

Climate Change Research in India

Retrospect and Prospect

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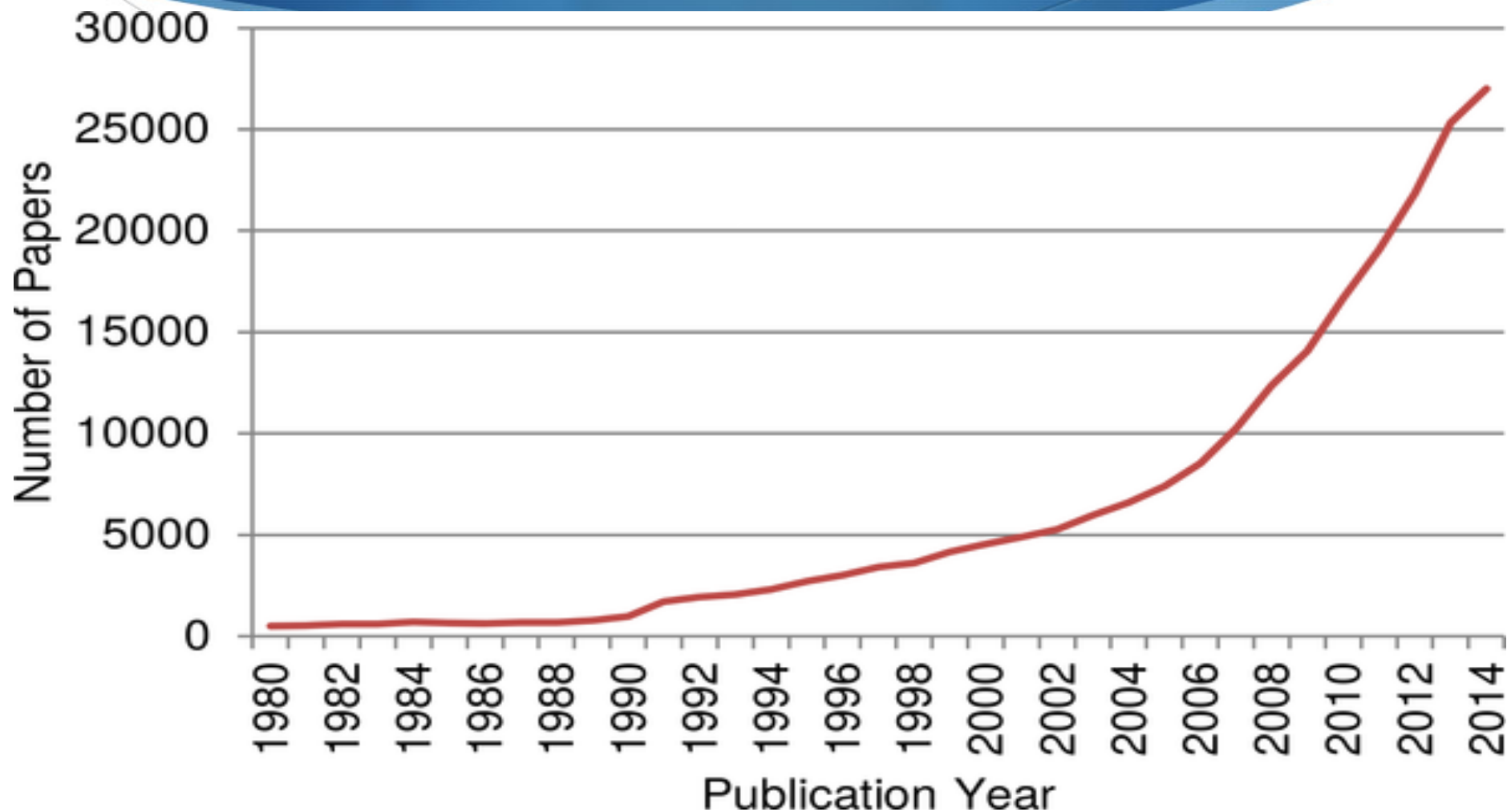
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Global Trend and India's Climate Research Initiatives



Global Trend of Climate Change Relevant Papers (1980-2014)



India's Strength and Weaknesses in Climate Research Areas

Strength

- ◆ Exponential Rise in number of Research institutions in past decade
- ◆ Over 3000 Scientists/Research faculty
- ◆ More than 2500 research students
- ◆ Nearly 400 scientists with International recognition
- ◆ 450 Institutions teaching/doing Research
- ◆ 100 years of systematic Climate Data

Weaknesses

- ◆ Poor Inter-institutional collaboration
- ◆ Near absence of inter-university Collaboration
- ◆ Inadequate linkages between Science & Policy and Science & Society
- ◆ Weak partnership between Public and Private

Chronology of India's Initiatives in CC Research

IPCC Report	India's Key Initiatives in CC Research
1990- FAR	<ul style="list-style-type: none"> ◆ Monsoon Trough Boundary Layer Exp. (MONTBLEX)- 1990 ◆ India's Methane campaign,1991
1996- SAR	<ul style="list-style-type: none"> ◆ Indian Climate Research Programme (ICRP),1997 ◆ LAnd Surface Processes EXperiment (LASPEX) – 1997 ◆ Indian Ocean Experiment (INDOEX),1999 ◆ Bay of Bengal Monsoon Experiment (BOBMEX)-1999
2001-TAR	<ul style="list-style-type: none"> ◆ Arabian Sea Monsoon Experiment (ARMEX),2001 ◆ Experiment on Monsoon variability under TOGA-I, 2002 ◆ International Centre for CC Research initiated, 2002
2007-AR4	<ul style="list-style-type: none"> ◆ National Action Plan on CC launched- 2008 ◆ State Action Plans on CC initiated -2009 ◆ 8 National Missions on CC Initiated-2009 ◆ A Centre for CC Research set up at IITM, Pune, 2010 ◆ DST set up 4 Centres of Excellence at IISc; IIT-B, IIT-M and ICRISAT; 12 Major R&D Prog; 2 Network progs (2011-13) ◆ 6 Task Forces and 11 State CC Centres, 2013-15
2014- AR5	<ul style="list-style-type: none"> ◆ 2014-18: 7 Centres of Excellence at IIT-D, BHU, IIT-KGP, NIMR, IITB, IITM, ICRISAT; 11 MRDPs; 4 Network Programmes, 11 State CC Centres

