UCHAI

Understanding
Climate & Health Associations in India

Understanding Climate and Health Associations in India (UCHAI)

Reflections and Proceedings of National Training Workshop
held on 22-24 September, 2015, New Delhi &
Summary of UCHAI Continuation Activities (Sept 2015-Oct 2016)

PREPARED BY

TARU
Taru Leading Edge

KNOWLEDGE PARTNER

Indian Meteorological Society

SUPPORTED IN PART BY

NIH National Institute for Environmental Health Science

Taru Leading Edge

Taru is a leading think tank and advisory services entity. As one of South Asia's most experienced climate- and disaster-mitigation agencies, Taru has undertaken technical assistance, implementation and monitoring programs for various national and international agencies. Taru Leading Edge was established in 1996 as an institution with trans-disciplinary expertise to engage with India's development challenges. The last two decades have seen Taru work on a range of institutional, financial, economic, social and technical issues across diverse public systems, cultures and corporate formations in more than one-third of rural and urban domains of India. Taru is one of the first agencies that started working on inter-linked issues of climate change and health, and demonstrated it with several good practices.

Indian Meteorological Society (IMS)

The objectives of IMS are the advancement of meteorological and allied sciences in all their aspects: dissemination of knowledge of such sciences among both scientific workers and the public, as well as their application to various constructive human activities such as agriculture and land uses, irrigation and power development, navigation of sea and air, engineering
and technology, medicine and public health, etc.

National Institute of Environmental Health Sciences (NIEHS)

Located in Research Triangle Park, North Carolina, NIEHS is one of the 27 research institutes and centers that make up the National Institutes of Health (NIH), U.S. Department of Health and Human Services (DHHS). The mission of NIEHS is to discover how the environment affects people, with the objective of promoting healthier lives. As part of its strategic plan, NIEHS supports efforts and partnerships to build capacity in low- and middle-income countries around the world in environmental health problems that contribute most to the global burden of disease.

Copyright

Suggested Citation

Dogra NK, Kakde VV, Bijalwan V, Kumari P, Prakash M, editors. Training Workshop on Understanding Climate and Health Associations in India (UCHAI); 2015 Sep 22-24; New Delhi, India. Taru Leading Edge; 2016

Disclaimer

This report represents proceedings of the UCHAI workshop. At the time of publishing, the document represented the best possible information based on the expert presentations during the workshop. TARU and the editorial team bear editorial responsibility for the content as the organization preparing the report. The document is not liable for any loss, damage, liability, or expense incurred or suffered by use of this report, including, without limitation any fault, error, omission with respect thereto. Neither the document makes any warranty, express or implied or assume legal liability or responsibility for accuracy, completeness, or use of any third-party information in the document. The document may include text, information, table or data that may be a copyright of a third party for which references have been given to the extent possible. Any specific name, logo, trademark, sign, and/or design or any other intellectual property referenced herein are merely used for dissemination purpose and are the property of their sovereign owners. The views expressed in this publication reflect the personal views of the presenter and should not be attributed to any organization with which the presenter is employed or affiliated. In particular views expressed in this document should not in any way be attributable to the Government of India or the US Government.

Document Design

How India Lives, a database and search engine for public data
(www.howindialives.com)

UCHAI

Understanding
Climate & Health Associations in India

Understanding Climate and Health Associations in India (UCHAI)

Reflections and Proceedings of National Training Workshop held on 22-24 September, 2015, New Delhi & Summary of UCHAI Continuation Activities (Sept 2015-Oct 2016)

PREPARED BY
TARU
Taru Leading Edge

KNOWLEDGE PARTNER
Indian Meteorological Society

SUPPORTED IN PART BY
NIH National Institute for Environmental Health Science

Dr. Sanjiv Kumar
Executive Director
(T): 011 26108982
Email: sanjiv.kumar@nhsrcindia.org

National Health Systems Resource Centre
Technical Support Institution with
National Health Mission
Ministry of Health and Family Welfare,
Government of India

Foreword

India's health systems have faced the challenges of maternal and child health and communicable diseases from time immemorial, with the two not necessarily being disconnected. Substantial process has been achieved in U5MR in India. It has come down from 126 (1990) to estimated 48, though not reaching the target of 42 by 2015. Yet, child deaths have come down from 3.36 million (1990) to 1.2 million (2015), which translated to 3,300 child lives saved every day! However, this progress is still not adequate as the under-5 years mortality rate in neighboring countries of Sri Lanka, Nepal and Bangladesh is 9, 40 and 41, respectively, whereas it is 48 in India. In recent years, non-communicable diseases such as heart diseases and diabetes have added another dimension to the challenge. At the same time, environmental challenges such as water and sanitation are also not new to India's development discourse. However, the recent addition of climate change and air pollution has further stressed India's health systems and will continue to compromise the nation's economic growth. This area is of particular interest to me since 2011 at a personal level when I guided the first vulnerability and adaptation assessment at the sub-national level in India.

In this backdrop, it is a pleasure to learn that the National Institute of Environmental Health Sciences (NIEHS) of the National Institutes of Health (NIH), United States, and TARU have initiated Understanding Climate and Health Associations in India (UCHAI), in conjunction with the Indian Meteorological Society (IMS) as a knowledge partner. In September last year, UCHAI began its activities with a training workshop. It was a privilege to serve as chair of the scientific committee for this workshop. The eminent panel ensured that speakers, trainees and participants were early- and mid-career faculty, practitioners and students from environment, health and public policy fields from across the country.

The scientific committee has transformed into an advisory committee, which is guiding webinars, proposal development and manuscript submissions. It is wonderful to see a vibrant community of practice evolving, using not only traditional modes of communication but also WhatsApp and Facebook. Five years ago, when the first systematic studies began, there were only few professionals working in this nascent discipline. Initiatives like UCHAI will provide a much-needed climate of change to move the frontiers of this field forward as India has recently ratified the Paris agreement.

New Delhi
4th October, 2016

Sanjiv Kumar
(Dr Sanjiv Kumar)

Preface

It is my great honor and pleasure to write a note of introduction for this report on the workshop on Understanding Climate and Health Associations in India, or UCHAI, held in September 2015. The National Institute of Environmental Health Sciences has partnered with Dr. Nitish Dogra, Taru Leading Edge, and other esteemed colleagues to support and expand a community of practice in India that will help enhance the resilience and preparedness of the health sector in India.

Our symbol for the UCHAI initiative is a mountain peak, reflecting the meaning of the Hindi word "uchai", with a stethoscope at the summit. The peak has two sides, symbolizing not only the challenges that both sides of the partnership must face to come together to promote health, but also the fact that both sides contribute to the teaching and experience the learning of this initiative, in the spirit of true partnership.

Climate change is a global phenomenon. While not all countries are experiencing the same degree of health risks associated with climate change that has occurred thus far, both United States and India have documented their vulnerabilities in recent reports and books. Both countries also have good reason to enhance and share their expertise in assessing and managing health risks.

As I noted during this workshop, the time is very auspicious for this partnership. The awareness and concern about health impacts of climate change is growing, as is the documentation of benefits, direct and indirect, of taking action to limit greenhouse gas emissions from many sectors of the economy. The health sector in developed and developing countries needs to embrace sustainability and resilience in its operations and facilities; and where health facilities do not have adequate energy for effective operations, they need to provide that energy in a way that is sustainable, healthy and also resilient to climate change-related extremes in weather.

Both countries must make critical choices related to future directions in health and sustainability. This workshop has played an important role in informing those choices by bringing together over 100 attendees and speakers from across India and the United States to share knowledge and build awareness on all of these issues.

Since the workshop, UCHAI partners have continued to educate and raise awareness, through webinars, creation of a website, thoughtful use of social media, and ongoing meetings and participation in international conferences. The community of practice is also serving as a testbed for the development of collaborative research and public health program proposals for India.

I hope this report will be widely read, discussed and acted upon in the coming years. I wish to express my gratitude to the organizers, the UCHAI advisory committee, and all the speakers who sacrificed their time to share their expertise at the workshop. I look forward to continued, productive collaboration with the UCHAI community of practice.

John M. Balbus, MD, MPH
Senior Advisor for Public Health
Director, NIEHS-WHO Collaborating Centre
for Environmental Health Sciences
National Institute of Environmental Health
Sciences, National Institutes of Health,
United States

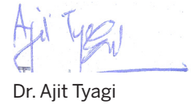
Message from the President

Understanding Climate and Health Associations in India (UCHAI) represents an excellent capacity building initiative of the National Institute of Environmental Health Sciences, United States, in this emerging field. When TARU Leading Edge, the host organization for UCHAI's inaugural workshop, approached us as a knowledge partner last year, we agreed to support this meeting. This was in line with the Indian Meteorological Society's (IMS) mandate of working not only on core meteorology issues but also with end users of this information such as the agriculture and water sectors.

Building bridges between meteorologists and health specialists is critical to move this field forward, and alliances such as UCHAI and IMS will be essential in this endeavor. We are also proud to say that with this partnership, India joins the league of select countries that have formal collaborations in place. In the UCHAI workshop, IMS speakers provided technical expertise related to climate science. These included Dr. M Rajeevan, Director, Indian Institute of Tropical Meteorology (now Secretary to the Government of India, Ministry of Earth Sciences), Dr. M Mohapatra and Dr. Pattanaik at the India Meteorological Department (IMD), Dr. Sagnik Dey at IIT Delhi, as well as Dr. Sangeet Srivastava at The Northcap University in Delhi NCR. IMS also facilitated a field visit to IMD for participants.

It is a pleasure to know that UCHAI activities are continuing with webinars, project proposals and a vibrant community of practice that is also utilizing social media such as WhatsApp and Facebook. While the partnership between UCHAI and IMS hinges on many individuals, a few of them deserve special mention. I want to thank Dr. K J Ramesh, current Director General of IMD for his consent and guidance to this partnership, which began when he was the Secretary of IMS. Dr. Pattnaik at IMD has interacted with the health fraternity for many years and his efforts to build on the engagement over the years are appreciated. Lastly, but by no means the least, we would like to thank Dr. Nitish Dogra, Sector Adviser (Health & Nutrition) at TARU. He is a public health physician by training who has worked in this area for almost a decade. He not only served as a convener for the UCHAI workshop but is also a life member of IMS.

My best wishes for the future of 'UCHAI', hoping it reaches newer heights.



Dr. Ajit Tyagi
President, IMS, NC

Acknowledgments

The Understanding Climate and Health Associations in India (UCHAI) training workshop was a significant capacity-building effort in this nascent discipline in the country, bringing together over 100 participants from Delhi and across the country. These participants represented academicians, researchers, policy planners and practitioners across the environment, health, social science and public policy disciplines. Many of the invited participants were early- or mid-career professionals selected after considerable deliberation.

A scientific committee was set up prior to the workshop to guide the agenda and the selection of participants. This committee comprised experts from the fields of environment, health and public policy. The committee was chaired by eminent public health expert **Dr. Sanjiv Kumar,** Executive Director, National Health Systems Resource Centre. While all committee members provided unstinting support, we would especially like to thank **Professor Anand Krishnan** from the All India Institute of Medical Sciences (AIIMS), New Delhi, and **Dr. Ramesh Dhiman** from the National Institute of Malaria Research (NIMR), for taking out time to carefully review the work plan.

Other members of the scientific committee included:

- **Professor Sanjay Zodpey,** Vice President (North), Public Health Foundation of India (PHFI)
- **Professor Shyamala Mani,** Professor, National Institute of Urban Affairs (NIUA), New Delhi
- **Ms. Suruchi Bhadwal,** Associate Director, The Energy and Resources Institute (TERI)
- **Ms. Anjali Singh,** Associate Professor, Indian Institute of Public Health (IIPH), Delhi NCR
- **Dr. Pawan Taneja,** Assistant Professor, Indian Institute of Public Administration (IIPA)
- **Dr. John Balbus,** Director, NIEHS-WHO Collaborating Centre for Environmental Health Sciences, NIEHS, NIH, USA
- **Dr. Banalata Sen,** Program Coordinator, Global Environmental Health Program, National Institute of Environmental Health Sciences (NIEHS), NIH, USA
- **Mr. Manu Prakash,** Director, Policy and Public Services, Taru Leading Edge

We thank the NIEHS for supporting the UCHAI initiative. We are especially grateful to **Dr. John Balbus** and **Dr. Banalata (Bono) Sen** for the hours of telecons and dozens of emails, which enabled the organizing team to ensure a world-class meeting. We are also extremely thankful to **Dr. K.J. Ramesh, Mr. S.C. Bhan** and **Dr. Dushmanta Pattanaik** from the Indian Meteorological Sciences (IMS) for agreeing to collaborate with UCHAI as a knowledge partner.

No event is possible without the dedication and support of the internal team. Accordingly, we would like to acknowledge **Vasundhara Bijalwan** and **Priyanka Kumari,** who served as consultants for the workshop. In addition, we are thankful to **Kumar Vibhanshu, Kritika Arora** and **Ashish Singh** for their efforts. Finally, the workshop would not have been possible if it were not for the support and oversight by **Mr. Manu Prakash,** Director, Taru, and the constant encouragement from **Mr. G.K. Bhat,** Chairperson, Taru.

Today, UCHAI has transformed into a community of practice, connecting experts and young professionals alike across the length and breadth of the country. We are grateful to everyone who has been part of this eventful journey taking this field to a new peak or uchai.

