CHAPTER I

INTRODUCTION

Land and water are the two most valuable and vital resources essentially required not only for sustenance of the life system but also for the material well being and prosperity of the mankind. The danger of soil erosion and land degradation are prevalent in many forms throughout the country. It has been estimated that, in India about 175 million hectares out of the total geographic area of 328 million hectares suffer from serious erosion and land degradation problems. Out of this, about 150 m. ha is said to be subjected to soil erosion by water and wind. Another 25 m. ha is reported to have been degraded through ravines and gullies, shifting cultivation, waterlogging, alkalinity and salinity etc. (17). In a recent analysis of annual soil erosion rates in India, it is estimated that about 5333 million tonnes (16.4 tonnes/ha) of soil is detached annually due to agriculture and various activities and of this, about 29% is carried away by the rivers into the sea. Nearly 10% of it is being deposited in our surface reservoirs resulting in loss of 1 to 2% of storage capacity annually.

Increasing demand for food, fodder, fibre as well as power in the recent times has been met through expansion in irrigation potential and generation of hydro-electricity by constructing multipurpose river valley projects. These

potentials are however, very limited. According to Eckholm (20) the expansion in irrigation potential for the world as a whole can at best be expected at a rate a little more than 1% against the annual increase of 3% that took place during the period 1950-70. A large number of multipurpose reservoirs have been constructed in our country for hydro-electric power generation, domestic water supply, irrigation, soil erosion control, flood mitigation, pisciculture and recreation purposes by investing huge amounts of money. The sites for such projects, though still available in some parts, have already become scarce in many areas such as in Tamil Nadu. Also, it has been estimated that even after exploiting all possible irrigation potential about 50% of the cultivated area will still remain rainfed (17). It is therefore imperative, notwithstanding the feasibility of constructing many more structures, to preserve the existing resources so as to perpetuate the benefits. Otherwise, there will be colossal dislocation in the socio-economic base which may ultimately disturb the very stability of the nation.

Most of the multipurpose dams have been designed to last for a period of atleast 100 years, but excessive siltation of reservoirs due to accelerated erosion is threatening the useful lives of these structures or projects. Even though, each reservoir has been designed to hold some sediment

coming from the catchment, the actual sedimentation survey showed much faster rate of silting of reservoirs. For Nizam Sagar, Mayurakshi, Panchet and Maithon reservoirs, the rate of siltation has been observed to be as high as 7 times the estimated rate (17). In order to bring down the alarming rate of siltation and to preserve the useful lives of the major multipurpose reservoirs, a centrally sponsored scheme of soil and water conservation measures was introduced in 1963-64 and is in operation till now in 31 major river valley projects in our country. At present, watershed management programmes are under operation in 276 sub-watersheds covering a total land area of 77 million hectares.

The basic objective of the watershed management programme is to maintain an optimal hydrological balance of the region or catchment by putting the land to its proper use. It is an established fact that it takes more than three hundred years for the development of 2.5 cm of depth of soil. One of the accepted methods of controlling soil erosion is to arrest its movement at its source. In order to be able to prepare a comprehensive erosion control programme, one should know the amount of hydraulic load any watershed is being subjected to and also its behavioural changes with respect to the causes of erosion. The land use pattern of any watershed has a greater role to play in reducing the soil loss and hence, it is the land form of any

watershed which gets modulated when subjected to a particular amount of hydraulic load.

The need for accurate information on watershed runoff and sediment yield has grown rapidly during the past two decades along with the acceleration of the watershed management programmes for the conservation, development and beneficial use of all natural soil and water resources. Prediction of runoff is essential to make adequate provision in the design of various components of the hydraulic structures. Also, proper prediction of the sediment yield from watersheds is a necessity if adequate provision is to be made in the designs to offset the ill effects of sedimentation during the lives of such works. It is very well known by now that overestimating the sediment yield adds unnecessarily to the cost of the structure and underestimating the sediment yield leads to premature decline in the usefulness of the structures and the services dependent upon it.

In order to prepare a comprehensive watershed management plan with limited available financial resources, it becomes imperatively necessary to select the critical watersheds, which are prone to yield relatively larger quantities of sediment for initiating quick treatment. A substantial amount of time, money and labour could be saved if an appropriate methodology for identifying the critical watersheds is developed. Observed sediment yields or sediment production

rates (S.P.R.) of watersheds could be most valuable information for this purpose. But direct collection of data is time-consuming and it is not possible to gauge all the watersheds. And also the elapsed time between the planning and final design and execution of watershed treatment plan is usually much too short to obtain adequate streamflow and sediment load data at the site. Therefore, indirect quantification is normally resorted to.

Various techniques and tools for predicting runoff ranging from simple empirical equations to complete routing equations are available in literature. Similarly, many empirical equations are also available to predict the sediment yield from watersheds. Information generated through soil and land use survey and aerial photo-interpretation are utilized to obtain weighted sediment yield/erosion index based on which inter-se priority of watersheds are determined and critical ones are selected for planning and execution. This method is also time-consuming as it requires considerable verification by ground truth. However, it does not give the absolute values of the sediment production rates from the watersheds. Although important advances have been made in this field, reasonably accurate technique to predict the runoff and sediment yield of an ungaged small watershed still plagues the hydrologists.

The Domodar Valley Corporation is the first river valley project located in the Eastern region of the country to tackle