Climate Change Programme of DST



Eight National Missions under NAPCC

- ◆ **National Solar Mission**
- ◆ **National Mission for Enhanced Energy Efficiency**
- ◆ **National Mission on Sustainable Habitat**
- ◆ **National Water Mission**
- ◆ **National Mission for Sustaining the Himalayan Eco-system (NMSHE)**
- ◆ **National Mission for a Green India**
- ◆ **National Mission for Sustainable Agriculture**
- ◆ **National Mission on Strategic Knowledge for Climate Change (NMSKCC)**

Both NMSHE and NMSKCC coordinated by DST were launched with broad objectives of building S&T Capacity for sustenance of Himalayan ecosystem and for developing strategic knowledge system

Approach Adopted by DST's Climate Change Programme

- ◆ **Objective mapping** of institutions and scientists for support– Scopus data
- ◆ Project outcomes must meet Mission objectives and deliverables
- ◆ **Programme rather than project approach**
- ◆ A mix of top down and bottom up approach towards project formulation – **Co-development of project proposals with investigators**
- ◆ **Linkages with Society and Policy** to be built at the proposal stage itself
- ◆ **Preference to younger scientists** as PIs who should have 15-20 years of active research life
- ◆ Build a **pool of experts** in CC research who could guide CCP
- ◆ Create a **network of investigators and students and nurture them on long term**
- ◆ **Optimize quantum of funding** – neither too less not too much

Climate Change Programme of DST

Major Programmes/Projects Launched under CC missions (NMSKCC and NMSHE)

NMSKCC

- ◆ 11 Centres of Excellence
- ◆ 23 Major R&D Programmes
- ◆ 11 State Climate Change Centres
- ◆ 7 National Network Programmes
- ◆ 7 Human Capacity Building Programmes
- ◆ 8 Global Technology Watch Groups (GTWGs)
- ◆ Indo-US Fulbright-Kalam Fellowships in Climate Change
- ◆ Indo-German Research Collaboration

NMSHE

- ◆ A Centre of Glaciology at Wadia Institute of Himalayan Geology, Dehradun
- ◆ 6 Thematic Task Forces anchored around 6 lead institutions
- ◆ State CC Centres in 11 out of 12 Himalayan States
- ◆ Inter-University Consortium of 4 universities
- ◆ Indo-Swiss Capacity Building Programme in glaciology and related areas

DST's Centres of Excellence

Sno	Institution	Thematic Area of study
1	IIT Bombay	Climate modeling, adaptation
2	IIT Madras	Peri-urban floods, waste management
3	ICRISAT, Hyderabad	CC and Plant protection
4	IISc, Bangalore	Cryospheric sciences, Climate modeling
5	IIT Delhi	India centric Climate Model development
6	IIT Kharagpur	Coastal vulnerability, mitigation
7	BHU, Varanasi	Modeling, adaptation-agri. and health
8	NIMR, Delhi	CC and vector borne diseases
9	IIT Bombay (2 nd Phase)	Urban Flood, modeling, Agri adaptation
10	IIT Madras (2 nd Phase)	CC impact on Coastal Infrastructure
11	ICRISAT (2 nd Phase)	CC and Plant Protection

Major R&D Programmes

SNo	Institution/Theme	SNo	Institution/Theme
1	NIO (Sea Level Rise)	13	IIT Bhubaneswar (CC adaptation)
2	NBRI (Forest Ecosystem)	14	Andhra Univ (Regional Climate Modeling)
3	DU (CC Adaptation and Resource Management)	15	CUSAT (Regional Climate Modeling)
4	IARI (CC and Agriculture)	16	ISSER, Pune (Paleoclimate)
5	NIO (Ocean acidification)	17	ISSER, Mohali (Air quality)
6	IIT, Delhi (Regional Climate Modeling)	18	IIT Guwahati (Adaptation for IHR)
7	BSIP (Quaternary CC for Glaciers)	19	IISc, Bangalore (Geoengineering)
8	IRMA (Sustainable Livelihoods)	20	NBRI (Forest ecosystem)
9	TNAU (CC Adaptation in Agri.)	21	IARI (Agri adaptation, crop modeling)
10	IIT Delhi (Storm Surges)	22	TNAU (Agri adaptation, crop modeling)
11	IRADE (Adaptation in HP)	23	CRRI (CC and rice production)
12	University of Allahabad (Extreme Rainfall Studies)		

National Network Programmes

Sno	Theme of Network Programme	Number of Projects
1	Climate Modeling	6
2	CC and Human Health	9
3	CC and Coastal Vulnerability	10
4	Climate Modeling (2nd Phase)	13
5	CC and Human Health (2nd Phase)	20
6	CC and Aerosols	8
7	Urban Climate	5

Institutions Anchoring Human Capacity Building Programmes

- 1) Administrative Staff College of India (ASCI), Hyderabad
- 2) Indian Institute of Public Administration (IIPA), New Delhi
- 3) Tata Institute of Social Sciences (TISS), Mumbai
- 4) Indian Institute of Forest Management (IIFM), Bhopal (2 projects)
- 5) Ashoka Trust for Research in Ecology and the Environment (ATREE) Bangalore
- 6) Visvesvaraya National Institute of Technology (VNIT), Nagpur

Global Technology Watch Groups (GTWGs)

- ◆ GTWGs set up for technology assessment, evaluation, prioritization, risk assessment and foresight in the areas of climate change adaptation and mitigation.
- ◆ As part of International negotiations for climate change, there was a need to come up with the country specific Technology Need Assessments (TNAs)

Global Technology Watch Groups (GTWGs)

SNo	GTWG sector	Lead Institution
1.	Renewable Energy Technology	NIAS, Bangalore
2	Advanced Coal Technology	IIT Madras
3	Water Resources	TIFAC, Delhi
4	Sustainable Agriculture	
5	Sustainable habitat	
6	Energy Efficiency	
7	Green Forest	
8	Manufacturing	

Fulbright-Kalam Fellowships in Climate Change

- ◆ In a September 2014 Joint Statement, the President of the United States of America and the Prime Minister of India launched a new U.S.-India Climate Fellowship Program to build long-term capacity to address climate change related issues in both countries.
- ◆ In pursuance of this statement, the **Fulbright-Kalam Climate Doctoral and Post-doctoral Fellowship** programme was launched.
- ◆ The selection process for first batch of 6 candidates was completed last year. The selection process for second batch of candidates for the year 2018-19 is completed.

