Roadmap for Planning Heatwave Management in India

September, 2016

PREPARED BY

TARU

Institute for Global Change and Sustainable Health
Taru Leading Edge

SUPPORTED BY

CDKN Climate & Development Knowledge Network

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The document is not meant to be prescriptive but merely suggestive in its endeavor to ensure a heat resilient India.

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Preface

This report offers a National Roadmap for Planning Heatwave Management in India. Led by Taru Leading Edge, Delhi, the process of mapping the pathway has been inclusive and participatory. The report draws on both, available best expertise as well as recent rapidly evolving experience and learning of managing heatwaves in Indian cities. Climate and Development Knowledge Network (CDKN) values everyone's contribution within and outside the panel of experts supporting the initiative of drawing National Roadmap.

Over recent decades, average and daily peak temperatures in India have risen and intense heat waves have become more frequent, affecting health and livelihood of India's vulnerable populations. In May 2010, the city of Ahmedabad, in the state of Gujarat, India suffered from a deadly heatwave with an estimated rise in mortality rate by 43.1%. This led to the first ever Heat Action Plan for Ahmedabad Municipal Corporation (AMC), supported by CDKN, and implemented by Natural Resources Defense Council (NRDC) as a leading partner, in partnership with the Indian Institute of Public Health (IIPH) Gandhinagar and the Public Health Foundation of India. Partners worked together to put the rising issue of extreme heat on the agenda of decision-makers in Ahmedabad.

The strong local government leadership in Ahmedabad matched with civil society action enabled the effective implementation of action plan, allocation of independent budget head for this purpose in the municipal budget, and dedicated resources within AMC's Department of Health to plan, implement and review the plan. The cooperation from national and local officials of Indian Meteorological Department (IMD) resources to institutionalize a process of sharing real-time data and information with the citizen has been both, innovative and effective.

The success from Gujarat has now spread to three regions and 10 cities. The regions of Nagpur in Maharashtra and Bhubaneswar in Odisha launched Heat Action Plans in March 2016 in anticipation of upcoming severe summer.

The leadership of Maharashtra State Public Health Department and Nagpur Municipal Corporation put into place, the Nagpur Regional Heat Action Plan. The plan led to coordination among Nagpur and four neighbouring cities, creating the first regional approach to heat wave planning in India. Similarly, in Odisha, The Odisha State Disaster Management Authority (OSDMA), along with the local branch of IMD is taking the action forward.

The guiding idea from different engagements suggest that there is no single institutional blueprint that is applicable everywhere and for all times, to manage extreme heat. Strong local leadership invariably can make a significant difference. Learning from the experience also suggest that "a national approach can support India in mitigating and adapting to changing temperatures and extreme heat by embedding actions in day-to-day life". For this, a National Roadmap was needed. This report fills this gap.

This National Roadmap is now an opportunity for the national, subnational and local leaders to prepare for heatwave planning process. The accumulation of cases and experiences in this report provides reassurance that others around the world are facing similar challenges and adopting various approaches towards climate compatible development for cities.

CDKN India Country Programme

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Drafting a roadmap for planning heatwave management in India has been a very significant initiative in terms of addressing a wide range of heat issues that cut across various sectors, institutions, policies and programmes. The support and contribution of sector experts and institutions were very helpful.

First and foremost, we would like to thank the expert review group which has contributed to the initial brainstorming, review of the evidence and suggested a way forward for policy relevant research. This group included the following experts.

- **Dr. Anand Krishnan**, Professor, Centre for Community Medicine, All India Institute of Medical Sciences (AIIMS), New Delhi
- **Dr. Anil Gupta**, Head, Division of Policy Planning, National Institute of Disaster Management (NIDM), New Delhi
- **Dr. Anuradha Shukla**, Chief Scientist, Central Road Research Institute (CRRI), New Delhi
- **Ms. Meena Sehgal**, Fellow, The Energy and Resources Institute (TERI), New Delhi
- **Dr. Rais Akhtar,** Adjunct Faculty, International Institute of Health Management Research (IIHMR), New Delhi
- **Dr. Sangeet Srivastava**, Assistant Professor, The Northcap University, Gurgaon, Delhi NCR
- **Dr. Shyamala Mani**, Professor, National Institute of Urban Affairs (NIUA), New Delhi

We are also grateful to **Dr. Peter Berry**, Senior Policy Advisor with the Climate Change and Innovation Bureau at Health Canada and **Dr. Rupa Kumar Kolli**, World Meteorological Organization at Geneva, Switzerland who interacted via Skype in the brainstorming meeting and shared their experience.

