



National Workshop on “Preparedness, Mitigation & Management of Heat Wave 2020”

**In Collaboration with Karnataka State Disaster Management Authority,
Government of Karnataka**

Venue: Hotel Radisson Blu Atria, Bengaluru

(5-6th December, 2019)



National Disaster Management Authority (NDMA), New Delhi
NDMA Bhawan, A-1, Safdarjung Enclave
New Delhi – 110029

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Background

Heat wave has emerged as one of the major severe weather events around the globe in recent years. Climate change is driving temperatures higher as well as increasing the frequency and severity of heat waves. Over the past several years, India too has experienced increasing instances of heat waves affecting the health and livelihood of vulnerable populations across a number of States.

National Disaster Management Authority (NDMA) issued national guidelines for preparation of Action Plan – Prevention and Management of Heat-Wave in April 2016 to provide a framework for implementation, coordination and evaluation of extreme heat wave related activities in the country. These Guidelines, which were further revised in 2017 and 2019, facilitate Ministries/Departments, States, districts and cities to prepare / update their Heat Action Plans. These guidelines also list long-term mitigation measures for addressing the issues at a broader level by underlining activities to be undertaken by States / local authorities in their respective areas to reduce the negative impacts of extreme heat wave conditions.

To bring all the stakeholders on one platform to discuss ways to further strengthen our preparedness for heat waves, NDMA organises annual National Workshops in collaboration with one of the heat-prone States. NDMA facilitates the States for preparing their Heat Wave Action Plans with clear roles and responsibilities of each department to prevent, mitigate and respond to Heat Wave. The Authority also reviews the status of heat wave preparedness through Video Conferencing with all heat wave-prone States. NDMA is also focusing on community sensitisation and awareness generation through Social Media, print / electronic media, advertisements and short TV commercial films, etc.

Several States have prepared their Heat Action Plans and their efforts towards its implementation have reduced heat-related mortality over the years. Nodal Officers have been appointed to closely monitor the situation at the district and *taluka* levels. Their efforts also include awareness generation campaigns and wide dissemination of simple Do's and Don'ts.

Coordinated efforts by all stakeholders have significantly brought down the number of heat-related deaths from 2,040 in 2015 to 1,111 in 2016. These numbers were further reduced to 384 in 2017 and 25 in 2018.

In 2019, India faced an even more intense, severe and prolonged period of heat wave as compared with the last four years. Comprehensive and continuous efforts by all stakeholder agencies restricted the number of deaths at 215.

In the light of the recent progress made and to continue with this momentum, there was a need to discuss and sensitise all the stakeholders on the impacts of climate change and long-term mitigation measures. Consequently, to prepare for Heat Wave 2020, NDMA organized a two-day National Workshop on Heat Wave (Themes: Early Planning-Effective Action, Save Lives & Heat Wave Risk Reduction) at Bengaluru in collaboration with the Government of Karnataka on December 5-6, 2019.

Objectives:

- Sharing of experiences on heat-wave Action Plans and responses based on the NDMA Guidelines;
- Discussing revised guidelines issued by NDMA in October 2019;
- Discussing emerging issues for 2020 summer season and future course of action;
- Climate change adaptation and long-term mitigation measures for heat risk reduction for sustaining and further reducing heat-related mortalities with a target of achieving zero mortality;
- Capacity Building for preparedness, mitigation and management of heat wave and for developing local thresholds;
- Effective monitoring mechanism and review of the implementation of Heat Action Plans; and
- Creating a database for policy decisions and undertaking prevention and mitigation measures.

Outcome:

The workshop aimed to help all vulnerable States / districts in preparing/updating their Heat Wave Action Plans and implement them. Drawing upon the experiences and best practices shared by other States, it discussed the integration of various developmental plans, including long-term measures such as increasing forest coverage and green areas to reduce the risk of heat waves as well as climate change impacts. Moreover, interactions with experts and various stakeholders from early warning and forecasting agencies, government departments and research institutions assisted in figuring out appropriate short, medium and long-term mitigation measures most suited for particular regions. The platform provided an opportunity for community capacity building and awareness generation.

Summary of the Workshop

The workshop aimed to sensitise States to the need of preparing and implementing Heat Action Plans in line with NDMA's national guidelines on Heat Wave 2019. Members of NDMA and senior officials from central Ministries/Departments, experts on heat wave, early warning and forecasting agencies, State governments and research institutions participated in the workshop.

Shri G. V. V. Sarma, Member Secretary, NDMA, emphasised upon the need to focus on action-oriented long-term mitigation measures and adopt an integrated approach for disaster management in the country. Smt. Vandita Sharma, Additional Chief Secretary and Development Commissioner, Government of Karnataka, highlighted the need for advance planning for better preparedness to deal with disasters, including heat wave. Shri R. Ashoka, Revenue Minister, Government of Karnataka, emphasised upon the need to focus on the most vulnerable sections of society.

Technical sessions on Day 1 focused on climate change, heat wave risk reduction, early warning, forecasting and preparedness for heat wave and lessons learnt from past experiences shared by various States. The sessions discussed climate change adaptation and long-term mitigation measures, impact of extreme heat on health in India, National Guidelines on Heat Wave – 2019, mainstreaming of Heat Action Plans and Budgetary provisions by Ministries/States based on national guidelines. Early Warning and Communication Strategy for heat-prone areas, local threshold estimation and effective forecast / warning for preparedness measures and Possibilities of Heat-stress Index for India were also discussed. The sessions discussed the issues of timely and accurate warnings and their dissemination to vulnerable populations to ensure effective mitigation of heat-related risks. Vulnerable states shared their experiences and best practices to help other stakeholders prepare and implement their Heat Action Plans.

Technical sessions on Day 2 focused on capacity building, enhancing effective response, inter-agency coordination and effective governance. Presentations were made on heat wave warning threshold and vulnerability assessment, operational issues and challenge for effective response, Climate Adaptive Heat Action Plan and Capacity Building for conducting threshold estimation at the local level. Following the presentations, all participants were divided into four groups to discuss issues of Sector-Specific Standard Operating Procedures and Plan, Building Long Term Resilience and Mitigation Measures, Coordination and Monitoring Mechanism within States / Districts and Cities / Towns, and Documentation and reporting strategy and data base.

The technical sessions rounded up with closing remarks from the session moderators and chairs discussing the way forward. The workshop concluded with the Vote of Thanks.



National workshop on Preparedness, Mitigation & Management of Heat Wave for 2020

Venue: Hotel Radisson Blue, Bengaluru

Programme Schedule

Day -I (5th December 2019)

Time	Program	Speakers/Chaired
09.00-09.30	Registration	
09.30-10.30	Inaugural session – Welcome, Introduction and Objective	
	<ul style="list-style-type: none"> • Nadageete and Invocation • Welcome to the Dignitaries • Introduction, objective and framing of Issues • Key note address • Special Guest • Inaugural address - Chief Guest • Vote of Thanks 	<ul style="list-style-type: none"> - Govt. of Karnataka and Participants - Shri T. K. Anil Kumar, Secretary, DM, Govt. of Karnataka - Shri G. V. V. Sarma, Member Secretary, NDMA - Smt. Vandita Sharma, Addl. Chief Secretary and Development Commissioner, Govt. of Karnataka - Shri R. Ashoka, Hon'ble Minister for Revenue & Municipal Administration, Govt. of Karnataka - Dr. K. V. Thrilok Chandra, Director, KSDMA
10.30-11.00	Tea break	
11.00-13.00	Technical session 1: Climate change and Planning of Heat wave risk reduction (Chaired by Smt. Vandita Sharma, Addl. Chief Secretary and Dev.Comm., Government of Karnataka)	
	<ul style="list-style-type: none"> • Global threat: Climate Change Adaptation and Long-term Mitigation measures • Impact of Extreme Heat on Health in India • National Guidelines on Heat Wave - 2019 • Mainstreaming of HAP and Budgetary provisions by Ministries/States based on national guidelines • Discussion & QA (30 Min) 	<ul style="list-style-type: none"> - Dr. Ajit Tyagi, Former DG-IMD and Member WMO - Prof. Mahaveer Golechha, IIPH Gandhinagar - Dr. Rajashree Kotharkar, Professor, V-NIT-Nagpur - Shri Anuj Tiwari, Sr. Consultant (PPM), NDMA
13.00-14.00	Lunch break	
14.00-15.00	Technical session 2 : Early warning, forecasting and Preparedness for heat wave (Chaired by Shri P. N. Rai, Member, BSDMA)	
	<ul style="list-style-type: none"> • Early Warning and Communication Strategy for heat prone areas • Extended Long-Range Forecast and communication • Local threshold estimation and effective forecast / warning for preparedness measures • Possibilities of Heat-stress Index for India: Projection of near future • Discussion & QA 	<ul style="list-style-type: none"> - Dr. Naresh Kumar, Scientist, India Meteorological Department (IMD) - Dr. A. K. Sahay, Sr. Scientist, IITM -Pune - Dr. S. C.Bhan, Sr. Scientist, India Meteorological Department (IMD) - Prof. (Ms.) Vidhya Venugopal, Sri Ramchandra University, Chennai
15.00-15.30	Tea/Coffee break	
15.30-18.00	Technical session 3 : Experience Sharing & lessons learnt for heat wave mitigation measures (Chaired by Shri Kamal Kishore, Member, NDMA)	
	<ul style="list-style-type: none"> - Karnataka - Gujarat - Andhra Pradesh - Maharashtra - Odisha • Discussion & QA 	<ul style="list-style-type: none"> - Dr. S.S.M. Gavaskar, Scientist, KSNDMC, Karnataka - Dr. Tejas Shah, AMC, Gujarat - Dr. M. M. Ali, APSDMA, Andhra Pradesh - Shri Omkar Khare, Consultant, DMU, Maharashtra - Dr. Pradeep Nayak, CGM-OSDMA, Odisha



