related disaster risks. In this sense, modern Japanese SABO can be understood as a comprehensive framework for Sediment-related Disaster Risk Reduction (SDRR), encompassing hazard reduction, exposure reduction, and the reduction of societal vulnerability at the basin scale.

CONCLUSIONS

The Joganji River serves as a landmark example of how sediment source management and the protection of areas with concentrated population and assets were integrated through a basin-wide sediment management framework. This integration became the foundation of modern Japanese SABO.

Many regions around the Pacific Rim share conditions like those of Japan, including steep mountainous catchments, short and steep-gradient rivers, and populated areas on downstream alluvial fans and floodplains. In such environments, the importance of basin-scale sediment management is likely to increase under climate change.

One of the greatest strengths of Japanese SABO lies in its integration of sediment source management and downstream protection within a single basin-scale framework. It is hoped that Japan's experience in SABO will contribute to the advancement of SDRR worldwide.

Keywords: SABO Philosophy; Sediment Control Planning; Sediment-related Disaster Risk Reduction; Erosion and Sediment Control; Basin-Scale Sediment Management; Sediment Source Management