6 Thematic Task Forces for the Indian Himalayan Region

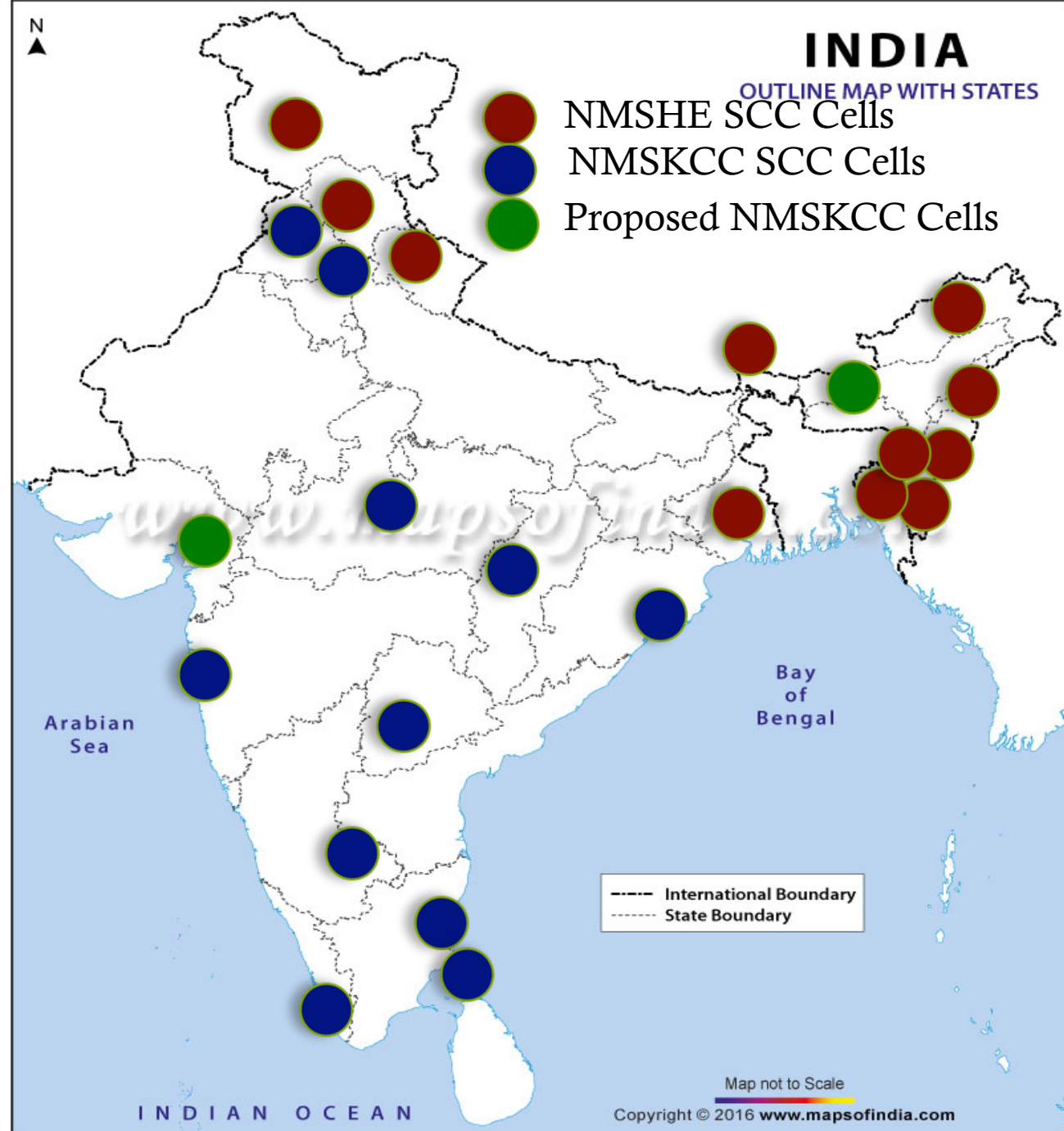
Task Force	Nodal institution
Natural and geological wealth	Wadia Institute of Himalayan Geology (WIHG)
Water, ice, snow resources including glaciers	National Institute of Hydrology (NIH)
Forest resources and plant bio diversity	GB Pant Institute of Himalayan Environment & development (GBPIHED)
Micro flora and fauna and wild life & animal population	Wild Life Institute of India (WII)
Traditional Knowledge Systems	Jawaharlal Nehru University (JNU)
Himalayan agriculture	Indian Council of Agricultural Research (ICAR)

State CC Centres

in Himalayan and Non-Himalayan States

Himalayan States		Non-Himalayan States	
1	J&K	1	Madhya Pradesh
2	Himachal Pradesh	2	Punjab
3	Manipur	3	Chattisgarh
4	Mizoram	4	Karnataka
5	Meghalaya	5	Kerala
6	Tripura	6	Puducherry
7	Sikkim	7	Tamilnadu
8	Uttarakahand	8	Telanagana
9	Nagaland	9	Orissa
10	West Bengal	10	Maharashtra
11	Arunachal Pradesh	11	Haryana

