INTRODUCTION
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Water is vital natural resources for existence of all kind of living matters, plants, animals and man. Increasing population pressure, haphazard urbanization and industrialization has imposed unbearable pressure on the water resources. So it gives pressure to maximize economic utilization of available water and also accelerate scientific study on all field related to water.

Mountain, by virtue of their geomorphologic features and location, are an important source of fresh water supply outside the pole regions. Glaciers, reservoir of fresh water in the mountain region are widely recognized to be sensitive climatic indicators (IPCC, 2001 and 2007). Glaciers are using as instrument in moderating, modifying and modulating the weather and climate of mountain region. They store information about past climates in the ice as enclosed gas bubbles, layers of dust and ice chemistry. Runoff from the glacier is naturally regulated and is extremely beneficial for the human beings, hydropower, irrigation etc. by producing the perennial flow to its river system (Hasnain et al., 1989).

As the world warms inexorably, glaciers in the Himalayas are melting away, putting at risk fresh water supplies for millions of people in Asia. The impact of global warming in all part of the world is still under debate (Yadav et al., 2004, Roy and Balling, 2005). Large emissions of CO₂, other trace gases and aerosols have changed the composition of the atmosphere. Due to these green house gases the energy budget of atmosphere and earth has changed. It is observed that since last ten million years, the temperature has changed constantly (Seiler and Hahn, 2001). This observed changes will have profound impact on snow accumulation and ablation rate in the Himalayas.

Glacier change can be shown by changes in its mass balance between accumulation and ablation and is very dependent on climate (Bennet, 2000). Glacier behaviors can be calibrated by defining the local relation between mass balance and climate. The monitored glacier network provides a highly useful tool for monitoring spatial and temporal climate and climate change for reconstructing and modeling past and future climatic scenario. It helps for hydrological and hazard assessment and management.
Introduction

Prediction of glacier response has great importance for glacier related hazard assessment, such as glacier-dammed lakes, pro-glacial lakes (glacial lakes outburst floods, Mool et al., 2001a and 2001b), avalanches and sea level rise etc. and hydrological management such as meltwater quantity and quality, snow cover area etc. To access such hazard, information on the rate of mass loss, subsequent glacier retraction and melt water production are required. Avalanche is also an important threat that stalks round the year and it is very complicated phenomenon in glaciated region (Ganju and Thakur, 2001).

The observed global sea level rise is a matter of international concern since it threatens vast low-lying areas including numerous highly populated coastal regions, which may be drowned in near future due to sea level rise. The calculated contributions to sea-level rise in 100 year up to 2100 vary from almost zero to about 6 cm by Arctic glaciers (Oerlemans, 2005).

To access quantity and quality of water geochemical and hydrological research has been carried out in various ecosystems to understand the factors controlling the chemistry of natural water (Likens et al., 1977; Baron and Bricker, 1990). The rapid snow melting processes and monsoonal rainfall over glaciers may affect the surface water chemistry in the Himalayan region very significantly. Even due to extreme climatic condition, different geomorphology and tectonic origin, the geochemical processes acting in this region are intense and lead to a high denudation rate (Collins and Hasnain, 1995). Therefore, evaluating chemical characteristics of snow, ice and meltwater are very informative and effective for management of the mountain water resources. To study the glacier historical response geomorphology of glacier is an effective source. Geomorphology of the glacier gives an idea of various glacio-fluvial activities of this region and reflects the remnant of a pre-glacial condition (Chaujar, 1987). Change in the snout position, debris cover, moraine, crevasses reflect mass gain or loss by the glacier.
Fig. 1.1 The contribution of mountain glacier to sea level rise (Fountain et al., 1997; Meier, 1984)

Application of remote sensing technique used extensively in glacial studies for various purposes such as glacier mapping, snout position etc. Initially, Landsat Multi-Spectral Scanner (MSS) imagery was used for mapping glacier, subsequently false colour composite made from visible and near-infrared satellite images have been used successfully to map various glacial features such as glacier boundary, accumulation area, ablation area, equilibrium line and moraine-dammed lakes (Kulkarni, 1991, Kulkarni, 1994, Kulkarni, 2003, Oststream, 1975).

The morphology, the bedrock topography, meteorological parameters, hydrogeochemical as well as the dynamics of Chhota Shigri glacier have been surveyed during the summer months of 1986, 1987 and 1988 (Dobhal et al., 1995, Kumar and Dobhal, 1997, Vardhan and Singh, 1989, Kumar, 1999, Kulandaivelu et al., 1989, Hasnain et al., 1989). The maximum and minimum velocity of glacier surface was 38\(\text{m/y}\) and 21\(\text{m/y}\) respectively (Kumar, 1989). The total retreat of the snout between 1963 and 1989 has been evaluated at about 195\(\text{m}\) (mean retreat over these 26 years of 7.5\(\text{m yr}^{-1}\); Dobhal et al., 1995) but a
Introduction

recent study (Kulkarni et al., 2007) reports an accelerated retreat since 1988 with a 800 m retreat of the glacier terminus between 1988 and 2003 (mean retreat over these 25 years of 32 m yr⁻¹). Attempts of mass balance measurements have been done in 1986-1988 (Dobhal et al., 1995, Nijampurkar and Rao, 1992, Kumar, 1999) but they are questionable because stakes were drilled into the ice up to 1.25 m depth only and only part of the accumulation area is taken into account in calculations.

The higher Himalayan ranges have some of the highest and biggest glaciers in the words but its glaciers are very poorly sampled in the field. In order to avoid the future water crisis in the coming decades, the study of the water reserves as glacier in the Himalaya and the effective management of the mountain water resources are essential to satisfy these growing demands. Present research has particular interest in the western Himalaya because this region is influenced by two major climatic systems i.e. the mid-latitude westerlies and the south Asian summer monsoon. The region is still poorly monitored due to logistical difficulties in maintaining observational networks at high elevation. Chandra river of Himachal Pradesh is one of the important sources of water which feed by different glaciers, among them one is Chhota Shigri glacier. Information available on mass balance, discharge and chemistry of snow, ice and meltwater of Chhota Shigri glacier is sparse and inadequate and needs to be substantiated by comprehensive studies.

Within the Chhota Shigri glacier most of the work concentrate on right bank of the glacier (part-A) due to easy accessibility, undulating terrain and less debris cover. In the light of the above said reasons the present study has been carried out in Chhota Shigri glacier part-B. Chhota Shigri glacier divided in two parts by medial morain, one originating from east side of the accumulation area and flowing on the right bank of the glacier, part-A and the second coming from the west side and flowing on the left bank of the glacier, part-B. Part-B flow direction in upper ablation zone is W-E and originating from high peak 6200m a.m.s.l. On the contrary, part-A has E-W flow direction and originating from approximate same altitude 6300m a.m.s.l. Lower portion of ablation zone is full of debris below 4500m a.m.s.l. in part-B while below 4300m a.m.s.l. in part-A. These features of glacier differentiate part-A to part-B motivates for further research.
OBJECTIVES

The literature review indicated that, there is not much work done on Chhota Shigri glacier part-B so far. After going through all available literature, the present work has been initiated with the following objectives –

1. To study the mass balance of Chhota Shigri Glacier Part-B.
2. To identify the most important climate processes controlling glacier growth and shrinkage.
3. To study the major ion chemistry of snow, ice, and meltwater of Chhota Shigri Glacier.
4. To estimate the hydrological impact of the glacier on local stream flow.
5. To determine the effects of climatic fluctuations on the glacier.