Dr. Nitish Dogra, MD, MPH
Fulbright Fellow (2013-14)
Member, Scientific Committee and Convener
Training Workshop on Understanding Climate and Health Associations in India (UCHAI)

Contents

Abbreviations and Acronyms

ACCCRN	Asian Cities Climate Change Resilience Network
CBPR	Community Based Participatory Research
CDC	Centers for Disease Control and Prevention
DDES	Demographic Development and Environmental Surveillance
DOHaD	Developmental Origins of Health and Disease
GEOSS	The Global Earth Observation System of Systems
GFCS	A Global Framework for Climate Services
GHG	Greenhouse Gases
ICMR	Indian Council of Medical Research
IDSP	Integrated Disease Surveillance Programme
IIPHG	Indian Institute of Public Health Gandhinagar
IMD	Indian Meteorological Department
IMS	Indian Meteorological Society
IPCC	Intergovernmental Panel on Climate Change
IUSSTF	Indo-US Science and Technology Forum
LAFS	Limited Area Analysis and Forecast System
MoES	Ministry of Earth Sciences, Government of India
MoHFW	Ministry of Health and Family Welfare, Government of India
NDMA	National Disaster Management Authority
NHSRC	National Health Systems Resource Centre
NIEHS	National Institute of Environmental Health Sciences
NIH	National Institutes of Health, United States
NIUA	National Institute of Urban Affairs
NOAA	National Oceanic and Atmospheric Administration
NRDC	National Resources Defense Council
NVBDCP	National Vector Borne Disease Control Programme
NWP	Numerical Weather Prediction
QPF	Quantitative Precipitation Forecast
RSMC	Regional Specialized Meteorological Centre
SCCT	Surat Climate Change Trust
SMC	Surat Municipal Corporation
SOCO	Single Overarching Communications Outcome
SSCF	Special Climate Change Fund
SST	Sea Surface Temperature
UCCR	Urban Climate Change Resilience
UCHAI	Understanding Climate and Health Associations in India
UHCRC	Urban Health and Climate Resilience Center
USIEF	United States-India Educational Foundation
WMO	World Meteorological Organization

Executive Summary

The fifth assessment report of the Intergovernmental Panel on Climate Change (IPCC) has clearly documented the growing body of worldwide evidence linking climate change with human health. Nations like India—which are disaster prone, and which have a high population density and a challenging Human Development Index (HDI) scenario—are especially vulnerable. The health impacts of climate change in the country has shown a number of different outcomes being affected, ranging from infectious diseases such as vector-borne diseases and water-borne diseases, heat and cold wave consequences, disaster-related injury and deaths, respiratory diseases, emerging as well as re-emerging diseases, and even mental health.

The Government of India in 2010 had recognized health as one of the four areas of priority for adaptation as per the 4x4 assessment report of the then Ministry of Environment and Forest. Various State Action Plans for Climate Change also mention health sector initiatives. The 2008 National Action Plan for Climate Change (NAPCC) mentions eight national missions under which the Plan would be carried out. In 2014, the national mission on health was added as one of the four additional missions. Capacity building has been identified as one of the critical goals of this mission.

It was against this backdrop that the Understanding Climate and Health Associations in India (UCHAI) training workshop was initiated in September 2015. This was an effort to bring all major concerned institutions, experts, decision-makers, academicians, researchers, practitioners and students under one umbrella. The focus was on three core frameworks in dealing with climate and health issues: vulnerability, adaptation and co-benefits. The workshop also covered other essential aspects such as policy research, skill building and networking. Synergized capacity building and sustainability were ensured by developing a web- and social media-based mentored community that is moving this interdisciplinary field forward in the country.

The overall goal of the workshop was to build capacity among early- and mid-career academicians, researchers, practitioners and students towards climate-proofing of the human health sector in the country. Specifically, it included:

- Understanding the fundamentals of climate science as it relates to health.
- Appreciating the policy relevance of health in the climate change debate.
- Assessing vulnerability of regions, populations and special groups to the health impacts of climate change.
- Orientation to best practices in adaptation.
- Explaining how certain interventions in the health sector can have vital co-benefits for climate change.
- Learning how to communicate the health impacts of climate change to decision-makers, researchers, practitioners and the community using traditional and newer channels such as social media.
- Developing a community of practice that will be expected to contribute in their respective regions.

Select experts from the environment, health and public policy fields from renowned institutions guided the workshop. The workshop gathered around 100 participants, including academia, civil society, donor agencies and government representatives. Perspectives and lessons based on empirical sectoral research and knowledge, as well as best practices, were presented. The approach of the workshop was to facilitate creative, insightful sharing woven into the learning process. Participants were engaged through presentations, lectures, videos, open house, group work, ice-breaking sessions and the like. Each session comprised of multiple speakers, chaired by an eminent expert. Sessions were followed by training, skill building and discussions. The workshop ensured improved understanding of top-down requirements (such as policies and institutions) and bottom-up requirements (such as researched evidence, good practices and partnerships).

The Indian Meteorological Society (IMS) was sought out as a knowledge partner for the initiative. IMS serves as a critical bridge between the climate and health communities in line with similar endeavors around the globe. A field visit to the India Meteorological Department (IMD) was a unique component of the training workshop that was facilitated by IMS. This field visit enabled participants to understand the practical dimensions of climate and weather, including instrumentation. UCHAI continues to work with IMS to strengthen capacity and linkages.

Several critical aspects emerged from each of the sessions. The climate science session emphasized data sources, sharing and accuracy. The epidemiology sessions emphasized weather and disease linkages, mathematical modeling, community participation, strengthening interventions for epidemics and mobile applications for disease surveillance systems. The adaptation session emphasized the importance of disaster-resistant health facilities and city-level plans such as the one in Ahmedabad for heat. The co-benefits session highlighted benefits to both climate and health from interventions such as the Metro and clean cooking stoves.

The key recommendations from the workshop were on validation of data through triangulation, evidence-to-policy translation, having environmental cells in health department as well as health cells in the meteorological department. Besides, inter-sectoral action for health is critical since the impacts of climate change on health involve a holistic approach.

The scientific committee that guided the UCHAI workshop has evolved into a wider UCHAI advisory committee, which plays an advisory and mentoring role. The committee guides the initiative in proposal development, manuscript submission and mentoring. UCHAI connects to a growing community of practice across India and beyond through webinars, social media platforms as well as an upgraded website.

In September 2016, UCHAI also co-hosted the 'National Consultation on Planning for Heatwave Management in India'. This meeting included experts from health, disaster, urban planning, public policy and earth science sectors, and they deliberated on the topic after the release of a roadmap. This document included a synthesis of evidence and review by national and international experts. It is expected the meeting would help in guidance to state-level and city-level heat action plans too.

UCHAI, roughly translated as 'peak' in Hindi, clearly represents a new peak in capacity building for India in this nascent discipline at the interface of climate change and human health.

Introduction

A Training Workshop on 'Understanding Climate and Health Associations in India' was held in New Delhi, India, during September 22-24, 2015. The initiative was relevant as climate change has been recognized as one of the focus areas in the context of bilateral mechanisms finalized between India and the United States[1].

The workshop was attended by experts, policymakers, academicians, researchers, practitioners and students from renowned institutions across the country (for the complete list of participants, see Annexure II). The overall goal of the training workshop was to build capacity among early- and mid-career academicians, researchers, practitioners and students in the area of climate-proofing of the human health sector in the country.

The focus of the workshop was on three core frameworks in dealing with climate and health issues: vulnerability, adaptation and co-benefits. The workshop also covered other essential aspects such as policy research, skill building and networking. It spanned technical sessions spread over three days. Talks were delivered by experts, supported by state-specific case-studies, onsite exercises, group work and a field visit to the India Meteorological Department (IMD).

The workshop aimed at enhancing the strength and efficiency of the health sector in addressing climate change challenges and policymaking. Further, a synergy of capacity building and sustainability was facilitated by developing a web-based, mentored community of researchers and practitioners, who will potentially move this interdisciplinary field forward in the country.

Workshop Objectives

- Understand the fundamentals of climate science as it relates to human health.
- Appreciate the policy relevance of human health in the climate change debate.
- Assess vulnerability of regions, populations and special groups to health impacts of climate change.
- Orient to best practices in adaptation for public systems, health services and communities.
- Explain how certain interventions in the health sector can have co-benefits for climate change.
- Learn how to communicate the health impacts of climate change to decision-makers, researchers, practitioners and the community, using both traditional and newer channels such as social media.

Workshop Outcomes

- Critically evaluate the relevance of evidence-based policy, especially as it relates to the climate negotiation process.
- Identify relevant resources to carry out vulnerability and adaptation assessments in their surroundings.
- Initiate policy-relevant cross-sectoral studies for interventions that provide co-benefits to more than one sector.
- Improve research output through multidisciplinary, collaborative proposals with suitable Indian and US mentors, who would further guide participants.
- Form a national climate change and health online discussion group.

[1] The White House (2015). U.S.-India Joint Statement "साँझा प्रयास - सबका विकास" – "Shared Effort; Progress for All". Available at: http://www.whitehouse.gov/the-press-office/2015/01/25/us-india-joint-statement-shared-effort-progress-all [Accessed 29 Jan. 2015]

Inauguration Ceremony

Welcome and lighting of the lamp

The three-day workshop on 'Understanding Climate Change and Health Associations in India' began on the morning of September 22, 2015, with a welcome to all participants and speakers. The workshop was organized by Taru Leading Edge and the National Institute of Environmental Health Sciences (NIEHS), United States, with the Indian Meteorological Society (IMS) as a knowledge partner. The audience was given a brief overview of the workshop, its importance and what they stood to gain from it. Guests were introduced and were presented a plant as a token of thanks. This brief introduction was followed by lighting of the lamp by the guests to inaugurate the workshop on an auspicious note.

The inaugural speech was given by Dr. Soumya Swaminathan, Secretary, Department of Health Research, Ministry of Health and Family Welfare (MoHFW), Government of India, and Director-General, Indian Council of Medical Research. Dr. Swaminathan spoke of the need for people from different sectors, including from the MoHFW and the India Meteorological Department (IMD), to engage in interdisciplinary collaboration as there was a need to exchange data and plan collectively.

"I would like to propose the formation of a special cell on climate and health under the Ministry of Health and Family Welfare for policy-relevant research and real-time information sharing".

Other speakers on the inaugural panel were:

- Dr. Sanjiv Kumar, Chair of the Scientific Committee & Executive Director, National Health Systems Resource Center (NHSRC)
- Mr. Douglas A. Morris, Acting Minister Counselor, Economic, Environment, Science and Technology Affairs, Embassy of the United States of America
- Air Vice Marshal (Dr.) Ajit Tyagi, Indian Meteorological Society (IMS)
- Mr. Ajay Raghava, Deputy Director (Climate Change), Ministry of Environment, Forest and Climate Change
- Mr. G. K. Bhat, Chairperson, TARU Leading Edge.

The keynote address was given by Dr. John Balbus, Senior Advisor for Public Health & Director of the NIEHS-WHO Collaborating Centre for Environmental Health Sciences, NIEHS, NIH, USA.

Insights from the Guests

In the opening address, Dr. Sanjiv Kumar emphasized the need to understand climate change and its impact on health. He mentioned how health scenarios have changed over the years, specifically in India. He noted the importance of understanding climate change issues and concepts while addressing health. He thanked TARU and members of the Scientific Committee for conceptualizing this workshop as an effort to build capacities among people working in the diverse fields of climate and health to understand linkages between the two.

Douglas A Morris spoke of promoting strong bilateral ties on climate change and health research, which will encourage professionals to take knowledge back to communities and have impact at the grassroots level. He highlighted the need for larger programs to address environmental problems and support vulnerable populations.

G.K. Bhat thanked the Scientific Committee and Dr. Nitish Dogra for organizing this workshop. He stated this workshop was just the beginning and TARU planned to continue to put forth efforts towards climate change and health impacts at the national and regional levels in India.

Dr. John Balbus began his keynote address by thanking all dignitaries, TARU and the speakers for their efforts to highlight and address climate change and health associations in India. He provided a brief overview of NIEHS, which was designated a WHO Collaborating Centre for Environmental Health Sciences in September 2013 with six focus areas: Developmental Origins of Health and Disease, Network of Children's Environmental Health Collaborating Centres, Electronic Waste, Health Implications of Climate Change and Sustainable Development, Cookstoves and Indoor Air Pollution and WHO Chemical Risk Assessment Network Support. He stated that the need to address climate change and health is also realized by WHO, and quoted a statement by Dr. Margaret Chan.

"The evidence is overwhelming: climate change endangers human health. Solutions exist and we need to act decisively to change this trajectory."

Dr. Margaret Chan,
Director-General of the World Health Organization
in her opening remarks at the WHO Climate
and Health Summit on August 27, 2014

Dr. Balbus said we were at a unique time in human history, a time in which we, as a global community, must make a conscious and extremely difficult choice towards a more sustainable future. He emphasized that our choice will create different health outcomes. He explained that not only is climate change an important health issue, but also that the health sector is important for climate change action because it is uniquely connected to communities and a major part of national economies. While discussing reports from the Intergovernmental Panel on Climate Change, The Lancet and an earlier Indo-US workshop on Climate Change and Health, he explored interactions between climate and health in India (adverse-health effects due to heat waves, effect on labor work capacity and productivity among vulnerable populations, etc.).

Dr. Balbus also spoke about recent US actions on climate change and health, which included a release of the draft Climate Health Assessment, 14 commitments from the US private sector, and the US Sustainable and Climate Resilient Health Care Facilities Toolkit, among others. He promoted the idea of a 'Community of Practice' for climate change and health, which would help connect communities and community health workers to government scientists and decision-makers. This would also bring together senior and developing health researchers, as well as public health professionals. In the end, he expressed hope that the UCHAI workshop would help build capacity to assess and respond to challenges and opportunities for health posed by climate change.

The inauguration ceremony concluded with an introduction of the UCHAI website and vote of thanks by Dr. Nitish Dogra.

Session 1

Climate Variability and Change over India

Chair: Dr. A.D. Rao, Indian Institute of Technology (IIT), Delhi

Dr. Ben Zaitchik

Johns Hopkins University, United States

Fundamentals of Climatology

Dr. Zaitchik's talk outlined the concepts of climate, climate variability and change, and their impacts on resources. It highlighted five points:

- Specific data needs to link climate and health should be kept in mind.
- Time horizon is vital as the climate world distinguishes between predictions and projections.
- It is difficult to have perfect information about climate, making predictions uncertain. Hence, it is vital to ascertain the level of certainty required to make a decision.
- For decision-making purposes, it is crucial to develop an archive of information and databases related to climate and health. Eventually, these can be developed into a meaningful prediction system. For example, the relationship of cholera to flooding.
- We can't look at the human components of all systems. But if we want to develop meaningful prediction systems, we need to account for the fact that natural systems do interact with human systems.

Ms. Juli Trtanj

National Oceanic and Atmospheric Administration (NOAA), United States

Climate Services for Health: A Global Overview

The US National Oceanic and Atmospheric Administration (NOAA) aims to understand and predict changes in climate, weather, oceans and coasts, and share that knowledge with others. A linkage of climate and weather offers a seamless suite of forecast products (related to precipitation, seasonal climate, seasonal rainfall, etc.) The Global Earth Observation System of Systems (GEOSS) is a global distributed system, including satellite observation systems, global in situ networks and systems, and local and regional in situ networks. GEOSS will deliver the benefits of earth observations to data and information providers, as well as consumers, worldwide.

In a traditional generalized epidemic curve, we aim to reduce morbidity and mortality, which is reflected as the area under the curve. Climate information and tools tailored for public health can help us get ahead of the curve. If the public health community is better prepared to anticipate the first case, detection and monitoring will increase. So will laboratory confirmation, when that is possible. The response can be mounted much earlier, whether through public outreach, a bed net program, or a vaccine campaign. For this, an integrated information system is needed, which would inform from early warning to early action.