Locations of State CC Cells under NMSHE and NMSKCC

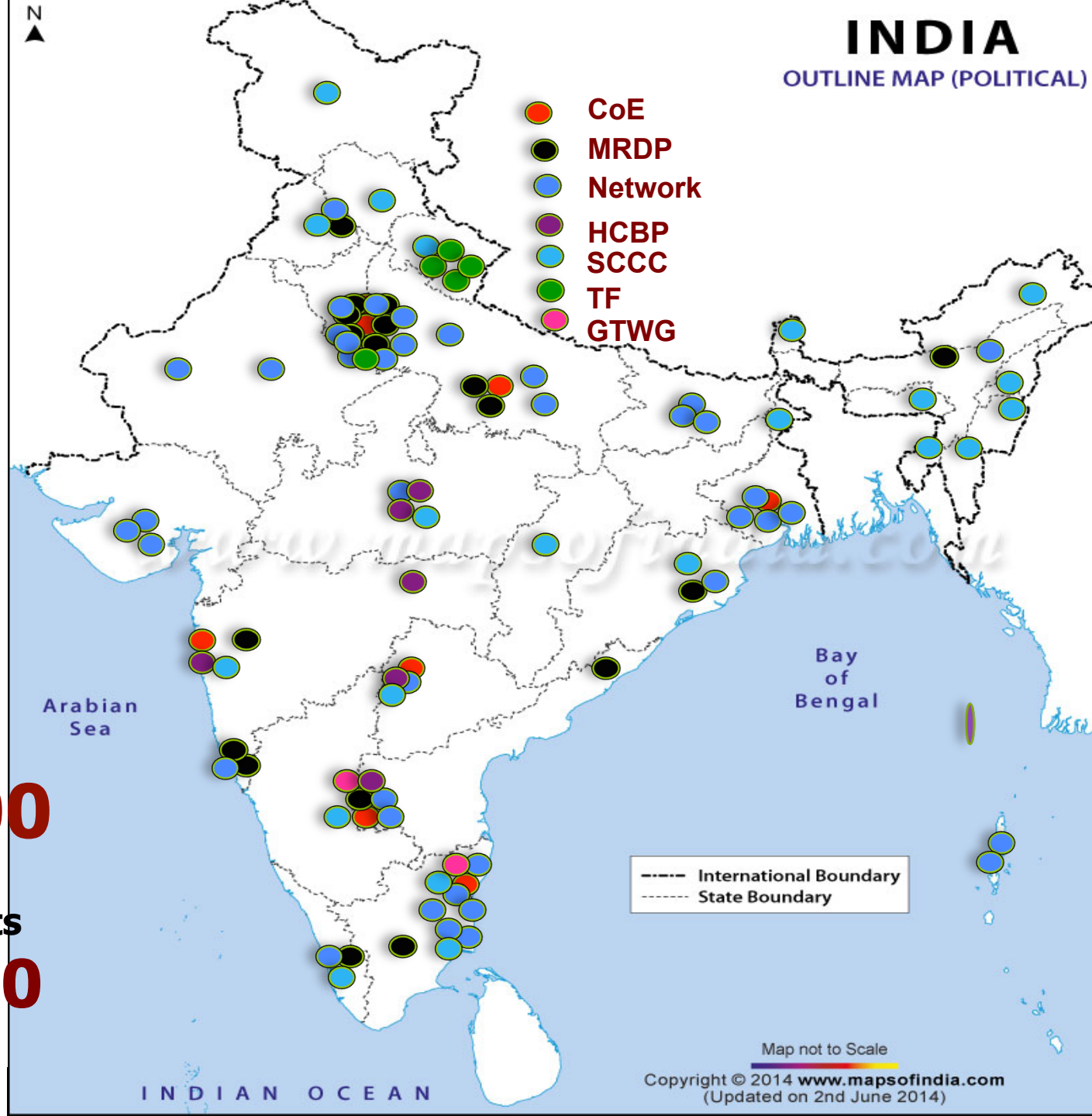


Locations of DST-CCP Programmes

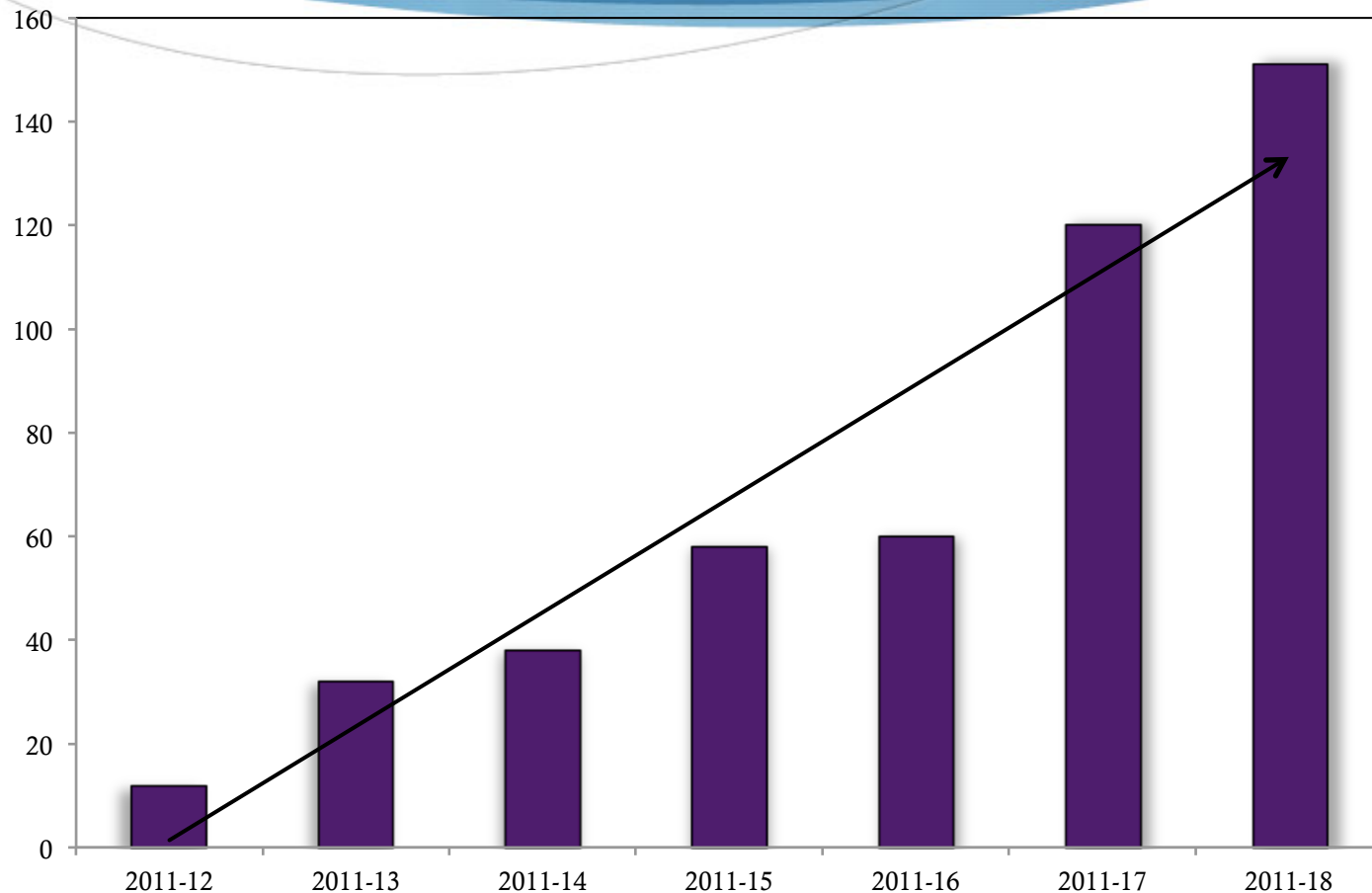
Total No of
programmes/
Projects: **>160**

