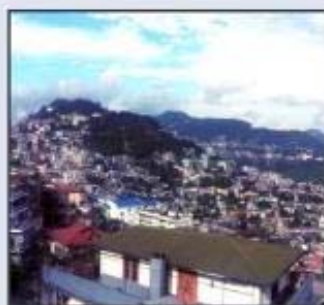


# Climate Change & Himalayan Informatics



J. Sundaresan  
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Ram Boojh

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## Foreword

Himalayan ecosystem has evolved over 65 million years and yet is vulnerable to changes on account of anthropogenic effect. It is the youngest mountain system which is dynamic and tectonically active and 31 of the Himalayan peaks are taller than 7600 meters. Three perennial river systems: Indus, Ganga and Bramaputra are part of this mountain system. More than 1.5 billion people in the plain, land and mountain regions in as many as six countries depend on the offerings of the Himalayan Ecosystem.

Whole Himalaya ecosystem is evolved and adapted to natural changes, the human civilization seeks revolutionary developments and forces man-made changes. Adverse changes in the Himalaya ecosystem could affect generations to come. Therefore, it is prudent to design the man-made changes within the carrying capacity of the Himalayan ecosystem. This would require a multi-dimensional decision support system for adaptation to changes and mitigating undesirable changes.

The Book "Climate Change and Himalayan Informatics" consists of many studies on climate change and urbanization. Application of geospatial technology and modeling is made. Impacts of climate change on cropping strategies by mountain communities and threat to agro biodiversity and its conservation are discussed. Paleo-climatic conditions are examined with studies and data collected from Arctic ecosystem. Institutional capacities for sustenance of Himalayan ecosystem are part of the session Himalaya informatics and database.

Probable responses of Himalayan ecosystem due to impact of climate change have been mapped providing inputs to the perspective of recent urbanization in many regions of Himalaya. The ecosystem is prone to periodic and episodic changes of tectonically active region and climate vulnerability and changes brought out by human activities. Causality of changes on the ecosystem needs to be studied, quantified and efforts should be made to counter ill impacts of anthropogenic activities. The present book is an effort in the direction of sustaining Himalayan Ecosystem. I congratulate the authors and editors for this valuable contribution with a noble interest.

  
( T. Ramasami )

## Preface

Himalaya have exotic control on the process of monsoon intensification hence Climate Change. Himadri was fast growing ever since the geodynamic evolution of Himalaya during 60-45 million years. It has reached a critical height so as to deviate the west to east flow of wind. The depression developed in this region had sucked the moist winds from Indian ocean and caused heavy spells of rain hence intensified the monsoon. This phenomena generated upwelling in the selected oceanic borders of Indian subcontinent before 8.5 million years. Rainfall had caused augmented sedimentation, rich biodiversity and splendid gene pool in Himalayan region and its plains. Indo-gangetic plain evolved due to the natural process occurred at Himalaya is the life line of millions of people. This become one of the most densely populated region of the world (250 persons/km<sup>2</sup> in Nepal to 800 persons/km<sup>2</sup> in Bangladesh). According to reports related to IPCC Indo-Gangetic plain is a major emitter of the climatic forcing gases and particles viz. CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, CO, NO<sub>x</sub>, BC and OC.

Climate change is a fact and its impact on the fragile mountain ecosystem is beyond doubt. Souring urbanization in and around mountain region and its impact is a new challenge for planning and development in this region. There are many models and experiences on mountain urbanization and its impact on ecosystem in developed countries. Whereas, studies, information and database related to the impact of Climate Change on the Himalayan ecosystem, ever increasing human settlement and urbanization are few. Present book "Climate Change and Himalayan Informatics" consists four sessions with sixteen chapters on various aspects of impact of climate change on Himalayan environment and its inhabitants.

Geospatial technology is a primary tool to develop methodology, to understand the phenomena and to prepare sensible target for adaptation and mitigation. There are four chapters in the session "Geospatial Technology, Modelling, Mitigation and Adaptation". The first chapter "Modelling energy and mass balance of Chhota Shigri Glacier" infers that the energy balance can be used as one of the approaches in estimating the mass balance of glaciers and in the recent years there has been increasing interest in predictive tools for spatially distributed estimates of mass balance further promoted by increased availability of remote sensing data. This study is the modelling of energy balance and computing the heat energy available for mass balance change in Chhota Shigri Glacier in the

Chandra Basin, Himalaya. Geospatial tools are applied to identify vulnerable zone for multiple hazards in the second chapter entitled “Natural hazards due to climate change in Himalaya and multicriteria decision analysis to identify vulnerable zone”. This study infers that region of medium drainage density, higher fracture density, high degree of slope and higher relative relief will be vulnerable and is adroit to landslide. Sustainable ecosystem development planning in Phakot sub-watershed, Tehri Garhwal district, Uttarakhand using Ikonos data is the third chapter in this session. Information generated in this study would form a baseline data in future, monitoring periodic changes in the parameters of natural resources. The consequences of Climate Change – Risks to the Globe, suggest effective implementation of the United Nations Framework Convention on Climate Change (UNFCCC).

