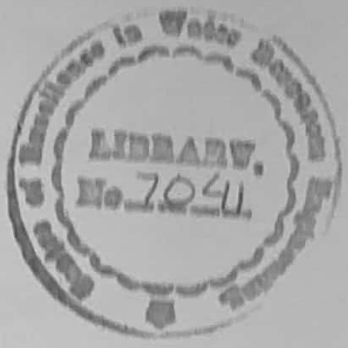
REGIONAL SCALE SEDIMENT YIELD MODELING USING GIS AND REMOTE SENSING



Submitted by

GHULAM NABI
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ABSTRACT

A grid based Regional Scale Sediment Yield Model RSSYM was setup in different catchments of Indus basin using coarse resolution grid data. When coarse grid data is used, the land slope decreases and sediment delivery is reduced. In this study the slope averaging effect was minimized by using the fractal analysis approach. The equations for fractal constant and fractal dimension were developed using Digital Elevation Model of 1 km^2 resolution (DEM) for local topography. The slope was computed for 250 m and 50 m downscaling from 1 km^2 grid. A comparison was made between fractal constant equation and fractal dimension to scale down the slope parameter. Both the equations were incorporated in the Regional Scale Sediment Yield Model (RSSYM). The model was applied to Phulra catchment. The results showed that fractal dimension equation gives better results as compared to fractal constant.

The RSSYM was applied on three more catchments of Indus basin namely Soan, Gariala and Phulra. For Phulra catchment of Siran river the total observed sediment was 0.304 million tons whereas the simulated sediment was 0.291 million tons. The coefficient of efficiency (COE) was 0.85 and the coefficient of determination was 0.83 which shows that there is a good correlation between the observed and simulated values.

In Gariala catchment the observed sediment was 6.01 million tons whereas simulated sediment was 6.80 million tons. The coefficient of efficiency for Gariala catchment was 0.91 and the coefficient of determination observed and simulated hydrograph was 0.81. Similarly for the Soan catchment the observed sediment was 10.61 million tons and simulated sediment was 12.29 million tons. The coefficient of determination and coefficient of efficiency for this catchment was 0.95 and 0.98 respectively.

A snowmelt runoff (SR) model was developed using temperature index approach and the model was applied to Astor catchment to test the applicability of temperature index approach for Indus basin. The terrain is difficult to measure the hydrological and hydraulics data. Most of the data was available at the outlet of the catchments. The input data included daily temperature and precipitation, dividing the catchment into different zone depending on the elevation difference. The elevation zones were generated from the DEM of the area. The snow depletion curves were made for the snow covered area derived from the satellite data analysis on monthly basis. The model output was discharge hydrograph. The COE was 0.91 which shows that there is a good correlation between the observed and simulated values. The statistical test showed that model performance was good. The results of SRM model encouraged to use temperature index approach for snowmelt runoff estimation in the Indus basin.

The SR model was coupled with the regional scale sediment yield model (RSSYM) and it was named as modified regional scale sediment yield model (MRSSYM). The MRSSYM model was applied to Astor and Gilgit catchments. For the Astor catchment total observed sediment load was 3.98 million tons whereas the simulated sediment load was 4.34 million tons. The coefficient of the model was 0.89 whereas the coefficient of determination was 0.83. Similarly for Gilgit catchment the measured and simulated sediment loads were 4.50 and 4.48 million tons respectively. The coefficient of efficiency and coefficient of determinations were 0.95 and 0.88 respectively. From these results it can be concluded that MRSSYM can be applied with confidence to various catchments of Indus basin where runoff is due to snowfall and snow melting.