Training Module

Extreme Heat Prevention and Management

GUJARAT INSTITUTE OF DISASTER MANAGEMENT

BUILDING RESILIENCE

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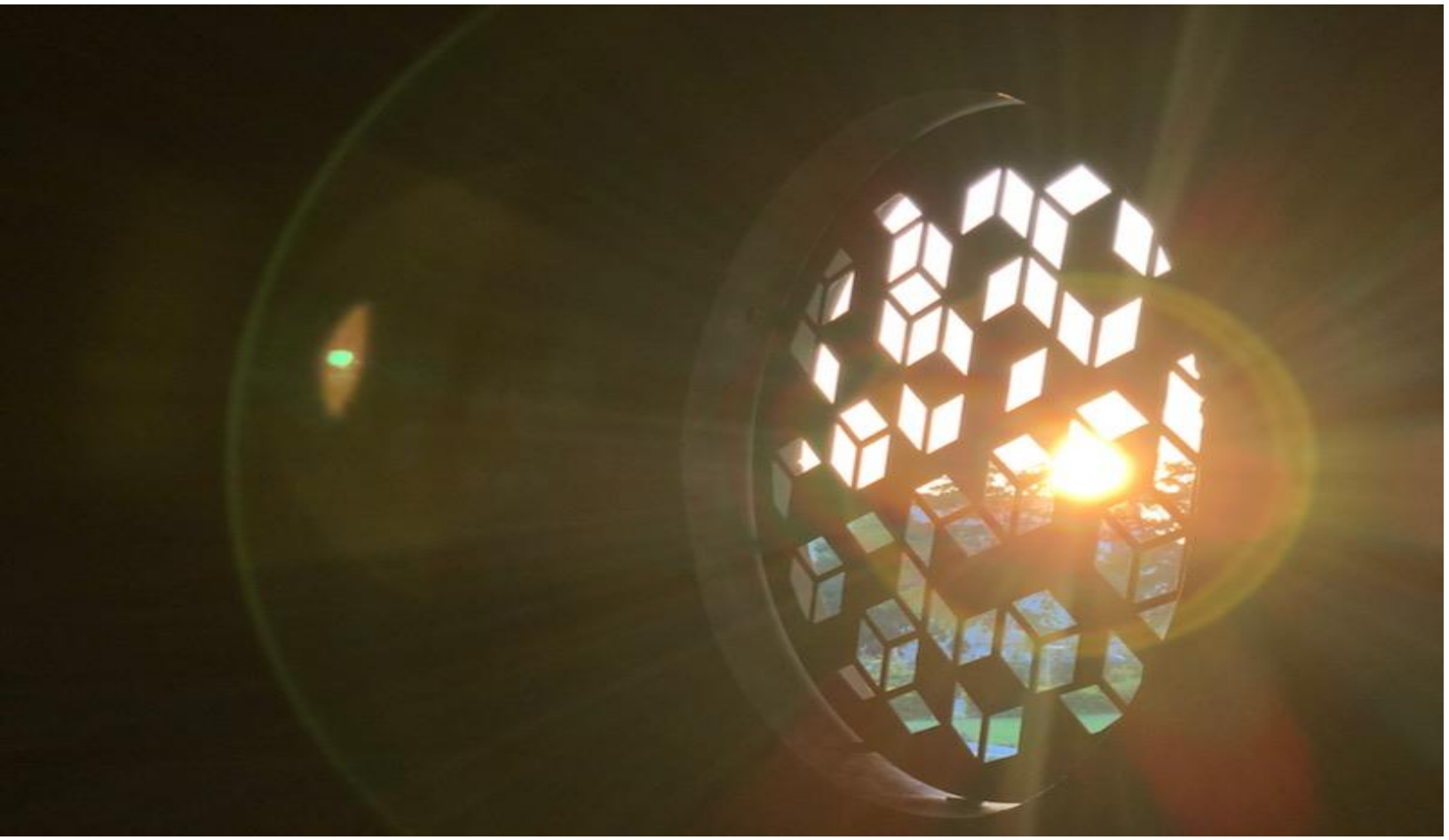
Extreme Heat Prevention and Management



Gujarat Institute of Disaster Management

Gandhinagar

Training Module on
Understanding Disaster Risk Management

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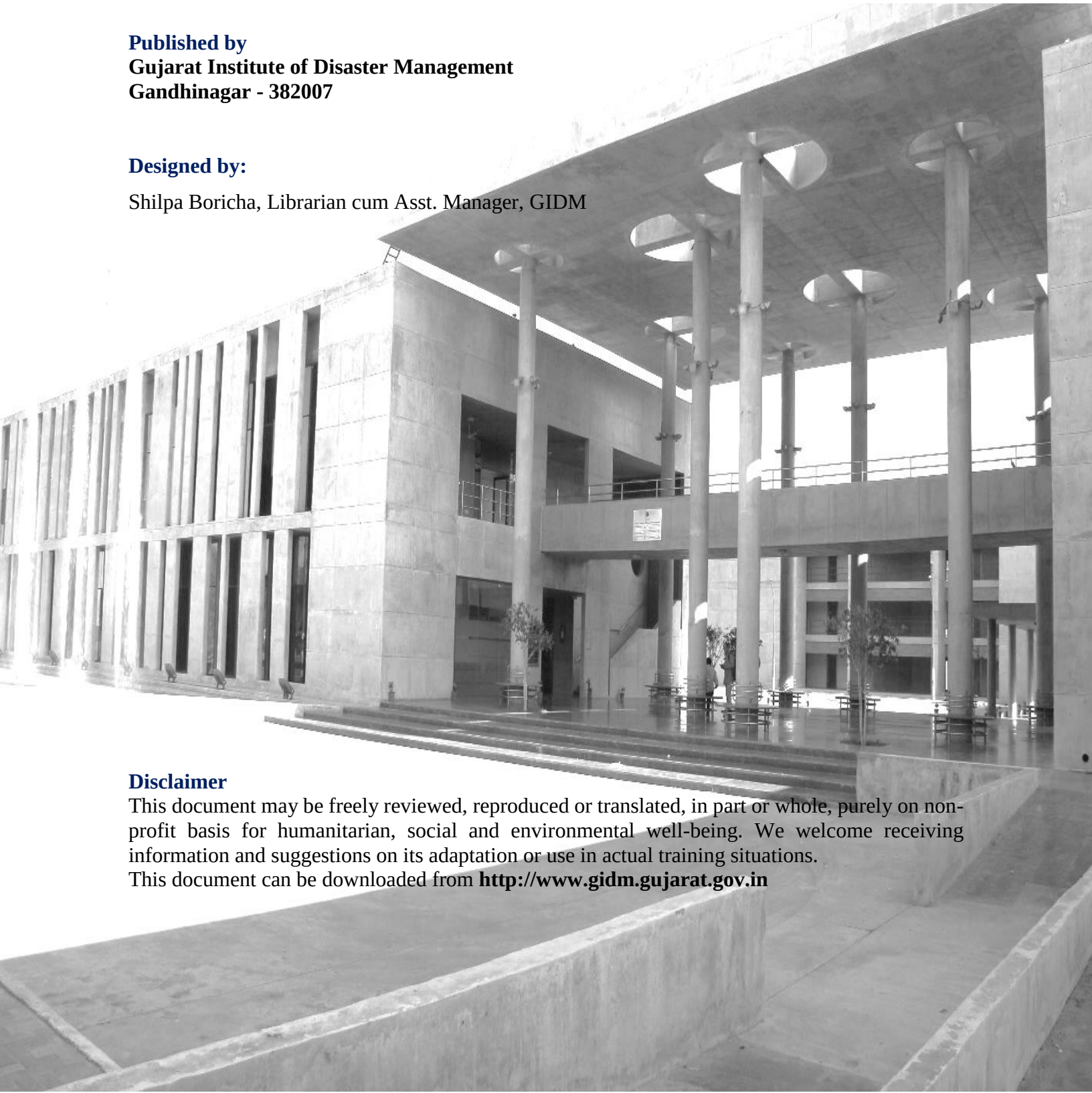

Message

Climate change has emerged as the biggest challenge to humanity in the 21st Century. It is imposing unprecedented damages on the environment, economies, and health of the people. And unfortunately, the impacts of climate change and global warming are further deepening the inequalities as the people at the bottom of the pyramid across the globe are facing higher consequences. On the other hand, the world seems to be failing on the 2015, CoP 21 Paris Agreement which aimed to limit the temperature increase to 1.5 °C above the pre-industrial era by end of the 21st Century as newer evidence coming in from the latest global climate studies are indicating that we may cross the threshold of 1.5 °C by mid of 21st century itself. This means, that the risk of occurrence of frequent, severe, and long-lasting extreme weather events like heatwaves will go further high...!

The encouraging part here is that governments, institutions, and communities all around the world are putting together efforts to minimize the ill impacts of heatwaves, especially on the health of the people. Learning from the disastrous extreme heat events in the past like the one in Europe in 2003 or South-Asia in 2015, many countries have developed their local Heat Action Plans to deal with any such devastating heatwave events in the future. I am happy to share that the city of Ahmedabad in Gujarat State has shown leadership by devising and implementing the first city-wide comprehensive Heat Action Plan of the South-Asia region since the year 2013 learning from which, numbers of cities and districts in several other states of India have developed their local Heat Action Plans.

Training is an integral part of disaster risk management as it empowers people to identify and understand the risk and then address it effectively. I appreciate the efforts of GIDM team especially Dr. Abhiyant Tiwari for coming up with the module on Extreme Heat Prevention and Management. I hope this module will help learners better understand the extreme heat from a disaster risk management lens. I am sure that learnings from this module will help in enhancing the awareness and add up to the heatwave risk reduction and management capacities of state and nation in long term.

(P. K. Taneja)
Director General

March, 2021
Gandhinagar

Glossary

AMC	Ahmedabad Municipal Corporation
CoP21	21st Conference of the Parties (Paris Agreement)
GHG	Greenhouse Gases
GIDM	Gujarat Institute of Disaster Management
HAP	Heat Action Plan
HEWS	Heat Early Warning System
IIPHG	Indian Institute of Public Health Gandhinagar
IMD	India Meteorological Department
IPCC	Intergovernmental Panel on Climate Change
NDMA	National Disaster Management Authority
NDRF	National Disaster Response Fund
NRDC	Natural Resources Defense Council
SDMA	State Disaster Management Authority
SDRF	State Disaster Response Fund
SFDRR	Sendai Framework for Disaster Risk Reduction
UHI	Urban Heat Island
UNDRR	United Nations Office for Disaster Risk Reduction
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organization
WMO	World Meteorological Organization

Content

Introduction to the Module

Introduction to the Module

About this module

The growing bodies of evidence are suggesting that due to man-made climate change, extreme weather events like extreme heat spells and heatwaves will become more frequent, intense. and long-lasting in the 21st century and we are already witnessing this happen. Each passing year is setting a new record of extreme heat. The world recorded its hottest decade ever from the year 2010 to 2019 and in that too year 2015 to 2019 were the hottest five years of world recorded ever in the history of mankind. Moreover, the initial climate reports suggest that even the year 2020 that faced lockdowns globally due to the COVID-19 pandemic has turned out to be one of the warmest years of the world's history with an annual average temperature of 1.25 ºC above pre-industrial levels. This extreme heat fueled up by anthropogenic climate change is adversely affecting the ecology, economy, and health of people from all walks of life and all parts of the world. And therefore, it becomes important to not just limit the rising temperature and heat by cutting down the carbon emissions but also to adjust and adapt to the inevitable extreme heat that is already taking place and mitigate its ill effects.

One can't act on something until one is not aware of it. And therefore, it necessary to be aware of extreme heat and its risk in the first place to take any measures to adapt to it and to mitigate its harm. Contemplating this, GIDM has developed the training module on the subject "Extreme Heat Prevention and Management" to help the trainers use it for the training of participants working in various government and non-government organizations and have a direct or indirect role in protecting the health of people from extreme heat during summers. This module will work as the guide for the trainer to train the participants on the key areas necessary for planning the prevention and management of extreme heat to minimize impacts on the health of people. The module is designed for a full-time residential training program and with modalities of interactive learning techniques like engagement, interaction, and feedback that helps the participants in effective learning.

Who shall use this module?

The module can primarily be used by trainers and experts from the field of disaster risk management and health but it can also be used by trainers and experts from any field who have experience working in the area of extreme heat prevention and management. It is splendidly emphasized as one of the guiding principles of SFDRR that "Engagement from all of society" is necessary for disaster risk reduction. Although, the primary and shared responsibilities of disaster risk reduction are still on some key agencies and stakeholders. Considering this, some of the key sectors in government and non-government organizations that may have an important role in addressing the risk of extreme heat on people are listed below and participants from government and non-government organizations working in these sectors shall be encouraged to undergo this training. The list of sectors given below is not exhaustive and it's reiterated here that participants from sectors that are not listed below have some level of understanding and interest in the subject of extreme heat should also be trained about identifying and understanding the risk of extreme heat in-order to empower them to reduce it.

- Health
- Disaster Management
- Women and Child Development
- Social Justice & Empowerment
- Education
- Urban Development
- Rural Development
- News Media

How to use the training module?

Trainers should use this module as a guiding template for the training of participants on the subject of extreme heat prevention and management. Various learning units in this training module are devised to develop step-by-step understating about extreme heat, how it differs from the heatwave, it's linkages with climate change and global warming, and then developing the understanding of participants about extreme heat through disaster risk lens. Details given about the topics covered in different learning units are meant to provide basic and brief understanding about those topics

respectively and it is done with the purpose to ensure that any trainer using this module can use it for participants coming from any background and not for participants coming with specialized background only. Although, the module gives flexibility to trainers using it to modify their presentations and training material based on the need and level of participants.

Trainer's Guide

To conduct a successful training, the trainer must be well aware of the requirements of training in terms of the profile of participants, content, and flow of the training, logistic and other arrangements required for residential training. In case of any external trainer using this module to carry out a residential training at GIDM, the program coordinator from GIDM shall help the external trainer and try to ensure that the following guidelines are met for training:

- Trainers shall provide the training specific background reading material to the program coordinator at least 5 days before the training if possible so that it can be shared with the registered participants beforehand.
- Registration shall be completed a day before the training program and details shall be made available to trainers to make them understand the profiles of participant trainees. This will help them in making changes in presentations and reading material if necessary, based on the profiles of participants.
- The program must start with public dissemination of risk information of the venue and the participants must be made aware of the signages of evacuation routes, assembly points, etc.
- A pre-test with 10 MCQs to assess the understanding of participants on the subject shall be conducted immediately after the inaugural session.
- Since this program is carried out based on interactive learning techniques, the trainer should look for the opportunities and innovative ways (using ICT Tools) wherever possible of engagement, interaction, and feedback from the participants before, during, and after each session.
- A post-test with 10 MCQs shall be conducted to assess the learnings imparted and the effectiveness of the program among participants on the subject.
- Lastly, a feedback survey of the entire training and each session if possible, shall be carried from participants to assess the effectiveness of trainers, training material, etc. which will help improve the training in the future.

Target Group

Participants working in the sector of Health, Disaster Management, Women and Child Development, Social Justice & Empowerment, Education, Urban Development, News Media in government and non-government organizations shall be encouraged in the first place to attend this training. The preferable group size should be 25-30 participants for each training.

Entry Behavior

- Level of participants: Anyone (From the sectors listed above or others interested)
- Age Group: Less than 50 years
- Educational Qualification: Anyone who has a basic understanding of science
- Disaster Experience: Not at all mandatory

Methodology

The training will be conducted in an interactive mode with a judicious mixture of lectures, discussions, demonstrations, experience sharing, group work, and case study analysis.

Teaching Aids

Training will have to be conducted with the help of the following:

1. Background reading materials/reference materials
2. Electronic handouts of presentations or additional material
3. Simulation exercise
4. A group is to be created on social media to ensure that the participants are in touch and are actively sharing knowledge amongst each other. Such groups can also function as crowd-based sources of data.

Training Materials and Equipment Required

The training will essentially be classroom-based and for simulation exercises, different the venues In the institute should be used. The training materials for classroom teaching like Computers, LCD projectors, flip charts, markers, etc. would be required.

Language of Instruction

The medium of instruction will be English, Hindi, and Gujarati

Seating Arrangements

The seating arrangements should preferably be four or five circular tables to facilitate group work and allow the trainer to move around the class for interaction.

Expected outcomes

After attending this training, it's expected that the participants will be better acquainted with,

- Identifying extreme heat and heatwave as a potential hazard
- Linkages between climate change, global warming, and heat
- Understanding the disaster risk of extreme heat
- Ways to prevent and manage the risk of extreme heat

Evaluation & Validation

Though the interactive learning methods used throughout the training program will be helpful in improvement of each successive sessions, an overall evaluation of course in terms of feedback from participants on trainers expertise, relevancy, and usefulness of the training and reading materials used and training coordinator's impression about the training as a whole will help in taming the module for future training.

Content Design

Session Title	Time	Methodology
Inauguration and Pre-Training Assessment		
Introduction	20 min	Interaction and Video
Pre-Test	10 min	MCQ Exam
Unit 1 Understanding Extreme Heat & Heatwave		
U1: L1 Defining Heatwave	30 min	PPT & Discussion
U1: L2 Heatwave VS Extreme Heat	30 min	PPT & Discussion
U1: L3 Global Warming, Climate Change, and Extreme Heat	30 min	PPT & Discussion
U1: L4 Extreme Heat events that made an impact	30 min	PPT, Discussion & Video
Unit 2 Disaster Risk of Extreme Heat		
U2: L1 Understanding Disaster Risk	30 min	PPT, Discussion & Video
U2: L2 Extreme Heat as Hazard	30 min	PPT & Discussion
U2: L3 Exposure of Extreme Heat	30 min	PPT & Discussion
U2: L4 Vulnerabilities to Extreme Heat	30 min	PPT & Discussion
Unit 3 Preparedness for Extreme Heat		
U3: L1 Heat Action Plan – Components & Development	30 min	PPT, Discussion & Video
U3: L2 Assessing Vulnerability & Developing Threshold	30 min	PPT & Simulation Exercise
U3: L3 Understanding heat early warning systems (HEWS)	30 min	PPT & Discussion
U3: L4 Institutional mechanisms to deal with extreme heat	30 min	PPT & Discussion
Post-Training Evaluation and Conclusion	30 min	MCQ Exam & Discussion

Public Dissemination of Risk Information of the Venue (PDRIV)

In case the training is being conducted at GIDM or at any other physical venue, it is mandatory that an audio-visual clip be shown about the venue that informs the audience / participants about the hazards the venue or the surrounding is prone to, the risks, the escape routes or evacuation plan and emergency assembly points. The audio-visual clip to be shown must not contain mere presentations or verbal directions. It should be a visual document of the actual evacuation route from common points like corridors or lounges to the assembly points, which may or may not be within the same establishment.

Primarily, a venue may be exposed to various different types of hazards and for an event of a day or two, hazards like flood or drought may be irrelevant and, in such cases, more immediate hazards like fire or earthquake should be dealt with. The focus should be on preparing the audience for evacuation if such a need arises during the program. The clip may be allowed to run repetitively while the initial arrangements are being made on the day of inauguration or when the participants start coming in and settling down for the first session of the training program.

