Vulnerability and Risk Assessment due to climate change in the Indian Himalayan Region (IHR)

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Vulnerability

Vulnerability to climate change is the risk of adverse things happening. Vulnerability is a function of three factors:

Exposure

Sensitivity

Adaptive capacity

What is vulnerability assessment?

Endeavor to understand and assess the ***propensity of a system to get adversely impacted***.

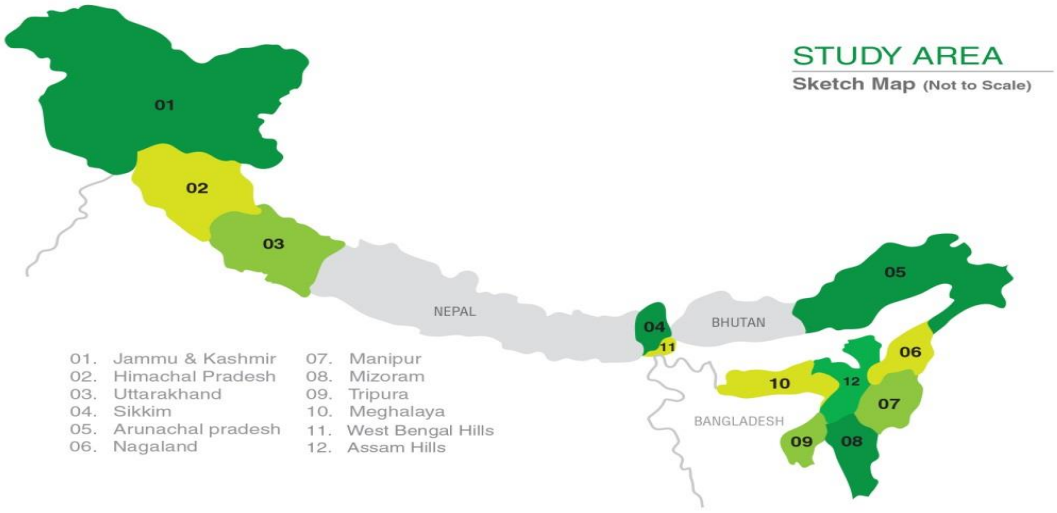
It involves identification and quantification of factors and mechanisms (called *drivers of vulnerability*) that ***compromise the capacity of a system to resist change and remain resilient and adaptable*** and thereby render a system vulnerable.

Why Assess Vulnerability?

1. To rank various blocks, districts, and states according to vulnerability index
2. To prioritize based on vulnerability profile of regions, communities, cropping systems, etc. for adaptation
3. To identify drivers of vulnerability
4. For adaptation planning

Target Groups for Vulnerability Assessment

1. Communities
2. Development agencies (international agencies, NGOs)
3. Policy makers / government departments
4. Researchers and students



Department of Science and Technology, Govt. of India is coordinating and implementing

The National mission for sustaining the Himalayan Ecosystem (NMSHE)

NMSHE engages with the States and intend to contribute in the development of **science backed developmental planning** to minimize risks due to climate change.

Approach

- **To assess Vulnerabilities of the Himalayan ecosystems and socio-economic sectors and associated risks for adaptation planning**
- To make systematic analysis, NMSHE builds capacities of
    - R & D institutions of the Indian Himalayan Region to carry out such assessments
    - States of the Indian Himalayan Region

Proposes a risk assessment based approach for understanding climate vulnerability and climate induced hazards and risks for adaptation planning

Catalysing action in the Himalayan States State Climate Change Cells (NMSHE-SCCC)

- Dept. Of Environment, Ecology and remote Sensing, J&K
- Department of Environment, Science and Technology, HP
- Department of Forests, Uttarakhand
- State Climate Change Cell, Sikkim State Council of Science & Technology, Sikkim
- Mizoram Council of Science, Technology and Environment Planning, Mizoram
- Directorate of Environment, Dept. of Forests and Environment, Manipur
- Dept. of Science, technology and Environment, Government of Tripura
- Meghalaya Basin Development Authority (MBDA), Forest and Environment Department, Meghalaya
- Nagaland Science and Technology Council, Department of Science and Technology, Government of Nagaland
- Department of Science & Technology, Kolkata, West Bengal
- Department of Environment & Forests Arunachal Pradesh