Socio-economic studies are highly beneficial for planning and development of the impact of Climate Change in any ecosystem. The session socio-economic perspectives consists six chapters. Impacts of climate change and coping strategies by mountain communities of Uttarakhand, a Himalayan states that climatic variability with in short horizontal distance due to altitudinal variation resulting in high degree of variation in vegetation and hydrological characteristics make mountain more vulnerable to any climate change phenomena. Above study infers that communities are adopting various coping strategies such as change in agricultural calendar, change in crops and crop varieties, re-adoption of traditional water management systems, alternative employment and out-migration etc, to overcome the problems resulting from climate change. Vegetation of the cold deserts of Himalaya are ascribed in chapter 6 of this session. An intensive and extensive survey of the area and critical study of the plants have resulted in the documentation of 1405 species, distributed under 490 genera and 98 families of flowering plants. This is a highly fragile and vulnerable mountain ecosystem in the country. A large number of species growing in this area are of medicinal and economic value which is used by local inhabitants. The threat to agro biodiversity and its conservation in Uttarakhand Himalaya is examined in chapter 7. Gene pool of traditional crops has also been continuously enriched by gene flow across the Himalayan states and countries through trading of grain and exchange of seeds. Present study concludes that the gene pool and the traditional agriculture systems are under threat. Because of diverse ecological and climatic conditions existing in Himalaya, it harbors several ecologically and economically important plant species like *Olea ferruginea* Royle. It showed lower relative water content, lower water potential and lower water content at saturation, but a higher leaf mass per unit area, higher density of foliar tissue, higher succulence and higher chlorophyll content compared to other co-occurring species, indicating its greater tolerance to drought. Chapter 8 consists the potential tree crop for sustainable development of North-west Himalaya. The chapter 9 suggests integrating

local perception and traditional knowledge for adaptation strategies in Central Himalayan agriculture from the impact of Climate Change. This study infers that very recently many traditional rural communities inhabited in different agro-climatic zones of this region are struggling through different adaptation measures as an attempt to reduce the risk of climate change vulnerability. Facebook supports numerous emergency-related organizations, including Information Systems for Crisis Response and Management (ISCRAM), Humanitarian Free and Open Source Software (FOSS) Project, as well as numerous universities with disaster-related programs. The last chapter (Chapter 10) of this session is “Climate change and social media: Facebook as an effective climate messenger”.

Conservation, management, adaptation and mitigation due to the disastrous effect of Climate change is imminent possible through informatics and database of the region. The session III “Himalaya Informatics and Database” have three chapters. A permanent GPS station at Almora has been selected for the study on diurnal variation in perceptible water vapors over Almora. Ecosystem based adaptation has therefore emerged as a potential approach. Institutional mechanism for the development of technologies and their usages required for the sustenance of Himalayan ecosystem. The focus will be on promoting understanding of climate change, adaptation and mitigation, energy solutions and conserve biodiversity. Chapter 12 of this session examines the institutional capacities for sustenance of Himalayan ecosystem. The information and data related to dumping site of MSW of the Guwahati Municipal Corporation is in the fringe area of Deepar Beel, a Ramsar site known for migratory birds and aquatic biodiversity is the last chapter of this session.

Cooler conditions persists and glaciations developed in higher regime of Himalaya. The cooler regions have a profile contemporary to Europe. The last session of this book ascribes the paleoclimatic conditions and also in search of possible indicators of climate change. The chapter 14 “*Cedrus deodara* (Roxb.) G. Don a possible indicator of climate change in Eastern Himalaya” concludes that climate change posing a threat to the production and productivity of the cash crops and livestock products in Sikkim. The chapter associates with “Impact of climate change on heterotrophic bacterial communities in the water and sediment of Kongs fjord in Norwegian Arctic” (Chapter 15). It suggests that consistent isolation of mesophilic bacteria from this high arctic fjord may be an indication of increased melting of arctic ice cover. Benthic faunal assemblage diversity and time scale changes in the ice cold Kongs fjorden Arctic ecosystem, is the last chapter of this book (Chapter 16). This is a barbing on the influence of the global climate change impacts in the arctic represented by Kongs fjorden system.

Himalaya is legendary and a unique ecosystem uplifted by the eternal geodynamic phenomena of nature. Climate and Himalaya are dual and are

dialectic. The book “Climate Change and Himalayan Informatics” is an attempt of dedicated researchers who had collected invaluable data from the rugged terrains of Himalaya during hostile weather. This book consists information and data from multidisciplinary aspects of impact of climate change and on mountain ecosystem. Himalayan mountain ecosystem is in the process of rapid urbanization. Information and data to develop multispectral management and decision support system for adaptation and mitigation to this fragile ecosystem are yet to be formulated. Present book is an important initiative for the above. Support from researchers, reviewers and publishers had helped the editors to bring out this book within a short period of time. Editors acknowledge the cover photos from the contributions of Dr. Achuta Nand Shukla & S.K. Srivastava, Botanical Survey of India and Dr. Pankaj Gupta, CSIR- Central Road Research Institute. This book will be highly beneficial to researchers, administrators and students interested in the study of Climate Change and Himalaya.

**J Sundaresan  
Pankaj Gupta  
K.M. Santosh  
Ram Boojh**

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