In addition to the audio-visual clip, along with the registration kit, a single-page document should be handed over to the participants with the evacuation routes marked and assembly points mentioned. Emergency contact numbers may also be provided if the participants come from other parts of the world.

Proper preparation in this regard on behalf of the organizers is also necessary. The venue selected for the training course must have a minimum standard of disaster preparedness measures. First of all, the venue must have a disaster management plan and an emergency evacuation strategy within it. For the evacuation strategy to be effective, proper signage should be placed on and around the campus premises. The evacuation strategy should have been a tested through mock-drills a couple of times keeping in mind the different groups and types of participants that might join the training program like differently-abled individuals or senior old-age personnel and for a mock-drill to be executed, the establishment must have a disaster management plan. Thus, everything is dependent on the other with the disaster risk management plan serving as the key document.

Inauguration and Pre-Training Assessment

Need of the session

This introductory session will provide participants an avenue to get accustomed to GIDM campus, training, trainers, each other, their knowledge about the subject, and expected outcomes of the training. It's also possible that participants may come from different departments and organizations and therefore may not be knowing each other and find it uncomfortable to interact with each other at the beginning. It is therefore suggested that the program coordinator and trainers of the first session should take the opportunity of this session and use it as an icebreaker and start with a more casual way of introduction rather than the formal one. Participants may be given a few minutes to interact with each other to know about each other's experience in disaster risk management and then asked to introduce their co-participants rather than introducing themselves. The level of awareness and understanding about the risk of extreme heat varies between people depending on their experience and connection with the subject. The pre-test taken during this session will give an idea to the program coordinator and trainers about the diversity in subject-specific knowledge among participants and thus help them modify the pace and content of training to a level that is appropriate to all the participants and meets the training need.

Objective of the session

- To make participants accustomed with GIDM campus, training, and each other
- To assess their earlier knowledge about extreme heat risk.
- To make any changes in the content of training based on the pre-test.

Duration: 30 mins (20 + 10)

Training aids

Paper cards, Flip charts, Markers, Pen, Papers, AV support etc.

Unit - 1
Understanding Extreme Heat & Heatwave

Need of the session

The first and very foremost important learning of this training is making the participants clearly understand the distinction between extreme heat and heatwave. Both of these terminologies are often used very lucidly and interchangeably but in reality, they are not the same. While all the heatwave wave events are extreme heat events, not all extreme heat events need to be a heatwave. It is very much possible that an event of very high-temperature day/s during summer may not satisfy the criteria for heatwave (if any) and can still be an extreme heat event...! What is that distinction? Why it is important? This will be explained to participants during this first unit of training. The unit will also draw the attention of participants to the most important climatological and weather-related global and regional phenomenon's which are climate change and global warming. The way they are linked with each other and how they are related to extreme heat will be described during this unit. Lastly, the unit will end with examples of some of the extreme heat and heatwave events of the past in India and other parts of the world that made a major impact in the field of extreme heat prevention and management.

Units of the session

Unit 1 Lesson 1: Defining Heatwave

Unit 1 Lesson 2: Heatwave VS Extreme Heat

Unit 1 Lesson 3: Global Warming, Climate Change and Extreme Heat

Unit 1 Lesson 4: Extreme Heat events that made an impact

Objectives of the session

- Give understandings, criteria, definitions, and distinctions of heatwave and extreme heat
- Elaborate Climate Change, Global Warming and their linkages with extreme heat
- Provide examples of significant extreme heat events from past

Duration

120 minutes. (30 + 30 + 30 + 30 minutes for each session)

Methodology

The trainer may start this unit by asking some very basic questions about the topics of interest covered in this unit. The results of the pre-test can help the trainer ask questions that are of everyone's interest. The trainer may also show some videos related to the subject before starting with the power-point presentations as videos may create higher interest among participants about the subject.

Training aids

Power-point presentation, flip-charts, markers, papers, pens, AV support, etc.

Unit 1 Lesson 1: Defining Heatwave

Flow of the session

The trainer may begin this session by asking the participants what do they understand by the term "heatwave". Let the participants first delve through their knowledge, understanding, and experience to figure out what is heatwave according to them and interact with each other and with the trainer for the first five minutes of this session. Heatwaves are generally considered to be an extended period of unusual heat (extreme heat). The World Meteorological Organization's older definition of heatwave given in the International Meteorological Vocabulary (WMO-No. 182) is *"Marked warming of the air, or the invasion of very warm air, over a large area; it usually lasts from a few days to a few weeks."* Whereas the newer one is *"a period during which the daily maximum temperature exceeds for more than five consecutive days the maximum normal temperature by 9 degrees Fahrenheit (5 degrees Celsius), the normal period being defined as 1961–1990."* According to the India Meteorological Department, a heatwave can be **qualitatively** defined as a condition of air temperature which becomes fatal to the human body when exposed. And, **quantitatively**, based on the temperature thresholds over a region in terms of actual temperature or its departure from normal. The criteria for the Quantitative definition of heatwave used by the India Meteorological Department are as follows,

Heat wave is considered if maximum temperature of a station reaches at least 40°C or more for Plains and at least 30 °C or more for Hilly regions.

1. ***Based on Departure from Normal***

   Heat Wave: *Departure from normal is 4.5°C to 6.4°C*

   Severe Heat Wave: *Departure from normal is >6.4°C*

2. ***Based on Actual Maximum Temperature***

   Heat Wave: When actual maximum temperature ≥ 45°C

   Severe Heat Wave: When actual maximum temperature ≥47°C

   If above criteria met at least in 2 stations in a Meteorological sub-division for at least two consecutive days and it declared on the second day

For coastal regions: *When maximum temperature departure is 4.5°C or more from normal, Heat Wave may be described provided actual maximum temperature is 37°C or more.*

In India, heatwave conditions are mostly observed during the summer month i.e. from March to June, and rarely in July as well. The states that are largely affected by heatwaves in India are Punjab, Haryana, Delhi, Uttar Pradesh, Bihar, Jharkhand, West Bengal, Odisha, Madhya Pradesh, Rajasthan, Gujarat, parts of Maharashtra & Karnataka, Andhra Pradesh, Telangana, Tamilnadu, and Kerala. Participants can then be informed that there is no universally accepted definition of a heatwave. Why? Let the participants contemplate the reasons for that which the trainer will explain in the next session. At this stage, the trainer should draw the attention of participants to the key terminologies in the heatwave definitions shared above. Are they able to recognize terminologies like *"marked warming", "Departure from normal", "lasts for few days", "at least two consecutive days"*? If yes, what do they understand from them? Any guesses on the reference climate period used by India Meteorological Department for comparing normal maximum temperature in heatwave criteria? (It's 1981-2010)

Objectives of the session

- Explain the basis of definitions of heatwave and key terminologies used in it
- Develop an inquisition on why there is no universal definition of a heatwave

Duration

30 minutes

Methodology

The trainer should encourage active engagement from all participants during this session. The trainer should let them interact with each other and with the trainer in a controlled manner to enhance participatory learning.

Training aids

Power-point presentation, flip-charts, markers, papers, pens etc.

Unit 1 Lesson 2: Heatwave VS Extreme Heat

Flow of the session

Now that from the previous session, the participants know the definitions and criteria of heatwave given by the World Meteorological Organization and the India Meteorological Department and have a fair understanding of key terminologies used in different heatwave definitions and criteria, they should be asked to quickly reflect upon why there is no universally accepted definition of a heatwave. It is because the ambient air temperature is geospatially a very local phenomenon and its daily and seasonal values can vary from region to region, place to place, or even between two districts or cities of the same state.

The trainer can here bring to the attention of participants that people are acclimatized to the local weather and climatic condition in which they live for longer. Going further, the trainer may use the following hypothetical example. **People living in hotter climatic zones like the Vidarbha region in the central part of India where the temperatures frequently cross and remain above 40°C during summer are generally more acclimatized and fit to face ≥ 45°C heatwave or extreme heat events as compared to those living in places in northern plains of India where average summer temperature is not as high as in Vidarbha region. The impact of a heatwave or extreme heat on human activities and health would therefore be different in these two regions. Another reason why there is no consensus on the universal definition of a heatwave is the criteria of the duration of extreme heat conditions.**

The definitions of heatwave given by the World Meteorological Organization and the India Meteorological Department and by national weather services of many other countries have considered extreme heat conditions for the duration of two or more days as qualifying criteria for a heatwave. But there is now substantial evidence available indicating that a rapid increase in deaths and hospitalization can be seen even on the same day of extreme heat event i.e. on the first day of a heatwave itself. Then why to wait for declaring heatwave until the extreme temperatures are not satisfying the duration criteria of a heatwave?

The important bottlenecks with heatwave definitions to be highlighted here are,

- No universally accepted definition of heatwave
- No one size fit for all criteria of temperature departure and duration for defining heatwave
- Impacts on human activities and health can be seen even on the first day of heatwave

However, extreme heat can be considered as summertime temperatures that are much hotter than the average temperature and which can cause health emergencies. When the extreme heat conditions persist for two or more days duration (depending on the criteria fixed by local authorities), it's defined as a heatwave. Important to note here is that extreme heat is the defining condition for heatwave but extreme heat for one day itself can harm the health of people. And, it is the temperature cut-off of extreme heat conditions that are largely used in developing a local early warning system.

Objectives of the session

- Explain the difference between extreme heat and heatwave in terms of place and duration
- Explain how extreme heat can impact people.

Duration

30 minutes

Methodology

All the participants must get a clear understanding and distinction between heatwave and extreme heat and for that it would be helpful to do a quick verbal assessment by asking participants to explain the distinction at the end of this session.

Training aids

Power-point presentation, flip-charts, markers, papers, pens etc.

Unit 1 Lesson 3: Global Warming, Climate Change and Extreme Heat

Flow of the session

Climate change and global warming are perhaps among the most known and discussed phenomenon of the 21st century, but to provide detailed understandings to participants about these two phenomena and their linkages with extreme heat, it's better to start with Figure 1 below and explain to the participants about the difference between weather, climate variability and, climate change in the very first place. As shown in Figure 1 below, the duration is the main criteria to differentiate between weather, climate variability, and, climate change.

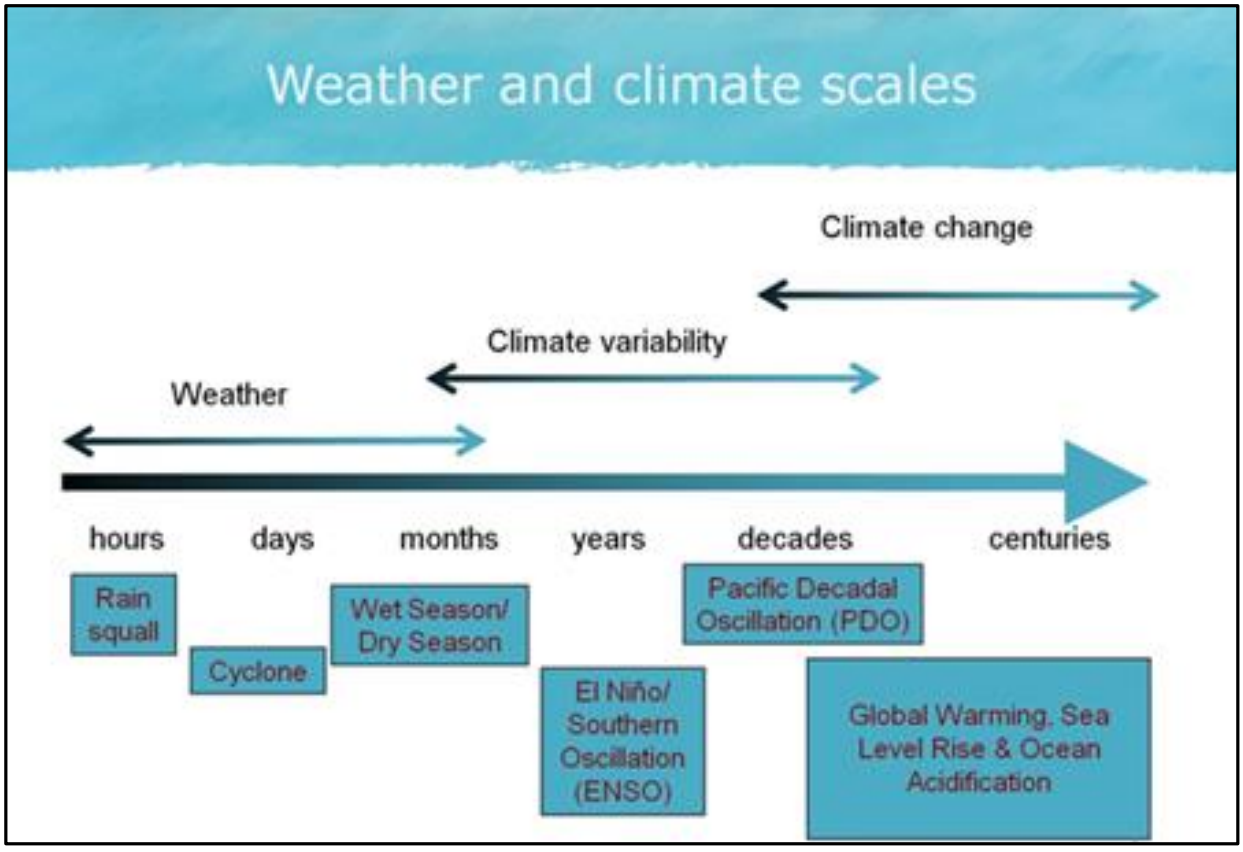

Figure 1: Difference between weather, climate variability and climate change

Source: Pacific-Australia Climate Change Science and Adaptation Planning Program

Weather is described as the current atmospheric conditions such as temperature, precipitation, wind-speed in a given place at a given time whereas the climate is the average weather condition of a particular place for a longer duration, ideally, 30 years.

The climate variability as explained by the World Meteorological Organization is *"variations in the mean state and other statistics of the climate on all temporal and spatial scales, beyond individual weather events."* The period for comparison here ranges from months to years and decades in some cases. Climate variability can occur due to both internal variability due to natural processes within the climate system and due to external variability as well which are mainly caused by anthropogenic (man-made) activities.

Similarly, the World Meteorological Organization has defined climate change also as *"statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer)."* And like climate variability, climate change may also occur due to both the natural internal processes of the climate system and external factors like man-made activities. But, the United Nations Framework Convention on Climate Change (UNFCCC) has made a clear distinction in defining climate change due to anthropogenic activities and has defined climate change as *"a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods"*

This is the right time to probe participants and ask them what did they understood about climate change from the session so far and what do they think is the connection of climate change with global warming. Is global warming a result of climate change or is it vice-versa?

Global warming is typically referred to as the increase in the average surface temperature of the earth since the pre-industrial era between 1850 and 1900. According to the Global Climate Report - Annual 2019 published by the National Centers for Environmental Information at National Oceanic and Atmospheric Administration, USA, *"the global annual temperature has increased at an average rate of 0.07°C per decade since 1880 and over twice that rate (+0.18°) since 1981."* and as per the World Meteorological Organization, *"the average global temperature for 2016–*

2020 is expected to be the warmest on record, about 1.1 °C above 1850-1900, a reference period for temperature change since pre-industrial times and 0.24°C warmer than the global average temperature for 2011-2015." Even in India, the annual mean temperature showed an increasing trend of 0.61°C/100 years between period 1901-2019 and an even stronger increasing trend of 1.0°C/100 years in maximum temperature (Figure 2)

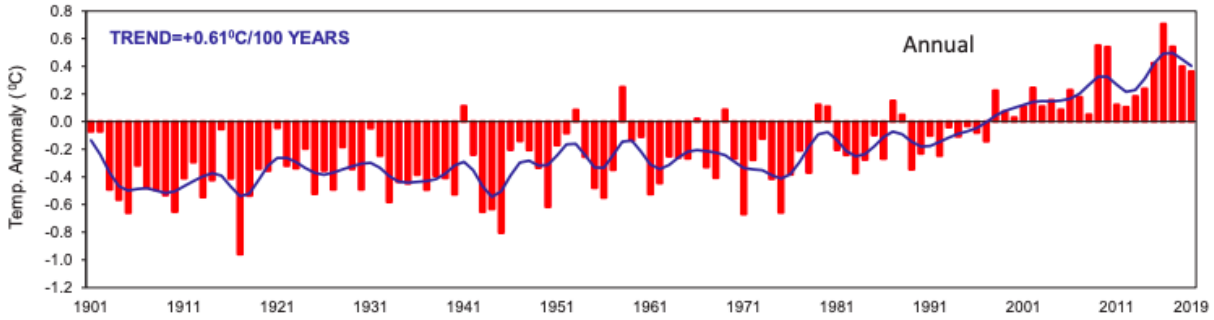

Figure 2: Anomaly in average annual temperature of India

Source: Annual Climate Summary – 2019, IMD

Going further, the trainer may use Figure 3 to explain to participants the collinearity between the increase in average global temperature (global warming) and carbon dioxide concentration since the pre-industrial era. The trainer can highlight that the sharp increase in average global carbon dioxide concentration occurred since the pre-industrial era is due to anthropogenic activities and climate studies relate this anthropogenic increase in carbon-dioxide level as the reason for the increase in the average global temperature.

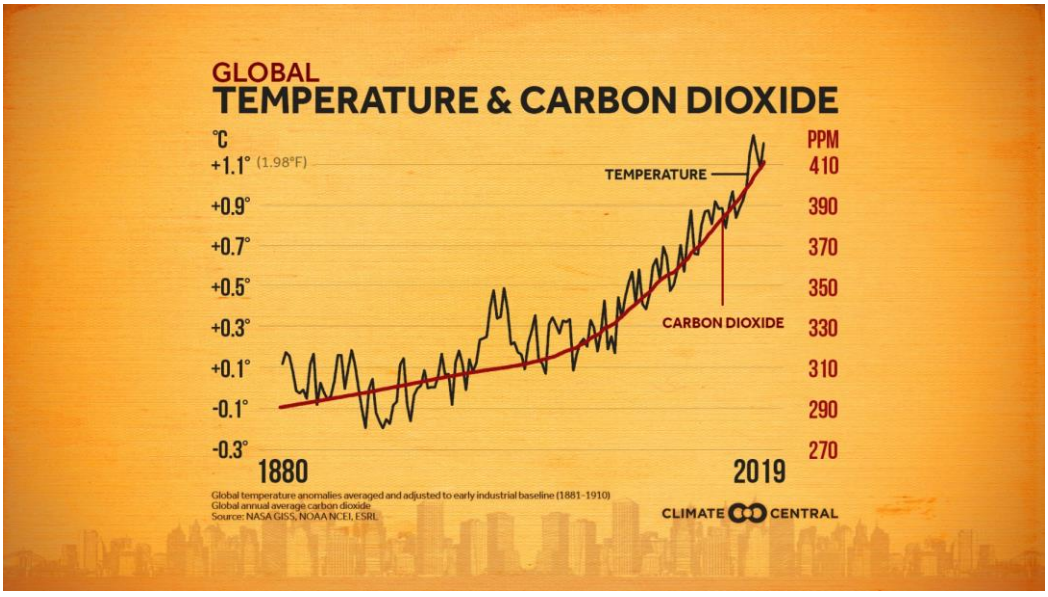

Figure 3: Historical increase in Temperature and CO2

Source: Climate Central

The link between climate change and global warming is that global warming is an increase in average global temperature whereas climate change includes both global warming and its effects like faster melting of glaciers, frequent and intense wildfires, drought, extreme weather events like extreme rainfall or extreme heat (heatwave).