In addition, a consultation was held with the UCHAI (Understanding Climate and Health Associations in India) advisory group. This group consists of experts from IIT, AIIMS, NIUA, NHSRC, NIMR, IIPA, IMS, TERI, NIEHS, and TARU. During this consultation IMD, WHO and DST representatives also participated. We would like to acknowledge the support of these experts for suggestions on end-to-end early warning systems. In addition, we would like to thank **Dr. Akhilesh Gupta**, Advisor, Climate Change Programme, Department of Science and Technology (DST), Ministry of Science and Technology, Government of India for elaborating on national research initiatives related to heat stress. We also thank **Ms. Nehmat Kaur**, Natural Resources Defense Council (NRDC), for consultation and the inputs to the document.

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We also express our gratitude to **Dr. Joy Shumake-Guillemot**, Officer-in-Charge, WHO/WMO Climate and Health Office, Global Framework for Climate Services (GFCS) Secretariat, World Meteorological Organization, Geneva Switzerland for the invitation extended to TARU for participation at 1st South Asia Climate Services Forum for Health held in Colombo in April 2016. Participation at this meeting provided a regional perspective for the work being undertaken and the first step towards a possible South Asian Heat Health Network.

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Manu Prakash,
Director and Practice Head, Policy and Public Services,
Taru Leading Edge,
On behalf of the Project Team

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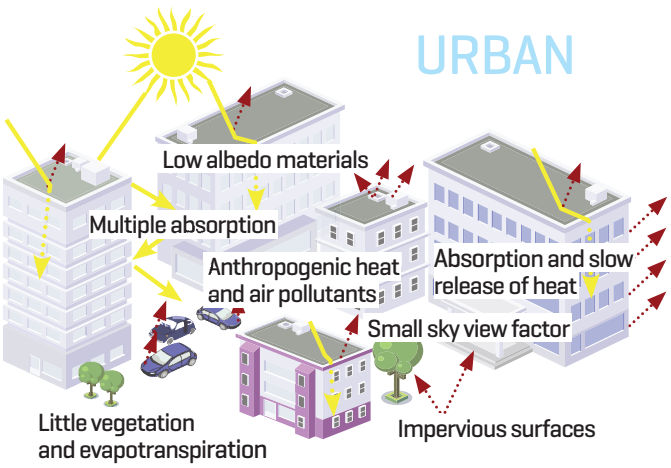
1. Executive Summary

Globally, 2015 was the hottest year on record, beating the record set in 2014 and making it the fourth time this century that a new high temperature record was set. The situation in India is also worsening. In 2015, more than 2,300 people died, making it the 5th highest in world history in terms of mortality due to heatwave. Most of the deaths are concentrated in Andhra Pradesh, Telangana, Punjab, Odisha and Bihar. In 2016, the month of April 2016, has seen the highest recorded average global temperature ever. The Intergovernmental Panel on Climate Change (IPCC) has also brought out that climate change has played a key role in intensifying and triggering extreme heat events and is likely to increase.

Heatwaves have serious health impacts, exacerbated further by increase in humidity. Population groups such as the elderly, very young, people with pre-existing health problems, housing issues and those who are economically challenged are most vulnerable and their vulnerability depends on the degree of exposure.

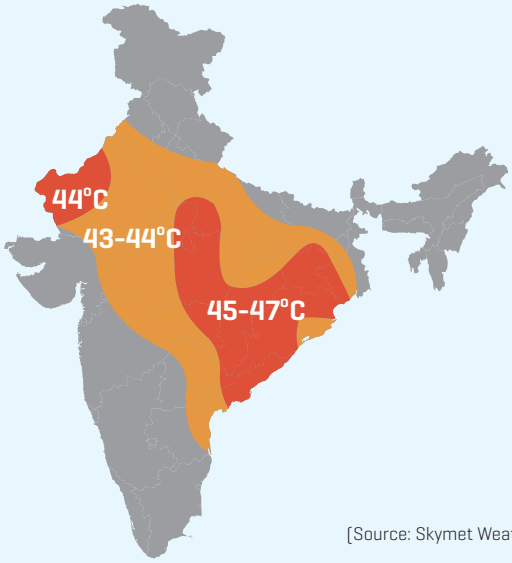
Heat impacts are more in urban areas due to Urban Heat Island (UHI) effect. Factors such as pollution, changing climate, sprawl, lifestyle and city geography as well as geometry increase UHI intensity. Impact of heat is increasing. Apart from vulnerable groups in cities and villages, workers working both outdoor (traffic police, street vendors) and in closed environment (miners, industrial workers) face considerable occupational risk to heat stress during extreme heat days.

CAUSES OF URBAN HEAT ISLAND (COURTESY OF J. FORKES, 2009)



WORST'S YET TO COME

An India Meteorological Department report says that heatwaves **(40°C+ temperatures)** are recurring more frequently and with greater intensity every year.