For example, seafood poisonings are under-reported, often misdiagnosed and may be increasing. One reason is pathogenic Vibrios, which were not reported to CDC earlier. Contaminated seafood closes shellfish beds, and results in losses in tourism, public trust and revenues. Environmental drivers include sea surface temperature, salinity and soil moisture, among others. A vibrio operational forecasting system provides 48-hour predictions, water salinity and quality monitoring, and other information on water quality profile. Such information is used in the Cholera Early Warning System Framework. The Global Framework for Climate Services (GFCS) approach identifies core pillars (such as users, government, private sector) and priority areas (water resources, human health and disaster risk reduction).

Dr. M. Rajeevan

Ministry of Earth Sciences

Understanding Climate Change in India

Climate variability is the temporal variation of the atmosphere—ocean system around a mean state, whereas climate change is any systematic change in long-term statistics of climate elements (such as temperature, pressure or winds)

sustained over several decades or longer. There has been a sharp increase in the concentration of carbon dioxide, and other greenhouse gases like methane and nitrous oxide, since the 1950s due to human activity and the industrial revolution. The resultant enhanced greenhouse effect has increased surface air temperatures, resulting in global warming.

Global instrumental temperature data suggests unprecedented warming during recent decades. These changes are a matter of concern for society, as a warming climate results in heat waves, wild fires and climate disasters, including droughts, floods, storms and hurricanes.

Over the years, the average frequency of heat-wave days in India is showing a rising trend. A trend comparison of urban versus rural rainfall shows a slight increase in heavy rain events in urban regions. Of the 338 rainstorms identified during the monsoon season, 149 rainstorms (or 44%) over the Indian subcontinent were associated with monsoon depressions and formed above the Bay of Bengal. IPCC models suggest a decrease in the number of rainy days and an increase in intensity of rainfall during the monsoon season.

Dr. Dushmanta Pattanaik

India Meteorological Department

Indian Climatology in the Health Context

Day-to-day health outcomes of human beings are most likely to be affected by climate variability and climate change because they are associated with weather and/or climate variables. These are temperature-related morbidity and mortality; health effects of extreme weather events (storms, tornadoes, hurricanes and precipitation extremes); air pollution-related health effects; water- and food-borne diseases; and vector- and rodent-borne diseases.

Carbon dioxide and other greenhouse gases have increased by more than 30% since pre-industrial times, trapping more heat in the lower atmosphere. This is causing deaths due to high temperatures and altering patterns of infectious diseases. Weather extremes (heavy rains, floods and disasters) endanger health, and destroy property and livelihoods. Rising sea levels cause floods, leading to injury and death, and increased risk of infection (water- and vector-borne diseases). An indirect effect of climate change on society is population displacement, which could increase tensions and risks of conflict.

Air pollutants have a direct effect on human health. Suspended particulate matter (SPM) can damage lungs, and cause bronchitis and asthma. SO2 may result in acid rain, and damage to lungs, eye and skin.

The health impacts of climate change are potentially huge, with developing countries more vulnerable than developed ones. Many projected impacts on health can be avoided through a combination of short-term public health interventions, adaptation measures in health-related sectors such as agriculture and water management, and a long-term strategy to reduce human impacts on climate. The problem is complex, and it is critical climate scientists and health

practitioners work together.

Dr. M. Mohapatra

India Meteorological Department, New Delhi

Extreme Weather

Most natural hazards are weather-related. For example, winter (January-February) sees incidence of western disturbances, cold wave and fog. Pre-monsoon months (March to May) register events of cyclonic disturbances, heat waves, thunderstorms, squalls, hailstorm and tornadoes.

Major natural disasters and risk management in India include risk management and early warning components. Risk management includes hazard analysis and statistics, preparedness and planning, prevention and mitigation. Early warning components include observation, monitoring, analysis and prediction, warning generation and dissemination.

Meteorological information from IMD is used in several ways to reduce disaster risk in the region: for example, hazard monitoring, technical support in risk assessment and management of natural resources during disasters. There is a national weather forecasting center in New Delhi, with regional centers in Delhi, Kolkata, Guwahati, Nagpur, Mumbai and Chennai.

Cyclone warning has four stages: pre-cyclone watch, cyclone alert, cyclone warning and post-landfall outlook. Nowcasting thunderstorms entails making location-specific forecasts for severe weather to aid planning of aviation activities, sports events and high-risk operations. A decision support system to issue quantitative precipitation forecast (QPF) and heavy rainfall warning is in place, but heavy rainfall forecast is still a challenge.

Drought monitoring and forecasting includes onset, spread, intensification and cessation of drought (near real-time basis) on a daily, weekly, monthly and seasonal time scale across the country. Some gaps are inadequate observations to initialize weather and climate models, the need for improved simulation of key processes and the interaction between these processes. Augmentation of observational network and numerical models with much finer horizontal and vertical grid resolution is the way ahead.

DISCUSSIONS/ SUGGESTIONS

NOAA shares data with federal agencies, and has an open policy of sharing data with any organization that requests for it.

There is no dearth of evidence and data on weather, but it is scattered and limited to few centers.

The quality of old data in the health system is questionable and it lacks a long time series. There is a need to collect good quality data for prediction purposes.

Prediction of heat wave and cold wave is 70-80 percent accurate.

Information on heat waves passes through a three-tier system: national (national disaster management, media), regional and state (district management/ collector). The data is in textual and graphical form.

It is important to have an environmental cell in the health department and a health cell in the meteorological department for better coordination, information-sharing and decision-making.

Field Visit to Indian Meteorological Department

The India Meteorological Department (IMD), under the Ministry of Earth Sciences (MoES), was established by the Government of India in 1875 with the objective to bring all meteorological work in the country under a central authority. IMD is headquartered in New Delhi and is headed by the Director General of Meteorology. There are different types of operational units such as meteorological centers in state capitals, forecasting offices, agrometeorological advisory service centers, flood meteorological offices, area cyclone warning centers and cyclone warning centers.

Participants visited the department on September 22, 2015. The objective was to provide health, environment and public policy professionals the opportunity to understand the practical aspects of climate science as well as the organization and functioning of different divisions of IMD. The tour was interactive and the group was encouraged to ask questions.

The two-hour tour comprised visits to the following sections:

Satellite Division: Meteorological information collected by INSAT-3D, India's exclusive meteorological satellite, was demonstrated by a senior IMD scientist. This satellite has the following mission objectives:

- To monitor the earth's surface and carry out observations in the oceanic region in various spectral channels of meteorological importance.
- To provide a vertical profile of temperature and humidity parameters of the atmosphere.
- To provide data collection and data dissemination capabilities from the data collection platforms (DCPs).
- To provide satellite-aided search and rescue services.

Forecast and Observatory: Weather forecasting is a very important activity of the IMD, and it caters to a wide spectrum of user requirements, ranging from agriculture to aviation. Short-range forecasting involves predicting weather conditions for any place two days in advance. In long-range forecasting, rainfall for the country as a whole is predicted before the monsoon season.

IMD provides very comprehensive forecasting services for aviation, shipping, fisheries, agriculture, flood forecasting, cyclone warning and many other special users, besides forecasts for the general public. For this purpose, IMD has forecasting offices at its six regional meteorological centers and meteorological centers in state capitals. In addition, it has two major forecasting centers in New Delhi and Pune.

The Northern Hemispheric Analysis Centre in New Delhi serves as a high-level interface between the IMD and government agencies, and also provides inputs to the electronic and print media. It also functions as a Regional Specialised Meteorological Centre under the WMO system, and executes wider responsibilities towards neighboring countries. The Indian Ocean and Southern Hemispheric Analysis Centre is located in Pune. The Office of the Deputy Director General of Meteorology (Weather Forecasting) and the 'Weather Central' at Pune coordinate the weather forecasting activities of IMD, particularly in times of events like tropical cyclones.

Cyclone warnings, bulletins for fishermen and ships, are issued by IMD's area cyclone warning centers at Chennai, Kolkata and Mumbai, and cyclone warning centers at Ahmedabad, Bhubaneshwar and Visakhapatnam.

Agro meteorological advisory and weather bulletins for farmers are issued by 17 IMD centers in various states. IMD also provides specific forecasts for mountaineering expeditions, national events, sports events, religious processions, elections and other special purposes.

Numerical Weather Prediction (NWP) is the methodology to predict the future state of atmospheric circulation and weather from knowledge of its present (initial) state, using known physical and hydro dynamical laws of atmospheric motions. NWP was initiated in IMD in 1973 with a simple model on an IBM 360/44 computer. A new computer, Cyber 2000U, supported by peripheral equipment, was installed and commissioned at IMD in New Delhi in 1995.

The New Delhi centre functions as a Regional Specialized Meteorological Centre (RSMC) under the WMO system for World Weather Watch. Most RSMC activities such as plotting of data on weather charts for synoptic analysis and production of prognostic charts have been automated on the cyber system, with its comprehensive applications and graphics software package.

A Limited Area Analysis and Forecast System (LAFS), comprising an advanced NWP model, has been implemented for short-range forecasting. The analysis and prognostic charts produced by LAFS are disseminated to centers in other countries as part of RSMC's responsibilities. The forecast model is also used to generate tropical cyclone track predictions. The cyber system also processes grid point data from World Area Forecast Centers in Washington, USA, and Bracknell, UK, to generate documentation charts for aviation.

Session 2

Fundamentals of Environment Epidemiology: Focus Climate Change

Chair: Dr Jugal Kishore, Vardhman Mahavir Medical College, New Delhi

Dr. Anand Krishnan

All India Institute of Medical Sciences (AIIMS), New Delhi

Study Designs

Epidemiological study designs can be broadly categorized as descriptive and analytical. Analytical study designs are of two types: observational and experimental. Cross-sectional, case-control and longitudinal studies are observational in nature, while trials constitute experimental studies. Experimental studies also can be further classified into random (cluster and clinical trial) and non-random allocation (quasi-experimental study).

The final choice of study design depends on the study question, resources (including time available), and an understanding of the strengths and weaknesses of different study designs. It is difficult to prove causality in environmental studies because the exposure is at a population level, and not individual level. Further, it is usually diffused and low, with problems of confounding and bias. More difficulties arise if there is a long latent period or multiple outcomes, and in cases of rare events.

Epidemiological studies answer six types of questions: who, where, when, why, what and how? Descriptive studies answer, is there an association between an exposure and an outcome? Analytical studies answer, what is the effect of an intervention?

Experimental studies in environmental epidemiology assess environmental exposures shared by a group of people. Ecological study designs and cluster trials are often used in environmental studies.

Dr. John Balbus

National Institute of Environmental Health Sciences (NIEHS), United States

Understanding Climate Change and Health Associations: Concepts of Epidemiology and Risk Assessment

Establishing causality, assuring good epidemiological studies and risk assessment are the three important considerations in epidemiology and risk assessment for climate change and health.

Epidemiology and meteorology are two disciplines needed to help attribute causality of health impacts to climate change, as well as time and spatial scales pose challenges. A

successful epidemiological study needs a large sample size, freedom from systemic errors and identification, and control of extraneous causes (confounding factors). For example, in studying effects from air pollution, rates of smoking can act as confounding factors.

The essential elements of environmental health risk assessment are hazard identification, dose response assessment, risk categorization and exposure assessment. Uncertainties in epidemiological studies are dealt with through repetition, statistical tools and large datasets. Exposure response relationships from epidemiology provide insight through health risk assessments. Future scenarios are needed to build assessments and guide decisions.

Dr. Kapil Goel

Centers for Disease Control (CDC), New Delhi

Surveillance for Climate-Sensitive Diseases

Climatic conditions affect the transmission of many infectious diseases. For example, floods contribute to increased cases of acute diarrheal diseases, cholera, typhoid and dysentery.

Diseases caused by pathogens that spend part of their lifecycle outside human, or other warm-blooded, hosts are particularly climate-sensitive. Depending on the strength of climate sensitivity and evidence available, diseases are classified as climate-sensitive. There are vector-borne diseases (like malaria and dengue), water-borne diseases (like cholera) and food-borne diseases. There are also diseases linked to floods, droughts, cyclones, heat stress, and air pollution and depletion of the ozone layer.

Among the various Indian disease surveillance systems, only the Integrated Disease Surveillance Programme (IDSP) and the National Vector Borne Disease Control Programme (NVBDCP) measure health effects in terms of water/food/vector/rodent-borne diseases.

IDSP is a web-based surveillance system where data on diseases flows every week from the grassroots (sub-center) level to the central level. It measures the incidence and prevalence of diseases related to public health. Weekly reporting is done under S-Syndromic, P-Probable/Presumptive and L-Laboratory confirmed forms.

Climate data like temperature, rainfall, humidity and air velocity is measured by the India Meteorological Department. There are several limitations in surveillance for climate-sensitive diseases: lack of high-quality disease surveillance data, lack of high-quality meteorology and climate data, absence of linkage of climate data with disease surveillance data, limited data sharing and limited opportunities for collaborations. So, linking disease surveillance data with meteorological data, strengthening interdisciplinary collaborations and promoting modeling studies of linked data to help develop an early warning signal system for India is the way forward.

Dr. Anurag Prakash Rawool

KEM Hospital and Research Centre, Pune

Case Study: Establishing Cohorts for Climate and Health studies

Climate change and variation is a continuous process. So is the correlation of changes in weather patterns and climate and their effect on health. To study such long term and continuous processes, we need population-based cohorts for studies on climate and health. The Vadu Health and Demographic Surveillance System (HDSS) covers 22 villages in Pune district, 140,000 individuals and 40,000 households. They are studied for longitudinal monitoring of health and demographic events. Field research assistants (FRA) collect data on laptops/tablets provided. This data is analyzed based on HDSS, and feedback is given to a respondent or the population as a whole.

Under demographic and health event monitoring, entry into population is by birth and in-migration (of workers), and exit is by death and out-migration. Confirmation of death is done by a verbal autopsy. Dynamic cohort is captured by episodes of diseases and hospital admissions, which are updated through cycles of enumeration. An initial census is conducted and follow-ups are regular. Pregnancies are also tracked for death of children below 5 years of age.

Population-based DSS can be used to establish cohorts. We collected rainfall and temperature data. Given the normal ranges seen, we found an increase in extreme heat mortality. Climate studies based on DSS can help predict health effects. HDSS platforms are ideal to form cohorts for climate change studies. A countrywide network of HDSS will help conduct cross-site cohort studies. More HDSS should be established, which could be representative of geography and population.

