Dr. Nisha Mendiratta
Advisor & Head,
Climate Change Program (CCP) & WISE-KIRAN,
Department of Science & Technology (DST),
Government of India, New Delhi
Ecosystem-based **adaptation** can reduce climate risks that many people already face — droughts, extreme heat, floods and fires — while also delivering co-benefits for biodiversity, livelihoods, health, **food security** and carbon sequestration.
Institutional Framework for Climate change in India

PMO Council in India
NAPCC

UNFCCC
National Coastal Mission (Draft is awaited) & Sustainable Transport (Mission doc. is awaited)

MoEF&CC

SECTORAL MINISTRIES

MoEF&CC  MNRE  MoP

MUD  MoA  MoWR  DST

NSM  NMEEE  NMSH  NMSA  NWM  NMSKC  NMSHE

Departments of Environment and Science and Technology in the States and Union Territories

Research Institutions

Bilateral Agencies and International organisations

SAPCC

Donor and international organisations

Donor and international organisations

MOEF  Ministry of Environment, Forest and Climate Change
MF  Ministry of Finance
MEA  Ministry of External Affairs
MoP  Ministry of Power
MNRE  Ministry of New and Renewable Energy
MUD  Ministry of Urban Development
MoA  Ministry of Agriculture
MoWR  Ministry of Water Resources
MST  Ministry of Science and Technology

NSM  National Solar Mission
NMEEE  National Mission on Enhanced Energy Efficiency
NMSH  National Mission on Sustainable Habitat
NMSA  National Mission on Sustainable Agriculture
NWM  National Water Mission
NMSKC  National Mission on Strategic knowledge for Climate Change
NMSHE  National Mission on Sustaining the Himalayan Ecosystem
NMGI  National Mission for a Green India
CCAP  Climate Change Action Programme
NAPCC  National Action Plan on Climate Change
SAPCC  State Action Plan on Climate Change
CCFU  Climate Change Finance Unit
EPLCSIG  Executive Panel on Low Carbon Strategy for Inclusive Growth

NMHS  National Mission on Himalayan Studies
8 Major National Missions of GoI Under NAPCC

By DST, GoI

1- NMSHE

- Building national S&T capacities in the area of climate change

2- NMSKCC

- Research & Adaptation to Climate change
Geospatial technique under NMSHE/NMSKCC are used for:

- Database Creation
- Vulnerability Assessment
- Modelling and Simulation
- Adaptation planning
  - Glaciers
  - Agriculture
  - Biodiversity
  - Wildlife
  - Disaster Management
  - Coastal Region
  - Climate & Health
Glacial Lakes of Sikkim Himalaya

- Snow cover area assessment using MODIS data showed **decrease in snow cover** for the period 2000 to 2020.

- **14 glacier lakes** were categorized as potentially **high risk** in Changme Khangpu basin.

- Updated **glacial lake inventory** for Sikkim Himalayas and 738 lakes were mapped for the year 2020.

- Identification of glacial **lakes prone to Glacial Lake Outburst Floods (GLOF)** in Changme Khangpu Basin in North Sikkim.

Maps showing (a) topographic variation, (b) monthly minimum snow-cover area, and (c) monthly maximum snow-cover area of Sikkim Himalaya.

