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SUMMARY AND CONCLUSIONS
The hydrological cycle is a major transport system in any ecosystem and exchanges the material and energy between the different component of system, which interacts with lithosphere, biosphere and atmosphere. Thus, chemical characteristics of water in each stage of the hydrological cycle can provide information about various biogeochemical processes in the region (Sullivians, 1984). Thus, water profile has been applied for identifying different biogeochemical, physical processes in many ecosystem studies (Liken, 1977).

The present study deals with the water chemistry of Dhauliganga river in a central Himalayan catchment. Sediments chemistry was also attempted to get better understanding of elemental mobility and fluxes within the basin. Finally textural and mineralogical investigations were carried out to evaluate how these factors influence the hydrogeochemical processes in the region.

Water samples were collected from source region to the downstream at selected stations in August 2000; November 2000 and May 2001 representing monsoon, postmonsoon and premonsoon season respectively. Bed and suspended sediments were collected at eight and twelve sampling locations respectively, in different seasons. The analysis of water and sediments for different parameters were carried out in the laboratory by standard methods and procedures.

The chemical composition of Dhauliganga river water reveals that it is alkaline in nature. Calcium is the dominant cation followed by magnesium, sodium, and potassium. Bicarbonate is dominant anion followed by sulphate, chloride, and small concentration of nitrate and phosphate in the river water.

The solute and suspended sediment concentration of the river water show marked seasonal and spatial variation. Temporal variability in solute and suspended sediment concentration is probably related to the flow regime and climatic conditions. In monsoon season enhanced melting of ice and snow in the high elevation and heavy precipitation in the middle and lower basin region resulted in
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High concentrations of solute contents and suspended sediments in Dhauliganga river basin. Postmonsoon and premonsoon season, characterized by low flow is associated with low concentrations of dissolved load and suspended sediments. Glacial activities mainly impart sediments in premonsoon season. Spatial variation in solute chemistry is influenced by lithology and fluvial processes in the drainage basin. There is gradual decline of TDS observed towards downstream in postmonsoon and premonsoon season inferring influence of glacial activity in the source region and subsequent dilution by ground water.

Water chemistry of Dhauliganga river is largely controlled by rock weathering. Bicarbonate weathering is the dominant process in Dhauliganga river basin. The high concentration of \((\text{Ca}^{2+} + \text{Mg}^{2+})\) to the total cations (>90%) and high ratio of \((\text{Ca}^{2+} + \text{Mg}^{2+})/(\text{Na}^+ + \text{K}^+)\) i.e. 12.94, indicate weathering of mineral rich in calcium and magnesium such as carbonates and/or alkaline earth silicates. Low ratio of \((\text{Na}^+ + \text{K}^+)/\text{Cations} (0.07)\) further suggests that contribution of dissolved ions via silicate weathering is less significant in the Dhauliganga river water.

The coupling of sulphide oxidation and carbonate dissolution imparts high \(p(\text{CO}_2)\) to the river water as well as relatively high concentration of calcium, bicarbonate and sulphate.

The TDS/TSM ratio analysis indicated dominance of physical weathering in the upper region and chemical weathering in the downstream region of Dhauliganga river basin.

The elemental composition of Dhauliganga riverbed and suspended sediment is characterized by the dominance of Si, Al, Ca and K. Fe and Mn are dominant heavy metals. Concentrations of Si and Al in Dhauliganga river sediments are comparable to Indus river basin in the Himalaya. Concentration of heavy metals is found low as compared to other river basin of India. The coarser grain nature of sediments and dominance of detrital minerals in the sediments are probably responsible for high concentration of Si and Al and low content of heavy metals. The element/Al ratio of bed and suspended sediments shows the similar order of metal mobility as Fe>Mn>Zn>Ni>Cu>Pb. There was no significant variation found
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for elemental concentration between >63μm and <63 μm size fractions of bed sediments suggesting that grain size control over sediment chemistry in Dhauliganga river is negligible specifically in sand and silt.

Grain size analysis reveals that bed sediments samples were moderately to poorly sorted (indicating high energy conditions, multiple sources), generally symmetrically skewed and mixed of mesokurtic to leptokurtic population. The mean size of sediments tends to found increasing towards downstream. Grain size distribution statistics suggest that it is influenced by physical weathering, slope and fluvial processes in the river basin.

X-ray diffraction study shows that quartz is the most dominant mineral followed by carbonates, feldspar, mica and illite in the bed and suspended sediments. It also confirms the results that chemical composition of water is influenced by lithological formations in Dhauliganga river basin.

The results of the study suggest high physical and chemical denudation rate in Dhauliganga basin. It is comparable to other Himalayan river basin and very high compared to the Indian and world rivers averages. This essentially refers to the geochemically fragile and very active landscape of Dhauliganga river basin.