# Chapter 9
# Inferring Relationship of Landslides, Tectonics, and Climate:
## Tons Valley, NW Himalaya

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## ABSTRACT

*Landslides, despite being the surficial impression of climate-tectonic-erosion linkage, are rarely explored in this context in Himalaya. The need for such study becomes more crucial in the evaluation of the regional hillslope denudation budget. We are of the understanding that the distributional pattern of landslides can reveal the relative significance of tectonic and climate. To test this hypothesis, ~ 55 landslides of the Tons River valley, Himalaya along with the tectonic and climate proxies are used in the present study. Steepness index and valley floor width to valley height ratio are*

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*used to infer the tectonic regime whereas; Tropical Rainfall Measurement Mission based daily rainfall data and swath profile of Normalized Difference Vegetation Index are used to deduce spatial variability in climate. The study revealed the possible existence of a positive feedback system in the Higher Himalaya Crystalline and the simultaneous role of tectonic-climate in the Lesser Himalaya Crystalline. The LHS is found to possess a zone of landslide cluster, possibly due to local fault.*

## ABBREVIATIONS

HHC, Higher Himalayan Crystalline; LHC, Lesser Himalayan Crystalline; LHS, Lesser Himalayan Sequence; MCT, Main Central Thrust; MT, Munsiari Thrust

## 1.0 INTRODUCTION

Landslides are the primary mass wasting process in the tectonically active hilly terrain (Hovius et al., 1997; Ballantyne, 2002; Sanchez et al., 2010; Gupta et al., 2016; 2017; Kumar et al., 2018, 2019a, 2019b; Jamir et al., 2017, 2019). Along with tectonics, the climate is also considered to control the distribution of landslides (Borgatti and Soldati, 2010; Kumar et al., 2019b). Though lithology and structures have also been noted to control the occurrence and distribution of landslides, tectonics and climate dominate at the regional scale (Guzzetti et al., 1996; Sanchez et al., 2010). Nonetheless, inter-relationship of climate and tectonics has rarely been associated with spatially varying landslide distribution patterns. Though the spatial distribution of landslides can be achieved easily using high-resolution satellite imagery and subsequent ground-truthing, there are many limitations to infer temporal distribution owing to the delineation of individual failure events, loss of landslide scarp, vegetation growth and dating constraints (Lang et al., 1999; Kumar et al., 2019b).

The Tons River valley, NW Himalaya is an appropriate region to infer such inter-relationship among landslide, tectonics, and climate considering the varying litho-tectonic and climate conditions of the valley (Uniyal and Prasad, 2006; Raman and Punia, 2011). The valley is endowed with numerous landslides in the structurally and lithologically contrasted rock mass. Steepness index ($k_s$) and valley floor width to valley height ratio ($V_f$) are used to infer tectonic variability whereas, TRMM based daily rainfall data of the last 19 years (2000-2018) and the NDVI are used to represent spatial variability in climate. This study will help to find out the relative influence of tectonics and climate on the landslide distribution and dimension, which may also be used further for the hazard assessment.