Objectives of State CC Cells

- Vulnerability and risk analysis to important eco-systems in the state and region.
- Institutional Capacity building and R&D for data base/ Information generation as per the requirements of state and national action plan on climate change.
- Training programmes for stakeholders including Government officials, researchers, community based organizations, media, etc.
- Public awareness for community

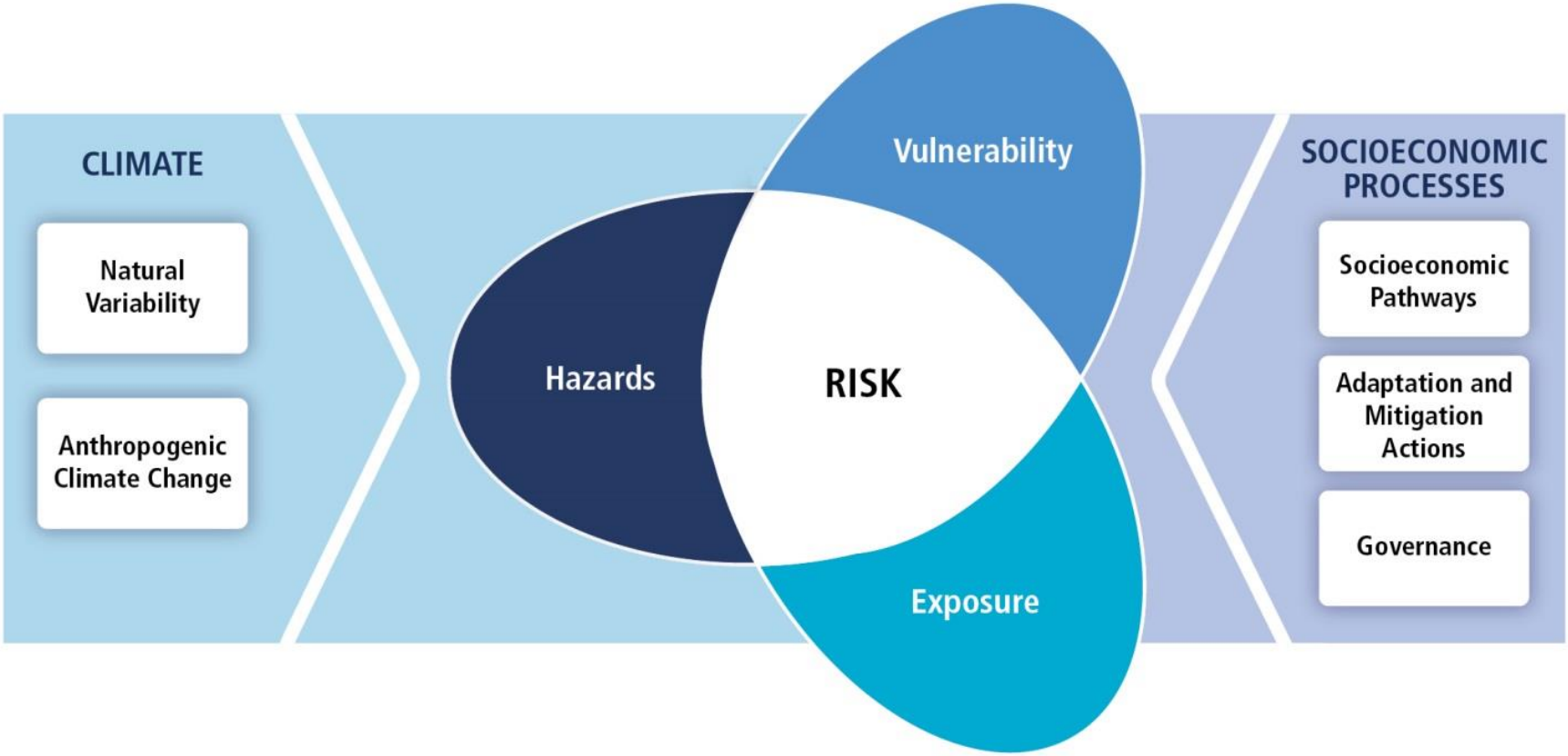
- Effort are on to develop a common vulnerability assessment framework for the IHR and scientific capacity building of the States at district or sub-district level.

