Addressing climate resilience development pathway : The National Mission for Sustaining the Himalayan Ecosystem

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Scope

- The changing climate signals in Himalayas, what we know, and where issues remain.

- Introduction to the National Mission for Sustaining the Himalayan Ecosystem

The motivation

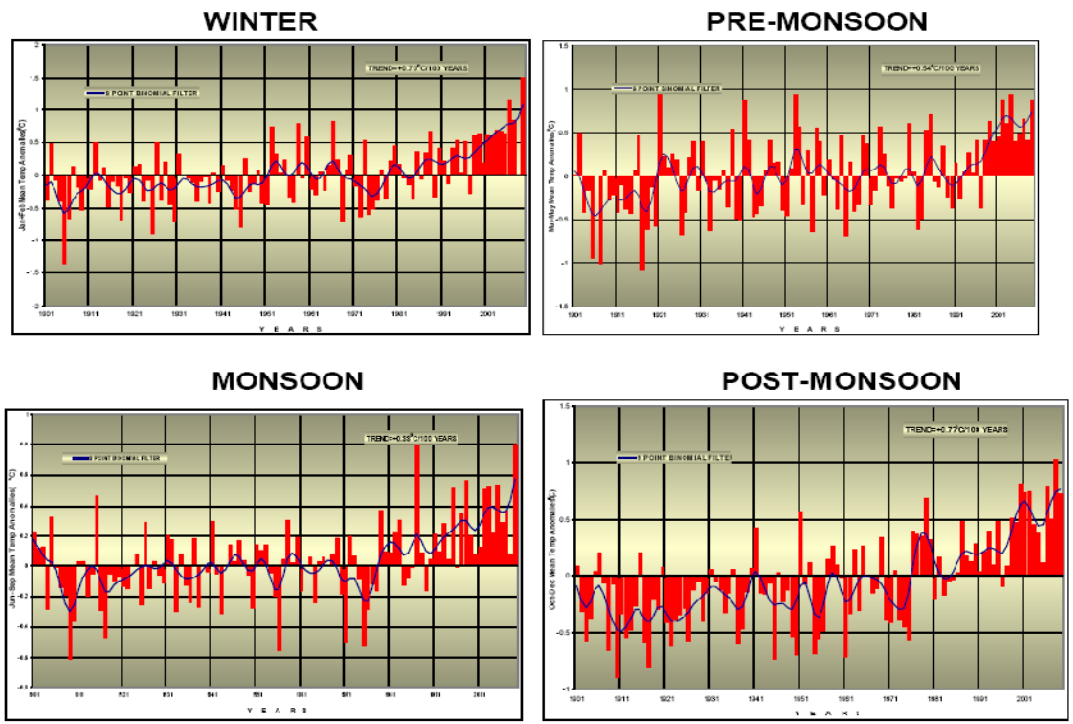


Figure-1: Mean Temperature anomalies in different seasons over India
(Source: India Meteorological Department, http://www.imd.gov.in)

- The mean temperature trends for different seasons viz. winter (Jan to Feb), Pre-monsoon (March to May), monsoon (June to September) and post-monsoon (October to December) season over Indian region are shown in figure-1. Like in many other parts of the northern hemisphere, significant warming trend over Indian landmass is evident from 1980 onwards in all the seasons and the Himalayan region has no-exception to these trends.