National workshop on Preparedness, Mitigation & Management of Heat Wave for 2020

Program Schedule

Day -II (6th December 2019)

Time	Program	Speakers/Chaired
9.00-11.00	Technical session 4: Capacity building & Enhancing effective response to Heat wave (Chaired by Dr. Ajit Tyagi, Former DG-IMD and Member WMO)	
	• Threshold and vulnerability assessment of Heat wave	- Dr. Lipika Nanda, Vice President, PHFI, Hyderabad
	• Issues and challenge for effective response of Heat wave	- Dr. G. K. Bhat, Chairman, TARU- Leading Edge
	• Operational issues: During the extreme emergency situation and response of heat wave	- Shri Rama Chandrudu, Additional Secretary, Government of Bihar
	• Climate Adaptive Heat Action Plan	- Shri Rohit Mangotra, Deputy Director, IRADe
	• Capacity building program – planning and implementation	- Dr. Anil Gupta, Associate Professor, NIDM
	• Capacity building for conducting threshold estimation at local level	- Dr. Abhiyant Tiwary, IIPH Gandhinagr / Anup Kumar Srivastava, Sr.Consultant, NDMA
	Discussion and QA	
11.00-11.30	Tea break	
11.30-01.00	Technical session 5: Inter agency coordination and effective governance (Chaired by Dr. Lipika Nanda, Vice President, PHFI, Hyderabad)	
	Group Discussion – in Four groups	Moderated by
	A. Sector Specific Standard Operating Procedure and plan	- Shri Pradeep Kumar Nayak, CGM-OSDMA - Ms. Ridhim Aggarwal, Addl. CEO & DIG, UK
	B. Building long term resilience and mitigation measures	- Dr. Vinay Sehgal, Principal Scientist, (IARI), Delhi - Prof. (Dr.) Rajashree Kotharkar, V-NIT, Nagpur
	C. Coordination and Monitoring mechanism within states/districts and cities/town	- Shri Polash Mukerjee, Expert, NRDC - Dr. Abhay Srivastava, Asst. Professor, HIPA
	D. Documentation and reporting strategy & data base	- Dr. Akshay Kumar, Asst. Director, NCDC, MoH&FW - Prof. Mahaveer Golechha, IIPH Gandhinagar
13.00-14.00	Lunch break	
14.00-15.00	Group Presentation (Chaired by Dr. Lipika Nanda, Vice President, PHFI)	
	Group A	Group B
	Ms. Ridhim Aggarwal, Addl. CEO & DIG, UK	- Dr. Vinay Sehgal, Pri.Scientist, (IARI), Delhi
		Group C
		Sh. Polash Mukerjee, Expert, NRDC
		Group D
		Prof. Mahaveer Golechha, IIPH Gandhinagar
	Discussion & QA	
15.00-16.00	Way forward, emerging issues and future course of action plan for 2020 (Moderated by Dr. D. N. Sharma, Member, NDMA)	
	Key learnings and recommendations for future action Concluding Remarks	- Dr. V. Thiruppugazh, Addl. Secretary (PP), NDMA Dr. S. C. Bhan, Sr. Scientist, IMD - Shri T. K. Anil Kumar, Secretary-DM, Govt. of Karnataka - Representative of MoH&FW

DELEGATES AND KEY DIGNITARIES

A total of 128 participants from the following organizations attended the workshop (See Annexure for details):

Central Government: (16 Ministries and 9 Departments)

1. Ministry of Agriculture, Cooperation & Farmers Welfare
 - i. Indian Agriculture Research Institute, (IARI)
2. Department of Animal Husbandry, Dairying & Fisheries
3. Ministry of Food and Consumer Affairs
4. Ministry of Drinking Water & Sanitation
5. Ministry of Earth Sciences
 - ii. Indian Meteorological Department (IMD)
 - iii. Indian Institute of Tropical Meteorology (IITM)
6. Ministry of Health & Family Welfare
 - iv. National Centre for Disease Control (NCDC)
 - v. Integrated Disease Surveillance Program (IDSP)
7. Ministry of Home Affairs
 - vi. National Disaster Management Authority (NDMA)
 - vii. National Institute of Disaster Management (NIDM)
 - viii. National Disaster Response Force (NDRF)
 - ix. Census Commissioner
8. Ministry of Housing and Urban Affairs
9. Ministry of Human Resource Development
10. Ministry of Information and Broadcasting
11. Ministry of Labour and Employment
12. Ministry of Power
13. Ministry of Road Transport and Highways
14. Ministry of Rural Development
15. Ministry of Jal Shakti
16. Ministry of Railways (Railway Board)

Research & Academics Institution (3 States)

1. Public Health Foundation of India (PHFI) - Bhubaneswar
2. Indian Institute of Public Health, Gandhinagar
3. Visvesvaraya National Institute of Technology, Nagpur

NGOs (5 States)

1. Indian Meteorological Society (IMS)
2. TARU Leading Edge
3. Natural Resource Defence Council (NRDC)
4. Integrated Research and Action for Development (IRADe)
5. UNICEF

State Governments (15 States)

1. Govt. of Andhra Pradesh
2. Govt. of Bihar
3. Govt. of Chhattisgarh
4. Govt. of Delhi
5. Govt. of Gujarat
6. Govt. of Haryana
7. Govt. of Jammu & Kashmir
8. Govt. of Karnataka
9. Govt. of Kerala
10. Govt. of Madhya Pradesh
11. Govt. of Maharashtra
12. Govt. of Odisha
13. Govt. of Tamil Nadu
14. Govt. of Telangana
15. Govt. of Uttarakhand

State Disaster Management Authority (8)

1. APSDMA - Andhra Pradesh
2. BSDMA - Bihar
3. CSDMA - Chhattisgarh
4. KSDMA - Kerala
5. State of Karnataka
6. DMU - Maharashtra
7. State of Odisha
8. State of Tamil Nadu

Municipal Corporation (14)

1. Ahmadabad - Gujarat
2. Gwalior - Madhya Pradesh
3. Chandrapur - Maharashtra
4. Vijayawada - Andhra Pradesh
5. Yadgir - Karnataka
6. Dharwad - Karnataka
7. Raichur - Karnataka
8. Bagalkot - Karnataka
9. Gadang - Karnataka
10. Devanagari - Karnataka
11. Chitradurga - Karnataka
12. Bangalore (R) - Karnataka
13. Bangalore (U) - Karnataka
14. Kalburgi - Karnataka

Administrative Training Institute (3)

1. Haryana
2. Karnataka
3. Chhattisgarh

Inaugural Session



Shri T. K. Anil Kumar, IAS, Secretary (DM), Government of Karnataka, welcomed all the dignitaries and the participants to the workshop. He said that Climate Change is resulting in extreme weather events such as intense heat waves and this workshop aimed to ensure advance planning and preparedness to bring down heat related deaths and illnesses.

Smt. Vandita Sharma, Additional Chief Secretary and Development Commissioner, Government of Karnataka, highlighted the rising global temperatures and erratic weather events in Karnataka. She emphasised on the need for advance planning for better preparedness to deal with disasters. She talked about the vulnerability of interior districts of North Karnataka to heat wave conditions and appreciated the support of National Disaster Management Authority in helping the Karnataka State Disaster Management Authority formulate its Heat Action Plan and bring down heat-related mortality. She urged the participants to evolve an implementable action plan which can provide succor to vulnerable communities. She also informed that Karnataka has proactively notified heat wave as a natural disaster and the State's Heat Action Plan is regularly updated. Weekly Weather Watch Meetings, involving all stakeholder departments, have led to better coordination in responding to disaster situations in the State. She also appreciated the inputs provided by the Karnataka State Natural Disaster Monitoring Center with its extensive monitoring network.



Shri G. V. V. Sarma, Member Secretary, NDMA, highlighted the need for appropriate mitigation measures for heat wave as the last five years have been the hottest so far. The intensity and frequency of heat waves is increasing with as many as 23 States affected by heat waves in 2019 – up from 19 in 2018. In 2015, only nine states were affected by heat waves. Shri Sarma mentioned the National Guidelines, first prepared and circulated in 2016, which were subsequently revised in 2017 and 2019. He urged the States to prepare their Heat Action Plans in line with the National Guidelines and ensure its implementation. NDMA has been organising annual national workshops for heat wave preparedness in collaboration with State Governments (2017 at Hyderabad, Telangana; 2018 at Vijayawada, Andhra Pradesh and 2019 at Nagpur, Maharashtra). The number of deaths due to heat wave related illnesses reduced drastically 2016 onwards due to coordinated efforts by all stakeholders.



Despite an intense and prolonged heat wave in 2019, the numbers increased marginally given the timely extensive efforts by all the stakeholders at all levels.

Shri Sarma suggested initiating comprehensive measures to collect relevant data pertaining to morbidity and mortality related to heat wave. While he appreciated the declining mortality due to heat wave, he also cautioned against complacency. Measures like micro-level analysis and identification of high-risk areas, increasing green areas, Cool Roof technology and community participation, etc. could help significantly in mitigating the ill-effects of heat wave, he said.