Having briefed about the linkages between climate change, global warming, and extreme weather events (extreme heat or heatwave), the trainer may use Figure 4 to explain to participants how "Hot Weather" and "Extreme Hot Weather" events will be more frequent, intense and long-lasting under future climate scenario due to global warming-induced increase in average temperature.

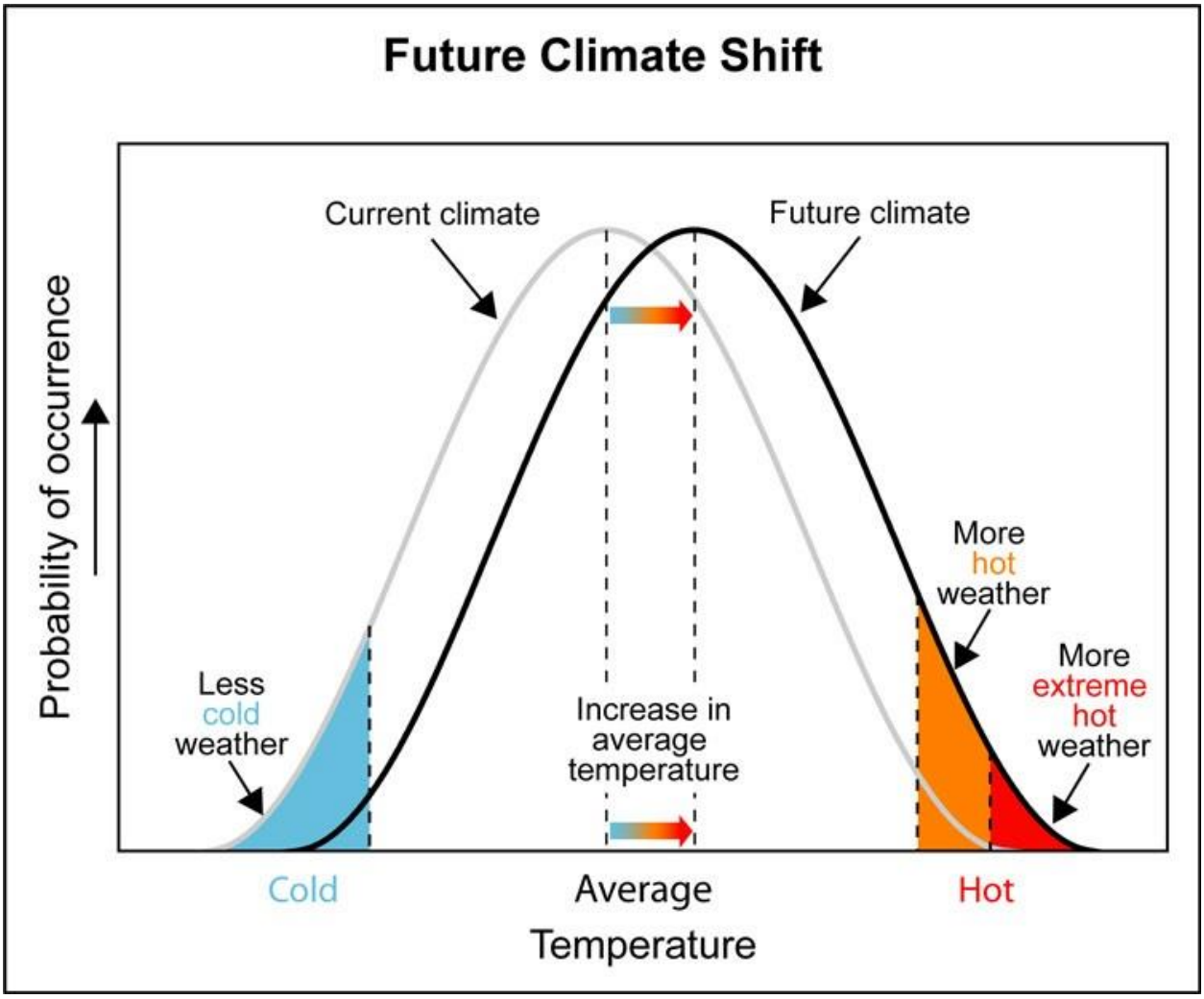

Figure 4: Future climate and weather shift

Source: U.S. Climate Change Assessment Program – SW Climate Change Network.

The trainer may also explain the greenhouse gas (GHG) effects to give a better understanding to participants about the connection between global warming and carbon dioxide. Using Figure 5, it can be explained to the participants that the Greenhouse Effect is a natural phenomenon and the layer of greenhouse gases in the atmosphere is necessary to trap the right amount of heat necessary for life on earth. But, it is the increasing concentration of heat-trapping greenhouse gases, especially Carbon-Dioxide, due to human activities such as the burning of fossil fuel in vehicles, power plants, industries, deforestation, etc. over the past one century which is trapping more heat in the earth's atmosphere than earlier and making the surface and atmosphere of earth warmer and warmer (global warming) with time.

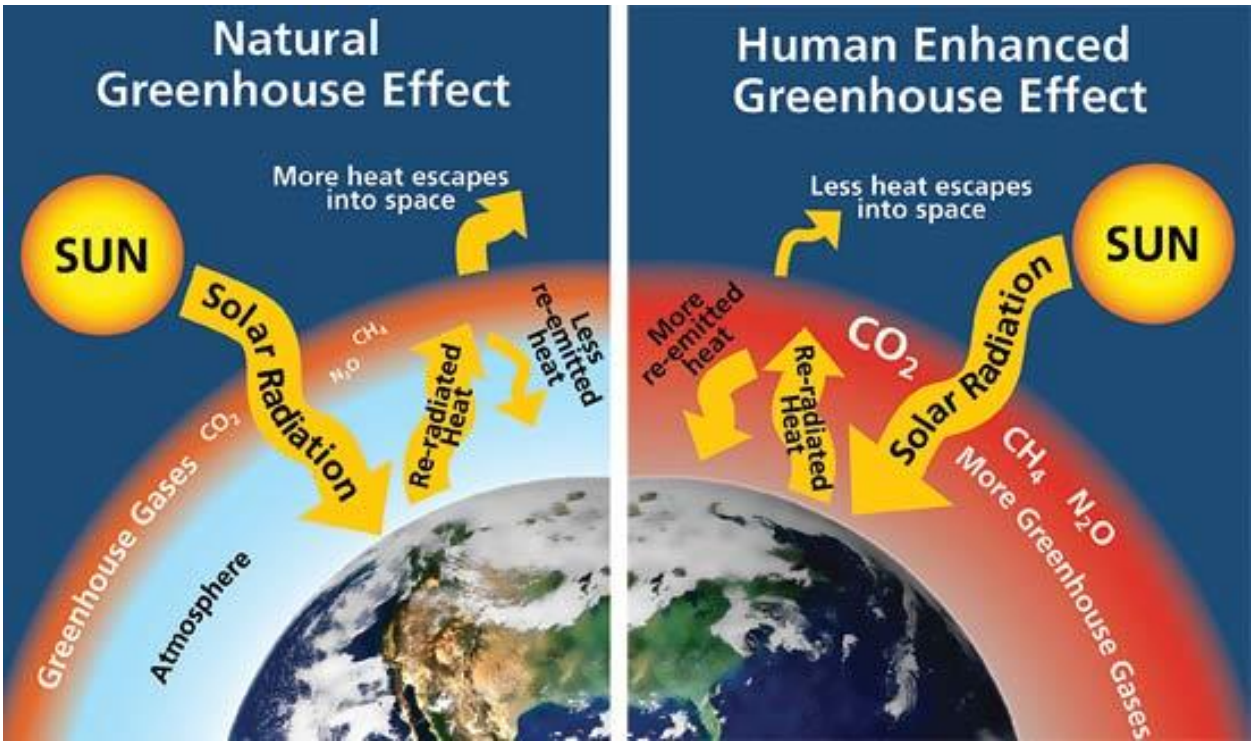

Figure 5: Greenhouse Effect

Source: Will Elder, NPS.

Objective of the session

- Develop an understanding of climate change, global warming, greenhouse effect, and their linkages with extreme heat (heatwave) among participants.

Duration

30 minutes

Methodology

The trainer shall try to engage participants and keep the session interactive as much as possible.

Training aids

Power-point presentation, flip-charts, markers, papers, pens etc.

Unit 1 Lesson 4: Extreme Heat events that made impact

Flow of the session

Participants at this stage after completing the earlier sessions are well versed in discretion between extreme heat and heatwave and their relationship with global phenomena such as climate change, global warming, and the greenhouse effect. And, with the knowledge of increasing frequency, intensity, and duration of extreme heat (heatwave) events, participants will also be able to identify extreme heat or heatwave as a matter of concern for current times and the future of mankind. To make the participants comprehend the scale and magnitude of impacts the extreme heat (heatwave) events can make, especially on the health of people, it would be apt to bring some of the major extreme heat (heatwave) events that occurred in India and elsewhere in the world and made significant impacts such as increased morbidities and mortalities to the notice of participants.

According to the *National Guidelines For Preparation Of Action Plan – Prevention And Management Of Heat Wave* - 2019 issued by the National Disaster Management Authority of India, heatwaves have caused 25,743 deaths in India between 1992 to 2018.

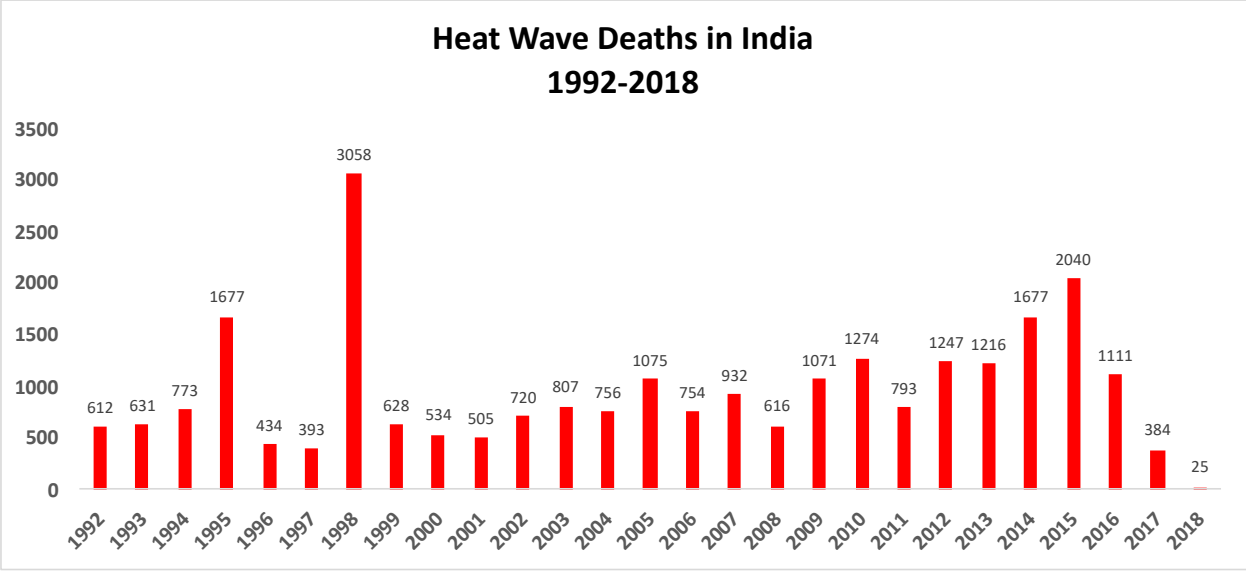

Figure 6: Year-wise Heatwave Death in India

Source: NDMA

The history of extreme heat (heatwave) events is not recent in India. As per the India Meteorological Department, the highest ever temperature recorded in the history of India until 2016 was 50.6°C in Alwar City, Rajasthan on 10th May 1956, but this record was exceeded by scorching 51°C temperature recorded on 19th May 2016 in Phalodi Town again from Rajasthan. During both these record-high extreme temperature events, the mercury kept soaring high for several days making them the two hottest heatwave events of India. Despite being the hottest extreme heat event in the history of India with 1111 deaths, as we can see in Figure 6, the 2016 heatwave wasn't the deadliest one so far in India. It's rather the extreme heat (heatwave) event of 1998 that so far has been the deadliest one in India with more than 3000 deaths across India of which more than 2000 deaths occurred in the state of Odisha alone. Figure 7 is one of the newspaper stories that covered the 1998 heatwave event in India.

Figure 7: 1998 Indian Heatwave News

Source: Daily News (Kingsport) – 12th June 1998

After the year 1998, the deadliest heatwave that India has faced was during the year 2015 with the temperature hovering above 40°C during the last two weeks of May and the first two weeks of

June in almost 13 states from all regions of India causing over 2000 deaths. The severe heatwave later continued in Pakistan also between 19th to 23rd June and succumbed nearly 1200 lives according to the *Technical Report on Karachi Heatwave June 2015 issued by the Ministry of Climate Change, Government of Pakistan.*

The history of heatwave events that made major impacts in other parts of the world as well goes back to even 18th and 19th Centuries. Nearly 1500 people died 1896 heatwave in Eastern North America. That could be termed as the first remarkable heatwave in the history of mankind. Later in the recent times of the 20th and 21st Centuries, the world has witnessed several extreme heat (heatwave) events from different parts of the world. The 1995 heatwave in Chicago, USA killed more than 700 people and was one of the worst heatwave events in the history of the USA. In 2003, the European heatwave killed more than 70,000 people, and in 2010 more than 56,000 people died due to heatwave events in Russia. The 2003 European and 2010 Russian heatwave events have been so far the deadliest extreme heat (heatwave) event in records. But, learning from these extreme events, especially the 1995 Chicago and 2003 Europe heatwave, several cities and states from countries across the world developed their extreme heat (heatwave) prevention and management plans and put them into practice to reduce impending impacts of such devastating events.

In India, after the 2010 heatwave event, the health department in Ahmedabad City Municipal Corporation along with the meteorological department and other key stakeholders initiated the development of extreme heat (heatwave) prevention and management plan and has been implementing it every year since 2013.

The trainer at this point shall bring following two points into the notice of participants and asked them to reflect on them.

- In 2003 European heatwave, around 15000 people died alone in France at Temperature hovering around ~37°C only during first two weeks of August 2003. Why?
- After knowing about some of the deadliest extreme heat (heatwave) events from past, do they think that it qualifies as "Disaster? Why?

Objectives of the session

- To make participants understand the scale and magnitude of impacts that extreme heat (heatwave) events can have.

Duration

30 minutes

Methodology

The trainer may play some online videos of news stories that covered the deadliest extreme heat events in past to make participants understand the severity of extreme heat as a potential hazard.

Training aids

Power-point presentation, flip-charts, markers, AV support etc.

Unit - 2
Disaster Risk of Extreme Heat

Need of the session

Now since the participants by the end of the first unit have developed a sound understanding about why the extreme heat (heatwave) events are a matter of concern for current and future times of mankind, the trainer can explain to participants about extreme heat (heatwave) from disaster risk management lens. Notwithstanding the extent of impacts that an extreme heat (heatwave) event can make primarily in terms of morbidities and mortalities, the extreme heat (heatwave) often doesn't get the due weightage it should get as a potential hazard as compared to other noticeable hazards like flood, earthquake, cyclone, drought, etc. when it comes to mainstreaming it with disaster risk management policies and practices. Why? This unit will help participants dwell on this divide. During this unit, the trainer will explain the definitions of disaster, disaster risk, and factors which are a hazard, exposure, and vulnerability that modify the disaster risk. It is possible that participants may not have taken any formal training on the basics of disaster risk management in past and therefore, this unit will also help participants in getting the understating of basics of disaster risk management keeping extreme heat (heatwave) as a hazard of interest in this unit.

Units of the session

Unit 2 Lesson 1: Understanding Disaster Risk

Unit 2 Lesson 2: Extreme Heat as Hazard

Unit 2 Lesson 3: Exposure of Extreme Heat

Unit 2 Lesson 4: Vulnerabilities to Extreme Heat

Objectives of the session

- Understand extreme heat from disaster risk lens
- Explain hazard, exposure and vulnerability keeping extreme heat (heatwave) as a hazard of interest.

Duration

120 minutes. (30 + 30 + 30 + 30 minutes for each session)

Methodology

The trainer shall continue using interactive learning techniques throughout this unit as well and look for the right opportunities to engage with participants to keep the participants interested during all sessions of this unit.

Training aids

Power-point presentation, flip-charts, markers, papers, pens, AV support etc.

Unit 2 Lesson 1: Understanding of Disaster Risk

Flow of the session

The trainer may start this session by explaining the standard definitions of "Disaster" given by the Disaster Management Act - 2005 of India and by the United Nations Office for Disaster Risk Reduction (UNDRR).

The Disaster Management Act - 2005 of India has defined disaster as, *"a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or man made causes, or by accident or negligence which results in substantial loss of life or human suffering or damage to, and destruction of, property, or damage to, or degradation of, environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area."*

Whereas, the UNDRR has defined disaster as, *"A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts."*

At this point, the trainer shall ask the participants to go through both these definitions carefully and understand them word by word to find out if and how extreme heat (heatwave) events fit into these definitions of disaster or not. The trainer may ask the following questions to participants to help them decipher the disaster definitions considering extreme heat (heatwave) as a hazard.

- Can an extreme heat (heatwave) event occurring in a given area lead to human, material, economic and environmental losses, and impacts? If yes, How?
- Can an extreme heat (heatwave) event be of a magnitude that is beyond the coping capacity of the affected community? If yes, How?

The 2020 report of *Lancet Countdown on Health and Climate Change* estimated that "*from 2000 to 2018, heat-related mortality in people older than 65 years increased by 53·7% and, in 2018, reached 2,96,000 deaths, the majority of which occurred in Japan, eastern China, northern India, and central Europe"*. The same report also mentioned that more than 300 billion work hours were lost in 2019 due to increasing heat as compared to 199 billion work hours lost in the year 2000 globally. With 118 billion hours, India alone accounts for more than 39% whereas, with 2 billion hours, the USA accounted for less than 1% of heat-related work hours lost globally during the year 2019. Unfortunately, the peril (risk) of extreme heat (heatwave) are not evenly distributed in different regions and countries across the globe or even in different socio-demographic groups within the same community, and therefore underdeveloped and developing countries, regions, and communities have to face higher consequences of extreme heat as compared to the developed ones.

On the other hand, the world seems to be failing to keep the *Paris Agreement – 2015* done during the *21st Conference of the Parties* of the *United Nations Framework Convention on Climate Change* which aims to *"Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change."* by the year 2100. There is newer evidence coming in from global climate studies that we may cross the threshold of 1.5 °C above pre-industrial levels by mid of 21st century itself. This means, that the probability of occurrence of frequent, severe, and long-lasting extreme heat (heatwave) events will go further high...!