- In order to define **priorities** and **formulate management strategies** subject experts from reputed organizations in the country are being engaged to help IHR States.

- State CC Cells : Identify one or two most vulnerable districts to undertake assessment at much finer resolution

VULNERABILITY & RISK FRAMEWORK

Integrated risk framework based on IPCC AR5 2014



Climate related **risk** results from a physical event (**hazard**) intercepting with an **exposed** and **vulnerable** system (eg, community or ecosystem)

This risk assessment based approach was adopted for understanding climate vulnerability and climate induced hazards & risks for adaptation planning in Kullu District of Himachal Pradesh

Indo-Swiss Collaborative Research on **Climate Vulnerability, Hazards and Risk Kullu District (**Overview and Key Findings)

- **Framework** for Integrated Vulnerability and Risks Assessment developed

- **Joint research work** (India and Switzerland) on vulnerability, risks and hazards assessment in Kullu district in partnership with DEST, Government of Himachal Pradesh
  - **40 contributing authors** from 15 Indian and Swiss institutions involved in the study
  - More than **10 studies** on baseline and sectoral assessments undertaken
  - More than **25 publications** in scientific journals , national and international conferences
- Result of joint research in Kullu district; common framework will enable **planning and implementation of adaptation actions** at the state level

Studies in Kullu: Framework Application

	Study		*Swiss partner*	*Indian partner*	*framework component*
1.	**Atmosphere/climate baseline data**				
a)	meteo-based baseline reconstruction		Meteodat	HP SCST&E	climate change
b)	proxy-based reconstruction		UGE	BSIP	climate change
c)	*modelling-based future assessments*		*Meteodat/UFR/UZH*		*climate change*
2.	**Cryosphere baseline data**				
a)	glaciers		UFR	HP SCST&E	climate change
b)	lakes		UGE/UZH	HP SCST&E	climate change
c)	permafrost		UZH/UFR	HP SCST&E	climate change
d)	snow		UZH	HP SCST&E	climate change
3.	**Vulnerability and Hazard and Risk Assessment**				
	Community Perception		Various	GPIHED	all components
Scalar	IHR / State level --> to village level	GLOFs	UZH/UFR	HP SCST&E	hazard and exposure
		Flood potential	UBE	HP SCST&E	hazard
	Village level / local	Extreme flood risk	UBE	BSIP	all components (case studies)
		Snow avalanches (Dhundi)	UBE	BSIP	hazard
Sectoral	Agri-Horticulture		Various	CSK Palampur	vulnerability and exposure
	Forest/Biodiversity		Various	GBPIHED	vulnerability and exposure
	Tourism		Various	Doon Univ.	vulnerability and exposure