DISCUSSIONS/ SUGGESTIONS

In the past, rainfall was used effectively to predict an outbreak of malaria. In order to minimize risks, it is crucial to link weather with health outcomes.

IMD is using conventional, automatic and newer technology to predict weather.

A surveillance system for vectors, cold waves and heat waves exists. So, there is no need to create a parallel system. The need is to link systems, promote data sharing and develop computer simulation models (mathematical method).

There is a need to analyze health data at the block and district levels on a weekly basis, and data at the state and central levels on a monthly basis.

It is important to keep in mind ethical issues while conducting environmental research linked with health, particularly for experimental design, where one group is exposed to risk and the other is not.

In a nutshell, generated evidence should lead to decision-making and forecasting.

Session 3

Epidemiology Methods and Tools Applied to Climate and Health

Chair: Dr. Anand Krishnan, AIIMS, New Delhi

Dr. Sangeet Srivastava

The Northcap University, Gurgaon

Modeling

Segregation of health risks due to climatic factors from other causal factors is usually done using baselines and established weather-health risk associations. Quantifying weather-health association is essential to predict climate-related health effects, but it does not necessarily represent the climate effect on health. Time series studies and spatial studies are the principal methods to analyze climate effects on a specific health outcome.

Modeling can be understood in three stages: weather-health risk modeling, climate modeling and projections, and modeling of future health risk estimates due to climate change. Representative concentration pathways (RCPs) are for climate projections and shared socio-economic pathways (SSPs) for impact assessment.

Most epidemiological studies concentrate on changes over a few days to a few weeks, and rely on the observation of past events. Understanding the impact of future climate change entails some form of modelling, usually combining evidence on short-term weather-health relationships (derived from epidemiological studies of past events) with models of future climates (derived from global circulation models).

Many assumptions are made in such modelling, including the probably unrealistic assumption that the health effects of climate change can be adequately represented by today's short-term weather-health relationships extrapolated to future climatic patterns. Modeling is based on the established association between climate factors and a specific health outcome. Modeling is a useful tool for predicting the future, but within limits.

Dr. Banalata Sen

National Institute of Environmental Health Sciences (NIEHS), USA

Community-Based Participatory Research

Community-based participatory research (CBPR) uses local knowledge and experiences to improve quality and validity of research, and brings together partners with diverse skills, knowledge, expertise and sensitivities to address complex problems. With a community-engaged research approach, communities are seen as partners and collaborators, and members are viewed as participants, not as research subjects.

NIEHS has assumed a leadership role in developing and implementing novel CBPR programs that address a broad range of social and physical environments, health outcomes and intervention strategies. Challenges encountered in CBPR are funding, multi-disciplinary research focus, barriers to developing partnerships and divergent expectations.

Community-based research efforts do not receive the same attention or resources as laboratory-based research. This challenge is particularly difficult for junior researchers, because they must exhibit their productivity to be considered for tenure. Schools of public health and government agencies can begin to address this challenge by developing incentives for their researchers to pursue more community-based research efforts.

With communities vested in research projects, researchers and funding institutions have a better chance of receiving quality data. Community participation increases the community's understanding of disease risks. Knowledge of problems can encourage community members to take ownership of the intervention, thereby leading to sustainable solutions. It builds capacity of communities and empowers them to address their problems.

Dr. Pawan Taneja

Indian Institute of Public Administration (IIPA), New Delhi

Mixed Methods Research

Research in climate change and human health is increasingly becoming complex, and the use of the right methodology for investigation has become a challenge. Mixed method research offers a solution. Research paradigm frameworks depend on the kinds of information used and the nature of truth.

Mixed method design types are triangulation, embedded, explanatory and exploratory. All these study designs have different attributes in terms of variants, timings, weighting, mixing and notation. For example, embedded has two variants: embedded experimental and embedded co-relational. Mixing is by embedding one type of data within a larger design using the other type of data. Timing can be concurrent or sequential, and weighting is unequal. It mixes both quantitative and qualitative data.

Dr. Shikha Dixit

The INCLEN Trust International, New Delhi

Spatial Epidemiology in Indian Context

Spatial epidemiology is the description and analysis of geographic variations in disease with respect to environmental, demographic, behavioral, socio-economic, genetic and infectious risk factors. Its tools are maps, geographical information system, remote sensing and global positioning system. Its major application is for small-area analyses, disease mapping, geographic correlation studies, disease clusters and clustering ecological studies.

SOMAARTH GIS is one of the major components of Demographic Development and Environmental Surveillance (DDES). At present, SOMAARTH's spatial databank contains a digital, geo-coded and dynamic database of about 200,000 individuals. SOMAARTH GIS is constructed mainly as a research and training platform to study environmental exposure and composition into large cohorts and study design.

SOMAARTH GIS contains thematic geospatial database pertaining to built and food environments, physical environment, access, health facilities, land use and land cover, neighborhood characterization and false color composite. Positional accuracy, attribute accuracy and temporal changes are data accuracy elements. There are challenges in terms of technical issues (data availability and quality, and exposure mapping) and manpower issues (lack of skill and knowledge, attrition and changing responsibilities).

Dr. Umamaheshwaran Rajasekar

Taru Leading Edge, New Delhi

GIS-Driven, Real-Time Disease Surveillance

The present disease surveillance system in India, IDSP, has coordination issues. GIS-driven, real-time disease surveillance has a number of challenges. For example, breeding sites and symptoms are currently tracked by different parties. There is a difficulty in identifying patients and limited connectivity as well as power.

One solution is to adopt the unified system, which will track both vector breeding sites and disease cases. The use of a combination of identity methods—such as mobile number, location and unique patient IDs—by the system can solve problems in identifying patients. Connectivity problems can be solved by a mobile app that is designed to use minimal battery life and syncs only when a reliable data connection is present. The application includes the ability to track health workers, and to ensure all data is entered in the mobile application, ensuring accurate and timely information. SMS-based reminders make it easy to track active disease cases and follow up.

Dr. Ramesh Dhiman

National Institute of Malaria Research (NIMR), New Delhi

Case Study: Climate Change and Vector-Borne Diseases

Malaria, Filariasis, Kala-Azar, Dengue, Chikungunya and Japanese Encephalitis are the major vector-borne diseases (VBDs) in India. A malaria epidemiological triad is one way to understand the association between climate change

and VBDs. This is analogous to all VBDs, and involves the development of insects, as well as the development of pathogens in insect vectors that are affected by climatic conditions. The relationship of temperature and relative humidity with malaria parasite and mosquito development is studied.

In the Indian Council of Medical Research (ICMR)-funded project, there is evidence-based assessment of biophysical determinants of malaria in the north-eastern states of India and the development of a framework for adaptation measures towards malaria control under a climate change scenario. Besides the earlier baseline, a vector density shift is also being seen in terms of time from April to May, and in terms of altitude from plains to hills.

There is a need to undertake situation analysis to figure out the knowledge/operational gaps in the current status of any VBDs. One challenge is that climatic determinants of all disease vectors are not known. Then, there are additional challenges like the lack of meta data at the sub-district level, dynamics of indoor, outdoor and water body temperature in vector ecology, and a poor understanding of disease modeling and social determinants (such as migration and socio-economic factors) of disease.

DISCUSSIONS/ SUGGESTIONS

Community participation requires trust building, which takes time. The upside and downside of data collection by engaging the community in research and data collection was discussed.

There is a need to strengthen epidemic intervention, assess threat for particular diseases, and connect exposure and pathways with outcomes.

The advantage of using mobile applications to collect real-time data in a disease surveillance system, and the associated challenges, was discussed.

It is important to validate the data through triangulation.

Session 4

Policy, Systems and Finance

Chair: Dr. Ramesh Dhiman, NIMR, India

Dr. Satish Kumar

National Health Systems Resource Centre (NHSRC), New Delhi

Integrating Climate in Health Policy

Tackling climate change could be the greatest global health opportunity of the 21st century due to the co-benefits of climate change mitigation strategies and promotion of a low-carbon economy. Climate change is part of a wider 'syndrome' of large-scale, human-induced environmental changes, many of which influence each other. Many major determinants of human health, wellbeing and social stability (for example, food supplies and water availability) are influenced jointly by climate change and other environmental stressors.

No policy can be climate neutral. There is an intersection of policy initiatives in energy, transport, climate and health. The National Environment Policy (2006) recognizes the health of people as its central pillar. In addition, there is India's Integrated Energy Policy (2006), National Action Plan on Climate Change (2008) and National Water Policy (2012). The Ministry of Health and Family Welfare, Government of India, initiated in 2014 the 'Health in All' policy and the concept of 'health cells' in 14 key ministries and departments.

The draft National Health Policy acknowledges the effects of extreme weather events and proposes mitigation strategies. It advocates coordinated action in seven priority areas, including reduction of indoor and outdoor air pollution. It also places emphasis on the school curriculum of the School Health Program to include environment-friendly and health-promoting behavior. Since capacity-building and skill-building at each level is essential to mitigate the effects of climate change, the health sector must widen its field of vision in order to play a substantive role in the policy discourse to forge effective links with other government sectors.

Ms. Suruchi Bhadwal

The Energy and Resources Institute (TERI), New Delhi

Integrating Health in the Climate Agenda

IPCC projects that have a high probability of increase in human morbidity and mortality are associated with changes in temperature and precipitation patterns, as well as with an expected rise in the frequency and intensity of extreme events. Population growth, standard of living, access to clean water and sanitation, improvements in healthcare, disease prevention and control programs, etc., further determine the magnitude of these climate-related health outcomes.

Populations at the margins of the current distribution of diseases are predicted to be particularly affected. In order to integrate health in the climate agenda, we need to create the right 'institutional environment'. This can be done by restoring international consensus on the issue, forming alliances with international organizations and building a scientific case.

At the national level, we need to create a [network/ climate advisory] group. This should comprise key institutions, and it should periodically update the government as well as a Climate and Health Mission, outlining/prioritising areas of action. A committee was constituted by the MoHFW in early-2015 to assist in drafting of the Mission.

Expansion and improvements in water, sanitation and, most importantly, healthcare facilities must be prioritized in regions with high rates of incidence of climate-sensitive diseases or deficiencies in healthcare delivery. Systems of disease surveillance and monitoring, as well as health data collection, need to be strengthened. There is also a need to improve the quality of epidemiological data in terms of the periodicity of collection and extent of coverage. We also need to build capacity through sustained measures by practical training of health sector staff to increase awareness on, and response capacity to, potential impacts on human health.

Dr. Sanjiv Kumar

National Health Systems Research Centre (NHSRC), New Delhi

Climate-Resilient Health Systems

Climate resilience is part of the WHO Framework, and the NHSRC framework. In such frameworks, there are system building blocks: leadership, healthcare financing, health workforce, medical products and technologies. Then, there

are outcomes: improved health, responsiveness, financial risk protection and improved efficiency.

While developing such a framework, coverage, quality and safety are considerations. Coverage across the full continuum of care, financial protection, access and quality are the keys to building an effective referral system and capacity across levels of the system.

There is also a need for synergies with other relevant priority public health programs. A case in point is TB and diabetes. Diabetes can worsen the clinical course of TB, and TB can worsen glycemic control in people with diabetes. Individuals with both conditions, thus, require careful clinical management. Strategies are needed to ensure that optimal care is provided to patients with both diseases: TB must be diagnosed early in people with diabetes, and diabetes must be diagnosed early in people with TB.

For a climate-resilient health system, we need early warning on increase in climate-sensitive diseases. We also need laboratory services, human resources for health, appropriate technologies, disaster as well as emergency preparedness and response, standard treatment protocols for climate-sensitive conditions, and universal healthcare, with a focus on the poor and the marginalized, who are the worst affected by climate change.

Dr. Charu C. Garg

National Health Systems Research Centre (NHSRC), New Delhi

Financing Climate Impacts and Adaptation for the Health Sector

Financing for climate adaptation for the health sector includes:

- Preventive measures: avoiding natural calamities through early warning systems, safer housing, improving air quality, etc.
- Investment in public health, especially for diseases directly impacted by climate change: provision of clean drinking water and sanitation, food security, vector control and improved surveillance.
- Financing for health impacts of climate change: strengthening health systems, emergency management plans for health systems to address health impacts from sudden disasters, and reducing out-of-pocket payments of households to avoid impoverishment and catastrophic health expenditures.

Globally, money from the Special Climate Change Fund (SCCF) is available to reduce health vulnerability caused by current and future climate change. Examples are disaster risk management and prevention, water and health, including monitoring disease vectors. The Adaptation Fund—financed from 2% certified emission reduction—supports concrete adaptation projects in developing countries.

The Ministry of Earth Sciences provides funds for early warning systems (for tsunami, floods, extreme weather conditions, cyclones, etc.), and assessment of air pollution as well as water sources. The Ministry of Health and Family Welfare provides funds for emergency medical relief in disasters, natural or manmade. The Ministry of Drinking Water and Sanitation provides funds for potable water, water quality monitoring and surveillance. A sum of 2.6% of GDP is spent for adaptation outside the healthcare boundary, which can be used for preventive care to obviate the impact of climate change on health. There is a need for health system-specific adaptation to combat the increasing incidence of diseases that are directly or indirectly due to climate change.

DISCUSSIONS/ SUGGESTIONS

The role of the government, international agencies, civil society and people in the process of formulation of policy and implementation was discussed.

Evidence must be brought to the policy level to translate it into policy.

Adequate measures should be taken to guarantee translation of policy at the ground level.

It is of utmost importance that health, meteorological and disaster departments collaborate and coordinate for risk mitigation.

Session 5

Vulnerability

Chair: Dr. John Balbus, NIEHS, United States

Dr. Rais Akhtar (in absentia)

International Institute of Health Management Research (IIHMR), New Delhi

Vulnerable Regions

The assessment reports of IPCC 2007 and IPCC 2014 assert that the world will face more extreme events: intense heat waves, heavy precipitation and flooding. All regions, developed and developing, are vulnerable to climate change. Several developed countries, including the United States, United Kingdom, Russia and Austria, are disaster-prone countries.

Change in climate leads to a change in trend and pattern of vector-borne diseases. India is seeing a lower incidence of malaria, but a greater proportion of plasmodium falciparum malaria, particularly in the most vulnerable eastern and north-eastern states. This is a cause for concern. In 1994, heavy precipitation in the deserts of Rajasthan led to flooding, and resulted in malaria outbreaks.