[Source: Skymet Weather]

Thus, there is a greater and urgent need, not only to mitigate the impact of extreme heat, but also adapt to changing norms of temperature in such-a-way that it gets embedded into all our planning and monitoring systems forever. There are many national and international examples for us to learn and adopt. Such plans have commonly emphasized inter-alia the need for strong institutional role to drive planning, collaboration (among all actors at different levels) and implementation, real-time surveillance and early warning systems (EWSs) and mass education on preventive and adaptive behavior. These can be further broadly divided into pre, during and post event with each period having short and medium-term strategies to mitigate impacts and long-term strategies to transform and adapt.

In India, the first systematic attempt at heatwave management planning has happened with Ahmedabad Heat Action Plan (AHAP), launched in 2013. With support from CDKN, the AHAP, was developed by Ahmedabad Municipal Corporation (AMC) in partnership with domestic and international experts focusing on four key strategies; a) building public awareness on risk of heatwaves through mass outreach programme in local language, b) implementing response system to prevent heat-related death and illness at the onset, c) initiating an EWS and inter-agency collaboration framework to alert

citizens on predicted extreme temperature and d) capacity building among city officials and healthcare professionals to recognize and respond to heat-related illnesses. Additionally, the work also led to identification of adaptive measures such as mapping high-risk areas and cooling spaces during extreme heat days and coordinating utility services such as water and electricity to support life. This model has been applied regionally at Maharashtra and Odisha.

Other notable initiatives include the National Knowledge Network Programme on Climate Change and Human Health, launched in 2011 by the Department of Science and Technology. These consist of several studies including those related to impacts of heat stress on health, especially in relation to occupation.

In addition, TARU has examined urban heat island stress in cities like Indore and Surat and demonstrated solution through cool roof initiative at community level under ACCCRN programme. Similarly, the India Meteorological Department (IMD) has remarkably supported more than 100 cities and town by providing frequent forecast on heat conditions as they do for rainfall and cyclones. The outlook not only comprises early warnings on heatwaves but also issues specific advisories for authorities to apply.

In this backdrop, a need for national heat action plan roadmap was felt, that will not only reach out to the maximum number of affected cities and states but also drive a national agenda to embed adaptation planning for rising temperature in our plans and design for space, utilities, infrastructure and industries.

The process for roadmap development has been consultative. An expert group has been formed to review the process. A review of national and international initiatives has been carried out. In addition, several interviews were carried out with sector leaders from Climate, Disaster, Environment, Health, Urban Management and Public Policy. Inputs were also sorted from various forums and workshops to gain insights – such as the Understanding Climate and Health Associations in India (UCHAI) Advisory Meetings, World Meteorology Organization meeting in Colombo. It has also taken field visits to Gujarat and Bihar. All the recommendations and insights emerged have been synthesized in the proposed roadmap.

This Roadmap identifies the potential goal, objectives, intervention framework; and priority areas for reflection during planning. It is now needed to be adopted and implemented by India – again a first in the South Asian region to make Heat Management a National Plan and Climate Agenda.

THIS ROADMAP MAY BE TAKEN FORWARD IN THREE STAGES

In the next 3-6 months

An Anchor Agency may be identified and tasked with initiating stakeholder engagement on heatwave management using existing materials.

→ Consultations and brainstorming with stakeholders will add to the analysis and issues identified within this report to support engagement during the NHAP development process.

→ Additionally, 5-10 vulnerable states and cities may be encouraged to undertake heatwave management planning. City-level exercises, besides their inherent merit, may also highlight specific areas of state and city-level support that the NHAP needs to plan for.

In the next 6-12 months

The Anchor Agency, after securing the necessary mandate and resources, could take forward and complete the NHAP development process.

In the next 12-18 months

The Anchor Agency could focus on extending support for heatwave management planning to priority states and cities, monitoring the process and its effectiveness and making informed changes in approach as it works towards the NHAP's stated goals and objectives.

2. Introduction

2.1 Heatwaves: Points of Note

A heatwave is a prolonged period of abnormally hot weather.