Total no of
Institutions: **>300**

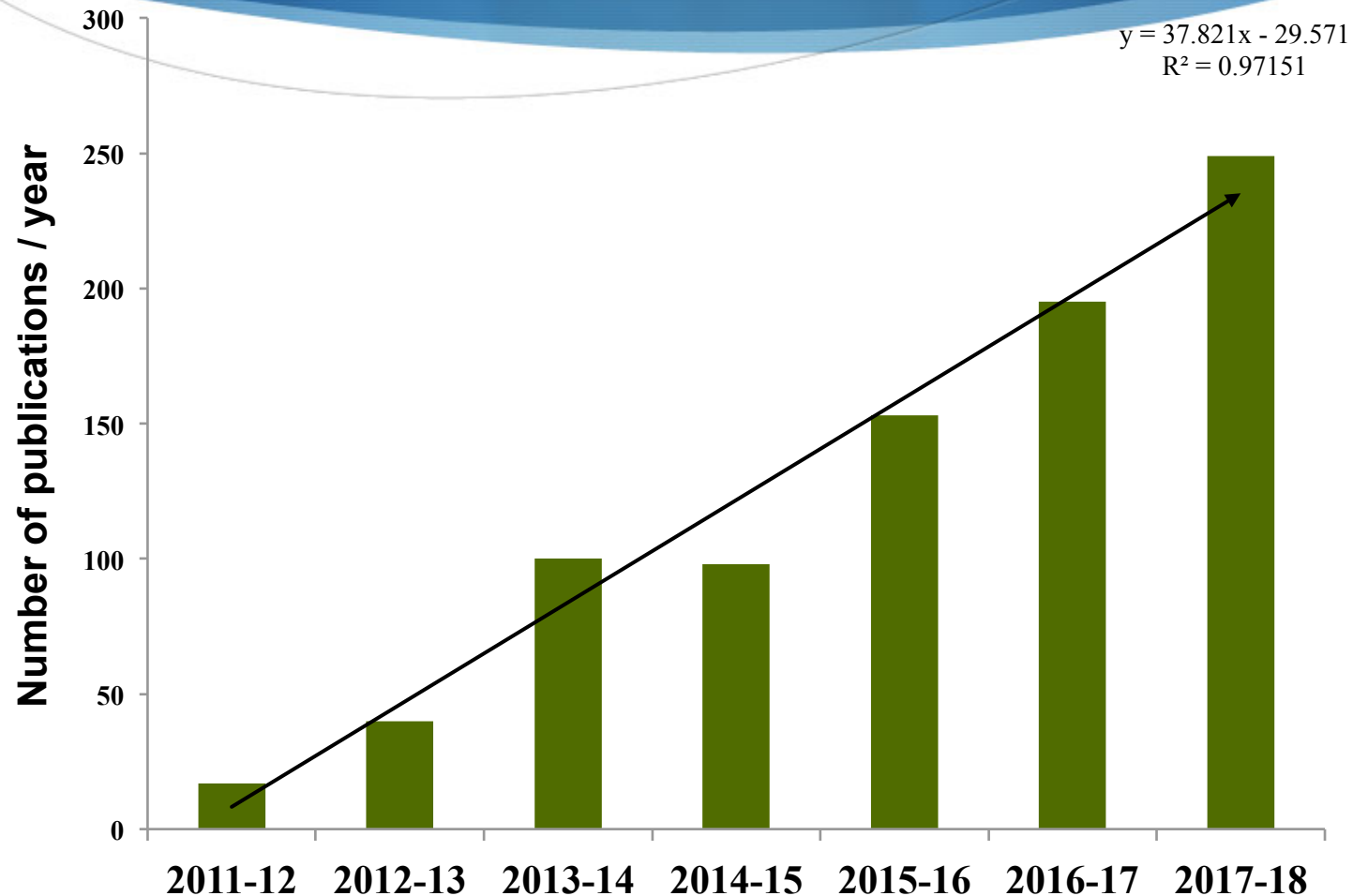
Total no of Scientists
/students: **>1200**



Cumulative Number of projects sanctioned under Climate Change Programme during 2011-18



Number of publications from the projects sanctioned under Climate Change Programme during 2011-18



Quantitative Outcome of CCP during past 6 years (2012-18)

