Sediment modelling in Nillambe Oya, Sri Lanka

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Abstract

Sedimentation in surface water bodies is a major problem worldwide as well as in Sri Lanka especially in the upper Mahaweli catchment. To address these issues, proper monitoring of sedimentation is necessary, but daily monitoring and data collection are greatly time consuming and costly. Therefore, development and application of models for accurate simulation of these variations will be a vital requirement for management of these ecosystems. Therefore, the present study was done with the objectives of calibrating and validating the HEC-HMS 3.5 and HEC-RAS 4.1.0 models based on climatic, sediment and landuse data and applying the calibrated models to predict sediment variations. With the purpose of addressing this issue, combination of HEC-HMS 3.5 and HEC-RAS 4.1.0 models were used to simulate flow and sediment changes in the Nillambe Oya, which is located in the upper Mahaweli catchment with typical landuse patterns of the central highlands of the mid and up country wet zone of Sri Lanka. During the period from May 2013 to September 2013; flow was measured and water samples were analysed for sediment in nine selected days. Rainfall data, other meteorological data, flow and sediment data were obtained from the Environment and Forest Division of the Mahaweli Authority and the Meteorology Department of Sri Lanka.
HEC-HMS 3.5 and HEC-RAS 4.1.0 models which are developed by the United States Army Corps of Engineers were used to simulate flow and sediment of the Nillambe Oya. The HEC-HMS 3.5 model was used to generate flow which is needed for HEC-RAS 4.1.0 model in order to perform simulation of sediment in Nillambe Oya. Daily flow data for five years (from October 1991 to September 1996) were used to calibrate the HEC-HMS 3.5 model and another set of flow data for five years (from October 1994 to September 1999) were used to validate the model. HEC-RAS 4.1.0 model was calibrated using sediment data collected and analysed in five days along with flow and other meteorological data. The

validity of the calibrated model was evaluated using sediment data collected in the other four days. The calibrated and validated HEC-HMS 3.5 model reliably predicted the flow in Nillambe Oya. The HEC-RAS 4.1.0 model simulates only the sediment derived from river scouring and it cannot simulate the sediment resulting from watershed erosion. According to the model simulations, the sediment concentration derived from river scouring varies from 6.9% to 10.3% when compared to the total sediment load. On average, 92% of the sediments carried by the river is resulted from watershed soil erosion. Therefore, proper watershed management actions should be taken in order to reduce the sediment load carried by the Nillambe Oya and also to minimise the impact of sedimentation of the Nillambe reservoir.

Keywords: Calibration, catchment, flow, HEC-HMS, HEC-RAS, modelling, sediment, validation