Delivering the Inaugural Address, Shri R. Ashoka, Revenue Minister, Government of Karnataka, said that the poor, women and children are the most vulnerable to heat wave and they should remain the focus of all heat risk reduction efforts. Heat wave is one of the causes behind forest fires. Drying up of water sources in forests forces



animals to move to human settlement areas. This causes human-animal conflicts, he said. He also suggested that animals should be considered when heat wave plans are finalised. He thanked NDMA for choosing Bengaluru as the workshop venue and wished productive deliberations during the workshop. The Hon'ble Minister also listed the various measures taken at the community level and also through the Government–Civil Society Forum to combat the ill-effects of heat wave in the State. Karnataka has notified heat wave as a State-specific disaster and the affected can get benefits from the State Disaster Response Fund.

Shri Thrilok Chandra, IAS, Director, Karnataka State Disaster Management Authority, delivered the Vote of Thanks for the Inaugural Session.



Technical Session 1

Climate change and Planning of Heat wave risk reduction

Chairperson: Smt. Vandita Sharma, ACS and DC, Govt. of Karnataka



Climate change Adaptation and Long Term Mitigation Measures

Dr. Ajit Tyagi: Global Threat

Dr. Tyagi, drawing from various scientific evidences, presented a comprehensive picture of Green House Gas (GHG) concentrations over the years. He also presented observations of increases in temperature to prove that Climate change is real. He suggested that heat wave conditions should be given due attention, both by the government and the civic community. He showed how Heat Wave is different from other disasters and termed it as 'Silent Killer'. He also explained the factors that exaggerate heat wave conditions and their impacts on various sectors.

He said that in 2018, a record number heat wave exposures of persons over the age of 65 years were recorded. According to him, the four broad areas the government agencies should consider are:



- CONTROL - Standard run initialized with Reanalysis data
- NOURBAN - Replace the urban area with cropland parameters : 2.5 degree cooler
- ALBEDO—Increase urban albedo value from 0.15 to 0.30 No Sig Change, Increase to .45 cooler by 1-2 degree
- GREEN—Increase Shade factor, and evapotranspiration by cooling 5-7 degree cooler

Impact of Extreme Heat on Health in India

Prof. Mahaveer Golechaa, Indian Institute of Public Health (IIPH), Ahmedabad

In his presentation, Prof. Golechaa quoted several research studies which prove that heat wave in India is not only resulting in medical expenses but also in significant loss of man-days. He said that one reason India's economy is susceptible to events like heat waves is its large informal sector comprising people who work with no formal contracts, including construction workers and manual farm labourers. Simply put, when it gets hot, it's difficult, indeed dangerous, to perform heavy labour outdoors.



According to Recent Lancet Report, India alone lost close to 75 billion labour hours in 2017 due to extreme heat, about half the global total of 153 billion hours lost to extreme heat days in the same year. About 80 per cent of the losses in India were in agriculture (Countdown). A study released by the International Labour Organisation (ILO) said that by 2030, India would lose 5.8 per cent of its working hours to heat stress as average global temperatures rise - equivalent to 34

million full-time jobs out of a total of 80 million globally.

Explaining the impact of heat on human physiology, Dr. Golechaa said that sweating leads to loss of approximately two litres per hours of water and salt under conditions of high humidity and physical exertion. If water and salt are not replaced adequately and concurrently, the fluid reserves would deplete, even though the body core temperature may not be very high. This condition is called '**Heat exhaustion**' (HE). The thermoregulatory response may get overwhelmed by the hot environment, even though the fluid and salt reserves of the body may be adequate. Such thermo-regulatory failure, coupled with exaggerated acute phase response (increased production of inflammatory cytokines and endothelium derived vasoactive factors and activation of coagulation process) and alterations in the expression of heat shock proteins (hsps), leads to '**heat stroke**'.

With reference to health impacts of heat wavy, he gave the following sequence of events, **Heat Edema > Sunburn > Heat Rash > Heat Cramp > Heat Exhaustion > Heat Syncope > Heat Stroke**

Heat rash is a skin irritation caused by excessive sweating during hot, humid weather. It usually appears on the neck, upper chest, groin, under the breasts, and in elbow creases. Its symptoms are 'Itchy Rash' with small red bumps at pores in setting of heat exposure; bumps can sometimes be filled with clear or white fluid. **Signs:** Diffuse, pruritic, maculopapular or vesicular rash in the setting of heat exposure, often with insulating clothing or swaddling. **Prognosis:** Full recovery with elimination of exposure and supportive care.

Heat Cramps are painful muscle cramps occurs due to low salt level in muscles. **Excessive sweating and dehydration** results in low salt level. **Symptoms:**

Uncomfortable appearance may have difficulty fully extending affected limbs /joints with pain. **Signs:** Painful contractions of frequently used muscle groups in the setting of heat exposure, often with exertion. **Prognosis:** Full recovery with elimination of exposure and supportive care(may require sometimes).

Syncope means fainting or dizziness. Heat syncope is a fainting episode that occurs in the heat, either during prolonged standing or exercise, or when rapidly standing from a lying or sitting position. It typically occurs in individuals who are not acclimatized to the heat. Dehydration can also contribute to this condition. **Symptoms:** Feeling hot and weak; light-headedness followed by brief loss of consciousness dizziness or lightheadedness, and fainting. **Signs:** Brief Generalized loss of consciousness in hot setting, short period of disorientation if any. **Prognosis:** Full recovery with elimination of exposure and supportive care, progression if continued exposure.

Exhaustion means tiredness. Heat Exhaustion is body's response to excessive water and salt loss through excessive sweating due to heavy physical exertion in hot environment. **Symptoms:** Feeling overheated, lightheaded, exhausted and weak, unsteady, nauseated, sweaty and thirsty, inability to continue activities. a normal or mildly elevated body temperature, heavy sweating, pallor (paleness), muscle cramps and muscle pain, fatigue, weakness, dizziness and lightheadedness, headache, and nausea. **Signs:** Sweaty/Diaphoretic; Flushed skin; hot skin; normal core temperature; generalized weakness, slight disorientation. **Prognosis:** Full recovery with elimination of exposure and supportive care; progression if continued exposure.

Heat Stroke is most severe form of heat related illness which can sometimes lead to death or permanent disability if not treated at proper time. It is a medical emergency, requires immediate hospitalization. When heat stroke occurs, the body temperature can rise to 106°F or higher within 10 to 15 minutes. (41 C) . Heat stroke occur when thermoregulatory mechanisms fails and symptoms are:

Hot, dry skin - Red or spotted skin - Extremely high temperature (above 104 F or 40 C) - rapid heart rate, difficulty breathing – Headache – Dizziness, loss of coordination - nausea and vomiting, confusion and restlessness, Convulsions, Loss of consciousness, unconsciousness/coma.

Regarding vulnerability, following groups are most sensitive according to him;

- Extremes of age (< 5 yrs. or > 65 yrs.).
- Pregnancy.
- Occupation- Workers in military, agricultural, construction and industrial settings, labourers, sports-persons, miners, etc.
- Low level of physical fitness.
- Lack of acclimatization to environment heat.
- Obesity.
- Alcohol use-acute and chronic.
- Skin diseases-psoriasis, pyoderma, etc.
- Sleep deprivation.

- Co-existing illnesses- fever, renal, thyroid, CVS, metabolic diseases.
- Previous history of heat illness.
- Use of drugs-phenothiazines, anti-cholinergics, anti-histaminics, ACE-inhibitors, MAO-inhibitors etc.
- High ambient temperatures, high atmospheric humidity, low air velocity worsen the situation.

He spoke about the difficulties in recording data pertaining to health impacts of heat wave. Recalling his experiences at grassroots level, for instance, at municipality ward level, he cited several instances of inability of his research team to explain the dose-effect relation between heat wave and mortality or even morbidity. He opined that this is lack of awareness at grassroots level.

About impacts of heat wave, Prof. Golechaa gave elaborate description of Physiological, Behavioral, Environmental stresses and progression of health impacts from Heat Rash – heat cramps- heat Syncope – Heat Exhaustion –Heat stroke.

Vulnerability of women, more specifically the pregnant women, he flagged the need to develop guidelines and intense capacity building programme.

National Guidelines on Heat Wave 2019 Prof. Rajashree Kotharkar, VNIT, Nagpur

Prof. Rajashree Kotharkar presented a chronological evolution of Heat Wave Action plan (HAP). Welcoming the latest Heat Wave guidelines 2019, she said the laying down of the goals for different time periods is a major value addition as it could bring accountability and also serve as ready reckoner for mid-course correction.



About Built Environment, Prof. Kotharkar described recent technological developments and need for their promotion to reduce the Urban Heat Island Effect. She has also highlighted the following issues:

- Evolution of Heat wave Action Plan.
- Improvements and additions in HAP 2019.
- Short term goal: Need to rediscover old knowledge to adapt and mitigate heat wave; Need zonal/ regional HAPs as we cannot look at every village at same level.
- Long-term goal: Capacity building should be implemented with proper knowledge, involvement of academicians and collaboration with centre of excellence for dedicated research.
- Mapping of hotspots and integrating with Vulnerability Assessments.

- Urban planners/designers can control the aspects affecting temperature regime of the city.

