Sediment Runoff Characteristics Caused by Debris Flow and its Control by Check Dams

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Usually, occurrences of debris-flows in several tributaries determine the size of debris-flow in the main stream. In general computational practices, if debris-flows occur in several tributaries, we often treat every debris-flow event separately. When we treat the debris-flow in a main stream that composed of many tributaries, order of debris-flow occurrences in each tributary could greatly influence the debris-flow characteristics such as flow-discharge, flow-velocity, sediment-volume and overall size of the debris-flow. **Chapter 2** describes the effects of such dependent events, which are obtained from numerical simulations on San Julian river basin in Venezuela. The focus was given to compare the results from dependent and independent solutions, referencing the data available from field visit. 1D governing equations proposed by Egashira *et al* . is put forward first to describe the mechanics of debris-flow. The simulated results suggest that the different possible sequences can produce different amounts of sediment volumes. Maximum sediment-volume difference between dependent and independent prediction was 0.12×10^6 m^3, which is very large and cannot be neglected. In other hands, check dams, usually constructed in series in the transportation zone of debris-flow, can be used to change the debris-flow characteristics by trapping debris mass and therefore to prevent potential destruction caused by debris-flow in downstream locations. In **Chapter 3**, the control functions of close type check dam against debris-flow is elaborately discussed. A criterion is proposed for evaluating control function of close type check dams with attention focused on potential storage volume of check dam and inflowing sediment volume. The potential storage volume can be determined by initial bed slope, original bed slope and equilibrium bed slope corresponding to inflowing debris-flow. Flume tests and numerical computations were conducted for investigating the change of debris-flow characteristics passing through a check dam as well as for testing a validity of the criterion. The results suggest that relative outflow sediment volume can be evaluated using two non-dimensional parameters which are newly introduced and specified in terms of a potential storage volume. **Chapter 4** describes all potential countermeasures and associated theoretical tools. Countermeasures for debris-flow can be classified according to their direct and indirect functions, mainly divided into structural and non-structural countermeasures sometime called as hardware and software tools. Governing equations, which are composed of mass and momentum conservation equations are explained and solved numerically to predict the sediment runoff volume and the flooding zone of the sediment disaster 1999 occurred in the San Julian drainage in Venezuela. 2D analysis in the fan area gives the idea of potential destruction caused by debris-flow event and meantime such prediction helps us to identify the risk level and therefore to ensure the required degree of control, so that the impact can be reduced to that extent. In addition, 1D analysis was carried out supposing several possible combination of check dams are constructed in possible tributaries. In general, optimization criteria for type, size and location of check dams are also introduced, which can later be used as check list for planning and designing check dams in any torrents.