To take any measure to reduce the risk of any disaster, the first step is to understand what is disaster risk. The trainer can here explain the definition of "Disaster Risk" given by UNDRR to participants which is, *"The potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity."*

The first set of keywords in the disaster risk definition that the trainer should ask the participants to focus upon is that risk is "potential loss" which means it can be decreased or increased and the second set of keywords to comprehend are "hazard, exposure, vulnerability and capacity" that are

functional units of disaster risk which means modifying these factors will decrease or increase the risk of disaster (heatwave in this case).

The trainer may continue to explain disaster risk using the standard equation of disaster risk given below,

$$\text{Disaster Risk} \propto \frac{\text{Hazard} \times \text{Exposure} \times \text{Vulnerability}}{\text{Coping Capacity}}$$

The next session in this unit will explain the factors hazard, exposure, and vulnerability that construct disaster risk keeping extreme heat (heatwave) as a hazard of interest. But at this point, the trainer should probe the participants here to think of why the sum of the total number of deaths due to extreme heat over the past three decades in India so far has been much less than a single heatwave event in Europe during 2003. Despite the fact, that India is not as developed as most of the countries of Europe and has a much higher population...!! Changes in which factors given in the disaster risk equation above have helped India keep the number of deaths due to extreme heat lower than Europe?

A very important subject in disaster risk management is the disaster (risk) management cycle. As we can see in Figure 8, the disaster (risk) management cycle illustrates different phases through

Figure 8: Disaster (Risk) Management Cycle

which disaster risk can be reduced and managed. The trainer may describe the five phases of the disaster (risk) management cycle by explaining their standard definitions given by the UNDRR and ask questions to participants about each of these five phases in the context of extreme heat.

Prevention: *"Activities and measures to avoid existing and new disaster risks."* Trainer may ask that what measures or activities can help in avoiding existing or new disaster risk?
Can we reduce heat??? Can we reduce exposure? What can we do to avoid the new risk of extreme heat?

Mitigation: *"The lessening or minimizing of the adverse impacts of a hazardous event."*
Can shifting working hours to morning and evening during the heatwave period help in lessening the adverse impacts of extreme heat?

Preparedness: *"The knowledge and capacities developed by governments, response and recovery organizations, communities and individuals to effectively anticipate, respond to and recover from the impacts of likely, imminent or current disasters."*
Do you think forecasts for heatwaves or extreme heat events issued by IMD are always accurate?
What capacities do you think we have to deal with the impacts of an imminent heatwave event?

Response: *"Actions taken directly before, during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected."*
Would increasing beds in the emergency rooms of hospitals before and during heatwave event be considered as good response measure against extreme heat?

Recovery: *"The restoring or improving of livelihoods and health, as well as economic, physical, social, cultural and environmental assets, systems and activities, of a disaster-affected community or society, aligning with the principles of sustainable development and "build back better", to avoid or reduce future disaster risk."*
Have we learned from past heatwave events to build back out capacities to fight against heatwave events better than earlier and if yes, please give an example?

Objectives of the session

- Explain definition of disaster and disaster risk from the perspective of extreme heat (heatwave) event as disaster.
- Illustrate disaster (risk) management cycle phases in context of extreme heat.

Duration

30 minutes

Methodology

Rather than the trainer simply explaining the definitions of disaster and disaster risk, the participants can be asked to reflect upon the different components of disaster definition and factors like hazard, exposure, and vulnerability in disaster risk definition. The trainer may run some videos of news stories on devastating heatwave events in India and elsewhere to make participants understand the disastrous nature of extreme heat events.

Training aids

Power-point presentation, flip-charts, markers, papers, pens, AV support etc.

Unit 2 Lesson 2: Extreme Heat as Hazard

Flow of the session

The trainer may begin this session with the disaster risk equation discussed in the previous session and ask the participants about the relationship between disaster risk and hazard. How the increase in hazard will affect disaster risk?

$$\uparrow \text{Disaster Risk} \propto \frac{\uparrow \text{Hazard (intensity, frequency, duration)} \times \text{Exposure} \times \text{Vulnerability}}{\text{Coping Capacity}}$$

The trainer may then explain the definition and types of hazard first and characteristics of hazard with extreme heat (heatwave) as an example of a hazard.

The UNDRR has defined hazard as *"A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation."* And depending on their origin they are further classified as,

- Natural Hazards: originating from natural processes and phenomenon
- Anthropogenic Hazards: originating from man-made processes and phenomenon
- Socionatural Hazard: originating from a mix of natural and man-made processes and phenomenon such as climate change.

The National Disaster Management Plan of India – 2019 has classified natural hazards in following five categories,

1. Geophysical – Earthquake, mass movement of earth materials, tsunami, volcano etc.
2. Hydrological – Flood, landslides and wave actions etc.
3. Meteorological – Extreme temperature, heatwave, cold wave, cyclone, heavy rain etc.
4. Climatological – Drought, Wildfires, extreme hot or cold conditions etc.
5. Biological – Viral/Bacterial epidemics, insects' infestations, etc.

It would be interesting here to ask participants that "As we know the extreme heat events are becoming more frequent, intense, and long-lasting due to anthropogenic climate change, in such situations how will you classify extreme heat (heatwave)? As Natural Hazard or Anthropogenic Hazards or as Socionatural Hazard?"

Hazards are further characterized based on their location of occurrence, magnitude or intensity, frequency of occurrence, and the probability of occurrence. Broadly speaking, hazards are characterized based on their spatiotemporal scale, intensity, and the probability of occurrence. And in case of extreme heat (heatwave) events as a hazard, an increased frequency, intensity, and duration in most parts of the world including India has already been predicted, observed, and, documented in several global climate studies and reports including the ones published by the IPCC periodically.

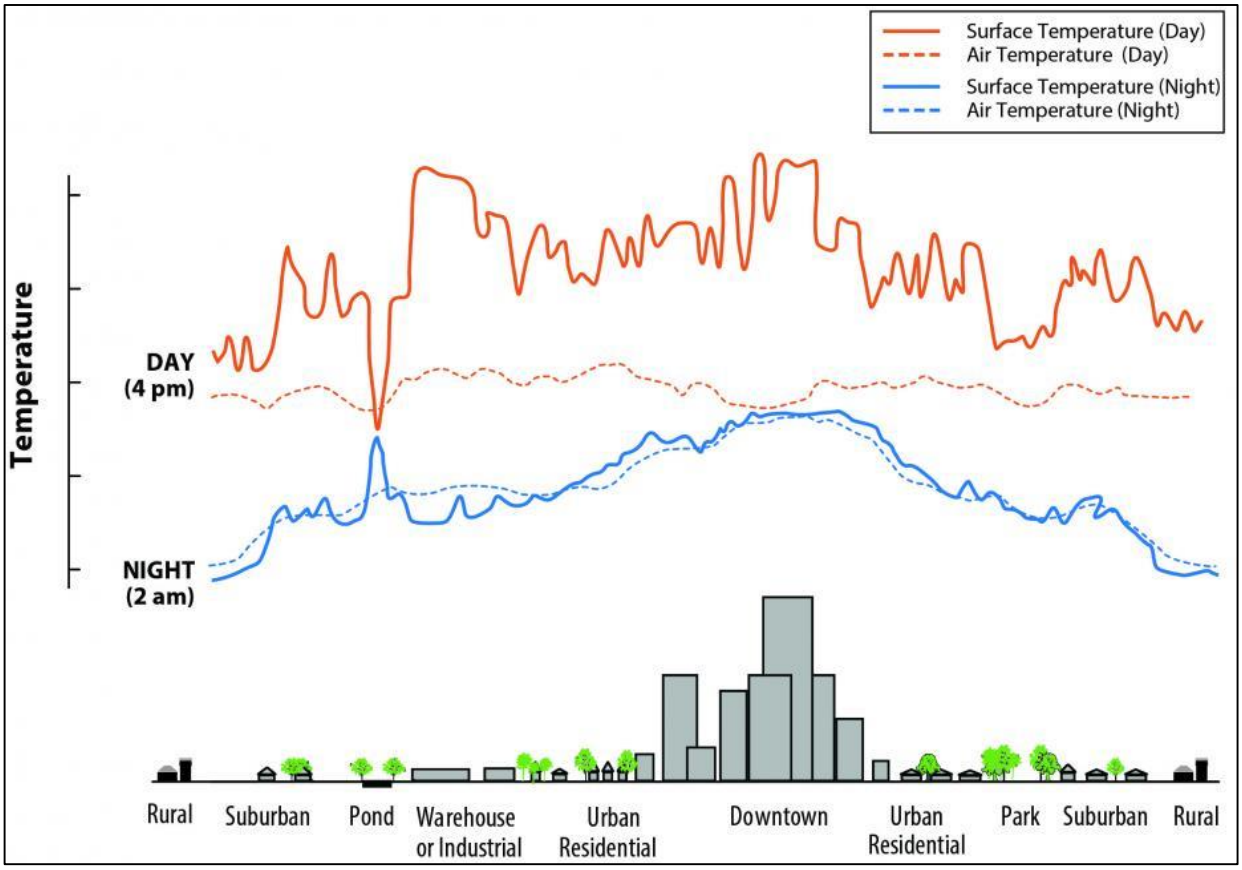

Figure 9: Urban Heat Island Effect

Source: EPA, USA

Trainer at this point of the session may describe a very interesting and important phenomenon associated with extreme heat called the “Urban Heat Island” or “UHI” effect. Going further, the UHI effect phenomenon may be used as an example to brainstorm for explaining some aspects of hazard, exposure, and vulnerability with regards to extreme heat (heatwave). As shown in Figure 9, the UHI effect is that urban areas that have a higher concentration of infrastructure such as roads, building, glass surfaces that absorbs and re-emits sun’s heat and have lesser greenery and water bodies as compared to peripheral sub-urban and rural areas become an island of higher heat.

Participants may now be asked to answer that “which characteristics of extreme heat as hazard may get affected by the UHI effect?” Can the UHI effect increase the intensity and/or duration of extreme heat hazards in urban areas as compared to peripheral sub-urban and rural areas?

Objectives of the session

- Understand types and characteristics of hazards
- Explain extreme heat as hazard using example of UHI effect

Duration

30 minutes

Methodology

Trainer may use power-point presentation to explain hazard and should keep interacting with participants to ensure effective learning.

Training aids

Power-point presentation, flip-charts, markers, papers, pens etc.

Unit 2 Lesson 3: Exposure of Extreme Heat

Flow of the session

Starting again with the disaster risk equation, the trainer may now ask participants to think of the association of exposure with disaster risk. It's obvious from the equation that an increase or decrease in exposure will increase or decrease disaster risk.

$$\uparrow \text{Disaster Risk} \propto \frac{\text{Hazard} \times \uparrow \text{Exposure (environmental, social, economic)} \times \text{Vulnerability}}{\text{Coping Capacity}}$$

But, can the exposure to extreme heat increase or decrease due to any human activity? A reasonable way to get the answer to this question from participants would be to first explain the definition of exposure to them.

The UNDRR has defined exposure as, *"the situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas."*

Although the vulnerability will be discussed separately in the next session it's important to highlight here that both exposure and vulnerability are the two main factors that largely contribute to an increase or decrease of disaster risk. This is also because, nothing much can be done to prevent the impacts of hazards, especially the natural hazards except reducing their intensity or scale to some extent. Lastly, the coping capacity and vulnerability are usually two sides of the same coin. They are complementary and opposite to each other. In fact, for most of the hazards, the information collected for vulnerability and coping capacity also happens to be the same. Details on coping capacity against extreme heat are covered in unit 3 of this training module.

Coming back to exposure, the trainer may ask the participants to re-read the definition of exposure above and think of circumstances that may put people or infrastructure in hazard-prone areas and increase/decrease their exposure keeping extreme heat as the hazard of interest in mind. Depending on the hazard, both exposure and vulnerability hold certain dimensions through which they vary.

These dimensions of hazards can be broadly listed as,

- Environmental Dimensions - such as built environment, geography, settlement type, etc. Exposure to heat can be higher in the urban settlement as compared to rural settlement due to the Urban Heat Island effect. Even the building/housing type can modify exposure to extreme heat. Houses particularly in slums with poor ventilations, tin-roofs, uninsulated walls and roofs, and limited to no cooling options such as fan, cooler, or air conditioner make indoor ambient temperature as high as the outdoor ambient temperature as walls and roof absorb and re-emit the heat inside slum houses. This substantially increases the exposure to the extreme heat of people like old age, young children, and non-working women who are confined to stay indoors most of the time...! This can also be seen from the cultural dimensions viewpoint which is explained in the next point. One such example can be found in Figure 10.

Printed from
THE TIMES OF INDIA

Women in slums face greater heat risk

TNN | Mar 29, 2017, 06.27 AM IST

AHMEDABAD: A recent study carried out by the Indian Institute of Public Health–Gandhinagar (IIPHG) on women in various slum clusters in the city has revealed that their body temperatures rise sharply during peak summers. The rise is by three to four degrees, up to feverish levels The study was conducted among four groups which are likely to be the most vulnerable — including incense stick makers, kite makers, rag pickers, and street vendors. The study shows that 80% of them experienced an increase in body temperatures. "We measured their body temperature in the morning before they started work and after their work (at least up to one hour) was done," said Dr Abhiyant Tiwari, a public health researcher, IIPHG. "Around 18% of the women reported average high temperatures even in the morning before they started working, which might have occurred due to constant exposure to heat."

More startling, women working indoors had higher body temperatures by a degree or two compared to those working outdoors. "This was particularly found in women who are involved in making kites or incense sticks," said Tiwari. "It clearly indicates that indoor temperature is higher than outdoor temperature. Most of these women work in their homes or in spaces with tin roofs." In fact, according to census data, around 5.13 lakh households in Ahmedabad City have roofs made of metal.

Constant exposure to heat and consequent increase in mean body temperatures is hazardous to a woman's health and can lead to a series of health problems.

Figure 10

Source: TOI

- Social Dimensions – such as demography, health, education, culture, etc.

  Certain cultural practices can modify exposure to extreme heat. For example, a large number of weddings in Gujarat and many other heat-prone states in India tend to take place during the summer season, and that too during afternoon hours. There have been incidences of people fainting or even dying due to exposure to extreme heat during wedding processions. Figure 11 is one of such examples of how cultural practices can modify the exposure.

Printed from
THE TIMES OF INDIA

Newly wedded groom dies of heat stroke

TNN | Jun 5, 2013, 10.34 PM IST

PALANPUR: Severe heat and extreme humidity prevailing in the region claimed the life of a newly wedded groom in Bhonjna village in Dhanera taluka of Banaskantha on Tuesday.

[redacted] was offering post-marriage prayers in the village temple when he suddenly complained of uneasiness. According to his family, Velabhai began vomiting and his condition deteriorated after he fainted on the temple's floor. He was referred to nearby hospital and later shifted to a hospital in Dhanera, but he died on the way.

"Patel died of heat stroke," chief district health officer, Banaskantha, [redacted] said. Meanwhile, the health authorities have asked people to follow cleanliness, especially in drinking water. E coli that causes gastroenteritis, has been found in several water samples randomly collected in Dhanera.

Figure 11

Source: TOI

- Economic Dimensions – such as working conditions and livelihood are among the most important drivers that can modify exposure to heat.

  Agriculture is still the largest source of livelihood in India with nearly 70% of people living in rural households dependent on it. People engaged in farming have to spend significant time in farm fields and work even during the afternoon hours of summers and this may expose them to higher temperatures. Talking about the urban working and livelihood conditions, people working outdoors like street vendors, traffic policemen are exposed to higher levels of heat due to their nature of work as compared to those working indoors in comfortable thermal environments. People working in an outdoor urban environment are exposed to higher levels of heat due to the urban heat island effect also. Because of higher heat reflective surfaces, air pollution, poor wind circulation, lesser green areas, and fewer water bodies, the hot air gets trapped in urban areas making people working in those

environments exposed to higher heat as compared to their rural counterparts. Figure 12 showcases a real-life example where a cop succumbed to extreme heat due to higher exposure while performing his duties outdoor.

Home > Ahmedabad > Report

Saturday heats up, cop dies on duty

Sunday, Apr 28, 2013, 12:36 IST | Place: Ahmedabad | Agency: DNA

DNA Correspondent

It is believed the traffic head constable may have died of sunstroke.

Saturday was hotter than other days, so much so that an on-duty traffic police head constable fell victim to the heat. He fell on the footpath at Rajendra Park crossroads in Amraiwadi area of the city due to the heat, police sources said.

"The incident occurred on Friday evening when the deceased - [redacted], was on duty. He fainted on the divider of the road near Rajendra Park. He was rushed to the hospital but died during treatment," said police sub-inspector [redacted]

The incident occurred around 8 pm. [redacted] colleague called for the ambulance and he was rushed to Shardaben Hospital in

Figure 12

Source: TOI

There is growing evidence suggesting that exposure to various hazards, particularly those worsening due to climate change such as extreme heat (heatwave) has increased at a much higher scale as compared to the reduction in vulnerabilities to hazards over the past few decades. According to a Lancet Countdown on Health and Climate Change report published in 2018, the number of people exposed to heatwaves across the globe has increased by around 125 million (Figure 13) between 2000 and 2016. The highest exposure of nearly 175 million additional people was recorded during the year 2015 which was also the year of the deadliest heatwave for India after 1998. This suggests that despite all the commitments and efforts made under the CoP21 Paris

agreement and Sustainable Development Goals to substantially reduce disaster risks, the risk of extreme heat (heatwave) is mounting with

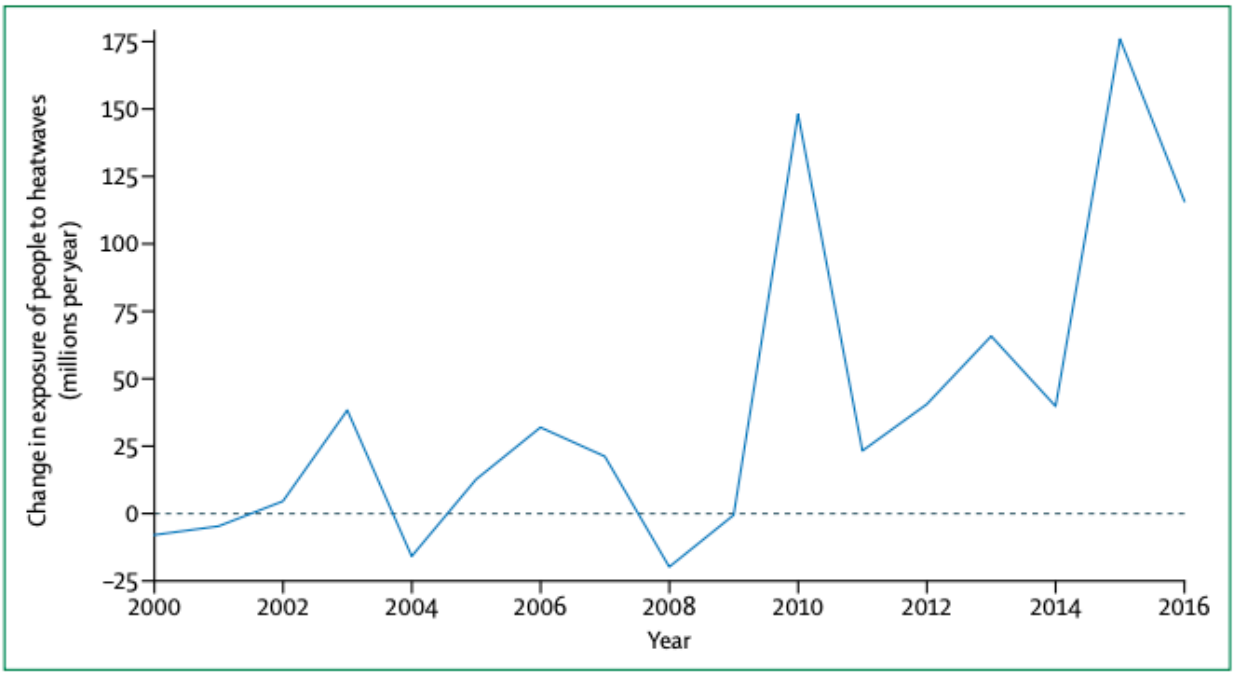

Figure 13: Change in heatwave exposure relative to the 1986–2008 average

Source: Lancet

passing time. And aligning with the global scenario of increased exposure to extreme heat, India too is experiencing a sharp rise in exposure to extreme heat. According to the National Disaster Management Authority of India, 23 states in India were affected by heatwaves in the year 2019 as compared to 19 states in the year 2018 and 17 states in the year 2017…!

