TECHNICAL SESSION - IV

SEDIMENTATION PROCESSES AND ENVIRONMENTAL ASPECTS

GENERAL REPORT

by

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The processes of sedimentation involve complex interaction of soil detachment, transportation and deposition processes thereby percluding the development of a reliable mathematical model for estimation of erosion under different agro-climatic conditions of the country. Since empirical or regression type models have limited applicability, process based models need to be developed and validated under varied conditions of the climate, topography, soils and landuse. However, in the absence of elaborate data required for the application of such models, USLE and its modified versions can be suitably applied for predicting erosion and reservoir sedimentation. Also while applying and extrapolating the results of small catchments, caution need to be exercised to evaluate the parameters more extensively which otherwise may lead to highly erroneous predictions.

It is estimated that of the total 5334 million tons of soil eroded annually in the country, about 10 percent is deposited in the reservoirs resulting in loss of storage capacity of 1-2% every year. It is further estimated that about 7 lakh ha irrigation potential is lost every year through reservoir sedimentation. The loss of storage capacity of the reservoirs apart from reducing their useful life has a direct bearing on environmental degradation. It highlights the urgency of identifying the critically eroded areas in the catchments of such reservoirs and treat them on priority basis.

All Indian Soil and Land Use Survey (AISLUS) Organization of Deptt. of Agriculture & Cooperation has identified 4254 watersheds covering about 11 million ha area under very high and high priority categories in 27 River Valley catchments out of which 615 fall under Himalayan zone. The Himalayas being the youngest mountain range in the world, are highly susceptible to accelerated erosion due to heavy rains resulting in excessive indiscriminate cutting of trees, extensive road construction, heavy grazing, mining activities and unscientific management of agricultural lands. Hence, studies should be immediately taken up to assess and quantify the extent of degradation of land, water and environment in this region and to suggest remedial measures through integrated approach on priority area basis to check this menace.

In this session the following six papers have been presented :

1. Hydrologic Responses of a Himalayan Pine Forest Micro Watershed (J.S. Rawat, M.J. Haigh and M.S. Rawat).

2. Sedimentation Study of Reservoir for Baglihar HE Project (S.P. Sen and Shankracharya).

3. Glacio Fluvial Sediment Transfer From Chhota-Shigri Glacier (Syed I. Hasnain)

4. Chemical and Sediment Load Characteristics of Chandra River, Lahul Spiti Valley,H.P. (A.R.Raju and S.I.Hasnain)

5. Study of Chemical Characteristics of the Western of Naukuchia Tal. (Kireet Kumar,D.S.Rawat & Ranjan Joshi)

6. Hydrology of Pookot Lake Ecosystem of Westren Ghats Region (E.J.James and V.Padmini).

Out of these, five papers pertain to Himalyan region and one to the Western Ghat region. Broadly,the authors have attempted to study the water quality and sediment production rate of lakes and reservoirs by identifying various quality parameters and employing suitable sediment estimation techniques.

A brief report of these papers alongwith their critical appraisal is presented below :

1. This paper presents preliminary observations of an experimental study taken up in a pine forested watershed in collaboration with Oxford Polytechnic, UK. Highest discharge was recorded in rainy season and the lowest in summer which seems to be logical. Similar trends were observed in the sediment discharge most of which is constituted of bed load. Though the study has reasonably exhibited normal trends, it would have been more appropriate to relate the variations in runoff and sediment production to the prevailing climatic, topographic and landuse conditions. Due consideration should be given to the soil type and geology of the area which is one of the key factors affecting runoff. The runoff-rainfall relationship should be developed to extrapolate the findings. The study appears to be quite useful and may generate valuable data if the above points are incorporated to widen its scope of applicability.

2. The authors, Mr. Sen and Shankracharya envisage to analyse the bed material and suspended load data employing theoretical and semi-empirical methods and to develop relationship between sediment load, velocity, hydraulic slope and discharge. HEC-6 model will then be employed to study the sedimentation profile in the reservoir of Baglihar dam on Chenab river. Analysis of samples at the three sites has shown that increased shear stress at one of the sites has considerably increased the sediment load due to transfer of bed load into suspended load. The average annual sediment inflow in the reservoir is estimated by both area increment method and empirical area method.

   The authors have presented a good analysis of sediment production rate at dam site. However, factors responsible for varying degree of sedimentation such as rainfall amount, intensity and distribution, seasonality, relief, soil types and landuse etc. as initially listed by the authors have not been discussed for their quantitative impact. For example, the higher production rate at one of the sites may not only be due to increased shear velocity but also due to changed land use pattern, soil type and geology. The authors seem to be aware of these lacking components and must include them in their future analysis.

3. This study has been conducted in a glaciated watershed of Lahaul-Spiti Valley in H.P. The main objective is to generate sediment and solute transport data and study the chemical processes operating at the interface of glacier ice mass and the bed rock. They concluded that chemical enrichment occurs wherever water passes over or through subglacial channels and has long contact periods. The analysis has indicated that glacierised basins of Himalayan region are experiencing high chemical denudation and steps should be initiated to prevent further deterioration of water quality and environmental pollution. Apart from studying the quality parameters, due emphasis need be given to study other causative factors of degradation and suggest remedial measures to ensure good quality water to the beneficiaries.

4. The paper basically deals with the systematic quantification of water quality parameters of a high altitude river in Himachal Pradesh. The reasons for the variation in chemical composition and the impact of soil and geological formations have been critically examined and discussed. It is inferred that alkalinity in the river water is largely due to dissolved load when water flows over sedimentary or igneous rocks. The silt concentration in the river is due to snowmelt runoff. The chemical analysis has clearly demonstrated that a close correlation exists between quality parameters and geophysical location of the river basin. The study need to be further extended to include the effect of factors like snowfall distribution, biomass and morphological characteristics on water yield to make it more comprehensive.

5. The authors have identified lakes as the major source of irrigation and domestic water supply in the high altitude Himalayan regions. While analysing the causes of pollution in the lake, the deterioration in lake water quality is attributed to excessive siltation load and human activities at the lake site. Among various parameters of lake water quality, dissolved oxygen is found to be most critically affected. Hence, efforts should be made to take up preventive measures in the catchment area to check erosion and thereby flow of nutrients and chemicals to ensure crystal clear water in the lake. The human activities should be properly regulated to prevent further pollution of the lake.

6. The authors have identified large number of factors responsible for degeneration of Pookot lake necessitating desilting operations for restoring the lost capacity. Many soil conservation measure such as closure and fencing of catchment area, construction of silt traps, afforestation and peoples participation programmes have been initiated which have dramatically reduced the silt load to 16 mm per year. However, the value of runoff coefficient assumed between 0.91 and 0.98 seems to be quite high as it applies to areas completely devoid of vegetation. From the landuse map, about 60 percent area is under forest, grass and coffee plantations. The ill managed coffee area may result in high soil erosion during establishment stage which may considerably decline as the canopy cover develops. The contribution of sediment traps will hardly serve the purpose untill conservation measures are taken up in the catchment area. The study is a good attempt to demonstrate the efficacy of soil conservation measure in conserving runoff and reducing silt load.