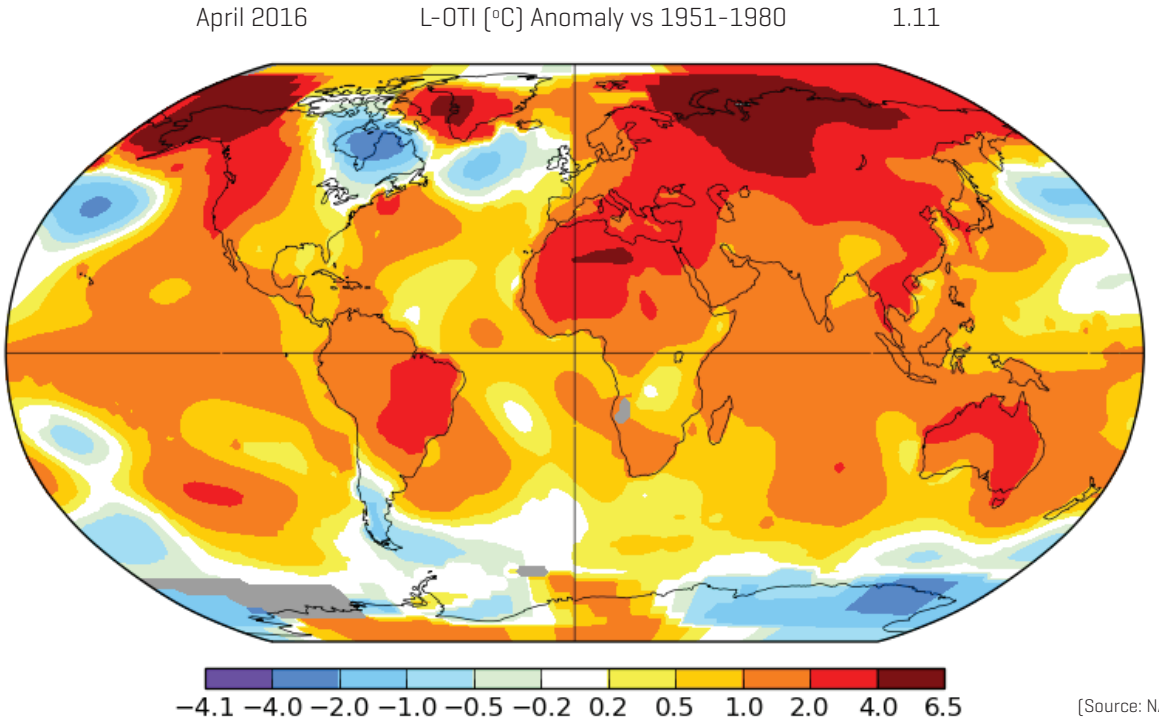
While definitions vary across and even within countries, heatwaves are generally measured relative to the usual weather in the area and relative to normal temperatures for the season. The World Meteorological Organization (WMO) identifies a heatwave 'when the daily maximum temperature of more than five consecutive days exceeds the average maximum temperature by 50C, the normal period being 1961-90.'

Extreme heat events are becoming increasingly common.

Globally, 2015 was the hottest year on record, beating the record set in 2014 and making it the fourth time this century that a new high temperature record was set (National Oceanic and Atmospheric Administration, United States of America, 2016). The proportion of the earth's surface area witnessing extremely hot summers has increased from 1% over the 1951-80 period to 10% over the 1981-2010 period (Hansen et al., 2012) and record breaking heat events were witnessed across the globe, including in Australia, Argentina, China, Central Asia, large parts of Europe, Mexico, Japan, South Korea and the USA. *In 2015, the heatwave in India killed more than 2,300 people, making it the 5th worst globally in terms of number of deaths*[1]. Most of the deaths were concentrated in Andhra Pradesh, Telangana, Punjab, Odisha and Bihar.

In 2016, global temperatures continue to soar. The month of April 2016, for example, has seen the highest recorded average global temperature (NOAA, 2016). India too witnessed one of the severe heat wave conditions during April 2016, contributing to many heat deaths.

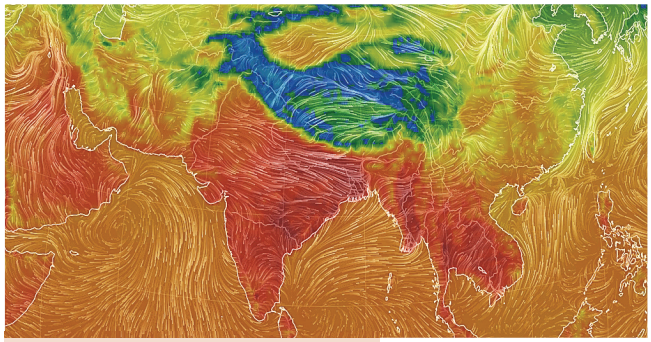
FIGURE 1 GLOBAL HEATWAVE CONDITIONS IN APRIL 2016



[Source: NASA]

[1] D. Guha-Sapir, R. Below, Ph. Hoyois - EM-DAT: The CRED/OFDA International Disaster Database –www.emdat.be – Université Catholique de Louvain – Brussels – Belgium.

FIGURE 2 HEATWAVE CONDITIONS IN APRIL 2016 IN INDIA



21.18° N, 79.75° E; 270° @ 8 km/h; 43.3°C

[Source: Earth Nullschool]

Climate change has played a key role in intensifying and triggering, extreme heat events.

About 75% of the moderate hot extremes occurring worldwide over land are attributable to warming (Fischer and Knutti, 2015). Australia's 'Angry Summer' of 2013 'was virtually impossible without climate change' (Climate Council of Australia (CCA), 2015); there's an '80 percent probability that the Russian heatwave of 2010 would not have occurred without climate warming' (Climate Communication (CC), 2012); the risk of extremely hot summers in Europe is ten times greater than when the 2003 heatwave struck due to the increasing impact of humans on climate (Carbon Brief, 2014); and, 'the rise in heat-trapping gases in the atmosphere has increased the probability of record-breaking temperatures 15-fold' in the USA (CC, 2012).