Mainstreaming the Heat Action Plan and Budgetary Provision by Ministries and States Based on National Guidelines

Shri Anuj Tiwari, Sr. Consultant, NDMA

Shri Anuj Tiwari simplified the entire process of mainstreaming Heat Action Plans by breaking it into different segments. Mainstreaming DRR into all developmental initiatives will enhance disaster resilience, reduce losses and hasten the progress towards development goals, he said.

Mainstreaming is the internalisation of risk awareness and incorporation of risk reduction measures into the overall policies and programmes within and outside government in such a manner that they gradually become integral to each other and ensure sustainability and co-existence. Shri Tiwari said that DRR is about accepting the coexistence of development and disaster management and then to find out ways to integrate them to reduce disaster risks and ensure sustainable development.



Towards ensuring the same, he highlighted the following:

- **Checklist for States to Develop Heat Action Plan**
 - **Step 1: Government Engagement** - Setting up a Heat Action Plan requires participation from State and district government leaders, municipal health agencies, disaster management authorities, and local partners.
 - **Step 2: Appointing a State Nodal Agency and Officer** – The State should appoint a head / nodal officer at the State or district levels and depute an agency to oversee the Heat Action Plan. It should also build the capacity of key officials and agencies and recognize their roles in the State Heat Action Plan.
 - **Step 3: Vulnerability Assessment and Establishing Heat-Health Threshold Temperatures**
 - **Step 4: Drafting and Developing the Heat Action Plan**
 - **Step 5: Team Preparation and Coordination**
 - **Step 8: Strategies for Reducing Extreme Heat Exposures and Adapting to Climate Change (Long Term Plans)**
- **Key Strategies (Para 2.7 of Guidelines):** Severe and extended heat waves can also cause disruption to general, social and economic services. Government agencies will have a critical role to play in preparing and responding to heat

waves at the local level, working closely with health and other related departments on a long-term strategic plan.

- Establish Early Warning System and communication systems
- Developing inter-agency response plan and coordination in field
- Preparedness at the local level for health eventualities
- Health care system capacity building
- Public Awareness and Community Outreach
- Collaboration with private, non-government and civil society
- Assessing the impact – feedback for reviewing and updating the plan

Relevant provisions

- **Chapter – V- Measures by the Government for Disaster Management**
- **Sec 35 (2) (a)** – Central Government may ensure appropriate allocation of funds for prevention of disaster, mitigation, capacity-building and preparedness by the Ministries or Departments of the Government of India.
- **Sec 36 (b)** – It shall be the responsibility of every Ministry or Department of the Government of India to – integrate in to its development plans and projects, the measures for prevention or mitigation of disasters in accordance with the guidelines laid down by the National Authority.
- **Sec 36 (e)** – It shall be the responsibility of every Ministry or Department of the Government of India to – allocate funds for measures for prevention of disaster, mitigation, capacity-building and preparedness.
- **Sec 37 (1) (a)** – Every Ministry or Department of the Government of India shall prepare a disaster management plan.
- **Sec 38 (2) (d)** – State Government may ensure allocation of funds for prevention of disaster, mitigation, capacity-building and preparedness by the departments of the Government of the State in accordance with the provisions of the State Plan and District Plans.
- **Sec 39 (c)** - It shall be the responsibility of every department of the Government of a State to – allocate funds for measures for prevention of disaster, mitigation, capacity-building and preparedness.
- **Section 49** – Allocation of funds by Ministries and Departments –
 - Every Ministry or Department of the Government of India shall make provisions, in its annual budget, for funds for carrying out the activities and programmes set out in its disaster management plan.
 - The provisions of sub-section (1) shall, mutatis mutandis, apply to departments of the Government of the State.

Regarding budgetary aspects, he suggested to make use

- **Para 5.10 Budget Allocations (NDMP)**
 - Integration of disaster risk concerns into government budgets should be tackled from two angles,

- ensuring that levels of public expenditure on risk reduction are sufficient and
 - that there are adequate financial arrangements to manage the residual risk.
- The presence of residual risk implies a continuing need to develop and support effective capacities for emergency services, preparedness, response and recovery, together with socioeconomic policies such as safety nets and risk transfer mechanisms, as part of a holistic approach.
 - While there are certain budgetary allocations to partially address requirements of relief (e.g., National Disaster Response Fund, State Disaster Response Fund), the mainstreaming of DRR requires each ministry, department and state/UT to make adequate provision for DRR as an integral part of the main budget by ensuring that all the major activities have incorporated DRR.

Technical Session 2: Early Warning Forecasting and Preparedness for Heat Wave

Chairperson: Shri P. N. Rai, Member, Bihar State Disaster Management Authority

An accurate prediction and monitoring system for Early Warnings makes communities prepared only when there is an equally robust system of disseminating those warnings. To enhance the efficacy of communications, Shri Rai suggested that the messages should be suitably tailored in local context; and the personnel at the Gram Panchayat level should be involved so that the warnings reach the last person. He also stressed on the need for data analysis and action-oriented plans.



Early Warning and Communication Strategy for Heat Wave Shri Naresh Kumar, IMD

Dr. Naresh Kumar discussed the definition, occurrence, duration, intensity, frequency and the causes of heat waves over different parts of the country.

He discussed the Early Warning System that is currently in place:

- National Level: National Weather Forecasting Centre, Met Subdivision Forecasting/Warning, Guidelines Developmental work.



- Regional level: Regional Meteorological Centres (06), District-wise forecasting/warning, other forecasts
- Local level: Meteorological Centres (20), District-wise forecasting/warning, other forecasts

He further specified the information / forecast / early warning that is issued by the IMD for Heat Waves:

- Bulletin issued daily at 1600 hrs IST during FDP period (1 April to 30 June 2019).
- Warnings at meteorological sub-division levels issued to different users such as Ministry of Home Affairs, NDMA, SDMA, Chief Secretaries of States, District Commissioners/District Magistrates, health departments, Indian Railways, Road transport, media etc.
- A colour code system is used for sending alerts to disaster managers.
- Seasonal and extended range (up to two weeks) outlook. Weekly extended range bulletin for temperatures and heat wave was also issued every Thursday.
- District level heat wave warning (up to five days).

Extended Long-Range Forecast and communication

Shri A. K. Sahay, IITM, Pune

Dr. Sahai presented New Heat Wave criteria for the Indian region is developed using bias corrected Tmax. & Tmin. daily gridded data as detailed below.

- Heat wave: $T_{max} > 36^{\circ}\text{C}$, $T_{max} > 95^{\text{th}}$ percentile (MAMJ), T_{max} at least 3.5°C higher than normal or $T_{max} > 44^{\circ}\text{C}$
- Severe Heat wave: $T_{max} > 36^{\circ}\text{C}$ and $T_{max} > 95^{\text{th}}$ percentile (MAMJ) and T_{max} at least 5.5°C higher than normal or $T_{max} > 46^{\circ}\text{C}$
- The observed patterns indicate that in the recent decade, heat wave spells are occurring early in the summer season and have also extended towards southern parts of the country.
- All heat waves are predicted well in advance and different heat wave prone regions, namely North-West, South-East and Northwest-Southeast, where the average number of heat wave per year is more than three.
- It is found that the Extended Range Prediction system gives a lead of at least two weeks even for a 70% probability of occurrence of heat wave.
- Such predictions are useful for other sectors too (e.g. Health, Power & Agriculture) as a guidance for preparing health warning strategies, agricultural bulletins, etc.



Local Threshold Estimation and Effective Forecast/Warning for Preparedness Measures

Dr. S. C. Bhan, IMD

Dr. S.C. Bhan listed out the variables that play an important role in local threshold estimation and effective forecast/warning and made the following observations and suggestions:

- How to define different threshold for different sectors as we don't have a very robust impact based definition of heat waves.
- As an effective heat wave service requires a well understood and scientifically defensible heat wave definition, it is important to have impact based definition of heat wave to close the gap between understanding and service demands. Sector specific thresholds are needed for provision of impact based forecast and warning system as well as for effective actions and graded response at different levels.
- Regions and occupations need to define their own thresholds.
- Need local thresholds to provide impact-based forecasts to initiate graded response at different levels.
- Encourage the use of colour coded warnings.
- Actual heat-health outcomes based on thresholds need to be computed.
- The local public health agencies need to take a lead role in issuing specific advisories.
- Need for capacity building/awareness programmes for public, local stakeholders and decision makers.
- Large urban regions need to be dissected into smaller areas with unique thresholds for each of these areas.



