

Possibilities of Design and Operation of Hydraulic Structures with Respect to Suspended Sediment Load by Modelling Hydrological-Sedimentological Responses of a River System

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The major problem associated with the operation and design of hydraulic structures is sediment transport, which decreases storage capacity of reservoirs and results in the inability to discharge sufficient flow for power generation, irrigation, domestic and industrial water supplies. Due to natural and human activities in the headwater areas, large amounts of soil become eroded and deposited behind hydraulic structures. The structures are subject to fluctuating inflow with sediment load of widely varying particle sizes, which in turn have a negative effect on its operation. Due to impounding and retention of sediment by structures, the downstream river system is exposed to degradation, and loss of more soil in the course of maintenance of the equilibrium conditions of flow. In order to cope with this problem, forecasting of the time of arrival of sediment laden flow after specific rainfall events at the reservoir is a prerequisite for proper reservoir operation and the design of impounding hydraulic structures.

For existing reservoirs, alternative sediment management strategies require the time and spatial responses of the basin for single or multiple rainfall events which are inducing sediment loaded flow at the headwater areas, the time of arrival at the intakes/cross streams, and at the entrance into reservoirs. This research considers the dam, reservoir and basin as one system and studies the interrelationships, in search of a scientific solution for the prevailing sedimentation problems in reservoirs. Modelling of the generation of suspended sediment load, its transport, addition of sediment at the junctions (pre and post confluence), diversion at intakes, regulation and its arrival at the entrance of reservoirs quantitatively and qualitatively assists in a proper management, operation of reservoirs and design of hydraulic structures. This study addresses the possibilities of design and operation of hydraulic structures with respect to the suspended sediment load by modelling hydrological and sedimentological responses in the river system.

This paper covers a part of the research, i.e. the modelling of rainfall intensities and evapotranspiration variation over the basin as an input to the design of hydraulic structures and operation of reservoirs by considering e.g. elevation, distance from the sea, azimuth of the computational units, and generating digital maps using GIS. Similarly, as the basin is located in the tropics where evapotranspiration accounts for a large portion of other hydrologic elements, a cell by cell variation is generated and compared with the observed value at nearby meteorological stations.