Before ending this session at this point, it will be worthwhile to ask participants to again reflect on connections between exposure to extreme heat and the UHI effect. The trainer can ask them to think on,

- What dimensions (environmental, social, or economic) of exposure to extreme heat can be directly or indirectly modified by the UHI effect? How?

Objectives of the session

- Explain the definition and dimension of exposure
- Understand extreme heat exposure using the example of UHI effect

Duration

30 minutes

Methodology

The trainer may use more real-life examples to illustrate the dimensions of exposure to extreme heat. In the end, the trainer shall give 5 minutes to participants to discuss with each other and share their or their communities' experiences with exposure to heat and how it changed (if it did) over a while.

Training aids

Power-point presentation, flip-charts, markers, papers, pens etc.

Unit 2 Lesson 4: Vulnerabilities to Extreme Heat

Flow of the session

Out of all the factors that construct disaster risk, vulnerability is the one that is most feasible to address to reduce disaster risk. It is relatively difficult to prevent hazards or reduce exposure as compared to reducing vulnerabilities for most of the hazards. The trainer may begin the last session of this unit again with the equation of disaster risk and by explaining the standard definition of vulnerability to participants.

$$\uparrow \text{Disaster Risk} \propto \frac{\text{Hazard} \times \text{Exposure} \times \uparrow \text{Vulnerability (physical, social, economic)}}{\text{Coping Capacity}}$$

Vulnerability as defined by UNDRR is *"characteristics determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards."*

The definition gives a clear understanding that certain factors determine the vulnerability of an individual, community, or system towards any particular hazard. The trainer may now explain these different factors of vulnerability and how they modify disaster risk with an example of extreme heat (heatwave) as a hazard.

- Physical factors – such as condition of infrastructures, geography, and land use, etc.

The trainer should ask participants to rethink the example of the urban heat island here and contemplate whether it qualifies and contributes as a physical factor that can increase vulnerability to extreme heat? Even within a city, the vulnerability to extreme heat can vary between different micro-climatic zones because of differences in infrastructure – areas with densely constructed buildings and roads will be hotter than areas with more open space, greenery, and water bodies within the same city. Even the housing conditions in which people

live can increase or decrease their vulnerability to extreme heat. This was an explanation of physical vulnerability at the local level but at larger levels, let's say at the global level the difference in vulnerabilities can be seen between countries depending on in which climatic zones they are.

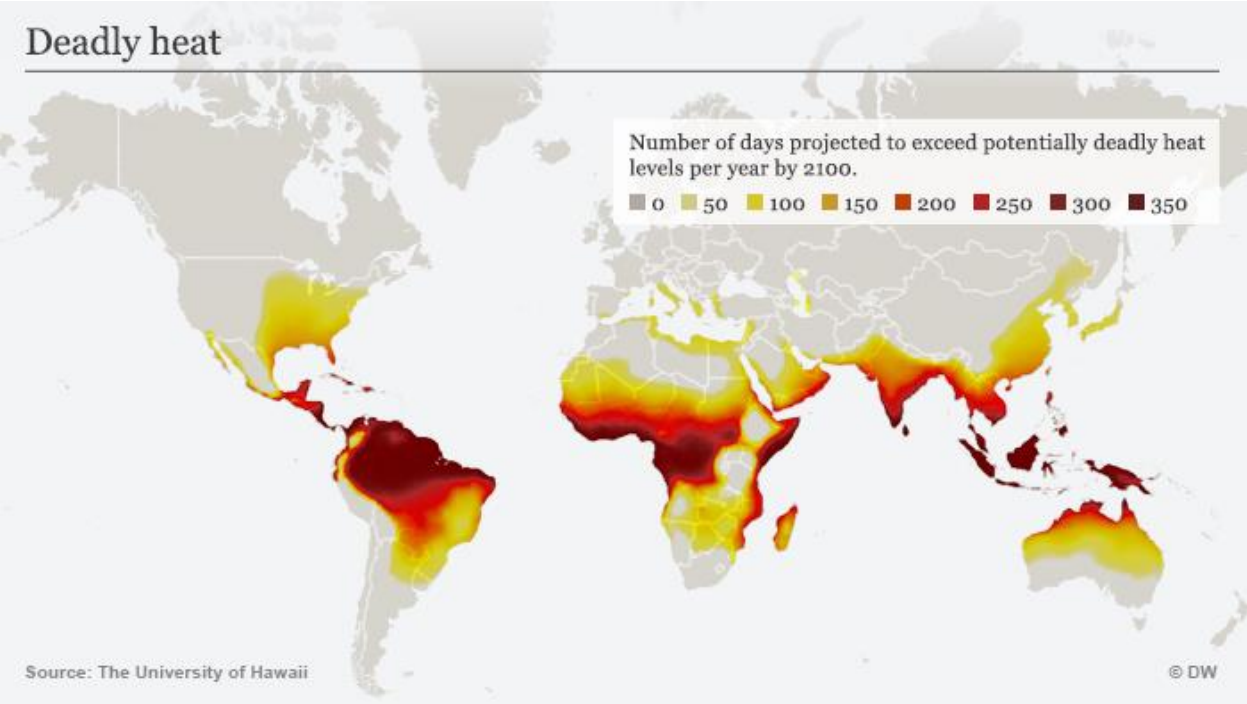

Figure 14: Global projections of extreme heat.

Source: University of Hawaii

It can be seen in Figure 14 that countries falling in the tropical zones will face higher vulnerability to extreme heat than the ones in temperature zones.

- Social factors – such as health, age, gender, culture, inequality, etc.

It is a well-known fact that people at extremes of age and those with chronic ailments or poor health conditions are more vulnerable to any hazard including extreme heat. Old age people and young children can get dehydrated at a much faster pace than a healthy adult when exposed to high-temperature conditions. And similarly, severe heat can exaggerate the underlying chronic health conditions such as heart disease, diabetes, chronic kidney, and respiratory diseases, etc. as an indirect impact of heat on health.

Gender too plays an important role in modifying vulnerability. A growing amount of evidence suggests that women are at higher risk to most of the impacts of climate change including extreme heat. A large proportion of women in India are still not part of mainstream employment and spending most of their time indoors in cooking and other household chores. On top of that, due to limited access or non-availability of private toilets especially in rural areas, women tend to avoid drinking water even during summers which put them at higher risk of getting dehydrated and ill due to heat.

- Environmental and Economic Factors – such as livelihoods, industries, businesses, air quality, natural resources, etc.

Rising temperatures are posing a great risk on several industries, businesses, and livelihood options like farming, fisheries, and daily wage laborers and increasing the economic vulnerability to extreme heat. Likewise, environmental conditions like poor air quality or depleted natural resources can further worsen the vulnerability of communities affected by extreme heat.

It is worth telling participants that vulnerability is dynamic in nature and not as simple as one may think of it. The vulnerability can vary in spatial and temporal dimensions as well. It could be due to a mix of factors like social and physical factors or social and economic factors or could be because of just one of these factors as well. It could arise and increase in a short period and it could develop over a longer period as well.

The trainer may ask participants at this stage to think of any cultural or religious practice that can modify vulnerability to heat based on their experience.

Objectives of the session

- Understand definition and factors of vulnerability
- Explain dynamic nature of vulnerability

Duration

30 minutes

Methodology

This session will be mostly covered through PowerPoint presentations by the trainer but the trainer may ask the participants to give examples of vulnerabilities from their experience at the end of the session based on the availability of time.

Training aids

Power-point presentation, flip-charts, markers, papers, pens etc.

Unit - 3
Planning and Management of Extreme Heat

Need of the session

The first two units of this training module focused on developing an understanding of extreme heat, heatwaves how do they relate with each other, understanding hazard, exposure, vulnerability to extreme heat from the disaster risk perspective. Now in this last unit of the training module, participants will be taught about the planning and management of extreme heat. This unit is the most important part of the training module because it deals with applying the knowledge to action. Through the different sessions of this unit, participants will get a sound understanding of what is a heat action plan, what are the key features of any heat action plan, what are the practices in place for developing a heat action plan. Participants will also get an essence of some of the technical features of heat action plans like assessing vulnerability, developing thresholds, and heat early warning systems (HEWS). In the end, participants will be briefed about the national and sub-national guidelines, policies, plans, and institutional mechanisms to deal with extreme heat events in India.

Units of the session

Unit 2 Lesson 1: Heat Action Plan – Components & Development

Unit 2 Lesson 2: Assessing Vulnerability & Developing Threshold

Unit 2 Lesson 3: Understanding heat early warning systems (HEWS)

Unit 2 Lesson 4: Institutional mechanisms to deal with extreme heat

Objectives of the session

- Illustrate the heat action plan, it's component, and process of development
- Demonstrate extreme heat vulnerability assessment and threshold development
- Highlight national and sub-national institutional mechanism to deal with extreme heat

Duration

120 minutes. (30 + 30 + 30 + 30 minutes for each session)

Methodology

The trainer shall encourage discussions among participants in this last unit of training. This unit also covers small simulation exercises which require some very basic skills of using Microsoft Excel and therefore it would be ideal to ask participants to form groups with 4-5 people in each group at the beginning of this unit itself.

Training aids

Power-point presentation, flip-charts, markers, papers, pens, AV support etc.

Unit 3 Lesson 1: Heat Action Plan – Components & Development

Flow of the session

Dangers of heat are increasing almost in all parts of the world with rising temperatures and more frequent, intense, and longer extreme heat (heatwave) events due to climate change. But unlike other natural hazards, the adverse impacts of extreme heat (heatwave) events, especially on the health of people such as excess morbidities and mortalities can be substantially reduced by effective public health and multi-agency heat prevention and management measures. Such measures help in enhancing the coping capacity and thus reducing the disaster risk of extreme heat as we saw in the formula of disaster risk in the previous learning unit.

The UNDRR has defined coping capacity as, *"the ability of people, organizations and systems, using available skills and resources, to manage adverse conditions, risk or disasters. The capacity to cope requires continuing awareness, resources and good management, both in normal times as well as during disasters or adverse conditions. Coping capacities contribute to the reduction of disaster risks."*

Heat Health Action Plans more commonly known as Heat Action Plan (HAP) are a guide for multi-stakeholder comprehensive planning to take short and long-term measures to mitigate the impacts of extreme heat, primarily on the health of the people. The short-term objectives of HAP are to reach out to people, especially those who are vulnerable to extreme heat, in well advance with accurate extreme heat forecast and take measures like keeping the hospitals and emergency health services prepared for any heat related health emergencies. Whereas the long-term objectives of HAP are to reduce exposure and vulnerability of people to extreme heat by taking developmental planning measures like increasing green cover, water bodies, initiating cooling solutions such as "Coo-Roof" for houses and other buildings.

The trainer may use an example of the Ahmedabad Heat Action Plan here to explain to participants about the key components of HAPs and the key steps of developing a HAP.

After the devastating heatwave of 2010, the Ahmedabad Municipal Corporation (AMC) in partnership with the Indian Institute of Public Health Gandhinagar (IIPHG), Natural Resource Defense Council (NRDC), and other partners, developed and implemented the first HAP of India in summers of the year 2013. And with that, Ahmedabad also became the first city in South-Asia to implement a comprehensive city-wide HAP. Since then, Ahmedabad city is implementing HAP every year with necessary modifications. A range of activities to be carried out pre, during, and post-summer season and during extreme heat days in summer are suggested in the Ahmedabad HAP for different stakeholders such as the public health department which is also the nodal agency for Ahmedabad HAP, hospitals, 108 emergency ambulance services, AMC media and press office, Labour department, water department, electricity department, transport department, NGOs, etc. All the stakeholder-wise activities suggested in HAP ultimately fit into the four key components/strategies of Ahmedabad HAP which are as follow,

Components of HAP:

1) Building Public Awareness and Community Outreach:
   The two main purposes of this component of HAP are,
   - Raise awareness among the general public about the dangers of extreme heat and what are the Do's and Don'ts for extreme heat.
   - Reach out to communities that are at higher risk for extreme heat like traffic police, slum dwellers, outdoor workers, etc. with targeted information.

   Measures like raising awareness among the general public about the dangers of extreme heat and what are the Do's and Don'ts through the dissemination of multilingual pamphlets, through billboards across the city, running awareness videos at cinema halls and digital display screens in the city, through talk shows at the television and FM radio channels, etc. Special sensitization workshops/sessions are also held for targeted communities that are at high risk. ASHA Workers who are the field health workers play a pivotal role in both raising general public awareness and reaching out to the targeted communities with information on heat health risk and safety.

Figure 15: Heat awareness pamphlet.

Source: Ahmedabad HAP

All these activities of public awareness and community outreach are carried out throughout the summer season. Figure 15 is one of the heat awareness material that is used in Ahmedabad HAP

2) Initiating an Early Warning System and Inter-Agency Coordination:

The purpose of this component of HAP is to ensure that the extreme heat warning and alerts received from the meteorological department is effectively and timely communicated to all the stakeholders and citizens. The nodal officer of the nodal agency (health department of AMC in case of Ahmedabad HAP) on receipt of extreme heat forecasts from the meteorological department communicates it further depending on the alert levels, lead time, and probability of occurrence of alert warning issued by the meteorological department. The alerts are further communicated by the nodal agency using several means of communication like press advisory for print media, announcements through television news and FM Radio channels, emails, bulk SMS, social media to ensure that it each reaches to all the stakeholders and citizens.

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THE TIMES OF INDIA

Heat wave grips Guj again, red alert for Ahmedabad

PTI | Jun 6, 2016, 08.37 PM IST

Ahmedabad, Jun 6 () Heat wave returned to grip most parts of Gujarat today after a gap of almost two weeks, with Idar town sizzling at 44.6 degrees Celsius, prompting the civic authorities here to issue a red alert for Ahmedabad tomorrow which remained the second hottest at 44.5 degrees Celsius.

Meanwhile, a 70-year-old man died of heat stroke today, taking the toll due to heat-related complications in the city so far to 18.

As per the release issued by the civic body, the man, hailing from Dani Limda area, died at the civic-run V S Hospital.

The Ahmedabad Municipal Corporation (AMC) today came out with an advisory for the citizens as they predicted that the mercury may touch 45 degrees Celsius mark tomorrow, which falls into the 'Red Alert' category.

Heat wave condition prevailed in major parts of the state as weather remained dry during the day in most cities, except those in coastal region, stated the press bulletin by the Meteorological Centre here.

During the day, Idar remained hottest at 44.6 degrees Celsius, followed by Ahmedabad (44.5), Gandhinagar (44.4), Surendranagar (44.3), Deesa (44.0), Valabh Vidya Nagar (43.1) and Vadodara (42.6).

Figure 16: Heatwave alert in newspaper in 2016.

Source: TOI

What is shown in Figure 16 & 17 above the real extreme heat warning issued by the AMC through print media and bulk SMS in first week of June after receiving a red-alert warning from the IMD.

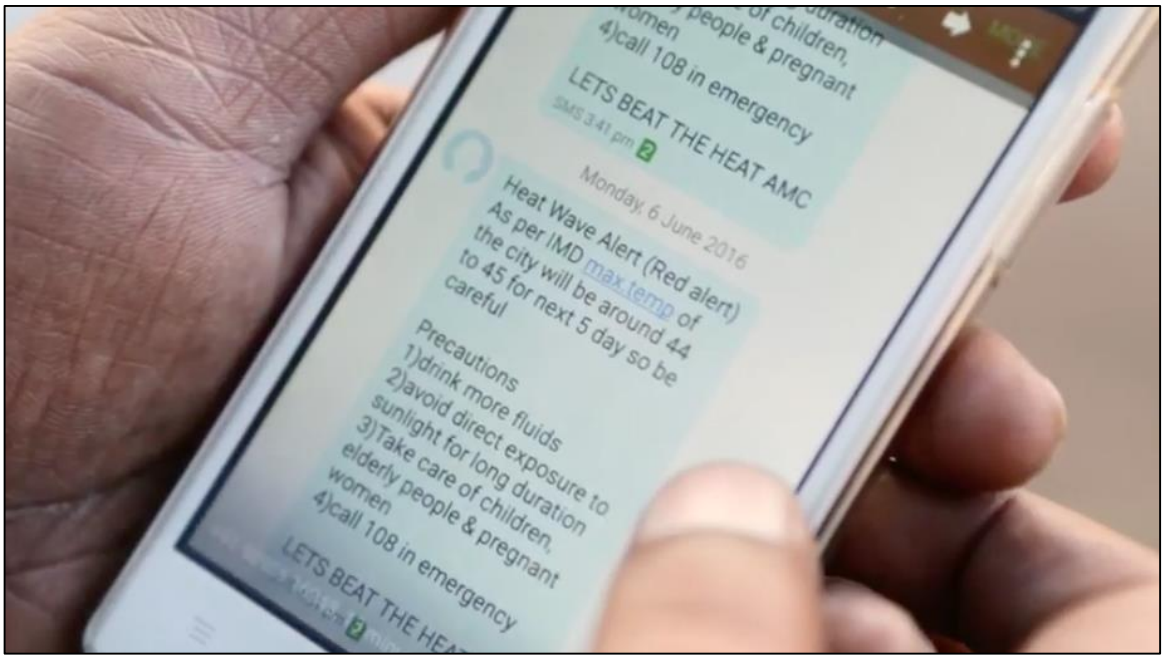


Figure 17: Heatwave alert in SMS.

Source: CDKN, TERI

Alert Category	Alert Name	Temperature Threshold (°C)
Red Alert	Extreme Heat Alert Day	≥ 45°C
Orange Alert	Heat Alert Day	43.1°C – 44.9°C
Yellow Alert	Hot Day Advisory	41.1°C- 43°C
White	No Alert	≤41°C

Figure 18: Color signals for heat alert.