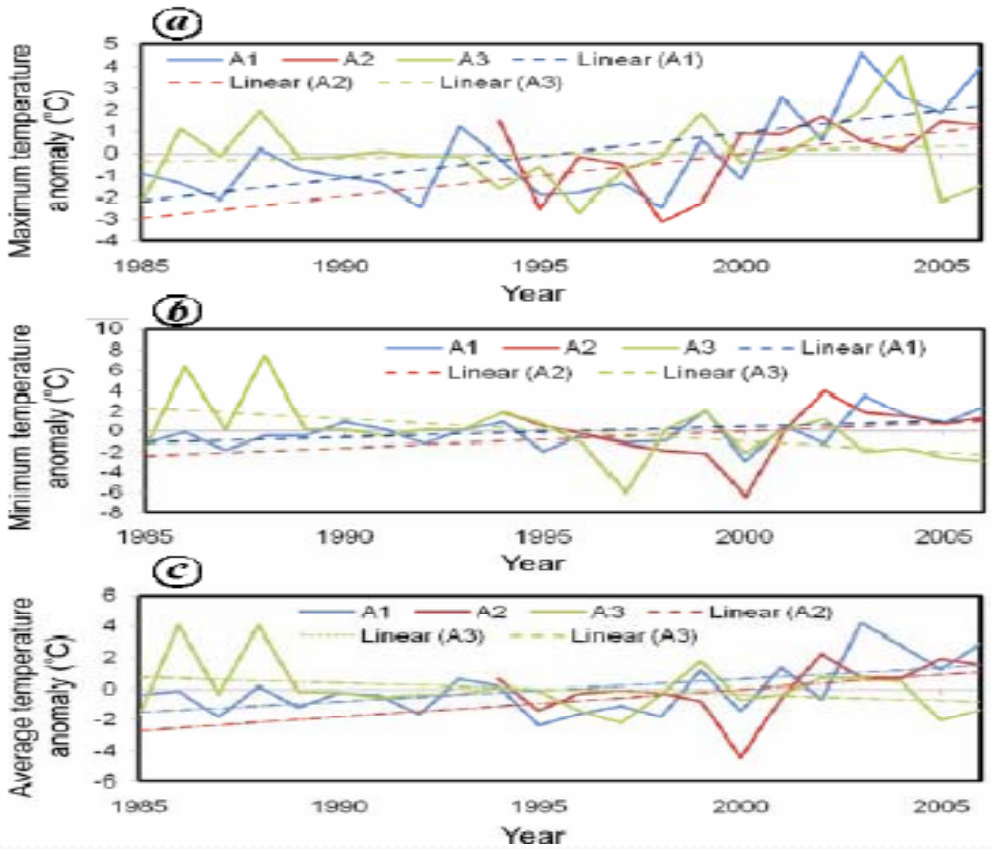


Figure.2. Time series of (a) maximum, (b) minimum and (c) average temperature anamolies at stations situated in ablation (A1), transition (A2) and accumulation (A3) zones of Siachen Glacier, Himalaya during December to February of 1984 to 2006 (Source: Dimri and Dash, 2010)

- The winter time seasonal (December to February) mean temperature anomalies (figure 2) showed increasing trends in the seasonal maximum temperature across the Siachen Glacier (Dimri and Dash, 2010). However, warming is present at ablation zone and cooling is prevalent in accumulation zone of the glacier suggesting considerable variability in the micro-climate of the Karakoram Himalaya.

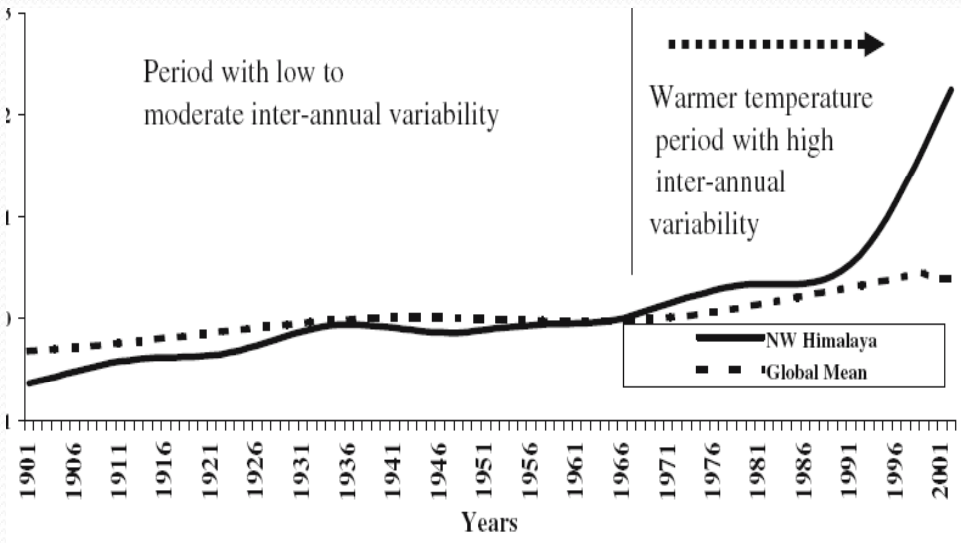
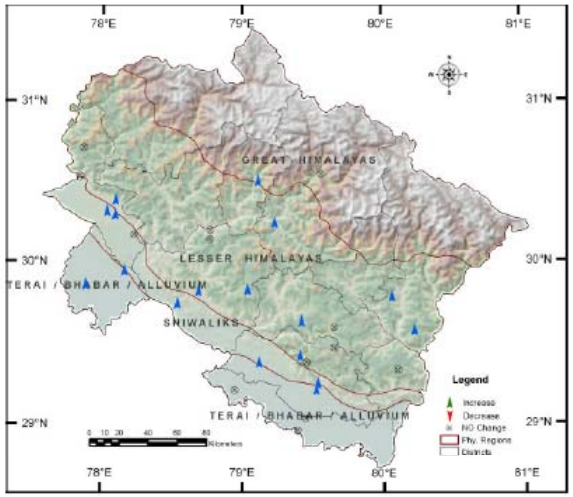