Possibilities of Heat-stress Index for India: Projections of near future Prof. Vidhya Venugopal, Sri Ramachandra University

Prof. Vinugopal discussed different indices which are in vogue for different professions such as:



- Indices based on calculations involving the heat balance equation (**"rational indices"**), e.g., the WBGT for warm weather or the required clothing insulations for cold environments
- Indices based on objective and subjective strain (**"empirical indices"**), e.g., the physiological strain index
- Indices based on direct measurements of environmental variables ("direct indices") and their advantages vs disadvantages in Indian context as follows:

- Effective Temperature: CET, ET, NET, PET, SET
- Humidex: Canada
- HI: USA
 - Comfort indexes: PMV
 - Physiological models: PHS, Fiala etc.
 - WBGT: most comprehensively studied
 - UTCI: for both hot and cold temperatures

However, stressing about empirical indices, she opined that

- The **Effective Temperature (ET)** combines the effects of Air temperature, Humidity, Air movement & clothing – **radiant heat**.
- The **Corrected Effective Temperature** summates the separate environmental factors of air temperature, humidity and air velocity and also an allowance is made for radiant heat.
- **Heat Stress Index** is a comparison of evaporation required to maintain heat balance (E_{req}) with maximum evaporation that could be achieved (E_{max})
 - Allowable exposure time = $2440 / (E_{req} - E_{max})$ minutes
- **Humidex** (humidity index) is an index used to describe how hot an average person feels (Temp + Humidity)
- **Predicted 4 Hour Sweat Rate (P4SR)** amount of sweat secreted by young fit acclimatized exposed to the environment for 4 hours

Similarly, on Rational Indices, she mentioned the following:

- **Analytical** determination and interpretation of heat stress using calculation – **Predicted Heat Strain**
- **Required Sweat Rate** - Analytical - T_a , WBT, Humidity, air velocity, radiation, thermal insulation, property of clothing, metabolic work rate and posture
- **Thermal Work Limit** - Work areas evaluated using T_a , WBT & radiation, plus air movement, atmospheric pressure & clothing to predict a safe maximum continuously sustainable metabolic rate for the conditions (Wm^{-2})
- **Universal Thermal Climate Index (UTCI)** is a non-occupational hygiene index to assess heat stress in the outdoor thermal environment for public health purposes. Uses T_a , WBT, T_g , Wind speed & RH

She stressed that the most suitable indices for the heat wave management in India should be selected.

Technical Session 3

Experience Sharing & Lessons Learnt for Heat Wave Mitigation Measures

Chairperson: Shri Kamal Kishore, Member, NDMA

Some vulnerable States shared their experiences, best practices, challenges and lessons learnt to help other stakeholders draw lessons to better implement their Heat Action Plans. The success stories from these States emphasise the importance of advanced planning, better preparedness and timely intervention. This session was chaired by Shri Kamal Kishore, Member, NDMA.



Karnataka: Presented by Shri S. S. M. Gavaskar, KSNDMC

Karnataka State Natural Disaster Monitoring Centre (KSNDMC) has installed GPRS-enabled solar powered telemetric weather monitoring stations across the State. Each of these stations provide data every 15 minutes. Real-time weather information is also widely disseminated to all stakeholders, including end-users, using various media such as alerts, advisories, SMSes, e-mails, Social Media, print and electronic media, etc. A 24x7 interactive weather help desk - Varun Mitra - receives around 800 calls every day. The State has formulated its Heat Action Plan and takes measures such as rescheduling school and office hours, ensuring flexible hours for MNREGS workers, stocking Oral Rehydration Solution, etc. to tackle the onslaught of heat waves. The State also undertakes public awareness campaigns about heat wave through innovative IEC activities and community outreach programmes.

Gujarat: Presented by Dr. Tejas Shah

Ahmedabad suffered a major heat wave during 2010 which resulted in a number of deaths. A detailed study was done on this with the help of Indian Institute of Public Health, Gandhinagar. Consequently, Ahmedabad became the first city in the country to develop its Heat Action Plan in 2013. It also developed a colour code system to ensure appropriate action such as issuing of alerts. Interventions are made in the following areas: 1) Community Capacity Building: This is done through dissemination of multilingual pamphlets, advertisements and public messages with simple tips on heat stress prevention. Sensitisation workshops are conducted for high risk groups. 2) Capacity Building: Medical professionals are trained to recognise, diagnose and treat heat-specific symptoms and follow standard surveillance protocols. Community health workers are trained to recognise heat danger and offer prevention tips to poor and vulnerable communities. 3) Reducing heat exposure: This is done by promoting adaptive measures such as using sprinklers and water dispensers at public places, cool roofs, green cover, etc. 4) Early Warning System: Once a forecast is received, it is communicated to all stakeholders.

Ahmedabad has received the 8th Earth Care Award for the pioneering work in implementation of its Heat Action Plan.

Future actions on heat risk include adopting cool roofs technology and a Carbon Neutral Plan for all buildings.

Andhra Pradesh: Presented by Dr. M. M. Ali, APSDMA

The State has mapped hotspots and vulnerable areas so that targeted planning and preparedness activities are undertaken. The State undertakes a massive outreach and communication programme using an optimum media mix. Various mock drills are conducted at the State and district levels to build capacity. School-level mock drills are conducted to create awareness among schoolchildren. Other measures include distribution of Oral Rehydration Solution packets and butter milk, stockpiling of medicines and provision of clean drinking water at public places.



The following activities would be undertaken for tackling Heat Wave 2020:

- Continue the existing programmes

- Preparing heat wave action plan 2020
- Incorporating National Remote Sensing Centre (NRSC) predictions to ensure adequate response
- Predict accumulated heat stress index
- Use All India Radio (AIR) services for wider dissemination

Maharashtra: Presented by Shri Omkar Khare, Consultant, DMU

The State formulated its Heat Action Plan in 2017 and its mitigation and response measures are focused in the Vidarbha, Madhya Maharashtra and Marathwada regions. A city-specific Plan for Nagpur has also been prepared in 2019 by the Nagpur Municipal Corporation. The State's Disaster Management Unit works in close coordination with IMD, State's health department and Maharashtra State Disaster Management Authority. A State-wide awareness campaign is undertaken using several media such as SMSes, local TV advertisements, pamphlets, hoardings, local newspapers, radio jingles, WhatsApp and Social Media. The government also effects changes in office and school timings, and working hours for MNREGS workers. Other efforts include keeping markets closed in the afternoon, providing public shelters, equipping traffic police with cool jackets and helmets, sprinkling mist at public places and keeping ice bags available at Public Health Centres (PHCs).

Long-term measures include town planning, afforestation, plantation drives, rainwater harvesting, providing shelter for traffic police, using green nets in market areas and strengthening inter-sectoral coordination.

Odisha: Presented by Dr. Pradeep Naik, Chief General Manager, OSDMA



The following activities are undertaken by the Odisha State Disaster Management Authority to reduce the adverse impacts of the prolonged heat wave conditions in the State:

- Organizing State-level preparatory meeting on management of Heat Wave every year under the Chairmanship of Chief secretary, involving all the important stakeholders departments.
- Preparedness meetings of District Disaster Management Authorities for monitoring the situation on a continuous basis.
- Conducting studies and identifying threshold temperatures for different cities/regions.
- Preparation of Heat Action Plan and coordination with all departments towards

implementation.

- Issue appropriate directives to the concerned departments for taking preparatory and precautionary measures for Heat Wave Management.
- Incorporate and update information related to Heat Wave in on OSDMA and related websites.
- Coordinating awareness campaigns and IEC activities.
- Facilitating involvement of Civil Society Organisations for taking different mitigation activities.
- Capacity building of different stakeholders on heat wave management.
- Heat Alert/ warning dissemination to the concerned authorities/institutions/public once it is received from IMD.
- Temperature forecasts and heat alerts are sent as bulk messages on mobile phones, including to the media for wider broadcast.
- Conducting awareness generation campaigns on heat wave safety measures.

Technical Session 4

Capacity building & Enhancing effective response to Heat Wave

Chairperson: Dr. Ajit Tyagi, Indian Meteorological Society

Threshold & Vulnerability Assessments Improving resilience of people to cope with heat wave

Dr. Lipika Nanda, Vice President, PHFI, Hyderabad

Dr. Lipika Nanda presented a case study of heat waves in Odisha. While coastal areas experience humid heat, western parts experience dry heat. More than 2,000 deaths were reported in 1998 and 1999. Such high mortality rates led to the formulation and implementation of the first-ever State-level Heat Wave Action Plan (HAP). She pointed out that unless due care is taken every year, shortcomings in the execution of heat wave action plan may lead to losses. For instance, in 2005, Odisha lost 236 lives due to heat waves. Factors such as increasing urbanization, pollution, industrialization and climate change have exacerbated this problem.



Further elaborating on **Temperature-mortality association**, Dr. Nanda

explained the following:

- Distributed lag non-linear model that IIPH has adopted, wherein,
- All-cause mortality was modelled with T_{\max} as the explanatory variable and its lag structure as the third dimension
- The non-linear relationship of the temperature was defined using 2nd degree basic splines
- Model adjusted for humidity, day of the week, day of the year and time to adjust for long-term and seasonal trends
- Slice graphs drawn with predicted relative risks against varying lags and varying temperatures, once at a time with median T_{\max} of 36.6 degrees as the reference temperature
- The modelled relationship between T_{\max} and all-cause mortality using a Poisson regression with a regression spline to model the non-linear association

She presented the advantages of this model in computing the relationship between temperature and mortality. However, she also cautioned that local factors should also be given due attention. Using this model, she explained the possibility of developing two

“thresholds” approach and strategy to develop “traffic light” method of heat warning; thus not creating unnecessary “panic” at lower temperatures nor “complacency” at higher temperatures among the population.

She also presented findings of vulnerability assessment conducted for the two cities–Cuttack and Bhubaneswar. Samples were collected from 26 slums (13 from each city) + 10 Non-slum areas. Personal data was collected from 766 households (306 Slum HHs + 460 Non slum HHs). In total, information was collected for 1,009 Individuals. The study indicated that:

- Males staying indoors were two times higher at risk of getting heat illness compared with females. This was due to ventilation and building materials used.
- Presence of kitchen outside the home makes the residents two times more vulnerable towards heat exposure and illnesses.
- Presence of chronic conditions predisposes higher risk (2-4 times) of getting heat illnesses.
- Using fans/airconditioning/coolers decreases the chances of getting heat illnesses by 60 per cent.