Key assessment findings

Atmospheric Baseline

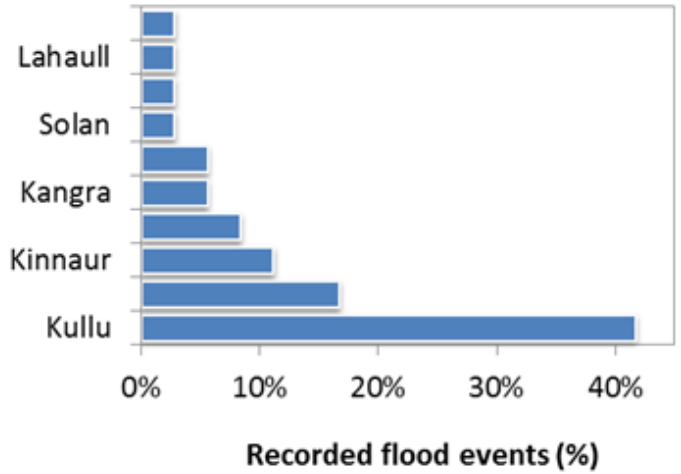
- Local climate assessment (1981 – 2010) demonstrates increase in mean annual air temperatures across all elevation levels
- Increasing trend for spring temperatures of about 1°C over 30 years, stronger at higher elevations

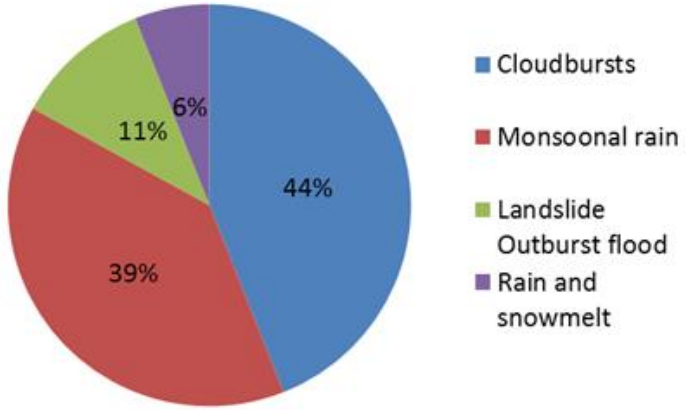
Cryospheric Baseline

- Fragmentation of glaciers observed (a total of 236 glaciers were mapped in 2002 (total area of 529 km^2), whereas the same glaciers when mapped in 2006 have fragmented to become 242 individual glacier entities (total area of 489 km2)
- Assessment from 2002 and 2013 reveals an area loss of about 9 km^2 (~1.5%) and an increase in mean elevation of about 30 m