Figure 3. Comparison of temperature trend in NWH with global trends (after Bhutiyani et al., 2007)

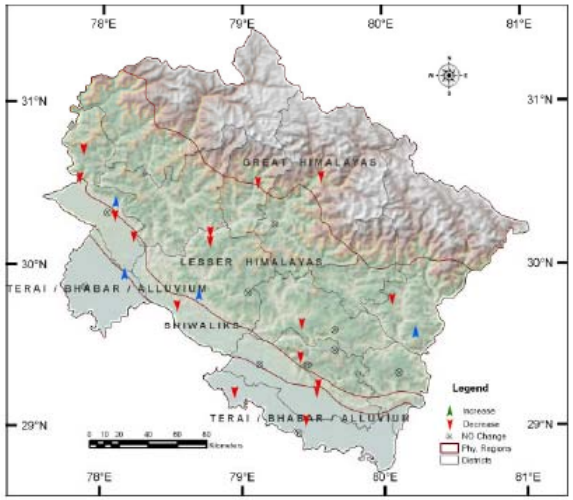
- There is a measure of converging indication from global, regional and sub-continental data that the Indian land mass has been warming at an enhanced rate, particularly during the last three decades with the North West Himalayan (NWH) region showing the highest rise, especially in the winter season (Borgaonkar et al, 1994; Bhutiyani et.al, 2007 and 2009; Kothawale and Rupa Kumar, 2005).

- Warming In the NWH shows a sharp rising trend around mid sixties with acceleration in the last two decades (Fig.1 and 3). There is a rise of about 1.7°C for the entire country in the last century. The gross rise in mean air temperature in NWH in the last two decades is about 2.2°C (Bhutiyani et.al. 2007). The duration of winter has progressively reduced by 5-6 days per decade and approximately by about two weeks in three decades. Consequently, the amount of snowfall in winters has reduced. A larger proportion of winter precipitation now falls as rain instead of snow.