Regarding mitigation measures, Dr. Nanda suggested the following approaches, viz,

- Effective Communication strategies
- Distributing informational pamphlets for specific groups
- Ensuring drinking water supply
- Adequate provision of shelter homes
- Public access to cool places
- Changing of cooking fuel
- Chronic diseases and medication – more qualitative research is needed.

Issues and Challenge for Effective Response of Heat Wave

Dr. G. K. Bhat, Chairperson, TARU Leading Edge



Dr. Bhat spoke about the chain of events in June 2019 that led to affect 1,000 persons and caused 107 deaths in Gaya, Bihar. These included a steep hike in temperatures, severe dip in humidity, no winds, no rainfall incident, lowered groundwater table and the drying up of handpumps.

Community preparedness makes the ultimate difference between a hazard and a disaster. Every effort should be made to strengthen the capacity of the community. He made the following suggestions:

- Need for a single data repository where all the data can be accessed at one place.
- Worst case scenario generation should be undertaken as a learning opportunity and for vulnerability assessment.
- Use of cost-effective personal coolants.
- Use of nature as a cooling agent (lakes, ponds, forests, etc.).
- Communities should increase the area under forest cover, retrofit old buildings, install sensors to monitor and report water and air pollution.
- Private sector should engineer insulating building materials, and design built environment that can withstand wind and temperature extremes.
- Government should set up a real-time sensor networks for monitoring temperature, humidity and air quality, and release regular location-specific bulletins on heat conditions and hotspots.
- Civil society should prepare a catalogue of thermal comfort options; build public awareness of health risks from urban heat.

Operational Issues: During the extreme Emergency Situation and response of Heat Wave

Shri Rama Chandrudu, Additional Secretary, Government of Bihar



He presented the various initiatives taken by Bihar for mitigating the impacts of heat wave and made some suggestions.

- Despite an increase in the number of heat wave events in 2019, the number of deaths could be restricted due to sensitisation and capacity building of healthcare professionals. However, the number of deaths due to heat illnesses increased from 2018, especially in Aurangabad, Gaya and Nawada districts.
- A session on heat-related health issues and its reporting be kept for Auxillary Nurse Midwives (ANMs) and Accredited Social Health Activists (ASHAs) in trainings organized for them at the district and block levels.
- Water facilities should be available at public places.
- Beds/wards should be reserved for patients suffering from heat-related illnesses.
- Extensive IEC activities from time to time to make the public aware about heat wave preparedness and mitigation.

- Electricity Department should ensure uninterrupted electric supply to hospitals.
- Initiatives taken by Bihar govt.- Frequent review meetings with the Chief Minister as the Chair; imposition of Sec. 144 in some districts to prevent exposure; distribution of ORS packets; deploying water tankers at public places; ; setting up diagnostic laboratories in critical districts; monitoring teams to ensure effective implementation; and giving a compensation of Rs. 4 lakhs to the next of kin of victims.
- Initiatives taken by Public Health Engineering Department- tanker supply water, installment of new hand pumps and drinking water facilities for animals.

Capacity Building Programme – Planning and Implementations

Dr. Anil Gupta, Associate Professor, NIDM



Dr. Gupta, in his presentation on building capacity for mitigation of adverse impacts of heat wave, enlisted the broad objectives of heat wave management:

- Enable effective early warning, communication – reception and perception
 - Enable effective risk mitigation with involvement of all key departments/sectors and stakeholders at all levels
 - Enable effective preparedness with resources, knowledge, skills/behaviour and response mechanisms
- Enable capacity building to analyse situations/events and draw lessons for improvement and mainstreaming into development

Dr. Gupta highlighted the ongoing efforts in the management of heat waves and the key players involved in various activities:

- Key stakeholders involved in addressing all cross-cutting issues of heat wave management- NDMA, Ministry of Health & Family Welfare, NIDM-Centre of Excellence for Climate Resilience.
- Training of target groups including experts/academics, professionals, legislators, advisors, officials, communities, Urban Local Bodies, Industry, Resident Welfare Associations/Civil Society, corporate sector, teaching community, Non Governmental Organisations, Trade Unions, etc.
- Capacity building of resources - NDMA, Ministry of Environment, Forest and Climate Change (MoEFCC)/Ministry of Home Affairs (MHA)/National Institute of Disaster

Management (NIDM)/ University Grants Commission (UGC)/ National Environmental Engineering Research Institute (NEERI)/ Industrial Toxicology Research Centre (ITRC)/Professional Organisations/ Indian Science Congress Association (ISCA)/Indian Medical Association (IMA)/Red Cross/ Indian Public Health Association (IPHA)/Indian Institute of Public Health (IIPH)/ Indian National Science Academy (INSA)/ National Institute of Agricultural Sciences (NAAS)/Corporate sector/ Federation of Indian Chambers of Commerce and Industry (FICCI)/ Confederation of Indian Industry (CII)/ Associated Chambers of Commerce and Industry of India (ASSOCHAM)/Public Sector Undertakings (PSUs), etc.

- Institutional mapping for education, training and research in Disaster Management at the district, State and central levels.
- Initiatives by NIDM- Training modules on heat wave (as an integrated component of Hydro-meteorological hazards and Extreme Events), Heat wave in India (Documentation study, which is in the process of being updated), Climate Change Adaption in Industrial Estates Planning and Management (including Heat Stress and Drought), Peri-urban Imperatives for Urban Resilience, Climate Change and Health Resilience, Climate DRR into City Planning.

Capacity Building for conducting Threshold Estimation at Local Level Shri Anup Kumar Srivastava, Sr. Consultant, NDMA

- We have worked on determining threshold temperatures for 100 cities in India with IMD providing weather data for more than 10 years, the office of the registrar providing city-specific mortality data and the State government providing data on births and deaths.



- Local thresholds are essential for effective heat health early warning system.
- Threshold estimation should be done at Megacity (Population >10,00000) and District levels.
- Megacities/Districts should be the operational units for HAP development and implementation.
- States should develop State-specific heat wave action plans in line with the national guidelines issued by NDMA. Cities/districts should prepare and

implement their local heat action plans with locally determined thresholds.

- Tmax is the most widely used thermal variable.
- All-cause mortality is the most widely used health impact variable.
- Estimation of threshold- Time series analysis; percentile based- 90th, 95th, 99th, statistical analysis.

Capacity Building for conducting Threshold Estimation at Local Level

Dr. Abhiyant Tiwary, IIPH Gandhinagar

There is no universal definition of heat wave; it is a spatial phenomenon and its effects vary depending on many variables. It is, therefore, imperative that that local thresholds are



developed. In 2003, Europe reported 15,000 heat wave deaths when the temperature $\sim 37^{\circ}\text{C}$. On the other hand, in India, IMD's Heat Wave Definition starts at 40°C for plains.

For evolving local threshold levels, Dr. Tiwary suggested considering the following:

- Ambient temperature doesn't vary much geographically within a district unless there are major differences in physiography.
- Threshold estimation should be done at Megacity (Population $>10,00000$) and District levels.
- Megacities/Districts should be the operational units for HAP development and implementation.
- States should develop State-specific heat wave action plans in line with the national guidelines issued by NDMA. Cities/districts should prepare and implement their local heat action plans with locally determined thresholds for early warning and the following variables:

Thermal variables

Tmax
Tmin
Tmean
HI
PT
Humidex
WBGT
UTCI

For evaluation of health related impacts of heat wave, he suggested considering the following information sources:

- All-cause daily mortality count data
- Cause-specific daily mortality count data
- Hospital daily admissions count data
- Emergency ambulance (108) services daily call count data

For establishing the local thresholds, he suggested considering:

- Data Period for analysis – Try to get data for as many years as possible, especially for summer months (March-June).

- Epidemiological Studies
 - Time series analysis
 - Other possible analysis (Anova – Surat)
- Percentile Based - 90th, 95th, 99th (Seasonal / Monthly)

- Published Research

Technical Session 5

Inter Agency Coordination and Effective Governance

Chairperson: Dr. Lipika Nanda, Vice President, Public Health Foundation of India

All the participants were divided into four groups and respective group leaders presented the outcome of their group discussion at the end of the session.

