Risk Identification and Preparedness for Extreme Heat: Some Lessons from the Field

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Asian Institute of Technology
Outline

• Survey
• Identifying the vulnerable groups
• Adapting to heat
• Action plan
India reels under deadly heatwave

BRACE YOURSELVES  IMD predicts increase in temperature as shooting mercury sparks water clashes across country

SCORCHING TO DEATH
Unusually hot summer has already claimed over 100 lives

91 Total deaths reported so far from three heatwave-hit states
Telangana 35
Odisha 31
Andhra Pradesh 25

Maximum temperature (°C) in major locations

Nagpur 44
Hyderabad 44
Medak 43
Bikaner 42
Lucknow 42
Bhubaneswar 41
Warangal 41
Daltonganj 41
Delhi 40.1
Gorakhpur 40
Bhopal 40
Chandigarh 39
Water trains bring scant relief here

Ground report from Marathwada region of Maharashtra, parched by back-to-back drought years

LATOR, APRIL 27
Haribau Kamble, an unemployed labourer in India's richest state of Maharashtra, is forced to queue for hours in scorching heat to fetch water even as the government puts on trains to ship water to the region parched by back-to-back drought years.

Maharashtra

Like Kamble, millions of Indians have been hung out to dry in the state with the worst drought in four decades ravaging crops, killing livestock, emptying reservoirs and slowing hydroelectric power output. Mismanagement of water resources, with powerful politicians pushing for bigger supplies to industries, have made the situation worse, experts say.

“The government says it is bringing water by train every day, but we are getting water once a week,” Kamble said, after standing in line for three hours to fill two pitchers at a tap in Latur district, 500 km southeast of Mumbai in drought-stricken Marathwada region. Locals had been hoping a 50-wagon daily water train would ease shortages, but they were disappointed as the 25 lakh litres carried by the train and ferried by tankers to villages was not enough to meet the needs of Latur’s five lakh people and Marathwada’s 1.9 crore.

Marathwada, home to many sugar mills in Maharashtra, is one of the several regions in India that received below-average June-September rains in 2015. New Delhi estimates that overall 33 crore, a quarter of the country’s population, are currently affected by drought.

Water is set to get scarcer over the next two months as temperatures soar above 40 degrees Celsius, drying up Marathwada reservoirs that are now just 3 per cent full. “That Maharashtra would face a water crisis was clear when monsoons failed, yet the state took no action to curb supplies to water-guzzling industries like beer and sugar,” said Parineeta Dandekar, associate coordinator at the South Asia Network on Dams, Rivers and People.

There are limits on how much water the government can supply by train. Had it reserved water sources for drinking last year, the situation would have been much better now.” The need of the hour is cost-effective steps such as enforcing restrictions on water use and ensuring canals do not leak. — Reuters

HEATWAVE TOLL SURGES PAST 4,000 IN 4 YEARS

4,204 people have died due to heatwaves since 2013 till March 2016, Union Minister YS Chowdary said in the Lok Sabha on Wednesday.

87 people died till March this year, Chowdary said in a written response to a question in Parliament.

56 deaths have been seen in Telangana, followed by 19 in Odisha. Andhra Pradesh has recorded eight deaths, while Maharashtra, Tamil Nadu, Karnataka and Kerala have one casualty each due to heatwave.

1,433 people died in 2013, of whom 1,393 were from undivided Andhra Pradesh.

549 died in 2014, but the toll again rose to 2,135 in 2015.

Centre puts onus on states for drought

New Delhi: Under attack over dealing with the drought in the country, the Centre on Wednesday put the responsibility for addressing the situation on states. Insisting that the government was doing its bit to provide relief to those affected, Agriculture Minister Radha Mohan Singh said: “The role of Centre and state is different. It is clearly defined in the manual for drought management and we cannot change it overnight. The Centre’s role is to monitor and the state’s role is to provide assistance and help the affected people at ground level.”

Thu, 28 April 2016
epaper.tribuneindia.com/c/9945909
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.

No relief from heat, Ahmedabad sizzles at 43.6 degrees

TNN | May 17, 2013, 06.12AM IST

Tags: weather condition | Indian Meteorological Department

AHMEDABAD: The city was like a furnace on Thursday when the mercury climbed to 43.6 degree Celsius. This was the second consecutive day when the maximum temperature rose above 43 degrees.
Heat Health Collaboration: Scientific Research to Support Policy

- PHFI, IIPH, NRDC partnerships.
- MoUs with Ahmedabad Municipal Corporation & Gujarat govt.
- Partnerships increase with CDKN: Emory University, Georgia Tech, Mt. Sinai Medical School.