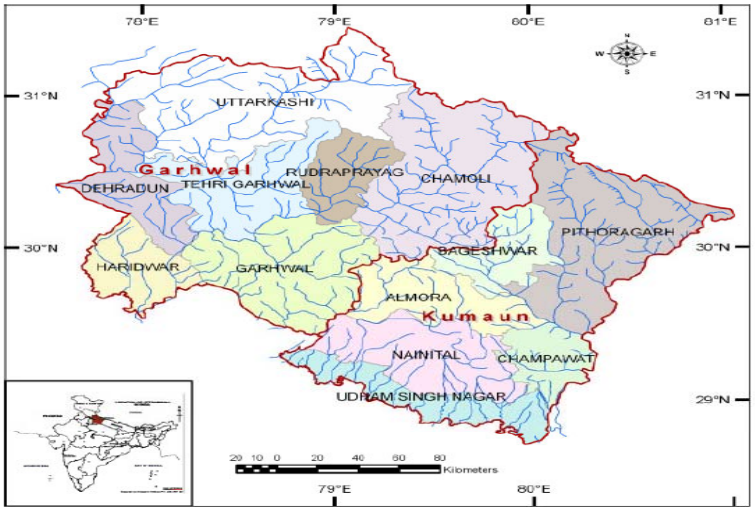
A. BASISTHA *ET AL.*



5. Spatial distribution of monsoon rainfall trend 1902–1964. This figure is available in colour online at www.interscien



6. Spatial distribution of annual rainfall trend 1965–1980. This figure is available in colour online at www.interscienc



A study by Baistha et al. (2009) for the historic data from 1902-1980 indicates a shift in monsoon rainfall trends in the Uttarakhand region of Himalayas around mid-sixties. The decreasing trend after 1964 was exclusive to this region, while th eincreasing trend prior to this was seen all over the nation.

Key Findings of Recent Glacial Studies in the Indian Himalayas

- The studies undertaken from mid 1970s till date have revealed the following interesting findings related to the glaciers in the Indian Himalayas:

- All the glaciers under observation, during the last three decades of 20th century have shown cumulative negative mass balance. Degeneration of the glacier mass has been the highest in Jammu & Kashmir (single glacier, 10 years record), relatively lower in Himachal Pradesh (3 glaciers, 10 years record), even lower in Uttarakhand (one glacier, 10 years record) and the lowest in Sikkim (one glacier,10 years record), thus clearly showing a declining trend from north-west to north-east.

- Irrespective of latitudinal differences, glacier melt contributes to about 25% to 30% of the total discharge of glacier ice. Maximum discharge takes place from mid-July to mid-August.

Key Findings of Recent Glacial Studies in the Indian Himalayas

- An experiment carried out shows that aerosol/ dust cover of 400gm/m2 – a thickness of about 2mm - has the maximum effect as far as melting of glaciers is concerned. This impact is maximum on north facing glaciers in the month of September. Additional thickness of dust up to 4mm does not make any appreciable change in melting. In fact thickness of dust beyond 6mm serves more as an insulator rather than a conductor of solar heat.

- Himalayan glaciers, although shrinking in volume and constantly showing a retreating front, have not in any way exhibited, especially in recent years, an abnormal annual retreat, of the order that some glaciers in Alaska and Greenland are reported

Key Findings of Recent Glacial Studies in the Indian Himalayas

- **Glaciers in the Himalayas, over a period of the last 100 years, behave in contrasting ways.**

  - Sonapani glacier retreated by about 500m during the last one hundred years.

  -Kangriz glacier has practically not retreated even an inch in the same period.

  -Siachen glacier is believed to have shown an advance of about 700m between 1862 and 1909, followed by an equally rapid retreat of around 400m between 1929 and 1958, and hardly any retreat during the last 50 years.

  -Gangotri glacier, which had hitherto been showing a rather rapid retreat, along its glacier front, at an average of around 20m per year till up to 2000 AD, has since slowed down considerably, and between September 2007 and June 2009 is practically at a standstill. The same is true of the Bhagirathkharak and Zemu.

- It is a bit early to make a conclusive statement that glaciers in the Himalayas are retreating abnormally because of the global warming. A glacier is affected by a range of physical features and a complex interplay of climatic factors. It is therefore unlikely that the snout movement of any glacier can be claimed to be a result of periodic climate variation until many centuries of observations become available. While glacier movements are primarily due to climate and snowfall, snout movements appear to be peculiar to each particular glacier.

Other issues

- Studies claim that BC melts Himalayan glaciers.
- The conclusion is subject to further verification owing to the fact that the science of BC at different levels/surface, and its impact on oceans is evolving.
- Observed datasets are sparse - need to be strengthened.
- Modeling constraints.
- Dust is also apparently playing a major role.