- **Group A: Sector Specific Standard Operation Procedures (SOPs) and Plan**
Group Leaders: Shri Pradeep Nayak, CGM-OSDMA, Odisha & Ms. Ridhim Aggarwal, Addl.CEO and DIG, Uttarakhand

- **Group B: Building long term Resilience and Mitigation Measures**
Group Leaders: Dr. Vinay Sehgal, ICAR-IARI, New Delhi & Dr. Rajashree Kotharkar, VNIT, Nagpur

- **Group C: Coordination and Monitoring Mechanism within States / Districts and Cities / Towns**
Group Leaders: Shri Polash Mukerjee, NRDC & Dr. Abhay Srivastava, HIPA

- **Group D: Documentation and reporting strategy and data base**
Group Leaders: Dr. Akshay Kumar, NCDC-IDSP, MoH&FW & Dr. Mahaveer Goleccha, IIPH Gandhinagar

Group A: (Sector-Specific SOP and Plan)



- Identifying sector-specific role and responsibility for preparedness and response plan for the following stakeholders:

- Water Resources
 - Health and Family Welfare
 - Labor and Employment
 - Public Works Department(PWD)
 - Women and Child Development (W&CD)
 - Animal Husbandry
 - Agriculture
- Education
 - Panchayati Raj
 - Indian Meteorological Department (IMD)
 - SC/ST Department
 - Transport and Communication
 - Forest Department
- Preparing concise, actionable short SOPs, including inter-agency coordination**
- Water Resources

- To ensure availability of water in reservoirs to used exclusively for drinking purpose
- Checking the groundwater level before and after March
- Preventing wastage of water
- Promote rainwater harvesting

➤ Health and Family Welfare

- Create awareness about dangers of heat wave and how to minimise the risk through intensive IEC campaigns, including distribution of pamphlets and flyers/putting up posters/TV/ radio/ print/Social Media campaigns. Also, it should create awareness about the most appropriate diet that should be taken during heat wave.
- Maintain sufficient supply of ORS sachets and ice packs at PHCs, Community Health Centers, Taluk/District/ private hospitals. It should encourage opening of ORS booths in coordination with NGO's or as a CSR initiative.
- Health centers in heat wave prone hobli/taluks should earmark beds at cool and ventilated locations to treat heat wave-affected patients.
- Ensure that ambulances/other PHC vehicles are stocked with ORS and ice packs.
- Train medical officers and paramedical workers on heatwave treatment protocol. Paramedical and ASHA workers to be sensitised on heat stress disorders, prevention and management.
- Instructions to be issued to DHOs to certify heat-related deaths occurred due to heat stress and share a copy of the post-mortem report with respective *Tahsildars* to expedite payment of *ex-gratia* to the next of kin.

➤ Agriculture

- Ensure piped water supply to all households.

➤ Forest Department

- Plantation of trees.
- Increasing forest area.

➤ Education

- Reschedule school timings to avoid peak heat period in heat wave-prone taluks/ district during summer.
- Avoid outdoor Physical Education Training/sports during peak heat period.
- If possible, paint the rooftop of schools white/ Albedo painting to reduce heat built-up and ensure cooler classrooms.
- Provision of cool and clean drinking water in earthen pots.
- Create awareness on heat wave prevention and management in schools using IEC activities. Train teachers to identify heat-related health risks and its management.
- Encourage planting of trees in the vicinity of schools (long-term plan).

➤ Women & Child Development (W&CD)

- Targeted dissemination of public awareness campaigns by the department of Health and Family Welfare with a special focus on infants, children below five years, pregnant and lactating mothers and geriatric population. Create awareness regarding importance of hydration.
- Create awareness on heat wave prevention and management in *anganwadis* using IEC activities. Training *anganwadi* workers to identify heat-related health risks and its management.
- *Anganwadis* should be kept functional during summers by planning staggered leaves to *Anganwadi* helpers/supervisors. *Anganwadi* timings should be rescheduled to avoid peak heat and ORS packets should be stocked in *anganwadis*, if necessary.
- If needed, buttermilk/curd will be served in *anganwadi* instead of milk.
- No outdoor activities should be undertaken during peak heat period; indoor activities should be planned to keep children engaged.
- *Anganwadis* should be opened for the general public as a resting place during vacations.

➤ Labor and employment

- To issue directives for flexible working hours to avoid peak heat exposure.
- Create awareness among construction workers, factory labourers, manual labourers and other workers whose occupations require intensive work outdoors on first aid, how to protect themselves from heat exposure, and on staying hydrated.
- Clean drinking water and cool place for resting to be provided at workplace.
- Stocking of ORS and ice packs, wherever possible, at work sites.
- Hospitals near work sites should be requested to reserve beds for patients affected by heat.
- To enforce relevant labour laws to protect health of workers during heat wave.

➤ Transportation

- Obtaining lists of risk areas and review bus timings and available shelters in those areas.
- Planning for shade / shelter, drinking water and fans in the waiting areas for passengers.
- Review plans with cab operators / auto / transport associations /highway patrols.
- Displaying precautionary measures (Do's and don'ts) on buses, autos, at bus stations and auto stands. Also, distributing pamphlets to passengers.
- Provision of providing ORS, ice packs and medical services at bus stations.

- Animal husbandry
 - Create awareness on effects of heat wave on livestock through IEC activity.
 - Construct water trough for animals at strategic locations.
 - Stock essential medicines to deal with heat-related stress in livestock.

- Department of Urban Development and Directorate of Municipal Administration
 - Ensure uninterrupted supply of clear drinking water during summers.
 - Disseminate heat alerts received from SEOC and SDMA to all stakeholders and general public.
 - Create awareness through intensive IEC activities.
 - Set up water kiosks at market places and other strategic locations in coordination with NGO's or as a CSR activity.
 - Designate public places such as schools (during vacations), public parks, etc. for resting during peak heat period.
 - Ensure adequate stock of ORS, IV fluids and other medicines in cooperation-run hospitals.
 - Promote and construct "Heat Resistant Buildings" as a mitigating measure in the long run.
 - Promote cool roofs initiative /white coloured roofs (albedo paint), green roofs and walls, and plantation in neighbourhoods to keep them cool.

- Department of Rural Development and Panchayat Raj
 - Sensitise vulnerable population on Heat Wave management and do's and don'ts issued by the department of Health and Family Welfare Department through posters, IEC activities, print/electronic media and social media.
 - Reschedule work timings (flexible timings) for workers under MGNREGA to avoid peak heat period.
 - Productive discount (reduced target/workload without any wage cut) during summers to prevent fatigue and exertion.
 - Provide drinking water at MGNREGA site and cooling place such as nearby schools (during vacation)/community halls for resting during peak heat period. Stock of ORS should be maintained.
 - Provision of water kiosks at strategic locations such as panchayat office, markets, etc., in coordination with NGOs or as a CSR activity.
 - Ensure that public places such as schools (during vacation), community halls, parks, etc. for resting during peak heat period during the day.
 - Provide clean drinking water to the community, take repairs pertaining to supply of drinking water on priority.

- Specific timeline for issuing office order/instruction to take action

- All states need to notify.

Group B: Building Long-term Resilience and Mitigation Measures



- Need for Action Plans which can reduce the impacts of climate change, carbon, energy and water footprints.
- Action Plans should not only focus on urban areas but also on rural areas.
- All cities should become carbon neutral in the next 20 years.
- Plans should be city-specific and tailored as per their specific needs.
- Emission reduction should be central to all Plans.
- Third-party monitoring and enforcement mechanism should be made simple.
- Use of environmental-friendly products should be promoted.
- Hazard Risk and Vulnerability Assessment (HRVA) should be carried out.
- Capacity building of all stakeholders.
- Need to strengthen the entire healthcare system. Community should be made aware of these facilities.
- In the long term, there is a need to improve:
 - Availability of data for developing the threshold data
 - Convergence of knowledge, practices and plans
 - Integration of Heat wave Management Plan with other DM Plans
 - Long-term plan needs to include many other sectors
 - Budgeting which may come from State – part of normal development plans

Group C: Coordination and Monitoring Mechanism within States / Districts and Cities / Towns



The group highlighted the lack of awareness among officials as well as communities, coordination and monitoring and inclusion of Disaster Management in the agenda of regular meetings at the district and State levels. It also pointed out the lack of a framework to include private medical practitioners in the management of heat-related health risks. The group made the following suggestions:

- Need to make Early Warning dissemination more user-friendly.
- Health Department should be made the nodal agency at the State level.
- Involvement of local bodies such as Panchayati Raj Institutions and Urban Local Bodies on heat wave management.
- Regular meetings with all stakeholders should be held.
- Coordination Committees – Health, Revenue, Water, etc. - should be formed.

Group D: Documentation and reporting strategy and data base

Key Issues, Challenges and Suggestions:

- Lack of sensitisation among stakeholders/political will
- Unavailability of mechanisms and institutions for data collection
- Lack of Adequate resources
- Poor data quality
- Lack of inter-agency coordination
- No standard uniform data collection and reporting template
- Data collection should be done throughout the year
- Dedicated staff for data collection and documentation
- Technical capacity of officials
- Lack of user-friendly method for data collection



Data Requirement

S.N.	Department	Data
1	Health	Morbidity, mortality, age, gender, occupation specific
2	Birth and Death	All cause mortality, segregated
3	IMD	Temp, Humidity, etc.
4	Water supply Dept.	Availability, quality, levels
5	Fire	Number of fire incidences
6	Education	Number of heat-related cases in school, WASH (Water, Sanitation and Hygiene)
7	Women and Child Development	Number of cases at <i>Anganwadi</i> Centre (AWC)- Children and Women
8	Urban Development	Population living in slums exposed to heat wave and measures taken for mitigation
9	Labour Dept.	Information about High-Exposure Group and measures taken for mitigation
10	Rural Development	MNREGS workers
11	Irrigation, Agriculture, Horticulture	Agriculture workers
12	Forest Dept.	Incidences of Forest Fire
13	Power Supply	Number of power cuts, initiatives
14	Transport	Number of cases, measures undertaken
15	Animal Husbandry	Livestock, number of losses
16	Media	Number of awareness sessions, activities, coverage

Reporting Structure

- District Level
 - District Collector should be nodal officer
 - His/Her office will coordinate with all line department for timely collection of data
 - State level - SDMA, Relief Commissioner/ Revenue Dept.
 - National Level
 - Nodal Dept. needs to be identified
 - Central Government line departments need to provide data at the national level

Reporting Period: Daily

Documentation

- Documentation of Plan Development: issues, challenges, learning
- Documentation of Implementation process
- Documentation of district, state-specific initiatives and innovations
- Documentation of planned interventions and those that are carried out
- Documentation of analysis report for the summer period
- Documentation of evaluation of impact of action plan
- Uniform documentation template for all the States

Summary of GROUP DISCUSSIONS

Following are some of the important suggestions that emerged from the Group Discussions:

- Capacity building of all the stakeholders, including officers, needs to be taken up.
- As first responders, there is a need to train and encourage communities to develop skills for managing disaster events. There is a need to study behavioural changes in the community, and preserve and proliferate local knowledge on heat wave mitigation and management.