Source: Sikkim University (CoE)
Glacial Lake Inventory of Uttarakhand

<table>
<thead>
<tr>
<th>Main type</th>
<th>Sub type</th>
<th>Total number</th>
<th>%</th>
<th>Total area (m²)</th>
<th>%</th>
<th>Mean area (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moraine-dammed lake</td>
<td>End moraine-dammed lake</td>
<td>44</td>
<td>3.5</td>
<td>1596367</td>
<td>21.0</td>
<td>36281</td>
</tr>
<tr>
<td></td>
<td>Lateral moraine-dammed lake</td>
<td>67</td>
<td>5.3</td>
<td>652054</td>
<td>8.6</td>
<td>9732</td>
</tr>
<tr>
<td></td>
<td>Recessional moraine-dammed lake</td>
<td>214</td>
<td>16.9</td>
<td>1589375</td>
<td>20.9</td>
<td>7427</td>
</tr>
<tr>
<td></td>
<td>Other moraine-dammed lake</td>
<td>4</td>
<td>0.3</td>
<td>98143</td>
<td>1.3</td>
<td>24536</td>
</tr>
<tr>
<td>Ice-dammed lake</td>
<td>Supra-glacial lake</td>
<td>809</td>
<td>63.9</td>
<td>2000524</td>
<td>26.3</td>
<td>2473</td>
</tr>
<tr>
<td>Glacier erosion lake</td>
<td>Cirque lake</td>
<td>48</td>
<td>3.8</td>
<td>1174222</td>
<td>15.5</td>
<td>24463</td>
</tr>
<tr>
<td></td>
<td>Other glacial erosion lake</td>
<td>77</td>
<td>6.1</td>
<td>466491</td>
<td>6.1</td>
<td>6058</td>
</tr>
<tr>
<td>Other glacial lake</td>
<td>Other glacial lake</td>
<td>3</td>
<td>0.2</td>
<td>17695</td>
<td>0.2</td>
<td>5898</td>
</tr>
</tbody>
</table>

Total                                    1266       7594871

Spatio-temporal area change (shrinkage) of the Satopanth Lake (2005-2017)

HNB Garhwal University, Srinagar, India
Maize crop Suitability
Enabling Crop Planning

Projecting suitability of growing maize crop in IHR (4 RCPs of the year 2030, 2050 and 2080) was done in 12 states.

Gain = 2.3 to 3.8%
No change = 62.2 to 76.7%
Loss = 20.9 to 36.1%

Source: ICAR
Agricultural risk map: Cartographic products at National-scale

- A novel unified country-level framework to quantify and map the decadal agricultural vulnerability and risks for entire India derived from multiple hydro-meteorological exposures and adaptive consequences
- developed using only the observed datasets procured from publicly available government data portals, such as CoI, IMD, CGWB, etc., and synthetically generated or simulated datasets were deliberately avoided
- Will benefit existing initiatives by the Government of India (GoI)
- Can provide invaluable information pertaining to agriculturally vulnerable hotspots to implement evidence-based coordinated actions
- Risk Classifier with choropleth as an open tool

Source: IIT, Bombay

Sharma et al. (2020), ERL
Climate change Impacts and adaptation gains

Under RCP (2.6, 4.5, 6.0, 8.5 RCPs) in 2020, 2050 and 2080 scenarios

Without adaptation, climate change is projected to affect all India productivity of

- Kharif irrigated maize (-9 to -27%)
- Mustard (-9 to -29%)
- Potato (-2 to -25%)

However, crops such as

- Kharif sorghum
- Pearl millet (-2 to +3%)
- Soybean (+2 to +11%)
- Kharif ground nut (up to +17%)
- Chick pea (-2.5 to +12%)
- Pigeon pea (up to +37%)
- And cotton are projected to have marginal mixed impacts

All these impacts are projected to have significant spatio-temporal and inter-annual variations

Low-cost adaptation strategies such as change in sowing time, variety, FYM, and irrigation and nitrogen management can improve the yield up to 40% in many parts

Naresh Kumar et al., 2022 comm
Status of Ecosystem Health in Bhagirathi Basin (4 x 4 km grids)

- Landscape level new knowledge about health status and biodiversity
- Long term monitoring of identified grids for periodic ecological health assessment and climate impact on long term basis
- Target areas for better climate-wildlife related management and planning

**Species richness (%) in total and for different taxonomic groups in different eco-climatic zones of Bhagirathi Basin**

**Overall status of biodiversity and habitat (%) of Bhagirathi Basin, and long term monitoring grids**

Source: GBPIHED
Novel information generated on taxa-specific species distribution, habitat and ecosystem health status of wildlife in the IHR