March 2011: Indo-US scientific workshop 40 experts discuss heat-adaptation strategies

March 2012: Fact sheet and report released & disseminated
Heat is increasing

AHMADABAD Annual Temp Max [°C]

Temp Max [°C]
Linear Trend: 0.30948 °C/dec,
SE=0.10913°C

Data: HOTHAPS Soft
Heat is increasing

AHMADABAD Annual Temp Max [°C], Days > 39°C

Temp Max [°C]
Linear Trend: 5.69519 days/dec, SE=2.32655days

Data:HOTHAPS Soft
The Challenge - Heat Kills

Temperature & Mortality Impact of May 2010 Heat wave

May 2010 compared with 7-day moving average deaths*, '09 and '11

Data source: Mortality statistics: AMC; Temperature: IMD
How Does the Heat Kill?

Temperature & Excess Ambulance calls through GVK EMRI 108 of May 2010 Heat wave

Data source: Mortality statistics: GVK EMRI 108; Temperature: IMD
Slum Community Heat Vulnerability Survey

• **Method** - 300 slum community members surveyed (primarily female heads of household); provided information on behalf of their households, providing information for a total of 1,650 individuals

• **Key Findings** – Slum communities are vulnerable and unaware of temperature and extreme heat dangerous

• **Key Recommendations** – Educate, Warn & Mitigate

*Summer 2011 community survey respondents*
Construction Worker Vulnerability Survey (HOTHAPS)

- **Method** – 100 workers from 4 construction sites from new west zone of Ahmedabad
- **Key Findings** – All construction workers are working in dangerous conditions – exposed to heat stress conditions (above ACGIH* standards); 10 percent hospitalized at least once during summer
- **Key Recommendations** – Educate, Employer Mitigation & Protective Policies

*American Conference of Governmental Industrial Hygienists*
March 2012 Workshop, *Health Effects of Heat in Relation to Climate Change*

- 2 focus groups held for health care professionals
- Dozens of semi-structured interviews with govt.

Informational pamphlets and hoardings in English (left) and Gujarati (right), circulated to the public during Ahmedabad’s hottest months in 2011 & 2012.
Ahmedabad Prep For Heat Wave

Ahmedabad gets its act together

In May, 2010, as many as 51 persons in Ahmedabad, mostly slum-dwelling citizens, died of sunstroke when the mercury rose to 46.5°C. City administrators consider the year as an eye opener; they witnessed huts and shanties turning into solar ovens, causing sunstrokes, and decided to take immediate action.

This year, the city municipal corporation has launched a heat action plan which is said to be one of the “first comprehensive early warning system and preparedness plan for extreme heat events in India”.

The plan “creates immediate and longer-term actions to increase preparedness, information-sharing, and response coordination, and reduce the health impacts of extreme heat on vulnerable populations.” The plan includes issuing alerts, especially to the vulnerable communities, and providing emergency medical care, especially to the elderly.
Policy Papers: Issue Briefs

Recommendations for Vulnerable Groups and Primary Actors

- Municipal Government
- Medical Providers
- Workers in High-Risk Occupations
- Slum Communities

Available online from:
http://www.nrdc.org/international/india/extreme-heat-preparedness/
Public Awareness
Community Outreach
## Early warning system - CFAN

**Monday 20 May 2013 - ORANGE ALERT LEVEL**

<table>
<thead>
<tr>
<th>Current Forecast (Created 19-May)</th>
<th>20-May</th>
<th>21-May</th>
<th>22-May</th>
<th>23-May</th>
<th>24-May</th>
<th>25-May</th>
<th>26-May</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alert Level</strong></td>
<td>Orange</td>
<td>Orange</td>
<td>Orange</td>
<td>Yellow</td>
<td>Yellow</td>
<td>Yellow</td>
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<tr>
<td><strong>Likelihood of Crossing Threshold</strong></td>
<td>High</td>
<td>High</td>
<td>Med</td>
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<tr>
<td><strong>Maximum Temp (+/- 1 SD)</strong></td>
<td>44.2°C (43.9-44.5)</td>
<td>44.1°C (43.7-44.4)</td>
<td>43.5°C (43.0-44.2)</td>
<td>42.9°C (42.3-43.6)</td>
<td>42.1°C (41.5-43.0)</td>
<td>41.7°C (40.8-42.9)</td>
<td>41.5°C (40.5-42.3)</td>
</tr>
<tr>
<td><strong>Probability of &quot;Safe Day&quot;</strong></td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>10%</td>
<td>25%</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Probability of &quot;Hot Day&quot;</strong></td>
<td>4%</td>
<td>4%</td>
<td>41%</td>
<td>78%</td>
<td>88%</td>
<td>73%</td>
<td>78%</td>
</tr>
<tr>
<td><strong>Probability of &quot;Very Hot Day&quot;</strong></td>
<td>96%</td>
<td>96%</td>
<td>59%</td>
<td>22%</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td><strong>Probability of &quot;Extreme Heat Day&quot;</strong></td>
<td>0%</td>
<td>0%</td>
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</tbody>
</table>

