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Coarse Sediment Displacement Upstream of Flood Mitigation Dams

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1. Introduction

Flood Mitigation Dams (FMDs) is known as one of the most eco-friendly options that exist among the flood control measures. It was surmised that the gateless bottom outlet in the FMD allows the fish passage and minimizes sedimentation through naturally sluicing incoming sediment. However, our field surveys in Shimane Prefecture, Japan, revealed that Masudagawa FMD disturbs the sediment transport continuity and traps the coarse portion of sediment. Trapping of the coarse portion of sediment within FMD may decrease the habitat structure variety along the river reach downstream. To realize practical solutions for this issue, the first step is to understand the process of coarse sediment transport upstream of the FMD.

2. Research methodology

We selected a relatively new method to investigate the mechanism of coarse sediment transport in FMDs that is called Radio Frequency Identification System (RFID). This system uses cube shaped coarse particles tagged with passive identification codes (ICs). Two different cube particle sizes, i.e. small (60×50×40mm) and large (100×80×70mm) were examined. These tagged particles made of concrete had been distributed upstream retention area of the Masudagawa FMD. The particle position was measured after each flood event. Field experiments have been carried out to monitor coarse sediment displacement following each flood event during flooding season over past three years (2011-2013). The main objective of our study is to find out the possible correlation between the tractive force, which is mainly initiated by each flood event, and the displacement length of each tagged particles.

3. Research results

Data analysis showed that the tractive force throughout the Masudagawa FMD is relatively low. In the upper part region which is located at a distance of at least 0.25-0.3 km from the FMD wall, the recovery rate for tagged particles is very low. This shows that the reservoir bed in this region is active. It means by each flood in addition to the new sediment deposition, the past deposited layers are also moved. The movement of past deposited layers buries the tagged particles under the reservoir bed, where cannot be detect by RFID antenna about 50cm and more. This interpretation is, indeed, in consistent with the bathymetry survey in the Masudagawa FMD.

However, in the lower part region, which it covers the areas between the FMD wall and 0.25-0.3 km upstream from it, the recovery rate for tagged particles are significantly higher compared to the upper part. In fact, the hydraulic condition on the lower part region in the Masudagawa FMD is different compared to the upper part region. The valley in the lower part region is wider and it is influenced by the FMD wall; where the stagnation process on flood flow is happened quicker and over a wider distance. Thus, the tractive force in the lower part is lower than the upper part region. Further, the reservoir bed in the lower part region is less active. Then, the chance for tagged particles to be detected is higher.

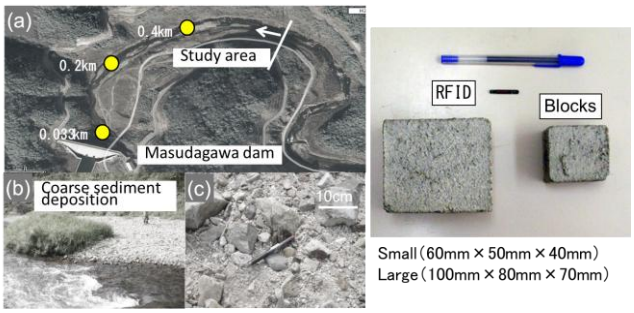

Figure 1 Study area and tagged particles with RFID