

Simulation and field investigation of scour and sediment transport after Dam removal in the mountainous creek in Central Taiwan

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The research focuses on using the flume experiments to observe the head-erosion phenomena caused by dam removal and simulate the channel evolution in the upstream and downstream of dam after dam removal by using CCHE2D model. The research area is in the Landaw river watershed in Huisun National Forest Area in the Central Taiwan. Two silt dams built in the Landaw river had been lowered down 2.5 m height to release the deposited sediment to transport to downstream in 2013, and the research proceeded long term observation of the head-erosion in the upstream of the silt dam by using UAV and field investigation.

The research proceeded the flume experiments to simulate the sediment transport from the upstream of the dam and simulate the channel evolution in the upstream and downstream of dam by using CCHE2D model after dam removal. The control factors in the flume experiments are the sediment size, the discharge, the channel slope, and the removal area of check dams. The sediment size settings in this research include totally 0.9 mm, half 0.9 mm and half 0.5 mm, and totally 0.5mm, while the discharge settings include 3.4, 83.0, and 102.6 cubic centimeter per second. The channel slope settings include 4.4, 8.7 and 13 degree. The research records the sediment yield volume, the geomorphologic changes and the knickpoints evolution in the longitudinal sections after removing different area of dams in 27 flume experiments. Based on the dominant factors for the bank erosion scouring, 27 flume experiments can be classified into 3 types, including infiltration-dominated bank erosion experiments, surface runoff-dominated bank erosion experiments, and infiltration and surface runoff co-exist bank erosion experiments.

Furthermore, the research also uses CCHE2D model to simulate the sediment transport after the dam removal process of the silt dam in the upstream of Landaw river watershed. The research uses the river discharge in the day with the maximum 24 hours accumulated rainfall from 2015 to 2018, and the original DSMs in 2010, 2016, 2018 as the topographic models to simulate the scouring process in the upstream of the silt dam after dam removal. The research also proceeded the field investigation to verify the simulation result.

The accumulated rainfall setting for the simulation of CCHE2D model is 585 mm in 24 hours, and this is the accumulated rainfall with return period years of 50 year in the Landaw river watershed. Based on the simulation result by using CCHE2D model with the accumulated rainfall of 585 mm in 24 hours, the elevation of main river has been lowered down 5.4 m, and the maximum width of the head-erosion in the upstream of the silt dam is around 5.24 m. The total erosion sediment volume is estimated as 1370 cubic meter. The slope in the longitudinal profile along the main river can be classified into two sections. The slope from the silt dam to 23 m upward in the upstream is estimated as 0.31, while that from the 23 m upward in the upstream to the 200 m upward in the upstream is estimated as 0.151. This means that the knickpoint is in the 23 m upward in the upstream of the silt dam. The result will be the basis for developing the assessment model for assess the feasibility of dam removal in the rivers.

Keywords: Dam Removal, CCHE-2D, sediment transport