Source: Ahmedabad HAP

By now, participants must be curious about what is red-alert, what are different levels of alerts and warnings, how are they decided, and what is the framework and flow of communicating these alerts to stakeholders and citizens. At this stage, the trainer can talk about Figure 18 which are color-coded signals for different temperature threshold levels used in the Ahmedabad HAP for heat alerts, and ask participants to think about how these temperature threshold levels are decided and what is their significance.

3) Capacity Building Among Health Care Professionals:

This primarily aims to train the medic and paramedic staff is to help them in rightly diagnosing and responding to heat-related illnesses from other conditions that may have similar manifestations during heat events. But the capacity building is not just limited to health professionals. The AMC in its later years of HAP started training other key stakeholders like school teachers also as they may not have a direct role in responding to heat-related illnesses but they certainly have a role in preventing them during extreme heat events. Figure 19 is one of such HAP training carried out for principals and teachers of schools at the town hall in Ahmedabad.

Figure 19: School teachers training for Ahmedabad HAP

Source: IIPHG

4) Reducing Heat Exposure and Promoting Adaptive Measures:

A series of measures like cool-roofs, enhancing green-cover, initiating mobile drinking water stations across the city during summer, keeping gardens open during afternoon hours for commuters to take rest in shades, keeping night shelters open during the daytime also, encouraging places like temples, mosques, malls to let people come in during afternoon hours for cooling, etc. are taken to encourage citizens to adopt measures that can reduce their direct heat exposure during extreme heat events.

Cool-Roof is a well-accepted, simple, and cost-effective solution for indoor cooling, especially in urban settings. They not just help in maintaining a comfortable indoor thermal environment bus also helps in reducing the cost of energy and increasing indoor productivity during summers. Depending on the application, it can reduce the indoor temperatures by 2 to 5°C as compared to outdoor ambient air temperature. During summers, the indoor temperature may

go as high as the outdoor air temperature because of poor ventilation and insulation in many houses, especially in slums. Options like application of sun-reflective paints, white tiles, coating of special cooling materials, etc. are used as a cool-roof strategy. The AMC under Ahmedabad HAP initiated the Cool-Roof Program during the summers of the year 2017 when the then Mayor of the city himself painted a tin-roof top of some of the slum households to commence the program. As mentioned in the Ahmedabad HAP 2019, the AMC is planning to expand the cool-roof program in all parts of the city in a phase-wise manner in years to come. Three strategies that AMC will be using to expand the cool-roof program under HAP are, 1) Mandatory cool roofs for all municipal, commercial and government buildings, 2) Voluntary cool roofing for residential buildings, and, 3) Cool roofing for low-income housing under HAPs and through CSR initiatives. Even a few NGOs in Ahmedabad like the Mahila Housing Trust (MHT), have taken a step forward and started implanting cool-roof solutions for their beneficiaries in low socioeconomic sections of the society in Ahmedabad.

Figure 20 is of the then-mayor of Ahmedabad initiating the cool-roof program under Ahmedabad HAP in 2017 and Figure 21 is on one of the hoardings across the city to encourage large-scale acceptance of the cool-roof program by citizens. Whereas Figure 22 is of cool-roof (Mod-Roof) installed by NGO MHT at the rooftop of one of their beneficiaries. The trainer may ask participants what would be the effect of sun-reflective cool-roofs on the UHI effect?

Figure 20: Ahmedabad mayor initiating cool-roof

Source: NRDC

Figure 21: Cool-Roof hoarding in Ahmedabad

Source: NRDC

Figure 22: Mod-Roof

Source: MHT

Development of HAP:

Learning from the experience of Ahmedabad, the NRDC, IIPHG, AMC and other key stakeholders of Ahmedabad HAP released a manual that provides step by step guide for developing a Heat Action Plan. The seven key steps mentioned in the manual for developing a heat action plan are,

1. *City Engagement:* Finding the local nodal department & officer, other key department, and stakeholders who have high influence and interest in HAP

2. *Vulnerability Assessment and Establishing Heat-Health Threshold Temperatures:* To understand who are at risk, what factors are modifying their risk, and when the risk increases.

3. *Developing a Heat Action Plan:* Writing down the whole plan with defined roles & responsibilities of all stakeholders and with time-bound activities and deliverables.

4. *Team Preparation and Coordination:* Carrying out capacity building exercises, mock-drills for better preparedness and coordination.

5. *Implementation and Monitoring:* Ensuring all the steps describes in the plan being taken when and wherever necessary and keep a watch for real-time corrective measures.

6. *Evaluating and Updating the Plan:* Reassess at what worked and what didn't to plan better for the future.

7. *Strategies for Reducing Extreme Heat and Adapting to Climate Change:* Think of long term. Think of prevention over response. Think of reducing risk over managing risk. Think of increasing green and blue cover of the city over increasing beds in heat emergency rooms in hospitals.

Depending on the profiles of participants, the trainer may choose to explain in detail each of the seven steps given above. Although it is mentioned as "City Engagement" as the first step for developing a HAP, the operational unit (Megacity / City / Urban Agglomeration / District / Village) for development and implementation of HAP depends on the geospatial variation in the ambient air temperature profile and the population covered under the implementation unit of HAP. Ambient temperature doesn't vary much geographically within the district unless major differences in contour/weather systems are present. And therefore, the HAP implementation unit should be at Megacity (Population > 1 Million) and District levels for which the temperature thresholds can be estimated.

Objectives of the session

- Briefly explain genesis of Ahmedabad HAP
- Illustrate different components and steps to develop HAP based on experience of Ahmedabad

Duration

30 minutes

Methodology

This session can be quite engaging. Participants may relate with different parts of this session from their own experience, especially if they are from Ahmedabad. Trainer may run videos of Ahmedabad HAP to make the session more intriguing.

Training aids

Power-point presentation, flip-charts, markers, papers, pens, AV support etc.

Unit 3 Lesson 2: Assessing Vulnerability & Developing Threshold

Flow of the session

The two most important aspects of planning strategies to deal with extreme heat events are 1) identifying the underlying vulnerabilities, and 2) developing a risk-based temperature threshold for heat early warning systems. This session deals with the most technical aspects of HAP and may be more suitable to participants coming from some specific backgrounds such as Disaster Risk Management, Public Health, Social Science with some basic levels of understanding of research methodologies.

Vulnerability Assessment:

The main purpose of carrying out a vulnerability assessment as a part of the development of HAP is to know who are at higher risk of extreme heat, where are they located, and what are the factors inflating their risk to help the decision-makers strategically priorities risk reduction decisions to be taken under HAP.

First of all, there is no standard or single method for vulnerability assessment because it is dynamic in nature, and which factors such as physical, environmental, socio-economic affecting will have more influence on vulnerability may change from hazard to hazard. Also, a vulnerability assessment can be conducted at various levels like at the household level or individual level, at the city/district level or community level, or even at the national or global level. And, the decision of which method and type of data (Primary – collecting original data through surveys Or Secondary – using already available/published data) to be used for vulnerability assessment depends on at what level it has to be assessed.

Let’s take a hypothetical example of carrying out a vulnerability assessment of City XYZ in India with a 5 million population. Suppose there are a total of 50 different administrative wards in the City XYZ and the decision-makers have to assess the vulnerability to extreme heat for each of these wards to make informed risk-reduction decisions under HAP of City XYZ. The trainer may

use Figure 23 & 24 as a theoretical example of one of the methods that can be used to assess the extreme heat-related vulnerability at the administrative ward level within the City XYZ.

HEAT VULNERABILITY INDEX - CRITERIA (Example)				
Vulnerability Factors	**Weighting Factor (WF)**	**Heat Vulnerability Scores (HVS) Criteria**		
		Low	**Medium**	**High**
Physical Factors				
Population Density	**0.3**	< 10,000 /sq.km = 1	10,000 - 14,000 /sq.km = 2	> 14,000 /sq.km = 3
% Household with Electricity		> 95% = 1	85 - 95% = 2	< 85% = 3
% Household with piped Water supply		> 80% = 1	70 - 80% = 2	< 70% = 3
Socio-Demographic Factors				
% of Population < 5 & > 60 years	**0.2**	< 30% = 1	30 - 40 % = 2	> 40 % = 3
Literacy Rate		> 85% = 1	75 - 85% = 2	< 75% = 3
Environmental Factors				
Avg. Summer Temperature	**0.3**	< 33°C = 1	34 - 36°C = 2	> 36°C = 3
Avg. AQI		< 100 = 1	100 - 200 = 2	> 200 = 3
Green Cover		> 10% = 1	5 - 10% = 2	< 5% = 3
Economic Factors				
Avg. Annual Income per household	**0.2**	> 5 Lakh = 1	2-5 Lakh = 2	< 5 Lakh = 3
Slum Proportion		< 10% = 1	10 - 20% = 2	> 20% = 3
Heat Vulnerability Index (HVI) = Sum of WHVS (Weighted Heat Vulnerability Scores = HVS * WF)		**2.6**	**5.2**	**7.8**

Figure 23: HVI Tool

Source: GIDM

What is shown in these two figures are examples of how simple vulnerability assessment tools can be designed and used. Devising the Heat Vulnerability Index (HVI) is a common practice while assessing vulnerabilities to extreme heat. Some of the sub-factor under physical, socio-demographic, environmental, and economic factors that can help assess an administrative ward level extreme heat vulnerability as used in this HVI tool examples given in Figure 21 & 22 above. It can be seen that sub-factors are given low, medium, and high vulnerability scorings based on their characteristics. For example, as shown in Figure 21, the higher "Green Cover" is given "Low" vulnerability scoring as it can add to the coping capacity of that particular ward against extreme heat. Similarly, lower "% Households with piped Water supply" is given "High" vulnerability scoring as it can add to the susceptibility of that particular ward against extreme heat.

It can also be seen in Figure 22, that Ward 1 has a total heat vulnerability score of 21 which is higher than the total heat vulnerability score of Ward 2. Despite that, the heat vulnerability index of Ward 2 is 5.6 which is higher than the heat vulnerability index of Ward 1. This is because of the adjustment of heat vulnerability scores with the weighting factors. Not all factors influence

HEAT VULNERABILITY INDEX - CALCULATION (Example)					
Vulnerability Factors	**Weighting Factor (WF)**	**Ward 1 - HVS**	**Ward 1 - WHVS**	**Ward 2 - HVS**	**Ward 2 - WHVS**
A	**B**	**C**	**D = (B * C)**	**E**	**F = (B * E)**
Physical Factors					
Population Density	**0.3**	3	0.9	3	0.9
% Household with Electricity		2	0.6	2	0.6
% Household with piped Water supply		2	0.6	2	0.6
Socio-Demographic Factors					
% of Population < 5 & > 60 years	**0.2**	3	0.6	1	0.2
Literacy Rate		3	0.6	1	0.2
Environmental Factors					
Avg. Summer Temperature	**0.3**	1	0.3	3	0.9
Avg. AQI		1	0.3	3	0.9
Green Cover		1	0.3	3	0.9
Economic Factors					
Avg. Annual Income per household	**0.2**	2	0.4	1	0.2
Slum Proportion		3	0.6	1	0.2
Total		**21**	**5.2**	**20**	**5.6**
Heat Vulnerability Index (HVI)					

Figure 24: HVI Tool

Source: GIDM

vulnerability equally. Some factors will have a higher influence on vulnerability and some will have less and accordingly the factors are given weighting factors. The weighting factors used in the HVI tool example here are arbitrary but in reality, they can be obtained through previous studies or pilot testing of the larger vulnerability assessment study to be carried out. The higher HVI of Ward 2 can suggest decision-makers priorities extreme heat risk reductions measures in Ward 2 than Warn 1 in the City XYZ

Developing Threshold:

While the vulnerability assessment is essential to know who are at higher risk of extreme heat, where are they located, and what factors are inflating their risk, the development of local extreme heat threshold is essential to know WHEN is the risk of extreme heat starts rising. Simply saying, what is the cut-off point of a thermal variable at which the risk of health impact starts increasing in a given population.

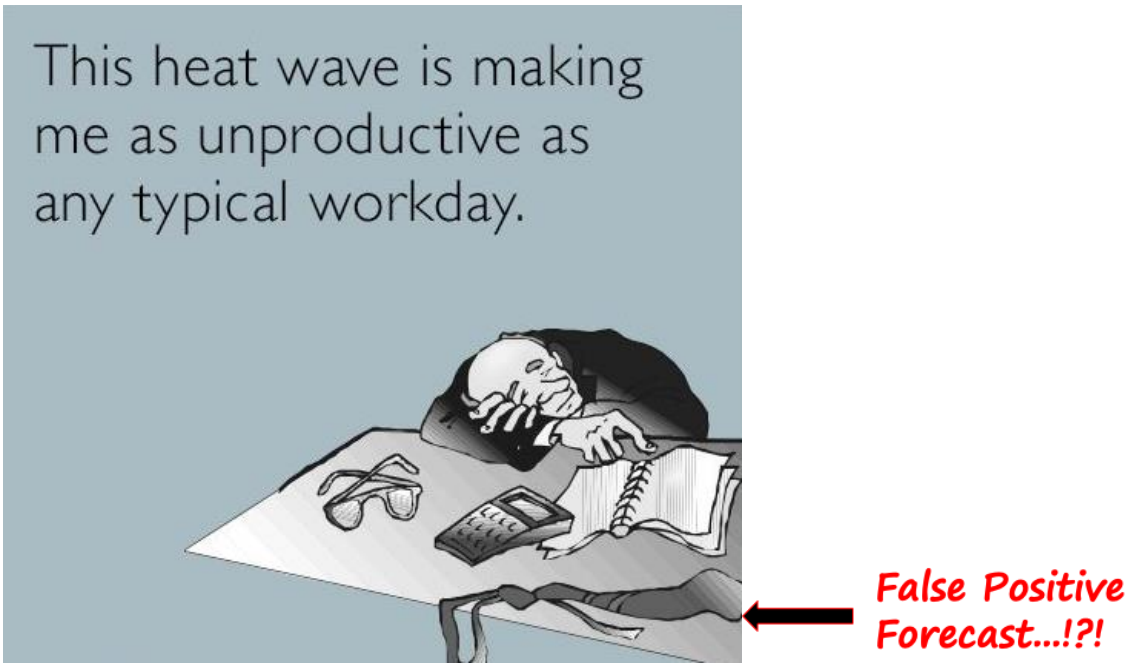


Figure 25

Source: Someecards

The trainer may start by asking participants "what is wrong with this gentleman in Figure 25?" If it is truly a heatwave day then this gentleman is unproductive on all workdays but if it's not a heatwave day in reality and still the gentleman is feeling unproductive thinking that it is because of heatwave then he must have received a false positive forecast of the heatwave. What does this mean? It can either mean that the temperature didn't actually reach the level to qualify as a heatwave or the qualifying temperature level for a heatwave fixed by the meteorological department is set low as any other summer day because the gentleman is feeling as unproductive as any other typical workday…! The lesson to learn here is that temperature cut-off to qualify as a heatwave (extreme heat) event shall be based on the level at which its impact can be seen on the population's health or productivity.

Heat-Stress is a common terminology used to indicate the impact of extreme heat on human health. Usually, it is understood as a situation where too much heat is absorbed by the body of a person which leads to situations like heat cramps, heat exhaustion, and if not treated then the dangerous situation of heatstroke. But the question that arises here is "how much heat is too much heat?" and for how long should it last to cause heat stress? Is that the criteria used by IMD for defining heatwave in India? We read in the earlier unit that during the 2003 European heatwave, around 15000 people died alone in France and that too at temperature hovering around ~37°C only for few days. Whereas, in India, IMD declares heatwave only if the temperature reaches 40°C in plains and remains above that for two consecutive days. This means that people living in different climates (hot/cold/humid) are acclimatized to local climate and weather conditions. A French resident will feel the temperature very hot in India during summer whereas for an Indian resident the summer temperatures of France will be quite comfortable and therefore, the extreme heat (heatwave) temperature cut-offs also known as Thresholds of one place should not be applied to another place in general.

Why should heat action plans of different cities/districts in India have their local thresholds? This is because the criteria of the heatwave in plains, hills, and coastal areas defined by IMD is applied for all such places. Whereas people living in the plains of northern India may have different temperature level susceptibility than people living in the central or western plains of India. Also, IMD declares heatwave only when the temperatures cross the cut-off value for two consecutive days whereas there is ample evidence suggesting that the health impact such as increased morbidities and mortalities can be seen on the very first days of extreme temperature events itself...! And therefore, local thresholds are essential for an effective heat-health early warning system.

There are many methods to determine extreme heat thresholds for health impacts. Some of them use simpler statistical techniques whereas some of them use rigorous and complex biometeorological techniques. The trainer may explain some important thermal variables and steps of threshold development methods that can be used in India.

What is the threshold for heat?

It is a thermal variable at which the risk of adverse health outcomes increases substantially.

Some of the thermal variables that are frequently used across the world for extreme heat thresholds?

- Tmax (Maximum Temperature)
- Tmin (Minimum Temperature)
- Tmean (Mean Temperature)
- HI (Humidity Index)
- PT (Perceived Temperature)
- Humidex
- WBGT (Wet Bulb Globe Temperature)
- UTCI (Universal Thermal Climate Index)

All these thermal variables except Tmax and Tmin are developed by applying different parameters of weather like temperatures, wind speed, humidity, radiation, etc., and different parameters of human conditions like the level of physical activity, clothing, body mass, and height, etc. in various complex biometeorological mathematical equations. And because of the complexities and levels of data required in these thermal variables, several developing and underdeveloped countries use the simple Tmax and Tmin to calculate thresholds for heat early warning systems.

Temperature / Humidity Index by NOAA, for USA

Relative Humidity %	Temperature °C																
	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
40	27	28	29	30	31	32	34	35	37	39	41	43	46	48	51	54	57
45	27	28	29	30	32	33	35	37	39	41	43	46	49	51	54	57	
50	27	28	30	31	33	35	36	38	41	43	46	49	52	55	58		
55	28	29	30	32	34	36	38	40	43	46	48	52	54	58			
60	28	29	31	33	35	37	40	42	45	48	51	55	59				
65	28	30	32	34	36	39	41	44	48	51	55	59					
70	29	31	33	35	38	40	43	47	50	54	58						
75	29	31	34	36	39	42	46	49	53	58							
80	30	32	35	38	41	44	48	52	57								
85	30	33	36	39	43	47	51	55									
90	31	34	37	41	45	49	54										
95	31	35	38	42	47	51	57										
100	32	36	40	44	49	56											

Caution | Extreme Caution | Danger | Extreme Danger

Figure 26: Humidity Index Chart

Source: NOAA

Figure 26 is a chart of the humidity index developed in the USA in the 20th century. It is a thermal variable that takes humidity along with temperature and a few other weather variables and human conditions into account and it is very useful for coastal regions but it cannot be applied for people living in different climatic conditions than the USA and the same goes for Humidex developed in Canada. Studies have found that even the universally most accepted WBGT (Wet Bulb Globe Temperature) which is also used for *ISO 7243 'Hot environments - Estimation of the heat stress on working man, based on the WBGT-index (wet bulb globe temperature)'* tends to overestimate the thermal comfort condition in tropical regions. And therefore, out of all these thermal variables, Tmax (Maximum Temperature) and Tmin (Minimum Temperature) are the most widely used variables in the world to estimate extreme heat thresholds for heat early warning systems. This is also because they are simple to use and largely available with weather services of all nations.

