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Modeling assessment of catchment sediments from ungauged river basins through fluvial system

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Erosion and sediment transport are part of the natural evolution of the landscape. Sediment assessment is a quantitative statement of the soil and associated material as it is transported from its source within the drainage basin to its eventual exit from the drainage basin through runoff. It accounts for processes and rates of erosion and sediment transport on hill slopes, valleys and river channels for final deposition in sinks. There are, however, inherent limitations in modeling the transported sediments due to limited temporal and spatial availability of requisite data and the complexity of the processes of sediment transport through the fluvial system. Sediments displaced from its source do not move out of the system in full but some quantity is trapped and retained in appropriate sinks within the basin itself, and so, the estimates of on-site sediment loss may not provide direct indication of the suspended sediment yield from the basin. The river channel form is determined by sediment supply, local geology, hydraulics and vegetation. Sediment transfer depends largely on the relative influences of erosion by rainfall, gradient, vegetation, soil texture and moisture content. The runoff coefficients and soil erosion rates are highest from ploughed bare plots and lowest from the dense forests. Rainfall intensity, duration and distribution in a basin, with given geology and land cover conditions, will determine the surface runoff, mainly responsible for the sediment transport.

A partial regression equation model was developed for assessing the sediment transport from river basins by Doolittle method as; sediment transport (t ha^{-2}) = (runoff as % of rainfall)^2 x 0.0452; where 0.0452 is the coefficient and runoff as % of rainfall = 9.293 + 0.147 x slope (%) + 0.048 x rainfall (cm) – 1.469 x vegetation (1 to 5 scale; 1 being the bare soil surface and 5, being the dense forest cover with bushes and grasses) + 0.054 x soil moisture (%) – 0.125 x soil clay (%). The model holds good under wide

range of agro-climatic conditions. The data used to evolve the model was taken from a long-term multidisciplinary study conducted with eight land use systems with watershed approach, to create different land covers such as grasses, fodders, agricultural and horticultural crops, forestry, agro-forestry and shifting cultivation. Different soil conservation measures such as bench terracing, trenching, half-moon terraces and local methods were adopted as per requirement. The runoff (surface and sub-surface flows) was monitored through monitoring gauges installed at the exit point of each watershed. A few constraints may limit the applicability of the model, the prominent among these are; unprecedented climatic events, very high slope of more than 100%, runoff variability which has spatial and temporal dimensions and, sediment trapping within the fluvial system with residence time increasing with increasing size of the basin. The data used in developing the model is from small area studies which can, however, be extrapolated successfully to represent a river basin.