In a nutshell, both developed and developing regions are vulnerable to climate change. Economic empowerment through the distribution of benefits of development—with the focus being not GDP but the Human Development Index—may minimize vulnerable conditions. Infrastructure development, as well as access to safe drinking water and health, are also important in the process of adaptation. Efforts should be directed to strengthen disease surveillance and weather forecasting systems.

Dr. Gita Pillai

Urban Health Initiative (UHI), Lucknow

Vulnerable Populations

The urban population of India is currently estimated at 30%, or 286 million people. By 2030, this is projected to increase to 41%, or 575 million people. About 75% of the urban population is poor. Big, and growing, gaps in basic services impact the poor disproportionately.

In order to reach vulnerable populations, the first step is to identify cities and towns whose population is below 50,000. The second step is to find, map and list slums where the urban poor live. The third step is to map accredited social health activists (ASHAs) so that they can identify people in need of services, and further counsel, refer and follow up to make sure that their needs are met. Organizing community health days and support groups can also help.

The fourth and final step is to make service providers and facilities available to those who need it. Facilities should be functional and monitored for quality. For example, vulnerability mapping and outreach is associated with meeting needs for family planning. There should be facilitated counselling by

ASHAs, counsellors and providers. Information on places, providers and prices should be publicized on both electronic and print media.

Dr. Nitish Dogra

Taru Leading Edge, New Delhi

Vulnerability Indices

Climate drivers through different exposure pathways affect health outcomes. In order to develop a climate vulnerability index for the health sector in India, we need an exposure indicator that remains constant, a sensitivity indicator (such as population density) and adaptive capacity indicators (such as human development index and public health preparedness).

Once a vulnerability index is prepared, the next step is planning at the state/district/sub-district levels, choosing best indicators for each outcome, and allocating weights for indicators, categories and outcomes. It is important that vulnerability considers community factors. Only if we start thinking of a paradigm shift from prevalence to vulnerability that vulnerability indices can be a critical decision-making tool.

Ms. Upasona Ghosh

Institute of Health Management Research (IIHMR), Kolkata

Case Study: Health Facility Access in Cyclone Affected Sundarbans

There have been scientific debates on the reasons for climate change in Sundarbans. There has been a rise in sea levels (17.8 mm/year between 2000 and 2009, according to a 2010 report from the School of Oceanographic Studies of Jadavpur University). There's also erratic rainfall and an increase in sea surface temperature (SST) in Sundarbans for all three seasons, namely pre-monsoon, monsoon and winters (IMD, 2009).

The challenges in accessing healthcare services in Sundarbans include physical inaccessibility, unaffordability and change in health-seeking behavior (preponderance of informal providers). On an average, it took 30-40 minutes to reach the nearest delivery facility in the non-deltaic and the deltaic portions of the study block. It was found that the access scores for blocks in the deltaic or the river-locked region in the block were lower than the region that was land-locked.

Climate-induced livelihood transition has aggravated the cost of care. For example, saline water intrusion in agricultural fields has resulted in crop loss. Salinity intrusion in pond waters is hampering fishing. This is causing an increase in out-migration of the male population in search of alternatives, etc.

In order to address change in health-seeking behavior, we need interventions by two crucial non-state players: NGOs and rural medical practitioners. Another alternative to a multi-sector approach towards health should incorporate climate-induced livelihood transition, food security and infrastructural development. Scientific evidence should be generated and the system should act on it, especially when it concerns the more vulnerable groups within the already vulnerable Sundarbans.

DISCUSSIONS/ SUGGESTIONS

Boat clinics can be the solution to increase healthcare access among vulnerable population in Sundarbans.

Quacks/untrained medical practitioners are the first point of contact in villages and people trust them. So, perhaps, there is a need to engage with them in the system. They could be trained in basic care and made aware of when they should refer a patient to a facility.

The evidence from Sundarbans is being used to make a case with the Department of Health, West Bengal, to roll out a specific health plan for the people of Sundarbans. Research institutes are also trying to highlight the issue in leading newspapers.

Session 6

Adaptation

Chair: Mr. G.K. Bhat, Taru Leading Edge, Ahmedabad

Ms. Sreeja Nair (in absentia)

National University of Singapore (NUS), Singapore

Climate Proofing of the Health System

Climate risk proofing is a tool to reduce climatic risks in developmental objectives and integrate adaptation options within the program (Tanner et al, 2007). Climate-proofing marks a paradigm shift from a 'reactive' to a 'proactive' approach. The tool analyzes the current and future risks to the objectives of the health program, the existing measures and the potential opportunities for climate risk management and adaptation as well as the cost-benefit analyses of selected adaptation interventions.

Climate risk screening selects high-risk health projects and includes sensitization and awareness generation of the program designers. Implementers are a key outcome.

Its process for a health program has six steps:

1. An overview of the health program's objectives and activities.
2. Identify current and likely future impacts of climate change on meeting program goals.
3. Identify ways in which program activities currently contribute to vulnerability reduction, managing of risks and building of adaptive capacity of vulnerable populations.
4. Identify opportunities to incorporate further climate risk management into the program through disaster risk reduction and climate change adaptation activities.
5. Prioritization of the selected adaptation options based on a range of criteria (multi-criteria analysis).
6. Development of cost-benefit analyses for select adaptation options where sufficient data is available.

Climate proofing of health programs can enable planned adaptation and better preparedness of communities that are vulnerable to health impacts of climate variability and change. The objective of climate-proofing is also to bring out the potential entry points for specific climate risk management measures.

Mr. Anup Karanth

Taru Leading Edge, New Delhi

Safe Hospitals

Hospitals provide life-saving services in the immediate response to emergencies. The large investment in hospitals must be protected from damage and disruption. Hospitals are critical community assets and important symbols of social well-being. Safe hospitals are central to the global target to substantially reduce disaster damage to critical infrastructure and disruption of basic services, including health and educational facilities, by 2030.

The Sendai Framework calls to strengthen critical facilities (particularly schools and hospitals). It advocates disaster risk prevention and reduction measures, and promotes the resilience of new and existing hospitals and other health facilities. Interdependency is the most important attribute of critical infrastructure.

A comprehensive safe hospital framework has select components: policy, norms and legislation, coordination and service delivery, resources management, and knowledge and information management.

Smart hospitals are safe and green. In order to build smart hospitals, the structural safety of the facility and air quality

should be improved, and structures should be equipped with environment-friendly appliances. Green operations will also improve smartness. This means using less paper and recycling; generating less waste (solid or otherwise) and pharmaceuticals, and disposing it off properly; using environmentally-benign chemicals, as well as more locally and sustainably produced food.

Dr. Vikas Desai (in absentia)

Urban Health and Climate Resilience Centre (UHCRC), Surat
Presented by Dr. Akash Acharya, Centre for Social Studies (CSS), Surat (in picture)
Community Resilience

The concept of resilience to ecology and the environment was introduced in 1973. Surat has a population of above 5 million. It has an urban health university. It has seen the introduction of strategies from the 100 Resilient Cities program to build a resilient, sustainable city.

The Urban Health and Climate Resilience Center (UHCRC) is the first knowledge hub of urban health and climate resilience. It is governed by the Surat Climate Change Trust (SCCT), its operational execution is by the health department of the Surat Municipal Corporation (SMC), and it is supported by the Asian Cities Climate Change Resilience Network (ACCCRN). Its current focus is on disease and climate surveillance, city vulnerability, intra-domestic environment and vulnerability, as well as community participation.

Community inclusive resilience process is built phase-wise as learning, facilitating and sustaining. It ranges from state/district to individual member. Resilience study dimensions are base level, factors, capacity to enhance, process, actors and impact. Resilience and community are difficult to define, and the definition varies from time to time, place to place, situation to situation. City resilience actors include administrators, corporates/philanthropists, community, academic institutions, NGOs, CBOs and VOs, among others. The urban health system is a strong base of community health resilience. Understanding, educating, encouraging and involving community for participation is the key to community health resilience.

Parthasarthy Ganguly

Indian Institute of Public Health (IIPH), Gandhinagar
Case Study: Ahmedabad Heat Action Plan

India has projected increases in air temperature of about 2-4 degrees by 2030. Yet, heat stress is an understudied area of climate change, especially in tropical countries. Until 2013, heat wave was not considered a natural disaster by the Indian government and the National Disaster Management Authority (NDMA).

In Ahmedabad, which has a population of 6 million, the annual average of maximum temperatures has been increasing steadily over the past 30 years. IIPHG and NRDC entered into MoUs with the state of Gujarat and the city of Ahmedabad (AMC) for collaborative work on heat and health. The objective of the Heat Action Plan is to provide an evidence base to ensure a buy-in from policymakers on implementation of heat mitigation efforts with documentation, evaluation and dissemination, and ultimately scale-up.

A key finding of a heat vulnerability survey done in slums was that such communities are vulnerable to effects of heat, and are unaware of temperatures and extreme heat. The success of this plan can be attributed to the strong partnership and communication between various institutions. Scaling up has been done in Surat, Nagpur and seven other cities in Central India, Odisha state in the East, Hyderabad city and Telangana state in the South. There are ongoing discussions with the Ministry of Health, NDMA and IMD for national replication.

DISCUSSIONS/ SUGGESTIONS

During emergencies, hospitals provide relief to victims, and hence need to be resilient to extreme weather. Unfortunately, in most disaster-prone areas, they too are vulnerable to disasters.

WHO states that all health facilities—hospitals, laboratories and clinics—need to be made disaster resilient.

Rigorous checks happen in bigger hospitals in cities. But this does not happen in all hospitals. There should be a body to check if hospitals are robust or not.

The Heat Action Plan in Ahmedabad was a success due to the active participation of government departments and strong political will. Keen interest by the commissioner catalyzed the coordination between government departments, private sector, academia, civil society and the public.

Session 7

Co-Benefits

Chair: Prof. Kirk Smith, University of California at Berkeley, United States

Prof. Kirk Smith

University of California at Berkeley, United States
Household Energy, Health and Climate: Introductory Talk

A policy or measure aimed at one objective might have positive effects on other objectives, irrespective of the net effect on overall social welfare. Climate mitigation and adaptation efforts benefit other sectors such as health, urban development, transport, employment and agriculture. Another term used is 'ancillary benefits'. On the other hand, cross benefits are those that are good for health, but not for the climate. For example, the reduction of sulfur emissions from fossil fuel combustion is a major health benefit, but it is also a major climate disadvantage.

Wood smoke has a number of harmful and toxic pollutants, including CO, NO2, hydrocarbons, and the like. Since the combustion efficiency is far less than 100%, it results in increased toxicity. Although chulha (traditional Indian cooking stove) use has declined as a proportion of population, due to the dynamics of population growth, the overall chulha use has remained static at approximately 700 million.

Ongoing efforts are attempting to link the benefits of chulha use with the carbon market since there are benefits to the climate. A Global Alliance for Clean Cook-Stoves was formed in 2010 to expedite this endeavor. Improvement in fuel use has occurred but the cleanest models have been disseminated only to a few tens of thousands of households. Also, so far, no biomass stove in the world is truly health protective for household use. Since, by 2050, the risk in higher emission scenarios will exceed conceivable adaptation potentials, it is imperative to take mitigation action today.

Dr. Sagnik Dey

Indian Institute of Technology (IIT), New Delhi
Outdoor Air Quality and Health

Household air pollution and ambient particulate matter had been reported as one of the substantial contributors to India's mortality burden in 2013. Air quality change (in terms of particulate matter) is projected to peak between 2030 and 2040. As per the future shared socio-economic pathways, five groups are defined:

SSP1: Sustainability; development achieved with reduced dependency on fossil fuels

SSP2: Middle of the road; fossil fuel dependency slowly reducing

SSP3: Fragmentation; countries with large populations and minimum resources struggling to maintain living standards
SSP4: Inequality; a small, rich, elite group causing most greenhouse gas emissions and the larger, poor group suffering its consequences; adaptation is difficult
SSP5: Conventional development; rapid conventional development poses challenges to mitigation

- The maximum population would fall under SSP3.
- Risk functions have been developed for PM 2.5 mass.

Risk functions are not well-known for other criteria pollutants. A framework for integrated exposure includes ambient and household (rural versus urban; male versus female). Source-specific exposure should be addressed for maximal benefit. In multi-pollutant exposure, we should know about the modality of interaction. There is a need to create a common data platform across India for cause-specific mortality/morbidity data. Climate data is now available from IMD and similar efforts are expected from the health sector.

Dr. Anuradha Shukla

Central Road Research Institute (CRRI), New Delhi
Climate Change and Co-Benefits of Road Transport Facilities

Road transport is the major transportation mode in India, choking cities and causing a huge increase in parking demand. The number of registered vehicles has also gone up, increasing the pressure on existing transport infrastructure. Road transport impacts environment negatively by creating noise, vibrations, and emission of air pollutants (PM, SO2, VOC, CO, etc., and GHGs).

A number of health outcomes are associated with transport-related air pollutants. For example, there is a risk of respiratory diseases from VOC, CO and black smoke; cancer risk from nitrogen oxide, diesel exhaust, etc. All combustion sectors are interlinked, which leads to the concept of co-benefits for better air quality in cities. For example, a program to improve the fuel economy of vehicles by increasing vehicle speeds, by reducing the number of vehicles on the roads, will result in a systemic reduction of all pollutant emissions.

There is a need for synergies between air quality and climate change, and the added benefits of an integrated approach, along with a multimodal public transport system. There is an urgent need to analyze public health and environmental benefits of integrated strategies for GHG mitigation and local environmental improvements in developing countries like India.

Mr. S. A. Verma (In absentia)

Delhi Metro, Delhi
Case Study: Best Practices in Mass Rapid Transit Systems (Presented by Mr. Varun Kumar Singh)

In 2015, the Delhi Metro Rail Corporation (DMRC) had six functional lines and 151 stations, and it ferried 2.5 million commuters per day. It's average ridership has increased by 156%. There are seven DMRC policies that relate to environment: sustainability in motion policy, water policy, quality policy, energy management policy, waste management policy and environmental policy.

The UN has certified Delhi Metro as the first metro rail-based system in the world to get carbon credits for contributing in reducing pollution levels in the city—5.15 lakh Certified Emission Reduction (CERs) every year for modal-shift project and 44,000 CERs for regenerative braking. Delhi Metro has significantly contributed to GHG reduction in the urban environment of Delhi.

The effect of metro during operations on surrounding environment is an area of study. We also need to correlate how commuting through metro affects the health of commuters, and consequently the overall impact on mortality and morbidity rate in a city.

DISCUSSIONS/ SUGGESTIONS

There is a need for a multi-modal integrated public transport system to wean away people from private vehicles to public transportation.