- ◆ ~950 research papers – >450 in inter. Journals
- ◆ ~1100 cumulative IF
- ◆ 70 new techniques developed
- ◆ ~450 students enrolled -250 PhD students
- ◆ ~150 project personnel recruited
- ◆ >250 workshops - 8000 participated
- ◆ >250 State level training programmes organised–
50,000 trained
- ◆ Supported over 40 national events - 2000 participants attended
- ◆ 1.5 Lakh people given exposure under Public Awareness Programmes

Optimization of Funds for different CCP Programmes

- ◆ Encouraged by a study published by National Institutes of Health (NIH), USA; CCP undertook a detailed study of the quantitative outcome of CCP projects in relation to quantum of funds provided to different categories of programmes (CoEs, MRDPs, Network, State CCCs, HCBPs, etc)
- ◆ The study brought out need for optimization of funds provided to different categories of programme
- ◆ Based on these results, EC of CCP recommended assigning upper limits of funds to various programmes

CCP's Research Outcome Per Cr of Funds Provided – A comparison with other international funding agencies

SN	Funding agency	Total Impact factor per Cr of Money spent
1	NIH, USA	4.77
2	NSF, USA	1.4
3	CCP	6.3 CoEs =13.3; MRDPs= 6.6 Network= 12.2, TFs=1.1

**Monitoring &
Assessment
Mechanisms
For DST's
National CC
Missions**

PM Council on Climate Change
(Chaired by Prime Minister)



Executive Committee
(Chaired by Principal Secy to PM)



Mission Steering Committee
(Chaired by Secretary, DST)



Expert Committee
(Chaired by an Eminent Climate Scientist)



Reviewers' Panel
(Chaired by an Eminent Climate Scientist)



PAMC 1

PAMC 2

PAMC 3

PAMC 4

Launching a New Programme Human and Institutional Capacity Building (HICAB) Programme

**in Climate Change for
Indian Himalayan Region**

as part of

**National Mission for Sustaining
the Himalayan Ecosystem (NMSHE)**

HICAB

*Exclusively Designed for
Universities and Institutions of National
Importance (IITs, NITs, etc)
in the Himalayan Region*

HICAB:

Broad Plan and Strategy

HICAB

NE Component

9 States - Assam, Arunachal, Nagaland, Manipur, Meghalaya, Mizoram, Tripura, Sikkim, West Bengal

**State
Network
Programme**

**State CoE/MRDP
(1 each), HCBP
(1 in the region)**

Western & Central Himalaya Component

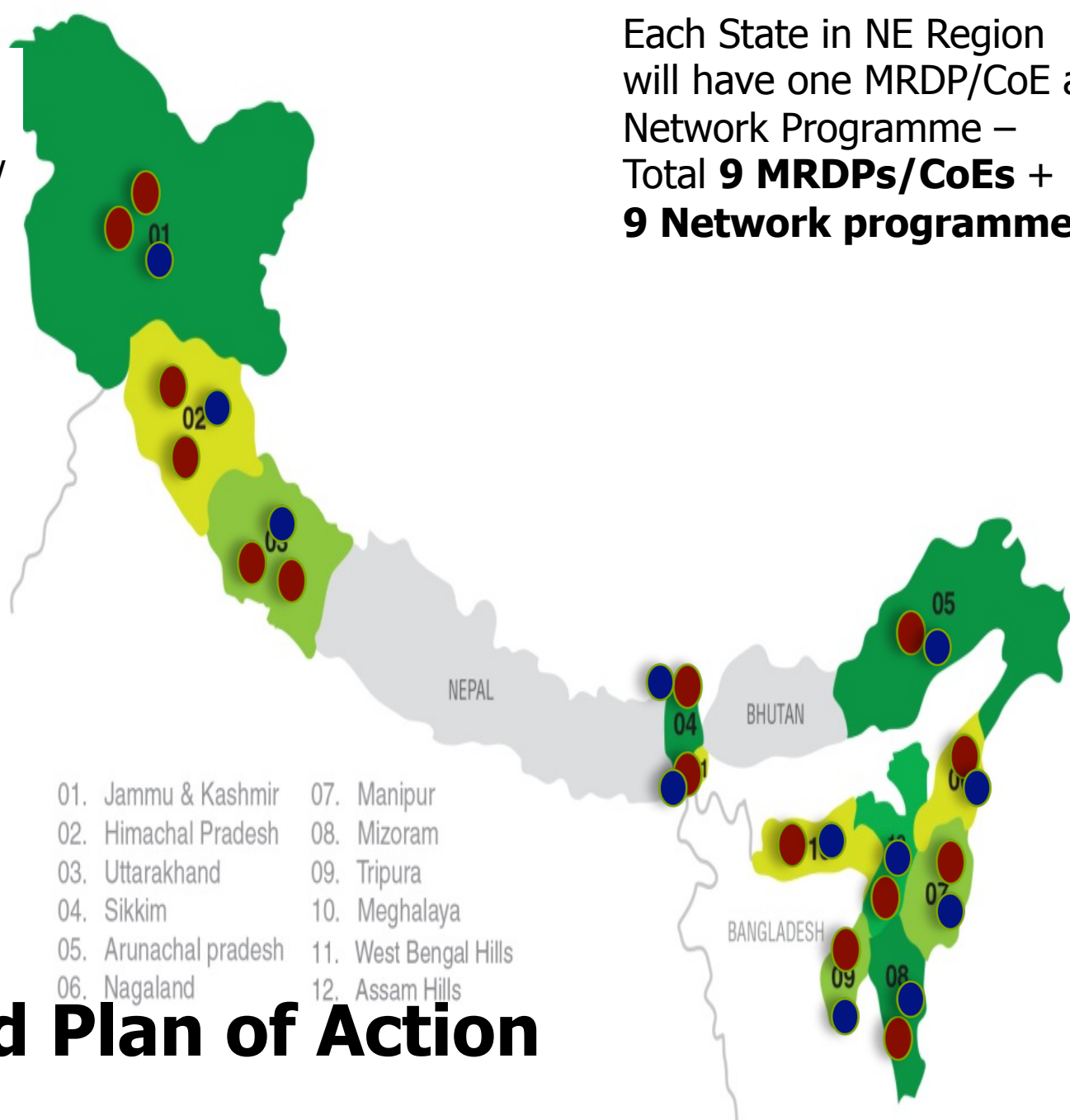
(3 States – J&K, HP and Uttarakhand)