The Way forward - Eight National Missions

- *The NAPCC set out eight "National Missions" as the way forward in implementing the Government's strategy and achieving the National Action Plan's objective. The focus of these missions is on "promoting understanding of climate change, adaptation and mitigation, energy efficiency and natural resource conservation."*

- National Solar Mission
- National Mission for Enhanced Energy Efficiency
- National Mission on Sustainable Habitat
- National Water Mission
- ***National Mission for Sustaining the Himalayan Ecosystem***
- *National Mission for a Green India*
- National Mission for Sustainable Agriculture
- National Mission on Strategic Knowledge for Climate Change

National Mission for Sustaining the Himalayan Ecosystem (NMSHE)

- *The overarching objective of the mission is to assess scientifically the vulnerability of the Himalayan ecosystem to short and long term variability in the weather and climate in all its dimensions of physical, biological and socio-cultural aspects, with a view to assist in framing appropriate policy measures and time bound action programmes to sustain its ecological resilience and ensure the continued provision of key ecosystem services*

- The Ministry of Science and Technology has been charged with the nodal responsibility.

- The mission attempts to address some important issues concerning
  -Himalayan Glaciers and the associated hydrological consequences,
  -Biodiversity conservation and protection
  -Wild life conservation and protection
  -Traditional knowledge societies and their livelihood
  -Planning for sustaining of the Himalayan Ecosystem.

- Sustaining the Himalayan eco system as a national mission, will focus on *the rapid generation of four types of national capacities*, They deal with (a) Human and knowledge capacities (b) Institutional capacities, (c) Capacities for evidence based policy building and governance and (d) Continuous self learning for balancing between forces of Nature and actions of mankind.

Primary Objectives

- **To network knowledge institutions engaged in research on Himalayan Ecosystem and develop a coherent data base** on the geological, hydrological, biological and socio cultural dimensions including traditional knowledge systems on preservation and conservation of the ecosystem
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- **To detect & decouple natural and anthropogenic induced signals of global environmental changes in mountain ecosystems and predict future trends on potential impacts of climate change on the Himalayan ecosystem with a sound S&T backup.**
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- **To assess the socio-economic and ecological consequences of global environmental change and design appropriate strategies** for growth in the economy of the mountain regions and the lowland systems dependent on mountain resources in the region.
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- **To study traditional knowledge systems for community participation in adaptation**, **mitigation and coping mechanisms** inclusive of farming and traditional health care systems
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- **To evaluate policy alternatives for regional development plans towards sustainable** tourism **development**, water and other natural resource management for mountain ecosystems in the region.
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- **To create awareness amongst stakeholders in the region for including them** in the design and implementation of the programme.
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- **To develop regional cooperation with neighboring countries**, to generate a strong data base through monitoring and analysis, to eventually create a knowledge base for policy interventions.

Broad Action Pathway

- Building human and institutional capacities in the different existing / new Institutions in the Himalayan region.
- Identify national knowledge institutions and develop a self sustaining knowledge network.
- Develop and adopt new scientific and technological methods for assessing the health of the Himalayan eco system including those of glaciers and create a data base of the same.
- Assess and quantify the changes in the Himalayan eco system attributable to the climate change as a result of global emissions and human activities in the region, and model for future projections
- Assess and explore means of augmentation of the carbon sink potentials of the Himalayan eco system
- To explore linking of traditional and formal knowledge systems through strategic mechanism of formalization for mutual benefit and value for the sustainability of the Himalayan ecosystem
- Identify Desirable Adaptation Policies to Improve Regional Sustainability
- Development of regional cooperation with neighboring countries
- Steering and monitoring of the mission through empowered committees and
- Evolve a periodical reporting system to the National Action Plan on Climate Change and PM's council.

More on the proposed actions

- **Continuous Monitoring of the Ecosystem and Data Generation**

  Data needs for the mission include ecosystem stability, delineation of areas of different land cover / land use, soil erosions, assessment of availability and demand of water and other natural resources, average yields, population growth rate, tourist information and other regional data. The data collected should include also spatial and temporal dimensions.

- **Glaciology Research**

  A National Centre for Himalayan Glaciology is being established by DST and a nodal center has already been initiated. The centre will also support Extra Mural Research on a sustained basis for long term observations on Himalayan Glaciers is being developed A preliminary effort to network knowledge institutions working in the area of Himalayan glaciology has already been made and database development on the ongoing work is being initiated. Multi institutional cooperation and networked R&D programmes in the areas of observational science and technologies for 10 representative Glaciers in the Himalaya have been initiated.