Heatwave frequency, severity and duration is likely to increase due to climate change.

There is 90-100 per cent probability of an increase in heatwave frequency, severity and duration during this century (Intergovernmental Panel on Climate Change (IPCC), 2011). Heatwaves of the strength that now typically occur every 20 years could happen annually on 60 percent of the Earth's land mass by 2075 should planet-warming emissions remain unchecked. Even with strong action to curb climate change, nearly a fifth of global land areas would still suffer intense heatwaves yearly in 2075 (Tebaldi and Wehner, 2016)[2] .

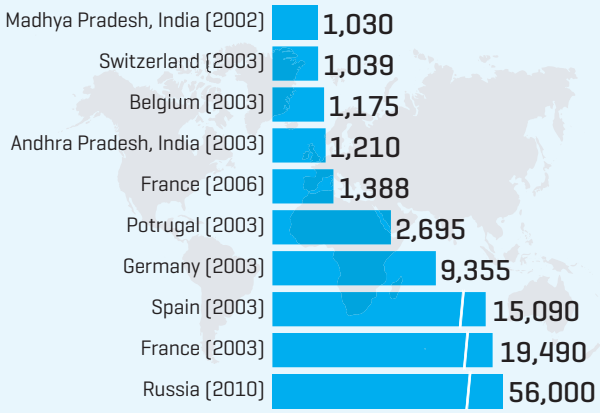
Heatwaves have serious health impacts.

Heat health issues arise once temperatures exceed a certain comfort zone[3] (CCA, 2016). There is consistent and extensive evidence of heat risks to health (Public Health England (PHE), 2015) – and recognition that such risks may be exacerbated by increases in humidity (IPCC, 2011.)

Common heat health impacts include dehydration, cramps, exhaustion and heatstroke (www.ndma.gov.in). More significantly, epidemiological studies show a positive association between heatwaves and mortality (McMichael et al., 2006)[4]. The European heatwave of 2003 led to more than 70,000 excess deaths in France, Germany, Italy, Spain and other countries and the Russian heatwave in 2010 resulted in over 55,000 excess deaths (Emergency Events Database (EM-DAT), 2015). Significant deaths have also been reported in countries such as Australia, Japan, Mexico and the USA in recent years.

Certain population groups are more vulnerable to heat health issues. Vulnerability to extreme heat events depends on the degree of exposure to the event, the individual's sensitivity and their capacity to adapt to the situation to protect health (CCA, 2016). More vulnerable population groups thus include the elderly, the very young, the mentally ill, those with certain pre-existing health problems

TABLE 1 10 HIGHEST MORTALITY HEAT EVENTS (IN ABSOLUTE TERMS)



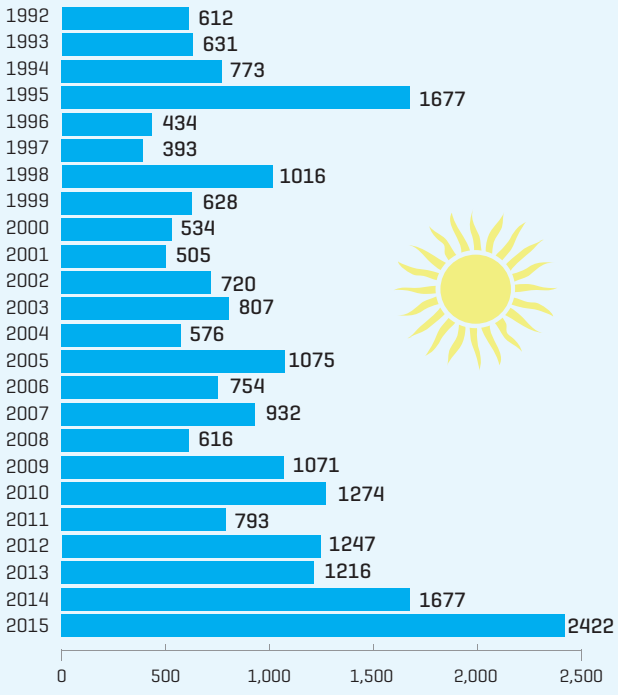
[Source: EM-DAT 2007]

[2] Major Australian cities, in the absence of effective adaptation measures, will see a significant increase in extremely hot days in the next 20-40 years (CCA, 2016); heatwaves like that of 2003 are likely to be 'very common' in Europe under all emissions pathways used by the IPCC (Carbon Brief, 2014); and, the same summertime temperatures that ranked among the top 5 percent in 1950-79 will occur at least 70 percent of the time by 2035-2064 in the USA even if global greenhouse gas (GHG) emissions grow at a moderate (lesser than current) rate (CC, 2012).