Now the trainer can describe the steps to estimate extreme heat thresholds for heat early warning systems:

- See if there are evidence of health impacts in past (recent if possible) extreme heat events.

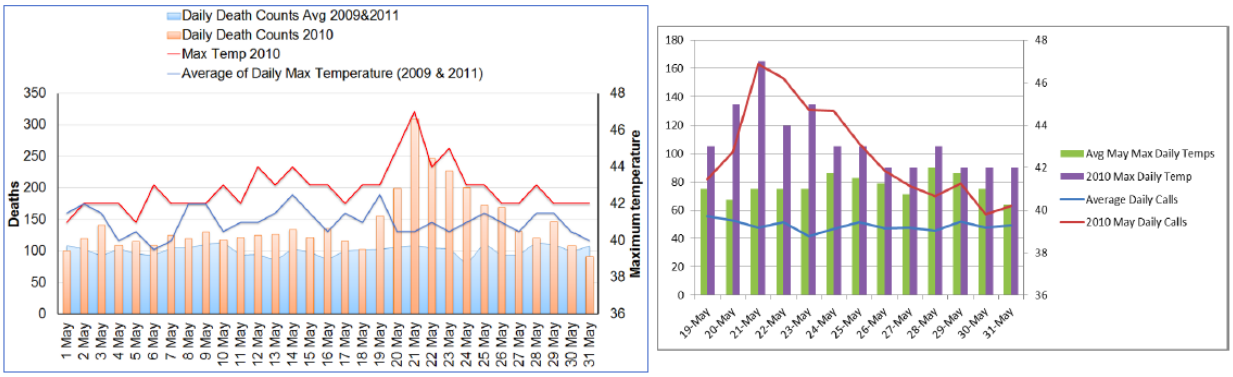


Figure 27: Daily Temperature vs Deaths & 108 Emergency Ambulance Calls

Source: Ahmedabad HAP

The Ahmedabad City witnessed (Figure 27) increased daily all-cause deaths and emergency ambulance calls during the month of May and particularly during the week of extreme heat event in the year 2010 as compared to average daily all-cause deaths and emergency ambulance calls in May month of years 2009 and 2010. Such evidence provides a strong indication to explore further and estimate the temperature thresholds at which the health impacts can occur.

There are two commonly used methods to estimate extreme heat thresholds for heat early warning systems are

1. *Epidemiological Study Based Method:*

   Type of analysis: Time-Series Analysis (most commonly used)

   Who can do it: Anyone proficient with (bio)statistical skills

   Data that can be used:

   Weather: Daily Thermal Variable and other weather variables like humidity, wind speed, etc.

   Health: Daily all-cause or cause-specific death count data

   Daily hospital admission admissions count data

   Daily Emergency Ambulance (108) call count data

Figure 28 is a scatter plot illustration of daily maximum temperature & daily all-cause deaths in Ahmedabad which is helpful in identifying the temperature thresholds. It can be seen here that the

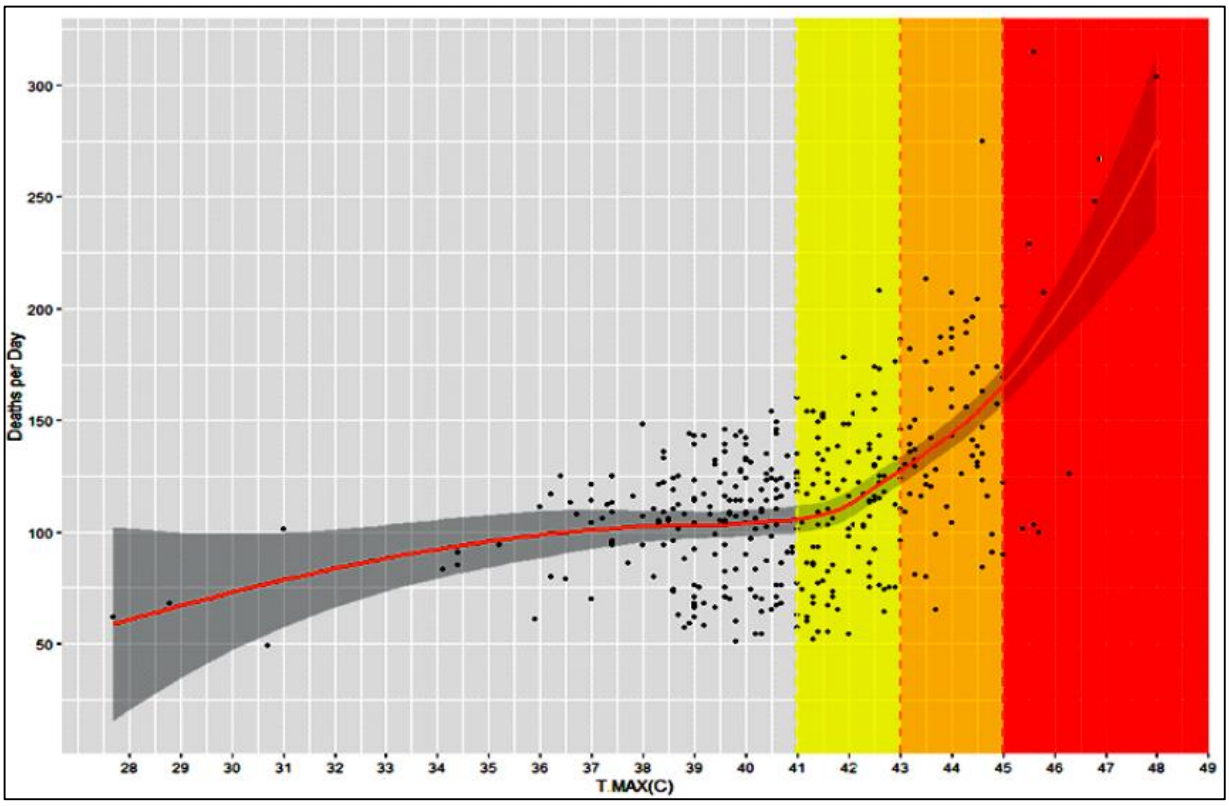


Figure 28: Ahmedabad temperature and mortality relationship

Source: NDMA

Count of daily deaths on Y-Axis starts increasing one the maximum temperature on X-Axis crosses 41°C and steeply rises further at 43°C and 45°C. And based on these cut-offs the temperature thresholds for color-coded heat early warning system in Ahmedabad HAP are set.

2. *Percentile Based Method:*

   It is often difficult, especially in rural settings to get health impact data for a considerable duration and of desirable quality that can be used in the time-series analysis to estimate thresholds. But, to address this issue, in a joined publication titled "Heatwaves and Health: Guidance on Warning-System Development" issued in 2015, the WHO and WMO have indicated that, *"In situations where there is basic meteorological information but no health data, a percentile-based threshold (90th, 95th) could be contemplated as a warning trigger value. Recent research has even indicated that thresholds as low as the 85th percentile for maximum temperature might be applied as a generic threshold."*

This suggests that in districts and cities where desirable health data is not available, the decision-makers may start with using the 85th, 90th, and 95th percentile of summer maximum temperature as the cut-off values of thresholds for heat early warning system. As shown in Figure 29, percentile thresholds can be set for the entire summer season or by each month of the summer season also.

Seasonal Thresholds for Heat wave Warning

City	85% Percentile	90% Percentile	95% Percentile
Baroda	40.0	42.0	44.0

Month-wise Thresholds for Heat wave Warning

City	Month	85% Percentile	90% Percentile	95% Percentile
Baroda	April	39.0	41.0	43.0
	May	40.0	42.0	44.0
	June	39.5	41.5	43.5

Figure 29: Summer Seasonal & Month-wise Percentile Based Maximum Temperature Thresholds (example)

Source: GIDM

Objectives of the session

- Explain the importance of vulnerability assessment and threshold estimation in HEWS
- Describes a few methods used for vulnerability assessment and threshold estimation

Duration

30 minutes

Methodology

This session will be more useful if a small exercise vulnerability assessment is carried out at the end. The trainer may divide the class into groups of 4-5 members each and guide them for vulnerability assessment exercise based on what they learned in this session.

Training aids

Power-point presentation, flip-charts, markers, papers, pens etc.

Unit 3 Lesson 3: Understanding heat early warning systems (HEWS)

Flow of the session

The UNDRR has defined Early Warning System (EWS) as, *"An integrated system of hazard monitoring, forecasting and prediction, disaster risk assessment, communication and preparedness activities systems and processes that enables individuals, communities, governments, businesses and others to take timely action to reduce disaster risks in advance of hazardous events."*

There are two essential elements of EWS as per this definition, 1) Climate Service - which can precisely monitor and provide accurate forecasts and predictions, and 2) A risk communication plan to reach out to every section of society in well advance. The risk in such a communication plan must be assessed based on vulnerabilities and thresholds. When this EWS criterion is applied to extreme heat, it can be termed as Heat Early Warning System (HEWS) which is an indispensable part of any HAP.

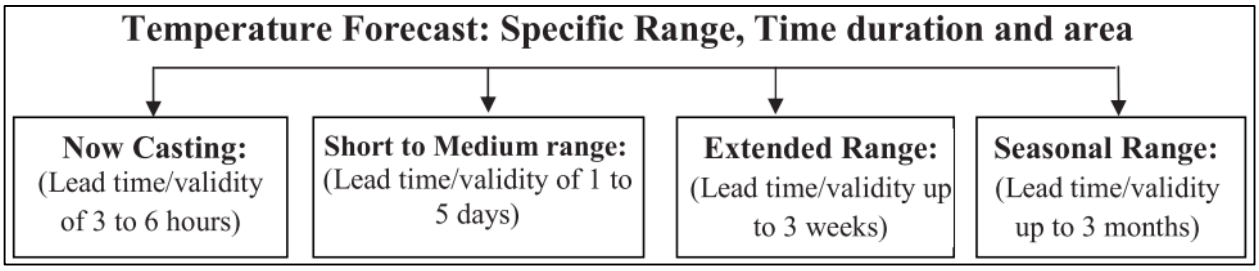


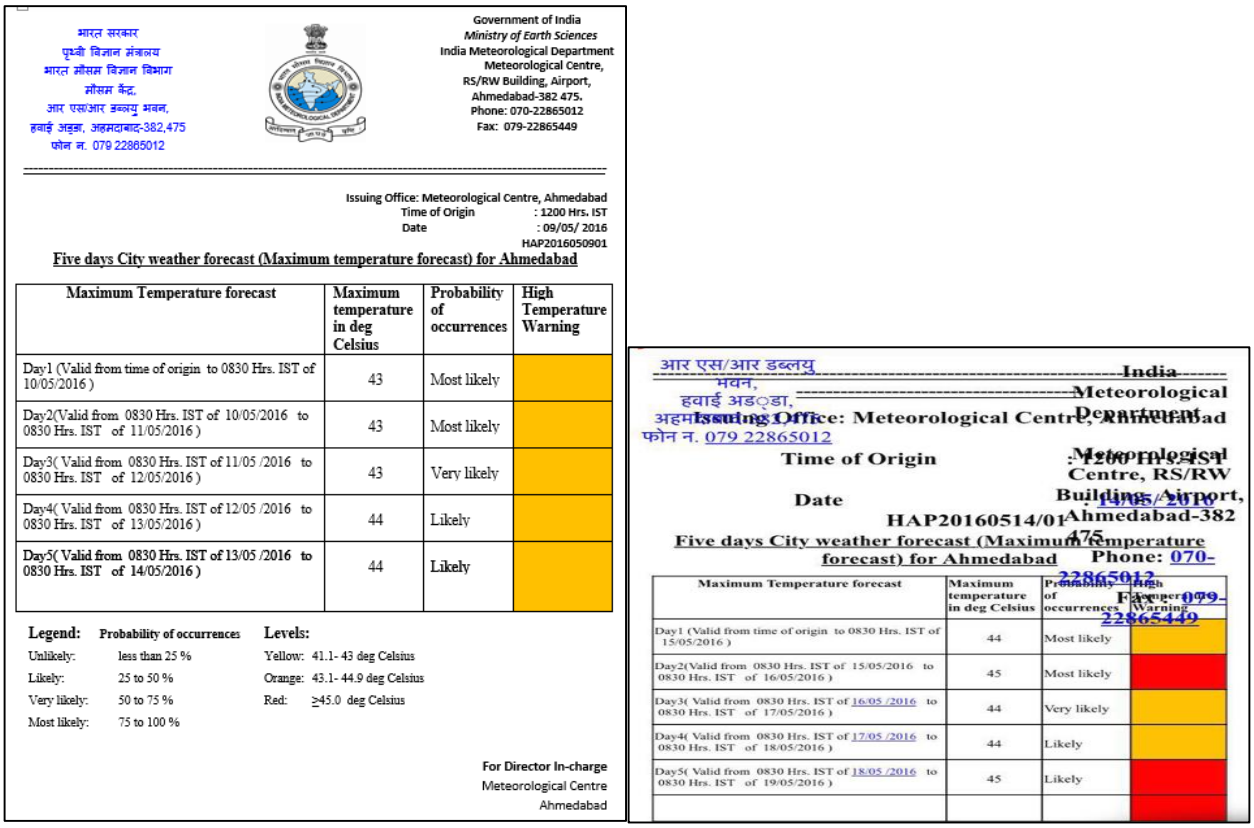
Figure 30: Weather forecasts system used by IMD

Source: IMD

The IMD in India is responsible for monitoring, predicting, and forecasting conditions including extreme heat during summers. As shown in Figure 30 above, IMD issues temperature forecasts for all its weather stations with different lead-time. The seasonal temperature forecasts issued by IMD which has a validity of up to 3 months are useful for long term planning at the beginning of summer season as it gives an idea about how hot the summer season is going to be as compared to previous years. Whereas the short to medium range temperature forecasts remain valid for 1 to 5 days and

they are the ones used for HEWS in HAPs. And need not mention that the probability of occurrence (forecast turning true) increases as the lead time for forecast decreases.

In the case of Ahmedabad HAP, the Ahmedabad office of IMD being the climate service provider and one of the key stakeholders, provide tailormade forecasts which are aligned with the temperature thresholds for the color-coded heat early warning system in Ahmedabad HAP. What we see in Figure 31 below is the 5 days advance temperature forecast issued by IMD for HEWS



भारत सरकार
पृथ्वी विज्ञान मंत्रालय
भारत मौसम विज्ञान विभाग
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फोन न. 079 22865012

Government of India
Ministry of Earth Sciences
India Meteorological Department
Meteorological Centre,
RS/RW Building, Airport,
Ahmedabad-382 475.
Phone: 070-22865012
Fax: 079-22865449

Issuing Office: Meteorological Centre, Ahmedabad
Time of Origin : 1200 Hrs. IST
Date : 09/05/ 2016
HAP2016050901

Five days City weather forecast (Maximum temperature forecast) for Ahmedabad

Maximum Temperature forecast	Maximum temperature in deg Celsius	Probability of occurrences	High Temperature Warning
Day1 (Valid from time of origin to 0830 Hrs. IST of 10/05/2016)	43	Most likely	
Day2(Valid from 0830 Hrs. IST of 10/05/2016 to 0830 Hrs. IST of 11/05/2016)	43	Most likely	
Day3(Valid from 0830 Hrs. IST of 11/05 /2016 to 0830 Hrs. IST of 12/05/2016)	43	Very likely	
Day4(Valid from 0830 Hrs. IST of 12/05 /2016 to 0830 Hrs. IST of 13/05/2016)	44	Likely	
Day5(Valid from 0830 Hrs. IST of 13/05 /2016 to 0830 Hrs. IST of 14/05/2016)	44	Likely	

Legend: **Probability of occurrences**
Unlikely: less than 25 %
Likely: 25 to 50 %
Very likely: 50 to 75 %
Most likely: 75 to 100 %

Levels:
Yellow: 41.1- 43 deg Celsius
Orange: 43.1- 44.9 deg Celsius
Red: ≥45.0 deg Celsius

For Director In-charge
Meteorological Centre
Ahmedabad

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हवाई अड्डा, अहमदाबाद-382,475
फोन न. 079 22865012

India Meteorological Department
Issuing Office: Meteorological Centre, Ahmedabad
Time of Origin : 1200 Hrs. IST
Date : 14/05/2016
HAP20160514/01

Meteorological Centre, RS/RW Building, Airport, Ahmedabad-382 475.
Phone: 070-22865012
Fax: 079-22865449

Five days City weather forecast (Maximum temperature forecast) for Ahmedabad

Maximum Temperature forecast	Maximum temperature in deg Celsius	Probability of occurrences	High Temperature Warning
Day1 (Valid from time of origin to 0830 Hrs. IST of 15/05/2016)	44	Most likely	
Day2(Valid from 0830 Hrs. IST of 15/05/2016 to 0830 Hrs. IST of 16/05/2016)	45	Most likely	
Day3(Valid from 0830 Hrs. IST of 16/05 /2016 to 0830 Hrs. IST of 17/05/2016)	44	Very likely	
Day4(Valid from 0830 Hrs. IST of 17/05 /2016 to 0830 Hrs. IST of 18/05/2016)	44	Likely	
Day5(Valid from 0830 Hrs. IST of 18/05 /2016 to 0830 Hrs. IST of 19/05/2016)	45	Likely	

Figure 31: 5 days advance temperature forecasts issued by IMD for Ahmedabad HAP on 9th & 14th May 2016

Source: IMD

as a part of Ahmedabad HAP. The first forecast was issued on 9th May 2016 where all the next 5 days were falling in the orange alert level category (43.1°C – 44.9°C) whereas two days were falling into the red alert level category (≥ 45°C) in forecast issues on 14th May 2016. And different departments/agencies/stakeholders of HAP take their respective actions associated with these color-coded alert levels of temperature forecast upon receipt of the alert warning from the nodal officer of HAP. The nodal officer is the primary recipient of the temperature forecast from IMD

and responsible to activate the HEWS and share the forecast further using an interagency communication plan depending on the level of temperature warning alerts received from the IMD.

Colour Code	Alert	Warning	Impact	Suggested Actions
Green (No action)	Normal Day	Maximum temperatures are near normal	Comfortable temperature. No cautionary action required.	Normal activity
Yellow Alert (Be updated)	Heat Alert	Heat wave conditions at isolated pockets persists for 2 days	Moderate temperature. Heat is tolerable for general public but moderate health concern for vulnerable people e.g. infants, elderly, people with chronic diseases	(a) Avoid heat exposure. (b) Wear lightweight, light-coloured, loose, cotton clothes. (c) Cover your head
Orange Alert (Be prepared)	Severe Heat Alert for the day	(i) Severe heat wave conditions persists for 2 days (ii) Through not severe, but heat wave persists for 4 days or more	High temperature. Increased likelihood of heat illness symptoms in people who are either exposed to sun for a prolonged period or doing heavy work. High health concern for vulnerable people e.g. infants, elderly, people with chronic diseases.	(a) Avoid heat exposure– keep cool. Avoid dehydration (b) Wear lightweight, light-coloured, loose, cotton clothes (c) Cover your head (d) Drink sufficient water- even if not thirsty (e) Use ORS, homemade drinks like lassi, torani (rice water), lemon water, buttermilk, etc. to keep yourself hydrated (f) Avoid alcohol, tea, coffee and carbonated soft drinks, which dehydrates the body (g) Take bath in cold water frequently. In case of SUNSTROKE: Lay the person in a cool place, under a shade. Wipe her/him with a wet cloth/wash the body frequently. Pour normal temperature water on the head. The main thing is to bring down the body temperature. Consult a Doctor immediately.
Red Alert (Take Action)	Extreme Heat Alert for the day	(i) Severe heat wave persists for more than 2 days. (ii) Total number of heat/severe heat wave days exceeding 6 days.	Very high likelihood of developing heat illness and heat stroke in all ages.	Along with suggested action for Orange Alert, Extreme care needed for vulnerable people.