Key assessment findings

Flood hazards at Kullu district



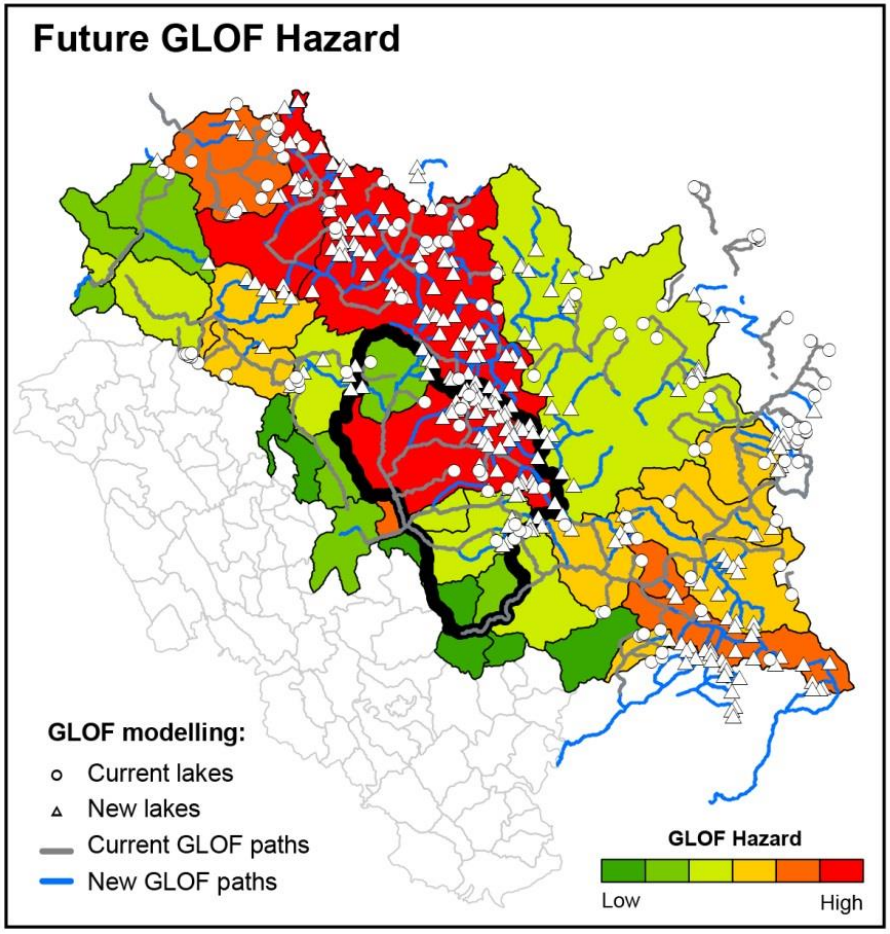


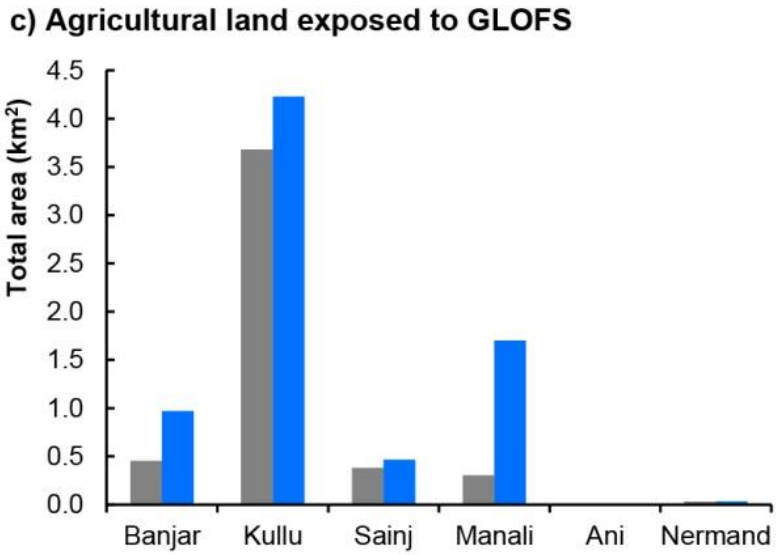
(left) Most affected districts in Himachal Pradesh according to recorded flood events.
(right) Triggers of recorded floods over the time period 1950 to 2014.

Key assessment findings

Glacial lake outburst floods

- The GLOF hazard will increase across all Tehsils, a notable GLOF “hot-spot” will emerge in Kullu - > Parvati valley.
- Increased threat to habitations, roads, and agricultural land.





Key assessment findings

Vulnerability of the agriculture sector

- Perceived climate impacts across the blocks of Kullu included: warmer and prolonged summers, delayed onset and uneven distribution of SW monsoon, shorter and warmer winters, decreasing snowfall during winters.
- Diseases in agriculture/horticulture crops are reaching higher altitudes, where they were not earlier reported.