Evidence shows that pollution has reduced since the inception of Delhi Metro. Inside the underground Delhi Metro, air quality is richer due to air filters, as compared to elevated metro stations.

Session 8

Inter-Sectoral Action for Climate and Health

Chair: Dr. Banalata Sen, NIEHS, United States

Mr. Pramod Deshmukh

Sanskriti Samvardhan Mandal, Nanded, Maharshtra
Agriculture

Climate change affects human health as a result of degraded quality and quantity of air, water and food. Direct impacts on human health due to these factors lead to market-oriented agriculture. This results in over-exploitation of natural resources, leading to overuse of chemicals. This further causes degradation of quality as well as quantity of food and water, ultimately affecting human health adversely. And so this vicious circle is created.

The ultimate aim of mitigating climate change should be health equity. In the agriculture sector, this can happen in two ways: eco-friendly agriculture and restoration of ecosystem. Eco-friendly agriculture can be achieved through indigenous seeds, organic farming and weather-based cropping. Restoration of ecosystem (watershed development) can be done through soil conservation, water harvesting structures, forestations and prevention of free grazing, change in cropping patterns, judicious use of water, biodiversity conservation and the use of non-conventional energy. Eco-friendly agriculture and watershed development together will ensure sustainable improvement in quality and quantity of air, water and food.

Mr. Shailendra Kumar Mandal

National Institute of Technology (NIT), Patna
Water

The scale of the water supply problem is increasing exponentially. By 2025, two-thirds of the world's population is predicted to live under 'water-stressed' conditions, while about 1.8 billion people will suffer from absolute water scarcity. As a result, climate adaptation, in various forms, is increasingly becoming part of the mainstream planning agenda in many regions of the world.

Groundwater accounts for over 65% of irrigation water and 85% of drinking water supply. Around 60% of groundwater sources will be in a critical state of degradation within the next 20 years. Local observations of annual water table decline exceeding 4 meters are common throughout India.

The per capita water supply in Patna Municipal Area (PMC) is 107 liters. The water supply in Patna Urban Area is through a battery of tube wells. As per a study conducted by the National Institute of Urban Affairs (NIUA), 75% of the population had a piped water connection. However, due to low water pressure and a poor supply system, around 40% of the population had both a private and public connection.

The main problem with the existing system is non-uniform supply in different areas and contamination due to various leakages. Unaccounted water loss is above 40% due to a poor and old supply network. Another problem is of arsenic content in water in areas surrounding the second layer of geological strata. Other issues are highly subsidized water supply, high operation and maintenance cost.

All water managers need to plan for resilience. The urban poor are particularly vulnerable as their capacity to adapt is much lower. The key to improving resilience will be to improve governance and the capacity of water managers in urban water. We need to draw attention to the critical role of groundwater and its management. Communication and sharing information is also vital.

Dr. Shyamala Mani

National Institute of Urban Affairs (NIUA), New Delhi
Urban Management

India is not a highly urbanized country: 31% as per the 2011 census. But in absolute terms, India's urban population is 377,105,760, which is more than the total population of the US. Urbanization leads to an increase in energy demand, inflation, and threat to property and infrastructure. It also results in an overall increase in

health burden, with increased risks of heat stroke, respiratory, water- and vector-borne diseases. There is also a threat to the environment as a consequence of urbanization in the form of deterioration of air, water and land.

NIUA is currently implementing the Urban Climate Change Resilience (UCCR) project, supported by the Rockefeller Foundation under the ACCCRN program. There are four key elements that make a city livable: water and sanitation, urban drainage, built environment and health.

Water pollution and contamination is one of the major problems. Municipal solid waste, if not disposed properly, can lead to problems like methane release, sub-soil pollution and blocked drainage. Threats to urban regions are drought, rising sea levels, cyclones, floods, landslides, water quality and shortage, and heat and cold waves.

In order to manage water demand, efficient water fixtures must be used. There should be greater use of treated waste water and leakages in the water supply system should be plugged. For sanitation too, alternative and innovative ways should be adopted: for example, anaerobic digester/biogas linked toilets, separate drainage and sewage network, and ensuring toilets for all (that is, no open defecation). There must be proper solid waste management, with composting, recycling and reusing, and provision of sanitary landfill sites. We need to upgrade the urban health system, ensuring sufficient emergency staff and aid, as well as a coordinated response.

DISCUSSIONS/ SUGGESTIONS

In Gujarat, with subsidization of electricity, water tables depleted astoundingly. Hence, it is important to study such links between electricity tariff and depletion of water tables. In the Patna study, this aspect was not considered, though water is free for all.

Even if their RWAs are hesitant, communities can approach agencies to manage their waste and recycle it.

A number of problems have arisen due to chemical farming, mono-cropping and growing cash crops. It is market-driven. So, again, it is difficult to convince farmers to return to organic farming.

Session 9

Communication and Advocacy

Vismita Gupta-Smith

World Health Organization, South-East Asia Regional Office, New Delhi, Communication and Advocacy

The first challenge faced by speakers while communicating to their audience is to understand, and to be able to answer the question: why? SOCO, or Single Overarching Communications Outcome, is the change you want to see in your audience from your communication. It is the fixed point on which to keep your mind when communicating.

You should develop messages to achieve SOCO only after considering the needs and nature of your target audience. SOCO is an outcome, and must therefore be expressed from the perspective of the audience; it is not an objective, which usually reflects your perspective. It must be explicit about the change you seek, it must be time-bound, and it must be realistic and achievable.

We are trained to be logical, complete and accurate. We fear being misunderstood, and this is the second challenge. For example, scientists, while speaking, usually communicate the message in the end. So, when communicating a state of pandemic, a scientist is likely to say: "WHO has confirmed an outbreak of a flu-like illness...with these symptoms and in the following countries...the lab analysis confirms a new virus...this means people have low or no immunity...we are in a pandemic." The correct way should be: "Scientific evidence confirms the world is experiencing the first influenza pandemic of the Century. We are working closely with experts from around the world to understand this new disease, prevent illnesses and deaths, and take action to stem its effects on society. We will continue to share information with you as we confirm it. Be assured the world is better prepared than ever for such an event. We are all in this together, and together we will do our best to prevent suffering and to save lives as the pandemic unfolds." It means getting to the point in the beginning itself.

The third challenge we face in communicating is we often fail to understand why our message is important to our listeners and focus on what we know. Today, a person is subjected to more information in a day than a person in the middle ages over their entire life. So, the information you design for your audience must clearly show the benefit of the actions you are asking your audience to take.

If they don't see the benefit, if it's not articulated to them

clearly, they probably won't absorb your message—and they are unlikely to follow your recommendations.

These are the 10 golden rules while communicating with the media:

1. Never lie.
2. Never say "no comment".
3. There is never an "off the record".
4. Be short, get to the point and always think of the audience.
5. Stay calm and confident.
6. Use simple language, avoid jargon.
7. Stay in control.
8. It is alright to say, "I don't know, but I'll find out".
9. Don't speculate.
10. Beware of reporters' tactics.

Group Activity 1

All participants were divided into four groups as per their respective zones of North, South, East and West. They were given the SWOT analysis of the 'Haryana State Action Plan on Climate Change'. All groups actively participated in the group activity.

- Almost all groups identified the plan's strengths to be the presence of a disaster risk reduction plan, investment in research and development, and vulnerability profiling. Funding was seen as a strength in that funds are allocated to different fields, enabling better inter-sector convergence—mobilizing expertise from different fields to come together.
- One group mentioned the absence of a situational analysis of the existing system as a weakness. Some other weaknesses identified were the plan being unrealistic, no mention of co-benefits, alerts and adaptation, and lack of clarity on time commitments. There could be the possibility of poor programme output.
- Inadequate political commitment was considered a major threat. However, one group identified political commitment as an opportunity. It credited political will for conceiving this initiative, to develop a plan with allocation of funds and the intention to bring together different sectors to address the impact of climate change on health.
- According to the groups, the plan provided an opportunity to strengthen disease surveillance. One of the groups stated the need for the development of a high-resolution climate and health model.

Group Activity 2

Again, all participants were divided into four groups as per their respective zones of North, South, East and West. Each group drafted a proposal. All groups actively participated in the group activity.

The four groups were given different themes to develop research proposals such as on climate and health vulnerability. The idea was to address the principles of grant writing. All four groups were able to appreciate the concepts and the need to work with colleagues across disciplines.

Networking and Partnerships

Moderator

Dr. Banalata Sen, NIEHS, United States

Dr. Diya Dutt, United States-India Educational Foundation (USIEF), and Dr. Smriti Trikha, The Indo-US Science and Technology Forum (IUSSTF), were present for the networking and partnership session. The aim of the session was to have an open discussion around collaboration between Indian and US universities for research on climate change and its impact. Participants were informed about various educational opportunities offered by US universities for doctoral and post-doctoral programs. The platform provided a partnership opportunity to Indian researchers to collaborate with US universities on the subject.

Valedictory

The three-day event came to an end with a brief address by Dr. Kayla Laserson, Director, CDC India Country Office. Dr. Laserson and Dr. Balbus handed over the certificates to the participants. Lastly, Dr. Dogra congratulated the participants and delivered the vote of thanks.

UCHAI Continuing Activities: a Year at a Glance

On 21 September 2016, UCHAI completed one year of its activities with a National Consultation on Heatwave Management in India. During this last year, the initiative has functioned under the guidance of the UCHAI Advisory Committee set up last year, with Dr. Sanjiv Kumar, Executive Director of the National Health System Resource Centre (NHSRC) as Chair and Dr. Nitish Dogra, Sector Adviser (Health & Nutrition), TARU, as Inaugural Member Secretary.

Partnership And Networking

Dr. John Balbus from NIEHS delivered a keynote speech at the Annual Monsoon Workshop of the IMS held at Indian Institute of Topical Meteorology (IITM), Pune in February 2016. Dr. Balbus described the UCHAI initiative including the community of practice, vision, scientific committee and the activities undertaken.

1st South Asia Climate Services Forum for Health at Colombo, Sri Lanka April 26-28, 2016

Dissemination events were held at a WMO meeting in Colombo, Sri Lanka, in April 2016 and at the University of Chicago, Delhi Centre, in September, 2016. During these events, an audience from the fields of climate change and health were informed about the UCHAI initiative model, and how it has identified and organised major players to support evidence and capacity building, using e-groups and social media to keep partners connected.

- The UCHAI Advisory Committee had a brainstorming meeting in February 2016, where officials of the Department of Science and Technology (DST), Indian Meteorological Society (IMS) and WHO were also invited.

Dr. Nitish Dogra making a presentation on UCHAI Network to the audience at the University of Chicago Delhi Centre

- UCHAI formally partnered with IMS for the UCHAI workshop held last year as well as the National Consultation on Roadmap for Planning Heatwave Management in India on 21 September 2016.

Communication/Outreach

- The primary communication mechanisms for internal communication are WhatsApp and group mails. These have already been established. There are currently 50-plus members in the UCHAI WhatsApp group and our listservs reach out to 100-plus participants of the UCHAI workshop.

- For external communication, a website and Facebook group have also been launched. The latter will also be used for internal communication.

Webinars

NIEHS supported 3 webinars in the past year. TERI received support for a webinar on Sustainable development and another one pertaining to intersectoral cooperation between the climate and public health sectors. TARU received support for a webinar related to heat adaptation in national and subnational levels in India. The webinars were coordinated by Ms. Meena Sehgal, TERI, and Dr. Nitish Dogra, Taru Leading Edge. Details of the webinars are available online at www.uchai.net.

Webinar 1: Sustainable Development Goals (SDGs): Hopes and challenges, 8 December 2015

- Speakers were chosen in such a way that the audience got an international and national perspective on the topic from both public policy and public health points of view.

- Dr. Banalata Sen, Program Coordinator Global Environmental health, NIEHS elaborated upon the broader vision, scope and participatory approach of SDGs in addition to showcasing the achievements of Millennium Development Goals (MDGs).

- Sir Andy Haines, Former Director, London School of Hygiene and Tropical Medicine spoke about need for linking health and environmental sustainability to achieve the SDGs.

- Dr. P G Dhar Chakrabarti, Distinguished Fellow, TERI spoke about the critical role that India must play for the world to achieve the SDGs. He deliberated upon the policy changes that are necessary to ensure this aspect.

- Dr Harshal R. Salve, Assistant Professor, AIIMS New Delhi addressed participants on the Indian perspective of SDGs

Webinar 2: Building the bridge between climate and public health, 14 March 2016

- The webinar discussed the use of meteorological forecasts for public health early warning systems.

- During the opening remarks, Dr. John Balbus, Senior Advisor for Public Health to the Director of the National Institute of Environmental Health Sciences (NIEHS) introduced webinar participants to the role of UCHAI in helping represent India's health sector to climate service agencies.

- Dr Joy Shumake-Guillemot, Officer in Charge, from the WHO/WMO joint office for Climate and Health and Ms. Anahit Hovsepyan, Scientific Officer at World Climate Applications and Services Division, Climate and Water Department, WMO, engaged participants on 'Global Framework for Climate Services and Overview of the User Forum and its Intent'.

- Prof. Dileep Mavalankar, Director at the Indian Institute of Public Health, Gandhinagar, shared his experiences on a 'Case Study of Climate Forecasts and Climate Services-Heat Health Early Warning Systems'.

Webinar 3: Integrating Heat Adaptation with Climate and Disaster Plans at State as well as National Level in India, 25 October 2016

- The webinar was planned with the need to involve experts working at international, national and state level on the specific topic in order to give a holistic picture.

- Dr. John Balbus, Senior Advisor for Public Health to the Director of the National Institute of Environmental Health Sciences (NIEHS) gave a brief overview and need for integrating heat adaptation plans with climate action plans.

- Dr Peter Berry, Senior Policy Analyst at Health Canada shared his experiences of integrating heat adaptation with climate action plan in Canada.

- Ms. Suruchi Bhadwal, Associate Director, TERI shared India's experience of integrating heat adaptation with national action plan for climate change and state level plans.

- Dr. Vikas Desai, Technical Director of Urban Health and Climate Resilience Centre (UHCRC) briefed crowd on various state and city action plans in India with a focus on Ahmedabad heat action plan.

Policy Analysis

- The UCHAI Advisory Committee is working on a paper to analyze the Health Mission within the National Action Plan for Climate Change, led by Dr. Pawan Taneja, IIPA New Delhi.

- A commentary is being drafted for submission to Environmental Health Perspectives on the relevance of the UCHAI initiative in the broader scope of climate engagement of India and United States, and also as a global exemplar.