- The database generated would be updated temporally
- The information is currently being used to develop species distribution models

Overall ecosystem health status in different 16x16 km grids of Indian Himalayan Region (the pink line is denoting Line of Control and Line of Actual Control, grids beyond this line are not considered for analysis)

Source: WII, Dehradun
Inventory of landslide for Uttarakhand and Himachal Pradesh

<table>
<thead>
<tr>
<th>Tectonic Division</th>
<th>No. of landslides</th>
<th>UK</th>
<th>HP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Siwaliks</td>
<td>56</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Lesser Himalaya</td>
<td>2173</td>
<td>283</td>
<td></td>
</tr>
<tr>
<td>Higher Himalaya</td>
<td>976</td>
<td>232</td>
<td></td>
</tr>
<tr>
<td>Tethyan Himalaya</td>
<td>98</td>
<td>299</td>
<td></td>
</tr>
</tbody>
</table>

Source: WIHG, Dehradun
Coastal Risk Maps: Cartographic products at National-scale

Coastal Risk Maps (following AR5 framework)

The developed coastal risk index (aggregating hazard, vulnerability and exposure following IPCC AR5) will lead to identification of factors which influences the risk and vulnerability of the coastal districts of India.

Malakar et al. (2021), JEM
Strategic Knowledge
- Cartographic products for 76 coastal districts of India
- Most districts of the eastern coast have higher risk indices (hazard-driven) compared to those in the west, and the risk has increased since 2001
- Python-3 based open tool PyTOPS for multi-attribute decision making (implementing TOPSIS) was developed for comprehensive indicator-based vulnerability analysis.

Source: IIT, Bombay
Present and Future Distribution of Dengue Vectors

Expansion of range of *Ae. aegypti* in the arid regions of Rajasthan

Expansion of range of *Ae. albopictus* in colder regions of the Himalayas

Temp. based factors contribute to *Ae. Aegypti* prevalence, whereas precipitation related factors contribute to prevalence of *Ae. albopictus*.

Results Published in: Hussain SSA, Dhiman RC (2021) - GeoHealth

<table>
<thead>
<tr>
<th>Variable</th>
<th><em>Ae. aegypti</em></th>
<th><em>Ae. Albopictus</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Coeff.</td>
<td>0.94</td>
<td>0.95</td>
</tr>
<tr>
<td>Sd</td>
<td>0.01</td>
<td>0.04</td>
</tr>
<tr>
<td>AUC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TSS</td>
<td>0.77</td>
<td>0.84</td>
</tr>
<tr>
<td>Jaccard</td>
<td>0.80</td>
<td>0.85</td>
</tr>
<tr>
<td>Sorensen</td>
<td>0.89</td>
<td>0.92</td>
</tr>
</tbody>
</table>

NIMR, Delhi
District-Level Vulnerability Assessment for 690 districts in the country

- All the districts are vulnerable
- 100 most vulnerable districts in India are in the states (13) of Assam, Bihar, Jharkhand, Odisha, Madhya Pradesh, Maharashtra, West Bengal, Jammu and Kashmir, Tamil Nadu, Mizoram, Manipur, Haryana, Telangana
- Nearly 90% districts in Assam, 80% in Bihar, and 60% in Jharkhand are highly vulnerable
Priority Areas Identified for Next 5 Years of DST’s CCP

◆ **Urban Climate**
  ✧ Expanded National network Programme on Urban Climate
  ✧ A CoE on Urban climate

◆ **Climate Modeling**
  ✧ Community Earth System Modeling Network

◆ **Extreme Events**
  ✧ A National Network Programme on CC & Extremes events
  ✧ A CoE on floods/water resource studies
  ✧ A CoE on CC Impact on Monsoon

◆ **Himalayan Studies**
  ✧ HICAB for IHR (6-8 CoEs, 20 MRDPs, 13 State Networks)

◆ **Glaciology**
  ✧ National Initiatives on Glaciology Research and Training
Thanks !!

Email: nisha67@nic.in