### Alert Levels:

- **Safe**: <41°C
- **Hot**: 41.2°C - 43.4°C
- **Very Hot**: 43.5°C - 45°C
- **Extreme Heat**: >45°C

### Likelihood of Crossing Threshold

- High: >75%
- Med: 50-75%
- Low: <50%
# Early warning system - CFAN

<table>
<thead>
<tr>
<th>Date</th>
<th>13-May</th>
<th>14-May</th>
<th>15-May</th>
<th>16-May</th>
<th>17-May</th>
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<td>15-May</td>
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<td>High</td>
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If you have trouble seeing the content of this email, you can view an online version here:  
username: NRDC  
password: 2013Test
Early warning system – MET

BHARAT SARKAR
MINISTRY OF EARTH SCIENCE
INDIA METEOROLOGICAL DEPARTMENT

DIRECTOR
Meteorological Centre,
RS/RW Building,
Ahmedabad Airport
Ahmedabad–380003
Tel: 079 22865165/22865012
DATED: 23/05/2013

PRESS BULLETIN

SYNOPTIC SITUATION:-
GENERALLY NORTH WESTERLY WINDS ARE PREVAILING AT LOWER LEVELS OVER THE REGION.

LOCAL FORECAST FOR AHMEDABAD:- SKY WILL BE MAINLY CLEAR.
MAXIMUM TEMPERATURE WILL BE AROUND 42°C.

TODAY’S MAX TEMP 42.5°C DEP +1°C
TODAY’S MIN TEMP 26.8°C DEP 0°C
R. H. RECORDED AT 0830 HRS IST 67%
R. H. RECORDED AT 1730 HRS IST 25%

RAINFALL FROM 19/0830 HRS IST TO 20/0830 HRS IST 000.0 MM
RAINFALL FROM 20/0830 HRS IST TO 20/1730 HRS IST 000.0 MM

SEASONAL TOTAL RAINFALL (FROM 01/01/2013) = 005.5 MM DEPARTURE FROM NORMAL = -004.3 MM

Sun rise : 05:55 hrs IST : Moon rise : 18:33 hrs IST
Sun set : 19:18 hrs IST : Moon set : 04:57 hrs IST

STATE FORECAST :-
WEATHER WILL BE SUNNY IN ALL DISTRICTS OF GUJARAT STATE & IN DIU DAMAN DADRA NAGAR HAVELI.
HIGH TEMPERATURE WARNING: NIL
<table>
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<th>STATION</th>
<th>MAX TEMP. (°C)</th>
<th>MIN. TEMP (°C)</th>
<th>Rainfall Yesterday’s 0830 hrs to Today’s 0830 hrs (mms)</th>
<th>Rainfall Today’s 0830 hrs to today’s 1730 hrs(mm)</th>
<th>STATION</th>
<th>MAX TEMP. (°C)</th>
<th>MIN. TEMP (°C)</th>
<th>Rainfall Yesterday’s0830 hrs to Today’s 0830 hrs (mms)</th>
<th>Rainfall Today’s0830 hrs to today’s 1730 Hrs (mms)</th>
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<td>DIU</td>
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<td>IDAR</td>
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<td>V.V. NAGAR</td>
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<td>25.4</td>
<td>===</td>
<td>===</td>
<td>MAHUVA</td>
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<td>BHUJ</td>
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</table>
Capacity Building
- User guides

Hoardings have been put up across the city, including this one in front of the VS Hospital
This user guide outlines the three alert levels in the AMC’s early warning system in Ahmedabad. The early warning system is an important component of the city’s Heat Action Plan to protect and prepare Ahmedabad’s residents for heat events. The heat alerts are triggered by temperature thresholds and correlate with the following color signals:

**COLOR SIGNALS**

<table>
<thead>
<tr>
<th>WHITE</th>
<th>No Alert</th>
<th>&lt; 41°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>YELLOW ALERT</td>
<td>Hot Day Advisory</td>
<td>41°C – 43.4°C</td>
</tr>
<tr>
<td>ORANGE ALERT</td>
<td>Heat Alert Day</td>
<td>43.5°C – 45°C</td>
</tr>
<tr>
<td>RED ALERT</td>
<td>Extreme Heat Alert Day</td>
<td>&gt; 45°C</td>
</tr>
</tbody>
</table>

For the early warning system, **temperature forecast for a seven-day period will be communicated to the AMC Nodal Officer and key health officials via daily automatic emails**. An example email is explained below. The forecasts are developed and generated from the Climate Forecast Applications Network in cooperation with Georgia Tech.

The AMC Heat Action Plan and its early warning system are designed to be consistent with the Indian Meteorological Department and Ahmedabad Meteorological Centre processes. The Indian Meteorological Department has defined the criteria for heat wave and the Meteorological Centre, Ahmedabad currently determines whether to declare a heat wave, as discussed in the Heat Action Plan.