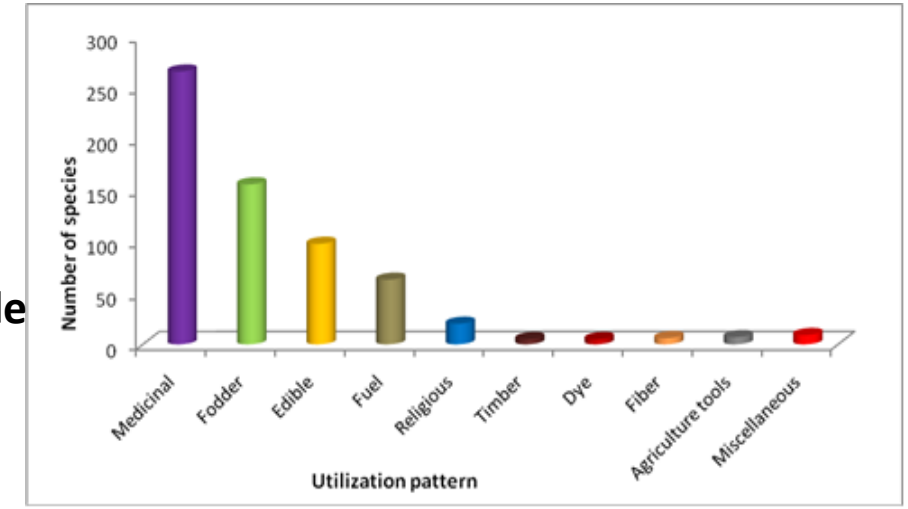
- Some adaptation measures are already occurring, eg, a shift of the fruit belt to higher altitudes, a shift from vegetables like, tomato, cauliflower and cabbage to horticultural 'cash' crops.

- Banjar was identified as a hot-spot of agricultural vulnerability, based on both quantitative assessment and farmers perceptions.

Key assessment findings

Vulnerability of the biodiversity sector

- Forest ecosystems provide wide-ranging economic and cultural services for local people.
- **Floral Biodiversity**: In the Parvati valley, **5 species were classed as Critically Endangered; 11 Endangered, 90 Vulnerable and 188 Near Threatened**. Continued anthropogenic pressures and changing environmental conditions may lead to species extinction in the near future.



- The altitudinal shift in several species, and changing composition and structure of the forest communities has been observed. Particularly sub-alpine and alpine vegetation are considered most sensitive to climate change.

- The forest communities near to habitations were more vulnerable than the communities distant from the habitations due to the dependence of the communities on forests for their sustenance in various ways.

Baseline Scenario and Problem Statement

- Current variety of apple plants has a chilling hours of 1000-1200 hrs.
- The unavailability of chilling hours below 1000 hrs is impacting apple production.
- Agriculture and horticulture practice in the state is mostly rain-fed with lower availability of micro irrigation facility
- Rainfall pattern has become more erratic and intense
- Unavailability of infrastructure for protecting fruit crops against climate extremes (hail net penetration is less than 2%
- Incidence of climate extreme events have increased in the recent past

Proposed Interventions

Promote high density spur variety (**low chilling) apple and pomegranate cultivation** by providing suitable imported plant with chilling hours 600-800 hrs and farmers training.

Provide **anti-hail nets and creation of pollinators colony** across the orchard for reduction of damage of fruits and enhance pollination

Facilitate micro irrigation in the high density orchard through **creation of water source** eg poly lined tanks and bore wells and establish source to tank facilities

PRIORITIZED ADAPTATION OPTIONS

Reducing GLOF Risk in Parvati Valley of Kullu district, Himachal Pradesh

Promoting Climate Resilient Agri-Horticulture in Banjar, Kullu district, Himachal Pradesh

Ecosystem Based Adaptation in the Great Himalayan National Park, Kullu district, Himachal Pradesh

Adaptation Project	Project Implementing Agency
Reducing GLOF Risk in Parvati Valley of Kullu District, Himachal Pradesh	State Council for Science, Technology and Environment
Promoting Climate Resilient Agri-Horticulture in Banjar, Kullu District, HP	Directorate of Horticulture
Ecosystem Based Adaptation in the Great Himalayan National Park, Kullu District, HP	Directorate, GHNP

Summary

- The state climate change cell has been set in 11 states out of 12 states in IHR to build S&T capacity in climate change science and adaptation areas.
- Efforts are being made to build institutional capacity in their states by connecting them with national /state level R&D/ academic institutions.
- DST has undertaken the task of developing Pan- Himalaya vulnerability and risk assessment under NHSHE. Plans are put together to create a seamless sub-distt level vulnerability and risk assessment atlas for the entire Indian Himalayan Region.


THANKS