Preface

Soil and water are among the important resources for sustenance of mankind. Today, these resources day by day are becoming scarce at worldwide level. As a result of ever continuing depleting soil and declining water resources in the Himalaya or elsewhere in the mountainous parts of the world is therefore becoming a matter of great concern. In the recent years lot of attention towards the hydrological studies pertaining to the Himalayan watersheds has been paid by the many researchers and environmentalists. The Himalayan rivers are the major contributors of sediments in the Indian ocean every year. The rate of erosion is also very high in the Himalayan rivers as compared to other parts of the world. The technical know-how about arresting this degradation and conserving soil and water resources therein, have become the major issues in the field of hydrological studies in different parts of the Himalaya. There have been a very few efforts that have been applied till the date at ground level on a limited scale. The average rate of erosion in the Himalayan Ganga basin was estimated to be 0.9 mm yr\(^{-1}\). In another study, this rate of erosion in the Ganga basin was estimated about 0.19 mm yr\(^{-1}\) \cite{Burbank2000}. Recently, Valdiya and Bartarya \cite{Valdiya1989} have estimated the erosion rate 1.7 mm yr\(^{-1}\) in the Central Himalaya. Similarly, in another study of the Nana Kosi watershed from the Central Himalayan region, the erosion rate is estimated about 5.66 mm yr\(^{-1}\) under different land use conditions \cite{Rawat1996}. These accelerated erosion rates are five to six times higher than the average erosion rate of 1 mm yr\(^{-1}\) for the Himalaya.

There are several factors that may contribute to this accelerated rate of erosion. Generally, it is observed that the high rate of erosion is estimated in the streams which had developed over the weak structural sequences. Moreover, the high rate of erosion is estimated in the watersheds of intensively and poorly managed agriculture. Overgrazing, deforestation, forest fires and other anthropogenic activities (dam, road, canal, settlements, bridge, mining and quarrying) are also the important factors which determine the rate of erosion in these areas. Spatial adjustments in channel morphology, stream area, length, gradient and its orders are also responsible for estimation of regime relationship factors. In the Himalayan region, major linear features such as thrusts, faults, folds and lineaments are significant factors for determining hydrological characteristics and erosion rates. As a result, all the drainage lines in the Himalayan terrain are developed along the structural features.
For determining the geo-hydrological responses and environmental degradations in the highly stressed ecological zone of the Lesser Himalaya, a watershed has been selected for the present study. This representative watershed Dhundsir Gad is the right bank tributary of the River Alaknanda which is located in the Tehri Garhwal of Uttarakhand. Geographically, the watershed is bounded by 78° 44' to 78° 49' E longitudes and 30° 13' to 30° 23' N latitudes covering 50.5 km² area. The watershed is well drained by streams and rivulets which are locally known as Gad and Gadheras.

The basic purpose of the present study is to identify the hydrological responses of the Dhundsir Gad and to assess the denudation rates of the middle order streams in the Lesser Himalayan region of Garhwal region. The study of geo-hydrological characteristics in relation to morphometry and water discharge including socio-economic have been studied in the following seven chapters.

The first chapter is an introductive part of the study regarding the problems, objectives, location methodology and special emphasis on a review on the work.

The second chapter deals with regional geology, lithology, strictures and soil. But the most important characteristic determining here is the quantity of sediment in an active river.

Chapter third portrays the geomorphologic characteristics of the Dhundsir Gad, i.e., absolute relief, relative relief, cross profile and long profile.

In the fourth chapter, the areal and linear aspect of the Dhundsir Gad including basin geometry such as drainage anomalies, drainage pattern and drainage system are discussed and the relation of these parameters are assessed in relation to water discharge and sediment budget.

Chapter fifth deals with the geo-environmental aspect of the basin in which the landform analysis, climatic data (such as temperature and rainfall), natural vegetation and socio-economic status are mainly considered. Moreover, the comparative study of these parameters within the altitudinal zones is described. The general pattern of land use, hydrological features, natural vegetation and biotic pressure in relation to altitudinal range has also been discussed.

The central theme of the study such as water discharge and sediment budget on four year data basis has been discussed in the sixth chapter. Monthly, seasonal and yearly water discharge pattern was obtained and analyzed. The rate of erosion by means of a
number of agents of denudation was computed after calculating suspended, bed and dissolved load. Thereafter, the denudation rate was estimated.

In seventh chapter, finally some concrete conclusions and specific recommendations based on field investigations were made. The management options were recommended after using this approach to attain sustainable development in an integrated manner where ecological processes are under operation at micro, meso and macro scales.

Ultimately, if technical approaches are disseminated by this study, these would become successful at greater extent. But there should always be an integration of basic science with the decision-making process for finding the resolution of these important issues. This study is therefore aimed at addressing only the initial steps in increasing the denudation rate of the Himalaya with its diverse settings. The fundamental challenge is to learn how to integrate socio-economic needs of the stakeholders with environmental viability. The Himalayan watershed has therefore become the experimental site to evaluate these issues in the background of the critical economy of the common people, ecological sensitivities and the policy issues of development to the concerned government.