Research

- Three concept notes for research projects related to early warnings systems, vulnerability indices and climate disasters have been submitted to DST by UCHAI committee members under a recent call.

- Another proposal under an India-EU call is also being developed in collaboration with Universite Catholique de Louvain, Belgium; University of Heidelberg, Germany; and other collaborators.

Release of the report titled 'Roadmap for Planning Heatwave Management in India' during the national consultation on planning heatwave management in India

Training

- Training material on climate resilient health facilities is being developed in collaboration with TERI.
- Customization of International Federation of Medical Students Associations (IFMSA) training material for medical students in India is underway with AIIMS.

National Consultation On Roadmap For Planning Heatwave Management In India

A National Consultation was held on September 21, 2016, on Planning for Heatwave Management in India in New Delhi. The workshop was organized by **Taru Leading Edge** in partnership with the Indian Institute of Public Health, Gandhinagar **(IIPH-G)**, Understanding Climate and Health Associations in India **(UCHAI)** and the Indian Meteorological Society **(IMS)**, supported by the Asian Cities Climate Change Resilience Network **(ACCCRN)** of the **Rockefeller Foundation** and the Climate and Development Knowledge Network **(CDKN)**.

The convenor of the workshop, **Dr. Nitish Dogra,** introduced the distinguished guests in the opening session of the workshop.

The chief guest was **Mr. Kamal Kishore,** Member, National Disaster Management Authority (NDMA). He spoke about the recognition of heatwaves as a serious threat to our society so much so that they are now seen as a disaster. He emphasized the need for urgent management measures, including indigenous solutions.

Prof. Rais Akhtar, lead author of the fourth assessment report of the Intergovernmental Panel on Climate Change (IPCC), spoke of the need for India to remain ahead of the curve in order to ensure a heat-resilient India.

Other speakers on the inaugural panel included **Dr. R.S. Dhaliwal,** Scientist F and Head, Non-Communicable Diseases at the Indian Council of Medical Research (ICMR); **Mr. Jagan Shah,** Director, National Institute of Urban Affairs (NIUA); **Dr. Dushmanta Pattanaik,** Indian Meteorological Society (IMS); **Dr. Sadhana Bhagwat**, National Professional Officer, WHO India Country Office; and **Mr. G.K. Bhat,** Chairperson, Taru Leading Edge.

All experts unanimously agreed that a national heatwave management plan for the country is urgently required as an overarching policy, while also developing city- and state-level heat action plans.

In order to guide this process, a report titled **'Roadmap for Planning Heatwave Management in India'** was released on the occasion. The report was developed under the guidance of eminent national and international experts, including those from health, disaster, urban planning and environment fields. **Mr. Manu Prakash,** Director, Taru Leading Edge, presented the details of the roadmap. The WHO/WMO Framework was elaborated upon by **Dr. Nitish Dogra.** An engaging debate took place during the consultation, with the following recommendations:

- The national government should formulate and adopt a national action plan on heatwave management. The roadmap developed should be used to guide this process.
- States and regional plans should be formulated and adopted.
- Inclusion of more sectors into the planning process for inter-sectoral convergence in the national action plan.
- Identifying and including research areas in the planning process.
- Identification of lead/anchor agency for preparing a national heat action plan.
- Formation of an advisory group, comprising experts from multiple sectors to aid the planning of national heat action plan.
- Effects of heat on water, transport, energy, loss of productivity and financial losses should be looked at within both urban and rural contexts, and the same needs to be updated in the WHO/WMO Framework.
- Rural planning should be given as much importance as urban planning.
- National Heat Resilient Network to be formed along with a community of practice and advisory group. Taru Leading Edge to spearhead the formation with the UCHAI initiative and other avenues.

UCHAI at the National Consultation on Roadmap for Planning Heatwave Management in India

ANNEXURE I

Advisory Committee

Dr. Sanjiv Kumar, Chair Advisory Committee, UCHAI, has 38 years of experience in public health in 29 countries in Central and South Asia, East and South Africa, Central Eastern Europe, and in academics. He worked in UNICEF as a health specialist at the state and national levels in India, and then held international positions as Chief of Health, Nutrition, Child Survival & Development and Senior Advisor, and also as Regional Advisor for 22 countries in Central Asia, Central and East Europe. He has developed leadership and strategic management courses for mid- and senior-level health officials, and supervised research projects for reputed national and international organizations. He currently heads the National Health Systems Resource Centre, which provides technical support to the Ministry of Health and Family Welfare and state governments in India. He has published about 100 papers in scientific and popular magazines, and chapters in books.

Members, Advisory Committee, UCHAI
(in Alphabetical Order)

Dr. Anand Krishnan is a Professor in Centre for Community Medicine. He also heads the WHO Collaborating Centre for Capacity Development and Research in Community-Based NCD Prevention and Control. A member of the National Steering Committee on Monitoring of National Program for Cancer, Diabetes, CVD and Stroke, he has authored 200 publications. He was awarded the BC Srivastava Award for Best Young Scientist in Community Medicine in India in 2000, the MK Seshari Award for Research in Community Medicine by the Indian Council of Medical Research in 2008, and the Harcharan Singh Oration of IAPSM in 2015.

Dr. Banalata Sen is Advisor to the Centre for Environmental Health at the Public Health Foundation of India (PHFI), where she is helping develop the Centre's portfolio of research, policy, advocacy, communication and outreach activities. She has over 14 years of experience in environmental health-related research, regulation, policy, communication and education. Prior to joining PHFI, she managed the global environmental health program at the US National Institute of Environmental Health Sciences (NIEHS), and led the training and capacity building initiatives of the WHO-NIEHS Collaborating Centre. She has served as a member of the Climate and Health working group of the US Global Change Research Program. Banalata has served as an editor, and led the education and outreach program, of the NIEHS journal Environmental Health Perspectives. At the US Environmental Protection Agency, she was involved in conduct of arsenic research, risk assessment, regulatory activities. She has worked as a consultant for WHO/SEARO and American Cancer Society, working on diverse issues ranging from pesticide use in SE Asia to community-led interventions in cancer prevention. She has received multiple awards for her contribution to agency mission at both NIEHS and the US EPA. She has a Ph.D. in Molecular Biology from Michigan Technological University and a Master's in Public Health Leadership from University of North Carolina at Chapel Hill with a specialization in global health program planning and evaluation.

Dr. Dushmanta Pattanaik has worked in climate variability and climate prediction for 18 years. He currently works in the Numerical Weather Prediction Division of IMD, New Delhi, specializing in extended range forecasting. He has contributed a chapter on Indian climatology in the context of human health in a book published by TERI in 2012 titled 'Climate Change and Disease Dynamics in India'. He is also the author of the publication 'Heat Index Outlook' over the Indian region, with its potential application to the health sector.

Dr. Harshal Salve currently works as faculty of Community Medicine at the All India Institute of Medical Sciences, New Delhi. He is a medical doctor, with a specialization in community medicine/public health from AIIMS, New Delhi. His areas of interests are mental health, non-communicable diseases, climate change, HIV/AIDS and health systems. He has 20 publications in national and international journal to his credit. Currently, he is also the editor of IDD Newsletter IQ Plus Jagriti and an editorial board member of the International Journal of Preventive and Public Health Sciences. He is also a member of IAPSM and IPHA. He has worked in health programs at the national and state levels. Currently, he also serves as guide/mentor to post-graduate students of Community Medicine at AIIMS, New Delhi.

Dr. John Balbus is the Senior Advisor for Public Health to the Director of the US National Institute of Environmental Health Sciences. He serves as the Department of Health and Human Services Principal to the U.S. Global Change Research Program and also co-chairs working groups on Climate Change and Human Health for the US Global Change Research Program and for the National Institutes of Health. He was a lead author on health for the US National Climate Assessment and a Review Editor on Urban Areas for the 5th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). He is currently leading an initiative on Sustainable and Climate Resilient Health Care Facilities as part of the US President's Climate Action Plan. Dr. Balbus received his MD degree from the University of Pennsylvania, his MPH degree from the Johns Hopkins School of Public Health, and his undergraduate degree in Biochemistry from Harvard University.

Mr. Manu Prakash is the Director and Practice Head of Policy and Public Services at Taru Leading Edge. He has rich experience of working especially within urban development, water, sanitation, health, environment, livelihood, sustainability, and governance spaces; with institutions like TARU, World Bank, UNICEF, UNDP, CARE, ILO, and Government of India. With a Master's degree from the Delhi School of Economics, he has contributed extensively to the development sector through designing and implementing large-scale community-driven programs, policy analysis and advocacy initiatives. Within the climate space, he has been guiding the process of strengthening the climate and health movement in India through UCHAI and other initiatives. Manu has also led the process of national roadmap development for 'Planning Heatwave Management in India'. He has also authored and co-authored many sector documents, reports and papers on various development issues.

Ms. Meena Sehgal did her Master's in Public Health from Emory University, Atlanta, USA. She has 22 years of work experience in data analysis, processing and interpretation. Her contributions have been largely in the form of data analysis, processing and statistical interpretation of findings for various health studies. She is proficient in epidemiological planning of studies and also in using statistical techniques like regression, correlation, stratified data analysis, multivariate and univariate analysis, and using software packages, including SAS, SUDAAN and Epi-Info. She has also served as Epidemiologist, Australian International Health Institute (AIHI), New Delhi, India, and Data Analyst, Centers for Disease Control, Atlanta, USA.

Dr. Pawan Kumar Taneja is a policy analyst specializing in health system research and health financing. He is currently working as Senior Faculty (Finance & Operations Research) at the Indian Institute of Public Administration, New Delhi, a policy research think tank of the Government of India. He holds a Ph.D. in Financing & Operations Research, MBA in Finance & Operations, M. Com in Finance & Quantitative Methods, and PGDStat in Statistics and Data Analytics. He has also done a Diploma Course on Leadership Development from MEASURE Evaluation, MSH (Management Science for Health) funded by USAID and Certificate Course in Global Health from Johns Hopkins Bloomberg School of Public Health. He has more than 16 years of rich and varied experience in teaching, research and industry. Prior to joining IIPA, he worked with prestigious institutes such as Indian Institute of Health Management Research (IIHMR), New Delhi. He has coordinated more than 15 operational research projects in healthcare financing, urban health, maternal and child health, health seeking behavior, climate change and healthcare, and disaster management, supported by UNICEF, WHO, HLFPPT, Plan International, Government of India, etc.

Dr. Ramesh Dhiman is a Scientist 'G' (Director Grade) at the National Institute of Malaria Research, Delhi. His field of research is climate change impacts on health, with an emphasis on vector-borne diseases, and early warning of malaria outbreaks using meteorological data and satellite remote sensing. Dr. Dhiman has served as reviewer of IPCC 2007 and IPCC 2014, and has contributed to the Prime Minister's National Action Plan on Climate Change (2008) and two generic protocols for assessment of impacts of climate change on vector-borne diseases for SEARO, World Health Organization. He is an expert member of the advisory committee on climate change with the MoEFCC and one of the National Coordinators for DST Climate Change Network. He has also represented the Ministry of Health at the World Meteorological Organization, Geneva, for Global Framework for Climate.

Dr. Sagnik Dey received his M.Sc. degree in Applied Geosciences from Jadavpur University, Kolkata, in 2000 and his M. Tech. degree from IIT Kanpur in 2002. Subsequently, he joined the Ph.D. program in the same institute and submitted his doctoral thesis on 'Aerosol Radiative Effects over Kanpur region in the Indo-Gangetic Basin, Northern India' in July 2007. Dr. Dey worked for three years (August 2007 to July 2010) as Post-doctoral Scientist at the Department of Atmospheric Sciences, University of Illinois at Urbana-Champaign, USA. He joined the Centre for Atmospheric Sciences, IIT Delhi, as Assistant Professor in July 2010. His research interests are to understand and quantify aerosol-cloud interaction and their impacts on climate change, and health impacts of aerosols using remote sensing and in-situ observations and models. He has published more than 50 research papers with an h-index of 19 (source: SCOPUS). He received the INSA Young Scientist Medal for 2008 and NASI-SCOPUS Young Scientist Award in Earth Sciences in January 2012. He is also the recipient of the Dr. Sudhansu Kumar Banerji MoES outstanding young faculty fellowship for the period 2011-2013.

Dr. Shyamala Mani, Professor, National Institute of Urban Affairs (NIUA), has a Ph.D. in Environmental Science from JNU and an MPH from School of Public Health, University of California and Berkeley, USA. She helped formulate and finalize several Biomedical Waste Management Rules. She is currently working with her colleagues at NIUA on Urban Climate Change Resilience (UCCR), supported by the Rockefeller Foundation under its ACCCRN program. Under UCCR, she and her colleagues have prepared a manual for municipal officials on Climate Change Mitigation, Adaptation and Resilience. They have conducted four regional workshops for six cities each, which will be integrating climate change resilience planning in their future action. Dr. Mani's research interests are to build capacity among urban planners towards climate change resilience, especially to strengthen public health aspects in cities and towns.

Ms. Suruchi Bhadwal has been working with TERI since 2000, and has contributed to several projects. She is an expert on vulnerability and adaptation and is a Member of Working Group on Climate Change and Environment for the XII 5-Year Plan (2012-2017). She has published several papers and has contributed as lead author for the IPCC AR4 WGII Report. Her area of expertise includes climate change and impacts, vulnerability and adaptation.

Dr. Nitish Dogra, Member Secretary, UCHAI Advisory Committee and Convener. He is a physician, physiologist and public health specialist by training, with a Master of Public Health (MPH) degree from the Johns Hopkins University, United States. Based in New Delhi, he has over a decade's experience in environmental health, with a strong focus on studying the health impacts of climate change. He was awarded the Fulbright-Nehru Environmental Leadership Program Fellowship by the US State Department and the Government of India for work related to climate change-attributable burden of disease in India. Dr. Dogra has worked extensively with the World Health Organization (WHO). In August 2014, he delivered, on request, an invited commentary at the Conference on Health and Climate organized by WHO Headquarters, Geneva, the first such global-level ministerial meet in this area.