Figure 32: Color Code signals for heat alert and suggested actions

Source: NDMA

Some of the suggested actions that should be taken by people at large based on the different levels of color-coded heat alerts are given in Figure 32.

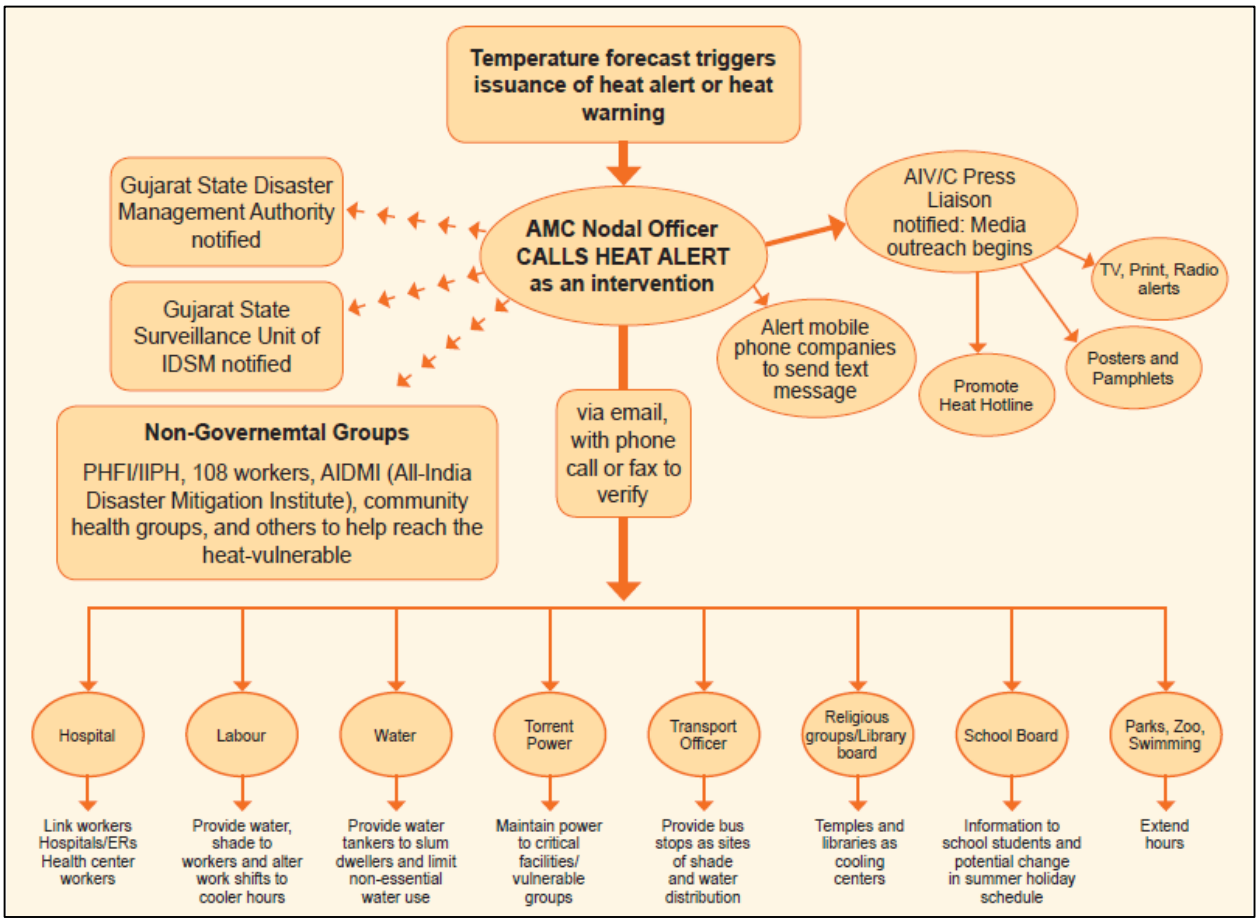

Figure 33: Interagency Coordination Plan

Source: Ahmedabad HAP

What is shown in Figure 33 above is the risk communication plan used in Ahmedabad HAP. As we can see in the figure that on receipt of temperature forecasts from IMD, the nodal officer issues heat alert or warning based on the levels of temperature in the forecast. The nodal officer communicates the forecasts to all the key stakeholders/agencies/departments, media, and people using various means of communication.

Objectives of the session

- Understand the importance of HEWS in HAP
- Explain linkages between the threshold and HEWS

Duration

30 minutes

Methodology

This session will be mostly covered through PowerPoint presentations by the trainer but the trainer may ask the participants to share their experience of heat forecasts that they might have received in the past.

Training aids

Power-point presentation, flip-charts, markers, papers, pens etc.

Unit 3 Lesson 4: Institutional mechanisms to deal with extreme heat

Flow of the session

Extreme heat (heatwave) has so far been given lesser importance as compared to other hazards like floods, earthquakes. They are often regarded or rather disregarded as "Silent Killers" because of slower and lesser dramatic onset and spatiotemporally spread of impacts as compared to other hazards like flood or earthquake. But the recent events like the 2003 Europe Heatwave, 2010 Russia Heatwave, and 2015 in India and Pakistan Heatwaves that succumbed thousands of lives in a shorter span have shown the world the destructive nature of extreme heat events. And under the threats of global warming and climate change, the perils of extreme are ought to mount high. The days of frequent, intense, and long-lasting extreme heat events as predicted by IPCC climate scientists are no more forecast now, they are already here. We have witnessed the last decade as the warmest decade and the last five years as the warmest five years in the history of the world. But the good part is that the governments, institutions, communities all around the world have now started taking measures to deal with extreme heat.

In India, after the development and implementation of South-Asia's first city-wide comprehensive Ahmedabad heat action plan in the year 2013, the NDMA and IMD have shown great leadership in advancing the actions to deal with extreme heat across the nation. The NDMA in the year 2016 issued the first "National Guidelines for Preparation of Action Plan – Prevention and Management of Heat Wave" developed by an expert committee constituted by NDMA. The revised guidelines were issued in the years 2017 and 2019. The heatwave guidelines issued by NDMA are also covered in the National Disaster Management Plan – 2019. Series of national level and heatwave prone state-specific consultation workshops are held by NDMA every year before, during, and after the summer season to improve actions to deal with extreme heat. Along with this, for the past few years, the IMD has also started providing five days advance temperature forecasts to hundreds of cities/districts in India to help them devise their HEWS. Under the guidance of NDMA and IMD at the national level and with the support of SDMA and other key departments in local governments, hundreds of cities and districts in several states of India have either developed their

HAP or are in process of doing the same. GSDMA in Gujarat has also developed "Gujarat State Action Plan: Prevention and Mitigation of Impacts of Heat Wave" during the year 2020.

As mentioned in the "National Guidelines for Preparation of Action Plan – Prevention and Management of Heat Wave" issued by NDMA in 2019, *"Heat wave has not been notified as a disaster by the Government of India yet. It is not in the list of twelve disasters eligible for relief under National/ State Disaster Response Fund norms. However, a State Government may use up to 10 per cent of the funds available under the SDRF for providing immediate relief to the victims of natural disasters that they consider to be disasters "within the local context in the State and which are not included in the notified list of disasters of the Ministry of Home Affairs subject to the condition that the State Government has listed the State specific natural disasters and notified clear and transparent norms and guidelines for such disasters with the approval of the State Authority."* States like Odisha and Kerala considering the risk of extreme heat (heatwave) events there have already considered heatwave in the list of state specific disasters. The order issued by the government of Kerala for the same in the year 2019 is given below. The trainer may use this to explain how the institutional framework of disaster relief under NDRF/SDRF works in India.

Government of Kerala order for including Heatwave in the list of State Specific Disasters

File No.DMB2/33/2019-DMD

GOVERNMENT OF KERALA

Abstract

Disaster Management Department-State Disaster Response Fund Norms -State Specific Disasters-Heat wave, Sun stroke, Sun burn-Notified- Orders issued

DISASTER MANAGEMENT(B) DEPARTMENT

G.O.(Ms)No.9/2019/DMD Dated,Thiruvananthapuram, 09/03/2019

Read
1. Letter No. 32-7/2014-NIDM-I dated 8-4-2015 from the Disaster Management Division, Ministry of Home Affairs, Government of India
2. GO (Ms) No. 194/2015/DMD dated 20-05-2015
3. Minutes of the State Executive Committee meeting held on 06-03-2019

ORDER

Government of Kerala had revised the norms of relief assistance from State Disaster Response Fund (SDRF) to the victims of natural calamities for 2015-20 in accordance with the recommendations of 14th Finance Commission (FFC) approved by Government of India, Ministry of Home Affairs as per Government Order read as 2nd paper above. As per the revised norms issued by Government of India vide letter read as 1st paper above, it has been permitted to use 10% of the annual SDRF/NDRF allocation for relief assistance to 'State Specific Disasters' within the local context of the State and instructed that such local disasters and the relief assistance norms have to be declared and approved by the State Executive Committee (SEC) of State Disaster Management Authority (SDMA).

2. Accordingly the SEC has declared the following items as State Specific Disaster and approved the norms for relief assistance as given as Annexure to this order.

a) Heat Wave
b) Sun Stroke
c) Sun Burn

3. Government have examined the matter and are pleased to order that the norms and scale of assistance declared and approved by the SEC of KSDMA and given as annexure to this order will be followed for providing relief assistance to victims of State Specific Disasters in the State.

File No.DMB2/33/2019-DMD

(By order of the Governor)
REMESAN.M.K.
ADDITIONAL SECRETARY

To:

The Secretary to Government of India, Ministry of Home Affairs (DM Division), 'C' Wing, III Floor, NDCC-II, Jai Singh Road, New Delhi-110 001 (with Covering Letter)
The Secretary Kerala State Disaster Management Authority, Thiruvananthapuram
All Secretaries of the Secretariat including Finance
All Members of the State Disaster Management Authority
The Land Revenue Commissioner, Thiruvananthapuram
The Resident Commissioner, 3, Jantar Mantar Road, Kerala House,New Delhi-100 001
All District Collectors
The Director, Institute of Land and Disaster Management, PTP Nagar, Thiruvananthapuram
The Principal Accountant General(Audit), Kerala, Thiruvananthapuram
The Accountant General(A&E), Kerala, Thiruvananthapuram
All District Treasury Officers
The Accountant General branch office,Kottayam/Ernakulam/Thrissur/Kozhikode
The Finance(BW) Department
The Information officer, Web& New Media
Stock File/Office Copy

Copy to:

All Departments of the Secretariat including Finance
Director of Agriculture
Director of Animal Husbandry
Director of Health Services
PS to all Ministers
PS to Principal Secretary(Revenue and DM)
Disaster Management A Department

Forwarded /By order

Section Officer

ANNEXURE

List of items and norms of assistance from State Disaster Response Fund (SDRF) for Heat Wave, Sun Stroke, Sun Burn

Item	Revised for 2015-2020
1 a) Ex-gratia payment to families of deceased persons	4,00,000/-
1 b) Ex-gratia for loss of eye(s)	40% to 60% loss – 59,100/- >60% - 2,00,000/-
1 c) Grievous injury requiring hospitalization	More than a week - 12,700/ Less than a week - 4,300/-
2 a) Coast of evacuation of people affected/likely to be affected	As per actual cost based on assessment of need by DDMA up to 60 days limited to the funds specifically provided for this state specific disasters, and may be extended upto 90 days with the approval of Government.
2 b) Hiring of boats for carrying out immediate relief and saving lives	As per actual cost based on assessment of need by DDMA up to 60 days limited to the funds specifically provided for this state specific disasters, and may be extended upto 90 days with the approval of Government.
3 a) Provision for temporary accommodation, food, clothing, medical care, etc. for people affected/evacuated and sheltered in relief camps.	As per actual cost based on assessment of need by DDMA up to 60 days limited to the funds specifically provided for this state specific disasters, and may be extended upto 90 days with the approval of Government.
3 b) Provision of emergency supply of drinking water in rural areas and urban areas	As per actual cost based on assessment of need by DDMA up to 60 days limited to the funds specifically provided for this state specific disasters, and may be extended upto 90 days with the approval of Government.
4 Disposal of dead bodies/carcases	As per actual cost based on assessment of need by DDMA limited to the funds specifically provided for this state specific disasters.

6 Replacement of milch animals, draught animals used for haulage	Milch animals - 30,000/- (Buffalo/cow/camel/yak/mithun) Sheep/goat/pig – 3000/- Draught animals - 25000/-camel/horse/bullock, etc. Poultry-50/-per bird 16,000/calf/donkey, pony, mule
Repair restoration (of immediate nature) of damaged infrastructure. 1) Drinking Water Supply	As approved by the DDMA, upto Rs. 25,000/damaged structure which is exclusively used for drinking water supply

- Expenses for responding to Heat Wave, Sun Burn and Sun Stroke shall be limited to the amount allotted exclusively for the purpose from the Government from time to time. No additional burden shall be taken-up without the prior approval of the Government
- Detailed Circular will be issued by the Government for utilization of funds provided to respond to Heat Wave, Sun Burn and Sun Stroke, from time to time.

The list of twelve disasters eligible for relief under National/ State Disaster Response Fund norms does include the Coldwave. The trainer should ask participants to reflect on what basis is Coldwave included in the list and not heatwave and should Heatwave be in that list considering we will see more heatwaves than cold waves in future climate scenario due to global warming and climate change?

Objectives of the session

- To illustrate institutional mechanisms heatwave prevention and management measures at national and state levels.

Duration

30 minutes

Methodology

In this last session of the training, the trainer may narrate the topic through a PowerPoint presentation and then engage with participants on the question given above at the end of this session.

Training aids

Power-point presentation, flip-charts, markers, papers, pens etc.

Post-Training Evaluation and Conclusion

Need of the session

This session is aimed to assess the overall effectiveness of the training. The difference between participants' understanding of the subject during pre-training evaluation and during the post-training evaluation will give a fair idea about the aptness of topics covered in the training and the trainer's ability to efficiently delivering the subject. This will also be useful in improving the training module in the future.

Objectives of the session

- Assess changes in participants understanding of various topics of the training
- Check whether the topics covered are aligned with the needs of participants.
- To get feedback from participants and trainees on changes required in future

Duration

30 minutes

Methodology

This will be a session of information discussion after the participants have completed their post-training evaluation test.

Training aids

Power-point presentation, flip-charts, markers, papers, pens etc.

Annexure 1: Symptoms and First Aid of Heat Illnesses

Heat Disorder	Symptoms	First Aid
Heat rash	Skin redness and pain, possible swelling, blisters, fever, headaches.	Take a shower using soap to remove oils that may block pores preventing the body from cooling naturally. If blisters occur, apply dry, sterile dressings and seek medical attention.
Heat Cramps	Painful spasms usually in leg and abdominal muscles or extremities. Heavy sweating.	Move to cool or shaded place. Apply firm pressure on cramping muscles or gently massage to relieve spasm. Give sips of water. If nausea occurs, discontinue.
Heat Exhaustion	Heavy sweating, weakness, Skin cold, pale, headache and clammy extremities. Weak pulse. Normal temperature possible. Fainting, vomiting.	Get victim to lie down in a cool place. Loosen clothing. Apply cool, wet cloth. Fan or move victim to air-conditioned place. Give sips of water slowly and if nausea occurs, discontinue. If vomiting occurs, seek immediate medical attention, call 108 and 102 for ambulance.
Heat Stroke (Sun Stroke)	High body temperature. Hot, dry skin. Rapid, strong pulse. Possible unconsciousness or altered mental status. Victim will likely not sweat.	Heat stroke is a severe medical emergency. Call 108 and 102 for ambulance for emergency medical services or take the victim to a hospital immediately. Delay can be fatal. Move victim to a cooler environment. Try spraying water, cold water on body & fan the wet body. If possible sponging or cool bath sponging to reduce body temperature. Use extreme caution. Remove clothing. Use fans and/or air conditioners. **DO NOT GIVE FLUIDS ORALLY if the person is not conscious.**

Source: NDMA

Annexure 2: Do's & Don'ts during extreme heat (heatwave)

DO's

Must for All

- Listen to Radio; watch TV; read Newspaper for local weather news.
- Drink sufficient water - even if not thirsty.
- Use ORS (Oral Rehydration Solution), homemade drinks like lassi, torani (rice water), lemon water, buttermilk, etc. to keep yourself hydrated.
- Wear lightweight, light-coloured, loose, cotton clothes.
- Cover your head: Use a cloth, hat or umbrella.

Employers and Workers

- Provide cool drinking water near work place.
- Caution workers to avoid direct sunlight.
- Schedule strenuous jobs to cooler times of the day.
- Increasing the frequency and length of rest breaks for outdoor activities.
- Pregnant workers and workers with a medical condition should be given additional attention.

Other Precautions

- Stay indoors as much as possible.
- Keep your home cool, use curtains, shutters or sunshade and open windows at night. Try to remain on lower floors.
- Use fans, damp clothing and take bath in cold water frequently.
- If you feel faint or ill, see a doctor immediately.
- Keep animals in shade and give them plenty of water to drink.

DONT's

- Avoid going out in the sun, especially between 12.00 noon and 3.00 p.m.
- Avoid strenuous activities when outside in the afternoon.
- Do not go out barefoot.
- Avoid cooking during peak hours. Open doors and windows to ventilate cooking area adequately.
- Avoid alcohol, tea, coffee and carbonated soft drinks, which dehydrates the body.
- Avoid high-protein food and do not eat stale food.
- Do not leave children or pets in parked vehicles - as they may get affected by Heat Wave.

Source: NDMA

References & Resources:

1. "National Guidelines for Preparation of Action Plan – Prevention and Management of Heat Wave", 2019 - NDMA
2. Ahmedabad Heat Action Plan 2019
3. National Disaster Management Plan – 2019; India
4. Gujarat State Action Plan: Prevention and Mitigation of Impacts of Heat Wave 2020
5. The 2020 report of the Lancet Countdown on health and climate change: responding to converging crises
6. CITY RESILIENCE TOOLKIT Response to Deadly Heat Waves and Preparing for Rising Temperatures
7. Heatwaves and Health: Guidance on Warning-System Development
8. Heatwave Public Awareness YouTube videos playlist by NDMA

GUJARAT INSTITUTE OF DISASTER MANAGEMENT

BUILDING RESILIENCE

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