The early warning system currently involves four levels: “No Alert”; “Hot Day Advisory”; “Heat Alert Day”; and “Extreme Health Alert Day” with color signals. The early warning
AMC Nodal Officer

<table>
<thead>
<tr>
<th>Action</th>
<th>Yellow</th>
<th>Orange</th>
<th>Red</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activate the alert and local response citywide by notifying the key city departments, the AMC Deputy Municipal Commissioners and the Gujarat state agencies via email listserve, fax or telephone.</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Display flags and other devices in the appropriate color to communicate the alert.</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disseminate public messaging about the dangers of heat-related illness through an AMC Nodal Office press officer and media outlets.</td>
<td>X</td>
<td></td>
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<tr>
<td>Receive weekly reports of the public health impact from health officials.</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coordinate with the local press and media outlets to publicize heat warnings.</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase access to places to cool off, including parks, lakes, swimming pools, public libraries, shopping malls, and the BRTS routes.</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ensure that communication channels remain operational during the alert.</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verify receipt of alert and confirm that appropriate actions are taken.</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activate &quot;cooling centers&quot; such as temples and public buildings like libraries and malls, and/or AMC-run temporary night shelters.</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Open emergency shelters for local communities.</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Hold frequent conference calls with a coordinated response team to discuss reports and address breaking developments.</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Ensure that communication channels remain operational.</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Communicate the suspension of all non-essential uses of water via the AMC Water Project’s protocol procedures.</td>
<td>X</td>
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<td></td>
</tr>
<tr>
<td>Communicate to the local utility company to prioritize maintaining power to critical facilities (such as hospitals and UHCs).</td>
<td>X</td>
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<tr>
<td>Extend hours of temporary emergency centers for residents without water or power.</td>
<td>X</td>
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<tr>
<td>Hold daily conference calls to discuss reports and address breaking developments with a coordinated response team.</td>
<td>X</td>
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<tr>
<td>Adjust the alert when local forecast temperatures fall below the relevant threshold by notifying the relevant agencies via email listserve, fax or telephone.</td>
<td>X</td>
<td>X</td>
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</tbody>
</table>

**Action items**

**Key Departments and Stakeholders**

- **AMC HD**
  - Post heat-related illness prevention tips and how to stay cool in urban health centres.
  - Encourage routine examination of admitted patients for signs and symptoms of heat-related illnesses.
  - Provide drinking water to vulnerable populations.
  - Ensure adequate supply of ice packs and IV fluids.
  - Ensure that adequate medical supplies are available, such as ice packs and IV fluids.

- **Press and Media**
  - Publicize heat warnings and produce ads on heat-health awareness, the “Heatline,” and protection strategies.
  - Increase hoardings, microphone announcements from auto rickshaws, and ads via other media citywide.
  - Increase staffing at hospitals and UHCs, if feasible.

- **AMC Press Officer**
  - Circulate warnings via text and other media.
  - Disseminate SMS text messages to warn residents.
  - Circulate warnings via text and other media.

- **108 Service**
  - Post heat-related illness prevention and how to stay cool tips on the side of 108 vans.
  - Disseminate SMS text messages to warn residents.

- **CO Groups**
  - Mobilize community leaders to check on and assist vulnerable individuals in targeted locations.
  - Circulate warnings via text and other media.
  - Post heat-related illness prevention tips and how to stay cool tips on the side of 108 vans.
  - Post heat-related illness prevention and how to stay cool tips on the side of 108 vans.
  - Provide drinking water to vulnerable populations.
  - Ensure that adequate medical supplies are available, such as ice packs and IV fluids.

- **AMC Water Department**
  - Implement a protocol for prioritization of all essential uses of water to critical facilities and enforce termination of non-essential use during the event of water shortage.

- **Local Utility Boards**
  - Implement a protocol for continuance of all essential uses of water and enforce termination of non-essential use.

- **CO Groups and LW**
  - Circulate warnings via text and other media.
  - Post heat-related illness prevention tips and how to stay cool tips on the side of 108 vans.
Next steps - Research

- Chart / Record review of all summer afternoon emergency room admissions
- WBGT temperature measurements in city
- Study on heat resilient habitats and traditional heat protective behaviors
- Thermal maps from ISRO (possibly)

WBGT instrument used for temperature measurements across the city
Next steps - Implementation

- Weather monitoring stations at 6 spots in Ahmedabad
- Real-time temperature displays
- Case study on construction workers for best practices
- Additional variables for threshold trigger determination in HAP

Site visit for the purchase of weather monitoring instruments
North India, 2016: The sale of air-coolers has increased drastically due to the summer heat. (Praveen Kumar/HT Photo)
The Eco-Cooler doesn’t require any electricity to function!