[3] Here, 'comfort zone' refers to an optimum temperature range where populations display the lowest death rates. They vary across latitude and climate zones.

[4] The mortality impact of a heatwave is uncertain in terms of lives lost. A proportion of deaths may occur among susceptible persons (for e.g. excess mortality from heatwaves is commonly related to cardiovascular, cerebrovascular and respiratory disease) but there is certainty that an increase in heatwave frequency and intensity increases the number of deaths (IPCC, 2011).

TABLE 2 RISING NUMBER OF HEATWAVE DEATHS SINCE 1992



[Source: National Disaster Management Authority]

(particularly heart, kidney, and lung or liver diseases) and housing and economic circumstances that increase health risks. (CCA, 2016; McMichael et al., 2006; PHE, 2015)[5,6]. Increasing heat deaths have been seen in India over the last two decades. Since 1992, there have been 22,562 deaths due to heat waves. 'In the last 23 years, India has had no fewer than 393 deaths in a single year. Between 1992 and 2004, the annual death toll crossed 1,000 twice – in 1995 and 1998. Since then, more than thousand people died in seven heat waves. The worst summer in terms of the sheer number of casualties was 2015 when 2,422 died'[7].

Heat impacts are more severe in urban areas[8].

Heat health impacts are more severe in urban areas where residents are exposed to higher and nocturnally sustained temperatures compared to surrounding areas due to a phenomenon called the Urban Heat Island (UHI) effect (CCA, 2016; IPCC, 2011).

UHIs, caused by a combination of more heat absorbing surfaces (rooftops, buildings and paved surfaces), the trapping of hot air between buildings, limited tree cover and other heat trapping and heat inducing factors such as fuel combustion and air conditioning, can result in average annual temperatures in urban areas being 1-30C hotter than surrounding areas (CCA, 2016; TARU). Factors such as pollution, climate change, sprawl, lifestyle and urban design increase UHI intensity.

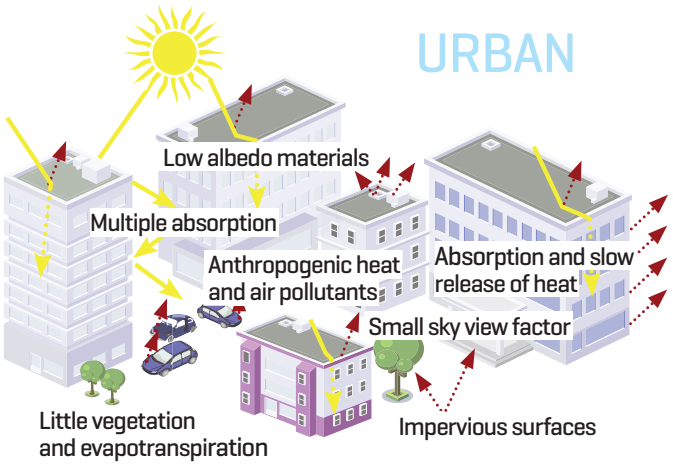
Higher urban temperatures mean:

- Greater energy use during the summer
- Increased air pollution and greenhouse gas emissions
- Negative effects of higher temperatures on human health and comfort
- Warmer storm water runoff affecting water quality

The impacts of heat are increasing.

In addition to cities and villages, specific industries (e.g., mining) emit as well as absorb considerable heat. This increases risks to a large workforce in these occupational settings. With the majority of workplace settings in developing countries being heavily influenced by outdoor temperatures, it can be expected that both indoor and outdoor workers will experience increased heat stress due to climate change and other factors. Even relatively modest

FIGURE 3 CAUSES OF URBAN HEAT ISLAND (COURTESY OF J. FORKES, 2009)



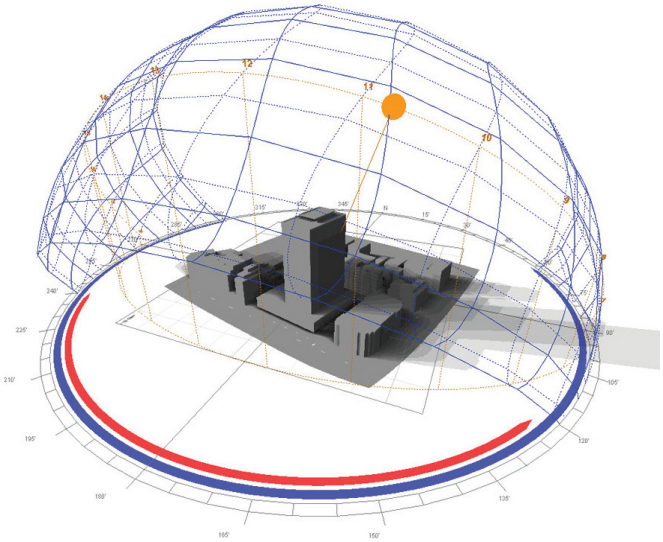
[5] The elderly are more likely to have existing medical conditions and reduced thermoregulation capacity; the very young metabolize differently and typically depend on caregivers for hydration and maintenance of safe temperatures; and, those with existing health conditions can find affected organs stressed. Lack of mobility and independence add to vulnerability, particularly among the elderly, the very young and the mentally ill.