ANNEXURE II [A]

List of Chair and Speakers at the National Training Workshop on September 22-24, 2015

Inauguration

Mr. Ajay Raghava
Ministry of Environment, Forest and Climate Change
New Delhi

AVM (Dr.) Ajit Tyagi
Indian Meteorological Society
New Delhi

Mr. Douglas A. Morris
Embassy of the United States of America
New Delhi

Mr. G.K. Bhat
Taru Leading Edge
Ahmedabad (Gujarat)

Dr. John Balbus
National Institute of Environmental Health Sciences
United States

Dr. Sanjeev Kumar
National Health Systems Resource Centre
New Delhi

Dr. Soumya Swaminathan
Ministry of Health and Family Welfare
New Delhi

Session Chairs And Speakers

Dr. A.D. Rao
Indian Institute of Technology
Delhi

Dr. Anand Krishnan
All India Institute of Medical Sciences
New Delhi

Mr. Anup Karanth
Taru Leading Edge
New Delhi

Dr. Anuradha Shukla
Central Road Research Institute
New Delhi

Dr. Anurag Prakash Rawool
KEM Hospital and Research Centre
Pune (Maharashtra)

Dr. Banalata Sen
National Institute of Environmental Health Sciences
USA

Dr. Ben Zaitchik (via video address)
Johns Hopkins University
USA

Dr. Charu C. Garg
National Health Systems Resource Centre
New Delhi

Dr. Diya Dutt
United States-India Educational Foundation
New Delhi

Dr. Dushmanta Pattanaik
India Meteorological Department
New Delhi

Mr. G.K. Bhat
Taru Leading Edge
Ahmedabad (Gujarat)

Dr. Gita Pillai
Urban Health Initiative
Lucknow (Uttar Pradesh)

Dr. Jugal Kishore
Vardhman Mahavir Medical College
New Delhi

Ms. Juli Trtanj
National Oceanic and Atmospheric Administration
USA

Dr. Kapil Goel
Centers for Disease Control
India County Office
New Delhi

Dr. Kayla Laserson
Centers for Disease Control
India County Office
New Delhi

Dr. Kirk Smith
University of California at Berkeley
United States

Dr. Madhavan Nair Rajeevan
Indian Institute of Topical Meteorology
Pune (Maharashtra)

Dr. Umamaheshwaran Rajasekar
Taru Leading Edge
New Delhi

Dr. M. Mohapatra
India Meteorological Department
New Delhi

Dr. Nitish Dogra
Taru Leading Edge
New Delhi

Dr. Parthasarthy Ganguly
Indian Institute of Public Health (Gandhinagar)
Ahmedabad (Gujarat)

Dr. Pawan Taneja
Indian Institute of Public Administration
New Delhi

Mr. Pramod Deshmukh
Sanskriti Samvardhan Mandal
Sagroli, Nanded (Maharashtra)

Dr Rais Akhtar (in absentia)
International Institute of Health Management Research
New Delhi

Dr. Ramesh Dhiman
National Institute of Malaria Research
New Delhi

Dr. Sagnik Dey
Indian Institute of Technology
Delhi

Dr. Sangeet Srivastava
The Northcap University
Gurgaon

Dr. Satish Kumar
National Health Systems Resource Centre
New Delhi

Mr. Shailendra Kumar Mandal
National Institute of Technology
Patna (Bihar)

Dr. Shyamala Mani
National Institute of Urban Affairs
New Delhi

Dr. Smriti Trikha
Indo-US Science and Technology Forum
New Delhi

Ms. Sreeja Nair (in absentia)
National University of Singapore
Singapore

Dr. Suruchi Bhadwal
The Energy and Resources Institute
New Delhi

Ms. Upasona Ghosh
Institute of Health Management Research
Kolkata

Mr. Varun Kumar Singh
Delhi Metro Rail Corporation
New Delhi

Dr. Vikas Desai (in absentia)
Urban Health and Climate Resilience Centre
Surat (Gujarat)

Ms. Vismita Gupta-Smith
World Health Organization
South-East Asia Regional Office
New Delhi

ANNEXURE II (B)

List of Trainees and Participants

Trainees

Mr. Abhishek Upadhyay
Indian Institute of Technology
Delhi

Dr. Akash Acharya
Centre for Social Studies
Surat (Gujarat)

Dr. Amit Bafana
National Environmental Engineering Research Institute
Nagpur (Maharashtra)

Dr. Anurag Prakash Rawool
KEM Hospital and Research Centre
Pune (Maharashtra)

Mr. Ashish Singh
Taru Leading Edge
New Delhi

Dr. Brogen Singh Akoijam
Regional Institute of Medical Sciences,
Imphal (Manipur)

Dr. Deepti Babar
Vardhaman Mahavir Medical College
New Delhi

Ms. Divya Narayanan
Healthy Energy initiative
Bangalore

Gaurav Kumar
National Institute of Malaria research
New Delhi

Mr. Harish Rajasekaran
Anna University
Chennai (Tamil Nadu)

Dr. Harshal Salve
All India Institute of Medical Sciences
New Delhi

Dr. J.K. Saini
National Institute of TB and Respiratory Diseases
New Delhi

Dr. K.C. Premarajan
Jawaharlal Institute of Postgraduate Medical Education and Research
Puducherry

Ms. Kirtika Arora
Taru Leading Edge
New Delhi

Mr. Kumar Vibhanshu
Taru Leading Edge
New Delhi

Dr. Manoj Joon
Municipal Corporation of Delhi
New Delhi

Ms. Lalitha Swathi Vadrevu
IIHMR University
Jaipur

Ms. Meena Sehagal
The Energy and Resources Institute
New Delhi

Ms. Megha Burvey
Taru Leading Edge
Indore (Madhya Pradesh)

Dr. N. Banerjee
National Institute of Research in Environmental Health
Bhopal (Madhya Pradesh)

Dr. Nemika Relhan
International Institute of Health Management Research (IIHMR)
New Delhi

Mr. Pramod Deshmukh
Sanskriti Samvardhan Mandal
Sagroli, Nanded (Maharashtra)

Dr. Pravin Naoghare
National Environmental Engineering Research Institute
Nagpur (Maharashtra)

Ms. Priyanka Kumari
Taru Leading Edge
New Delhi

Dr. R.K. Singh
National Institute of Malaria Research
New Delhi

Mr. Shailendra Kumar Mandal
National Institute of Technology
Patna (Bihar)

Dr. Shikha Dixit
The INCLEN Trust International
New Delhi

Dr. Shikha Vardhan
National Centre for Disease Control
New Delhi

Mr. Shivam Pandey
Indian Institute of Public Health
Delhi

Dr. Sneha Rajan
Vardhaman Mahavir Medical College
New Delhi

Dr. Shyamli Singh
Indian Institute of Public Administration (IIPA)
New Delhi

Mr. Sourangsu Chowdhury
Indian Institute of Technology
New Delhi

Dr. Sumanta Swain
International Institute of Health Management Research
New Delhi

Ms. Upasona Ghosh
Institute of Health Management Research
Kolkata

Ms. Vasundhra Bijalwan
Taru Leading Edge
New Delhi

Other Participants

Mr. A.K. Sengupta
International Academy of Environmental Sanitation and Public Health
New Delhi

Dr. Akanksha Sood
National Health Systems Resource Centre
New Delhi

Dr. Anil Jacob
International Union Against Tuberculosis & Lung Diseases
New Delhi

Mr. Bhaskar Deol
Natural Resources Defense Council
New Delhi

Ms. Jennifer Li
Jindal Global Law School
Sonipat (Haryana)

Mr. Jeff Smith
Breathe Easy India
New Delhi

Dr. Maneeta Jain
National Health Systems Resource Centre
New Delhi

Mr. Mukesh Patir
Ministry of Environment, Forest and Climate Change

Dr. Neha Singh
National Health Systems Resource Centre
New Delhi

Ms. Nehmat Kaur
Natural Resources Defense Council
New Delhi

Dr. Mangesh Patil
National Centre for Disease Control
New Delhi

Mr. Nehru Machineni
The Energy and Resources Institute
New Delhi

Dr. Prabhakar Sinha
Real Medicine Foundation
New Delhi

Dr. Pranil Kamble
National Centre for Disease Control
New Delhi

Ms. Priya Ghose
Embassy of the United States of America
New Delhi

Dr. Rinku Sharma
National Centre for Disease Control
New Delhi

Dr. S.C. Agarwal
National Centre for Disease Control
New Delhi

Ms. Scheherazade Oleksiw
University of Maryland
USA

Ms. Shamila Sharma
World Health Organization (WHO)
South East Asia Regional Office (SEARO)
New Delhi

Dr. Shilpy Gupta
Independent Researcher
New Delhi

Dr. Srikant Nadadur
Embassy of the United States of America
New Delhi

Ms. T.V. Padma
India Climate Dialogue
New Delhi

ANNEXURE II (C)

Organizing Committee

Taru Leading Edge

Dr. Nitish Dogra
Convener, UCHAI
Sector Advisor (Health and Nutrition)

Mr. Manu Prakash
Director, Policy and Public Services

Ms. Priyanka Kumari
Consultant

Ms. Vasundhra Bijalwan
Consultant

Ms. Priyanka Sarkar
Sector Specialist – Communications and Knowledge

Ms. Kirtika Arora
Senior Associate – Policy and Public Services

Mr. Kumar Vibhanshu
Senior Associate – Social Transformation

Mr. Ashish Singh
Trainee – Social Transformation

National Institute of Environmental Health Sciences, USA

Dr. John Balbus
Senior Advisor for Public Health

Dr. Banalata Sen
Program Coordinator for Global Environmental Health

Indian Meteorological Society (IMS)

Dr. K.J. Ramesh
Secretary

Dr. S.C. Bhan
Joint Secretary

Dr. Dushmanta Pattanaik
Member

ANNEXURE III

Glossary of Common Terms Related to Climate Change and Health

Adaptation
Refers to strategies, policies and measures undertaken, now and in future, to reduce potential adverse impacts of climate change.

Adaptive capacity
The ability of a system to adjust to climate change (including climate variability and extremes), to moderate the potential damage from it, to take advantage of its opportunities, or to cope with its consequences.

Air quality
A measure of pollutants in the air; a description of healthiness and safety of the atmosphere.

Climate
The average state of the atmosphere and the underlying land or water in a specific region over a specific time scale.

Climate change
A statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer).

Climate-sensitive diseases
Diseases sensitive to weather or climatic factors, with the current spatial distribution and seasonal transmission being affected.

Climate variability
Variations in the mean state and other statistics (for example, standard deviations, the occurrence of extreme events, etc.) of climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes of the climate system or due to variations in natural or anthropogenic external forcing.

Co-benefits
The positive effects that a policy or measure aimed at one objective might have on other objectives, irrespective of the net effect on overall social welfare. Co-benefits are also called ancillary benefits.

DOHaD
Developmental Origins of Health and Disease. The DOHaD concept describes how during early life (conception, pregnancy, infancy and childhood) the interplay between maternal and environmental factors induce physiological changes, fetal and child growth as well as development that have long-term consequences on later health and disease risk.

Early warning system
The set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities and organizations threatened by a hazard to prepare to act promptly and appropriately to reduce the possibility of consists of an external agent, a susceptible host and an environment in which the host and agent are brought together, causing the disease to occur in the host.

Exposure
Contact between a person and one or more bio-logical, psychosocial, chemical, or physical stressors, including

stressors affected by climate change

Heat wave
A period of abnormally and uncomfortably hot weather.

Impacts
The effects of climate change on natural and human systems.

Resilience
The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning and transformation.

Risk
The potential for consequences where something of human value (including humans themselves) is at stake and where the outcome is uncertain. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the consequences if these events occur.

Risk management
Plans, actions or policies to reduce the likelihood and/or consequences of risks or to respond to consequences.

Salinity Intrusion
The movement of saline (salt) water into freshwater aquifers, which can lead to contamination of drinking water sources and other consequences.

Sensitivity
The degree to which a system is affected, either adversely or beneficially, by climate-related stimuli.

Sea Surface Temperature (SST)
The water temperature close to the ocean's surface. The exact meaning of surface varies according to the measurement method used, but it is between 1 mm (0.04 in.) and 20 meters (70 ft.) below the sea surface.

Sustainability
A dynamic process that guarantees the persistence of natural and human systems in an equitable manner.

Vector-borne diseases
An illness caused by an infectious microbe that is transmitted to people by blood-sucking arthropods. The arthropods (insects or arachnids) that most commonly serve as vectors include: blood sucking insects such as mosquitoes, fleas, lice and biting flies and/or blood sucking arachnids such as mites and ticks. The term 'vector' refers to any arthropod that transmits a disease through feeding activity. Some of the most common vector-borne diseases are malaria, dengue, filariasis, lyme disease, etc.

Vulnerability
The degree to which a system is susceptible to, or unable to cope with, the adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.

Weather
The day-to-day changes in atmospheric conditions in a specific place at a specific time. More simply, climate is what you expect and weather is what you get.

Postcards
from the Participants

As an UCHAI workshop trainee, I got an opportunity to learn from the experiences of international and national climatologists, social scientists, NGOs, corporates like Delhi Metro and several government agencies. It helped me appreciate how everyone is preparing and integrating the system. It is essential to understand how day-to-day human activities affect the microclimate and what corrective steps are needed.

Dr. Manoj Joon,
Municipal Corporation of Delhi, Delhi

The UCHAI workshop was a unique learning platform where I could meet people both from health sciences as well as meteorological sciences, and could understand the linkages between the two. Apart from presentations and discussions, a visit to the Ministry of Earth Sciences (MoES) was also a very useful study trip. We were also able to sensitize their staff on the need to develop linkages with the Ministry of Health and Family Welfare (MoHFW) in order to reflect on the health implications of natural disasters.

Dr. Akash Acharya,
Centre for Social Studies, Surat (Gujarat)

The UCHAI workshop is a convergence of the scientific community to mitigate the adverse effect of climate change on health. It was an interesting and informative opportunity for me, as I, a trainee, had a chance to meet and learn from eminent persons at the forefront of the field associating climate change and health. Also, the group activities conducted at the end of the training motivated me by giving new ideas to work on.

Mr. Harish Rajasekaran,
Anna University, Chennai

The UCHAI workshop provides a platform to bridge the gap between the natural science and social science while also dealing with the vast area of climate change and health association. It was a unique opportunity as a speaker to present the sociological association of climate change with health in front of eminent natural scientists and medical personnel dealing with climate change. At the same time, it was a learning experience as a trainee on the epidemiological and climatological aspects of the same association.

Ms. Upasona Ghosh,
Institute of Health Management (IIHMR), Kolkata

New Delhi, Delhi, M-6, 2nd Floor, Aurobindo Marg, Hauz Khas, New Delhi -110016

Phone: +91-11-26518271, 26518272, Fax: +91-11-41580116

Facebook.com/Taru-Leading-Edge-Pvt-Ltd-217262251757105/

Twitter.com /taru_edge

Linkedin.com/in/tar-leading-edge-86112372