**State
Network
Programme**

**State CoEs,
MRDPs (2 each),
HCBP (1 in the
region)**

Each State in Western Himalaya will have 2 MRDPs/CoEs and 1 Network Programme
(Total 6 CoEs/ MRDPs and 3 Network programmes)

Each State in NE Region will have one MRDP/CoE and 1 Network Programme –
Total 9 MRDPs/CoEs + 9 Network programme



HICAB : **Proposed Plan of Action**

Some Thoughts for Consolidation of CCP and Bringing National Level Synergy

CARE

Collaboration of **A**cademic **RE**search Institutions in CC

CRICC

Consortium of **R**esearch **I**nstitutions in **C**limate **C**hange

STRENGTH

S&**T** **RE**search, **N**etworking, **G**rooming and **T**raining **H**ubs in CC

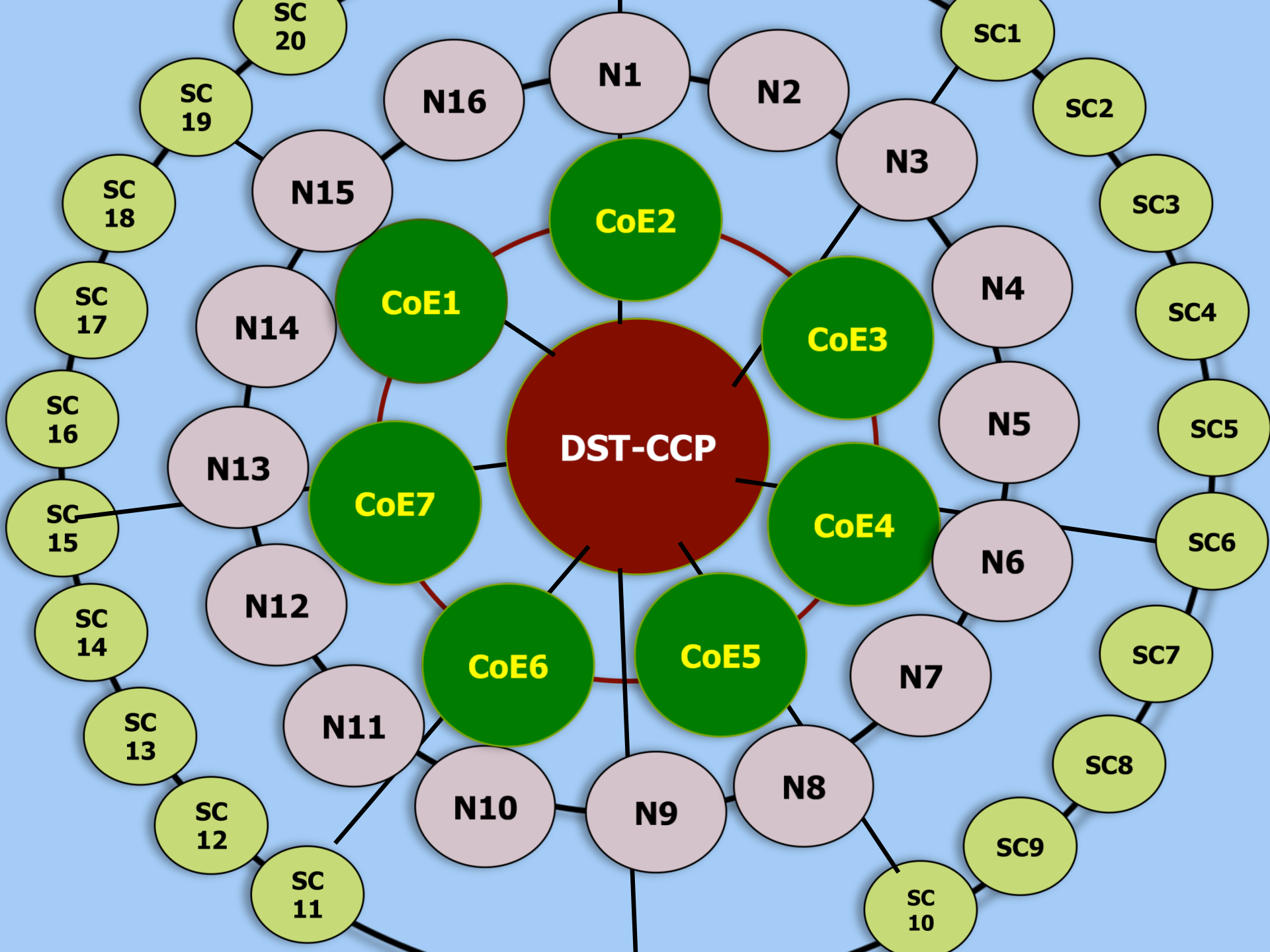
STRING

S&**T** **R**esearch **I**nstitutional **N**etwork and **G**rand Alliance- Inter-ministerial partnership

CARE

*Collaboration of **A**cademic &
REsearch Institutions in CC*

- ◆ Mentorship to younger and less experienced CoEs/MRDPs
- ◆ Mentorship to Network Programmes
- ◆ Adopting and Mentoring State CC Centres
- ◆ Interconnecting all CCP programmes
- ◆ Building a National Pool of Experts