[6] Notably, while some population groups are more vulnerable, anyone can be affected by extreme heat conditions. 'Healthy individuals often under-estimate their personal tolerance to extreme heat and are less likely to react to health warnings, placing them at risk' (CCA, 2016 citing Hanna et al., 2016).

[7] http://scroll.in/article/806916/one-chart-that-shows-the-rising-number-of-heat-waves-deaths-since-1992

[8] There's a view that rural-urban differences may reduce in time due to increase in weather cell sizes.

FIGURE 4 BUILDING EXPOSURE TO SUNLIGHT



[Source: http://design.epfl.ch/piraeus/2-day-to-day/3-process/shadow-study-qualitative-research]

increases in ambient temperatures could be expected to tip large worker populations over the threshold into the realm of heat stress related health risks.

Heat is significantly affecting the natural habitat as well. Increased forest fires are an example of this phenomena causing huge damages to humans, environments and animals. The recent Fort McMurray wildfire in Alberta, Canada and the forest fire in Uttarakhand; India both led to the massive evacuation of people. In India, 6.17% of the forests are prone to severe fire damage and with greater heat stress this is likely to increase. In absolute terms, out of 63 million ha. of forests, an area of around 3.73 million ha. is affected by fires annually, according to the Forest Survey of India[9]. In the US, the summer of 2007 brought the largest known fish kill in the 135-year history of Yellowstone National Park as trout succumbed to high water temperatures[10].

However, the most severe impact of heat is felt on water resources which evaporates fast during heatwave conditions, thereby increasing the vulnerability of humans, natural habitat and economic activity including agriculture (crops and livestock).

Increasing heat health risks need advanced preparation and urgent attention- underlining the need for systematic planning.

Heatwaves are silent killers. Mortality rises sharply within a day or two after extreme temperatures implying a short window of opportunity for effective action (PHE, 2015). Vulnerable populations do not always recognize that they are at increased risk making these events more dangerous (Health Canada (HC), 2012). At the same time, physiological and behavioral adaptations and changes in public health preparedness can reduce heatwave-related fatalities (McMichael et al., 2006).

The benefits of heatwave planning can be great. Much of the reduced mortality in France during the heatwave in 2006 compared to an event in 2003 has been attributed to early warning systems (CCA, 2016 citing Fouillet et al., 2008); and, the cost of running a heatwave warning system for Philadelphia was 'practically at the 'noise' level compared to the economic benefit of saving 117 lives in three years' (Ebi et al., 2004).

[9] http://www.fire.uni-freiburg.de/
[10] http://www.psr.org/assets/pdfs/more-extreme-heat-waves

2.2 Heatwaves in India

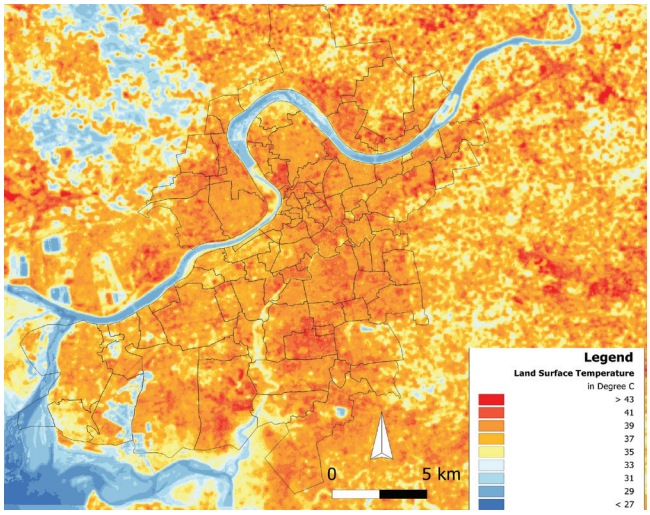
Heat health impacts in India are serious.

Estimates suggest that there have been over 22,000 heat-related fatalities in India since 1992 (NDMA, 2015). In 2015, the country witnessed the fifth deadliest heatwave in history (EM-DAT, 2015). In addition to the vulnerable populations identified above, the poor may be differentially impacted on account of gaps in health services, housing and basic amenities.

Moreover, Indian cities are vulnerable due to the UHI effect. For example, urban sprawl adds more built up areas generating heat emissions, and increasing impermeable surfaces and requiring longer travel distances; the latter, in turn, lead to more vehicle trips as well as air pollution. The substantial attributable anthropogenic component may raise temperatures by 1-2°C and reinforce positive feedback loops via added air conditioning. Urban mortality in India is expected to increase by 71-140 percent by the late 21st century under RCP 4.5 and RCP 8.5 scenarios because of higher temperatures (Dholakia et al., 2015).