- **Generation of Bio-Geo Database & Ecological Modeling For Himalayas**

More on the proposed actions

- **Prediction of Socio-Economic and Climate Change Scenarios**

  - The present-day ecological and economic impacts of economic and tourism development will be studied in detail. This will provide a baseline set of measurements that can be used to assess societal vulnerabilities to future climate and socio-economic changes.

  -In this Mission three types of scenarios will be specified: climate change, future socio-economic conditions, and adaptation options.

  -An analysis of how land use has been changing for the past 30 years over selected areas in the Himalayan region with respect to policy, population and economic increase and ecosystem condition change with some reasonable projections into the future would provide insights to the impact assessment to socio-economic and climate changes.

  -To handle a variety of data sources containing both spatial and non-spatial data, a geographic information system will be used to serve as a spatially-referenced database for integrated analysis. Various methods will be used to project future tourism development, population increase and economic growth.

  -Any integrated assessment should include studies on economic sectors (tourism, water resources, and agriculture), as well as sensitivities of fragile ecological systems to climate and economic changes in the region. The mission requires an integrative approach.

- **Vulnerability Assessment**

  -Tools of both computer-based and non-model based methods will be used for measuring vulnerabilities to determine how vulnerable these sensitive systems are to climatic perturbations and socio-economic changes.

  -Analyses of the social, economic, and ecological impacts (negative and positive) of alternative economic and climate change scenarios for different economic sectors will be undertaken to fill impact data gaps for key sectors that are sensitive to climate and socioeconomic changes. To improve impact information, expert judgment, and various ecological simulation or statistical models, GIS, will be employed to identify impacts of climate and socioeconomic change scenarios.

More on the proposed actions

- **Identification of desirable Adaptation Policies to Improve Regional Sustainability**

-There is a need to integrate scientific information on impacts, vulnerability, and adaptation in decision making processes, risk management, and sustainable development initiatives.

-There is a challenge in designing a suitable analytical system to relate at least semi-quantitatively sustainability and vulnerabilities of a complex mountain based ecosystem. Multi-criteria options evaluation (MCOE) of adaptation measures should be one of the major components of the proposed Mission. In order to select desirable measures among alternatives**, multi-stakeholder consultation** (MSC) and MCOE will be used to relate impact information to decision making requiring subjective judgment and interpretation.

-**Conservation linked sustainable management of natural resources of the very traditional mountain societies has to be community participatory. Efforts to integrate traditional ecological knowledge (TEK) with modern understanding** to evolve 'hybrid technologies / techniques' for better conservation and maintenance of ecology, economy and sustainable management of natural resources will be on.

More on the proposed actions

- ***Sustainable agriculture and food security***

-There is an urgent need to assess the different varieties of new hybrids of Wheat and other cereals which are resistant to temperature and diseases in the Himalayan region. An inventory of arable land and existing usable water resources is required. There is also a need to record and document the existing base in the Himalayan Ecosystem in terms of

Genetic diversity of crop plant, Genetic diversity of live stock, Genetic diversity of forest species., Acuatic diversity and Soil diversity.

-In addition to the above an awareness campaign for farmers on agro-biodiversity conservation, food security, legal rights and bio resources has to be planned. Further local youth have to be trained to set up seed bank. Integrated pest management and nutrient supply techniques may be adopted by farmers to better achieve agriculture output.

- ***Plantation Systems in the Himalaya***

Introduction of technology to create buffering mechanisms in the soil system for sustainableity

- ***Sustainable forestry***

Text-book based sylvi cultural knowledge has so far been the exclusive basis for forestry practices. However, in recent times, involvement of communities through TEK available in the realm of forest management, through introduction of socially valued species for joint forest management. –socially valued species and ecosystems.

- Sustainable development is constrained by the damage due to the climate change damage.
- The negotiations should take not of this aspect.

Acknowledgements

- Organizers for invitations.
- Dr. K. J Ramesh, MoES, India for discussions

- Material from GOI reports/papers and research literature.