CRICC

*Consortium of **R**esearch **I**nstitutions
in **C**limate **C**hange*

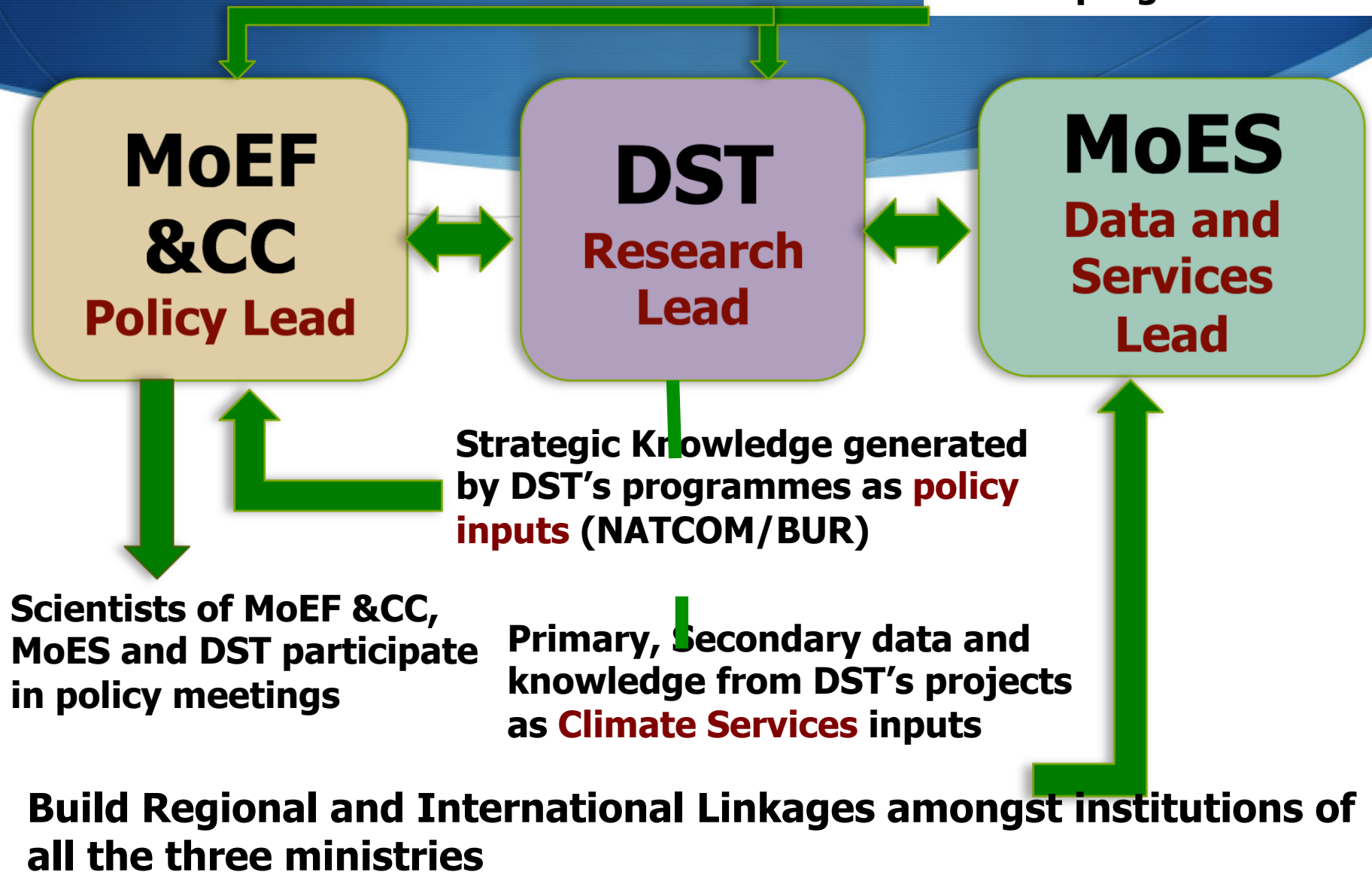
- ◆ **Develop City based clusters of R&D and Academic institutions – e.g; DRAC (Dehradun Research and Academic Consortium)**
- ◆ **Examples of potential cities having a good no of CC institutions- Delhi, Bangalore, Bhubaneswar, Hyderabad, Mumbai, Kolkata, Guwahati, Chennai**

STRENGTH *S*&*TRE*_{search}, *N*_{etworking}, *G*_{rooming} and *T*_{raining} *H*_{ubs} in CC

Training in CC Adaptation and Mitigation	Stakeholder Training at State Level	Training in Vulnerability & Risk Assessment for 12 Himalayan States	Training for Non-modelers in CC Modeling	Training for non-agriculturists in Crop-Weather Modeling	Training in Himalayan Glaciology
<ul style="list-style-type: none"> ◆ IIPA ◆ ASCI ◆ TISS ◆ ATREE ◆ IIFM ◆ VNIT 	State CC Cells in 22 Himalayan and Non-Himalayan States	<ul style="list-style-type: none"> ◆ IIT Guwahati ◆ IIT Mandi ◆ Guided by IISc, Bangalore 	<ul style="list-style-type: none"> ◆ IIT Delhi ◆ IITM Pune 	<ul style="list-style-type: none"> ◆ IARI, Delhi (For North, East and West zones) ◆ TNAU, Coimbatore (for South and Central zones) 	Divecha Centre, IISc, Bangalore

Broad Contours of **STRING**: MoEF -MoES-DST Grand Alliance

Weather, Climate data
and Capacity building to
scientists of DST's and
MoEF's programmes



Concluding Remarks

- ◆ India has a **strong climate change research base** in terms of number of quality researchers, data and infrastructure.
- ◆ The **Climate Change Programme (CCP)** of DST has **achieved considerable progress** during past 5 years.
- ◆ CCP aims to expand the research network of institutions and scientists covering over **2000 scientists/students** covering **400 institutions** in next 3 years.
- ◆ CCP is bringing out a **comprehensive report on strategic knowledge** out of these projects to help formulating policy
- ◆ A Report on **Social benefits of various programmes** is also being prepared.
- ◆ Greater **Centre-State linkages and partnership** are required to enhance the CC research outcomes.
- ◆ There is an urgent need to build **Inter-ministerial and inter-institutional synergy** and collaboration in climate research, services and policy
- ◆ **International and Regional cooperation** is being built which will bring big boost to collaborative research in India

Thanks !!

-Acknowledgement-

CCP Team in DST

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