- At the State and the district levels, the Department of Health should be the nodal agency for heat wave mitigation and management under the guidance and support of the Secretary (State level) and District Commissioner (District / local level).
- A cabinet committee should be formed to oversee disaster risk reduction and a working group under the chairmanship of Chief Secretary / Additional Chief Secretary should be formed to monitor the implementation of policies and plans towards Disaster Management.
- Local-level action plans and working group for heat wave mitigation and management should include local ASHA workers, Sanitation & Nutrition committees, healthcare and social workers, ex-servicemen and retired govt. officials.
- Need to strengthen the health sector system by providing necessary trainings and equipment.

- Need to improve the forecasting and early warning system and provide information with good granularity up to local level.
- Apart from usual communication models like mobile phones, satellite phones, etc., information should be disseminated through community radio to reach out to the last person.
- A standard pro-forma for documenting the heat wave incidences (on the lines of Incidence Response System-IRS) should be developed. The success / failure stories should be documented with all necessary information to facilitate the revision of Heat Action Plans.
- All stakeholder departments need to work in co-ordination to mitigate the impact of heat waves.
- River basin Authorities should map all the water resources, and identify and plug the vulnerable areas.
- Need to promote and incentivise rainwater harvesting, and educate the community to utilise surface water during pre-March period and use groundwater post-March when heat wave condition is likely to emerge.
- The work related to the restoration of lakes / tanks has to be prioritised.
- Agriculture department should promote drip irrigation, educate and support the community to adjust the cropping pattern as per the water availability or the changing rainfall scenarios.
- Disaster Management, including heat wave management, should be made a part of the school curriculum. Awareness programmes should be conducted for schoolchildren and teachers.
- In vulnerable areas, the authorities should proactively change the school timings, ensure availability of adequate safe drinking water and introduce Water Bell sessions to facilitate the children and teachers to have water periodically.
- Need to encourage and support the construction of Cool Roof and greenery around the school premises.
- Outdoor workers are among the most vulnerable to heat wave impact. Their work schedule and intermittent rest period should be adjusted depending on the heat wave condition.
- The transport department should encourage and promote use of public transport, carpools, energy efficient vehicles, e-rickshaws, cycle pathways, etc. as emissions from vehicles also add to heat wave conditions.
- Fodder Banks and Cattle Camps with adequate fodder and water should be opened in vulnerable areas. Necessary vaccination drive should also to be carried out proactively.
- Heat wave is not one of the disasters eligible for relief under SDRF norms. In order to provide relief, State Governments have to declare heat wave as a State-specific disaster and provide relief from the 10 per cent of the SDRF meant for such State-

specific disasters. Hence, NDMA and Govt. of India should take necessary steps to include it as a disaster which is eligible for relief from SDRF.

- A comprehensive database on demography, population density, health hazards, heat wave mortality, morbidity and other ancillary information needs to be developed. Data should be collected through a comprehensive and common data collection methodology and format at all administrative levels and throughout the year.
- Need to carryout Hazard-Vulnerability Analysis and Mapping with good granularity, and develop standard methodologies to determine worst-case scenarios. Standard Operating Procedures and policy interventions should be made based on the available data and its analysis.
- As a long-term mitigation measure, it is necessary to develop an action plan to reduce the impacts of Climate Change and also include factors such as carbon foot print, energy footprint and water foot print in the plan.
- Action plans should be developed not only for cities and towns but also for rural areas.
- Under the cool and clean city planning, all cities need to be carbon neutral in the next 20 years. To achieve that, methodologies need to be developed to quantify the area / city-specific carbon foot print, determine the optimum density of the city / town, enforce landscape, resources and topography management-related polices' implementation, increase the canopy cover, greenery and rejuvenate the water bodies within the city / town.
- Need to introduce third-party monitoring practices to evaluate the policy / project implementation mechanism (on the lines of Green Audit).
- Encourage and enforce the use of environmental-friendly technology and products.
- Create a robust platform for sharing and convergence of knowledge, Action Plans, Practices and ensure they are always functional and supported by law.
- NDMA should facilitate the making and/or updating of National / State / District and local level Standard Operating Procedures for heat wave mitigation and management.
- Heat wave Management Plans should be integrated with Disaster Management Plans at all administrative levels - National / State / District / *Taluk* / Panchayat.
- The necessary budget should be made available under State Action Plans on Climate Change or Sustainable Development Goals. However, the sector-specific line departments should make budgetary provisions in respective schemes and programmes.

Way Forward, Emerging Issues and Future Course of Action Plan for 2020

Chairperson: Dr. D. N. Sharma, Member, NDMA

The session on “Way forward, Emerging Issues and future course of action plan for 2020” was chaired by Dr. D. N. Sharma, Member, NDMA. The panel members were Dr. V. Thiruppugazh, Addl. Secretary (PP), NDMA; Dr. S.C. Bhan, DGM, IMD and Shri T. K. Anil Kumar, Secretary, Dept. of Revenue (DM), Govt. of Karnataka.



Dr. V. Thiruppugazh made the following points:

- Early Warnings and Advisories on Heat Wave need to be widely disseminated so that vulnerable communities are aware of their risks. Better implementation of State Heat Action Plans can be achieved through mobilization of resources, inter agency co-ordination, public awareness and community outreach, capacity building programmes for professional and stakeholders and measures for reducing heat exposure. Such adaptive measures include ensuring proper land use, using suitable building technology, conserving water resources, afforestation, reducing pollution, non-exploitation of natural resources and focusing on health and nutrition.



- Many States need to formulate and implement Heat Action Plans. These plans need to be in line with the National Disaster Management Plan (NDMP).
 - Need for strengthening the existing Early Warning System.
 - Need for understanding the local thresholds of Heat Wave.
 - Need for appropriate Institutional

Mechanisms for implementing the Plans.

- Need for an effective 360 degree Information, Education and Communications campaign.
- Need for robust data collection and its analysis for ensuring formulation of evidence-based policies.
- Need to regularly revise existing Plans for incorporating the latest developments. Need for long-term mitigation plans so that we look and go beyond the existing annual action plans and achieve Sendai targets by 2030.
- Need for developing an effecting monitoring mechanism.
- As per the recent research studies, the following need to be addressed / taken up:
 - Heat Discomfort Survey
 - Temperature mapping and vulnerability analysis in select cities
 - Evaluation of the existing Heat Action Plans and their implementation
 - Mainstreaming and Integrating development plans with long-term mitigation measures
 - Providing technical support to vulnerable States and Districts
 - Linking Heat Action Plans with Climate Change mitigation and adaptation actions
 - Heat wave risk reduction to be integrated with the SDMPs and DDMPs
 - Making DRR a mass movement

Dr. S. C. Bhan listed the following as the way forward:

- States and Research Organisations should take the lead and partner with IMD in developing thresholds for their States/districts. Technical assistance / support may be provided by NDMA and IMD.
- As the Heat Wave forecasts are stable and accurate, and become available two weeks in advance, the activities / mitigation measures need to be reviewed



based on the State-specific advisory.

- Research Organisations and Knowledge Centres sensitised to the Heat Risk in their respective States should take up vulnerability assessment locally.
- All the States need to take up post-season evaluation / audit to assess their Plan as well as its implementation. Accordingly, the gaps should be filled for an even robust Action Plan for the upcoming year.
- States should undertake awareness campaigns to educate the community by briefing them about the Do's and Don'ts to be followed for different heat-related symptoms and the locations of the nearest health care centres.
- He urged NDMA to announce any day every week as Heat Wave Awareness day so that specific campaigns focusing on different target groups can be undertaken.

Shri T. K. Anil Kumar highlighted the following points:

- There is a need for mainstreaming Disaster Management by integrating it with all plans and projects to arrive at multi-sectoral solutions.
- The capacity of States to handle multi-hazardous situations needs to be built. Hence, there is a clear need to strengthen State Disaster Management Authorities and District Disaster Management Authorities.
- Analysing the available data will help develop an insight that will make Heat Action Plans more effective.



Summarising the session, Dr. D. N. Sharma stated the following:

- An integrated Disaster Management Action Plan, based on relevant and accurate data, is needed. This Plan should include mitigation measures and Information and Communications Technology tools.
- With improved weather prediction models, the accuracy of Early Warnings and Advisories has improved a lot. However, we need to improve the way we communicate



these warnings to the last man.

- States should invest in Research & Development. Measures should be taken for building suitable temperature-resistant houses at an affordable cost for vulnerable sections.
- Heat Action Plans should include a quick response mechanism for fighting cascading effects of excess heat such as fire and smoke which affect sectors such as Transport, Power etc.
- Need to build the capacity of doctors, paramedics and volunteers to tackle health-related issues under the overall ambit of Disaster Management.
- There is a need to review the implementation of Heat Action Plan after every season so that gaps can be identified and implementation improved.
- The impact of heat waves impact is bound to increase with time due to the Climate Change. States need to be prepared to face all kinds of eventualities.

Annexure

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