Importantly, heat health impacts in India could be under-estimated because of under-reporting (Thompson, 2015)

FIGURE 5 URBAN HEAT ISLAND EFFECT AT DIFFERENT PARTS OF SURAT CITY



[Source: TARU 2015]

and the fact that such impacts may occur at temperature thresholds lower than those used to declare heatwaves (Prasad, 2015). Box 1 summarizes the Indian Meteorological Department's (IMD) guidelines on heatwave identification.

BOX 1 IDENTIFYING A HEATWAVE IN INDIA

When are heatwaves considered?
Maximum temperature

40°C Plains

30°C Hills

When are heatwave conditions said to be prevailing?

Normal maximum temperature	Departure from normal
Above 40°C	4-5°C or more
At or below 40°C	5-6°C or more

When are severe heatwave conditions said to be prevailing?

Normal maximum temperature	Departure from normal
Above 40°C	6°C or more
At or below 40°C	7°C or more

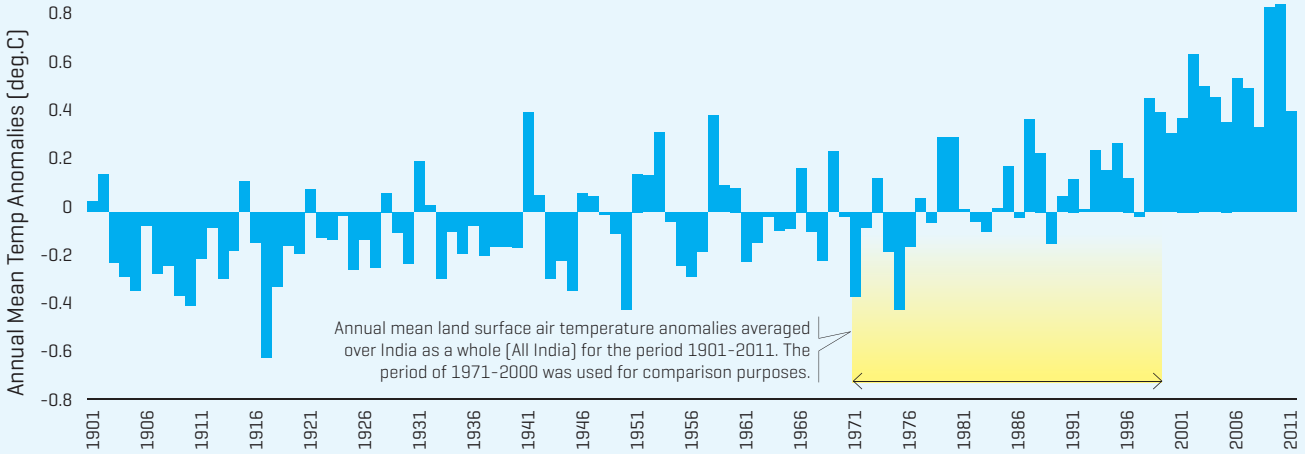
When should a heatwave be declared?
Recorded maximum temperature

At or above **45°C** **All locations**

At or above **40°C** **Coastal locations**

Note: The average pre-monsoon warm season daily temperature of 1970-1999 is defined as the normal temperature.
[Source: http://www.imdpune.gov.in/weather_forecasting/glossary.pdf; accessed on February 22, 2016]

FIGURE 6 ALL INDIA MEAN ANNUAL LAND SURFACE AIR TEMPERATURE ANOMALIES: 1901-2011



(Source: IMD, 2012)

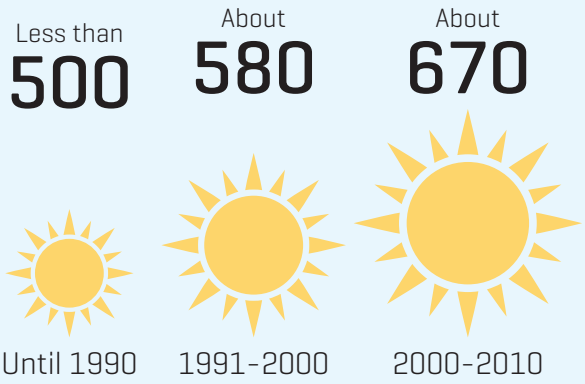
Heat as an occupational health hazard in India. The large population typically engaged in outdoor work[11] and/ or exposed to indoor heat[12] in Indian cities is more likely to be affected by heatwaves. Control of heat stress may have multiple co-benefits in terms of better health, improved productivity, lower rates of accidents, lower rates of morbidity and improved sense of comfort and social well-being[13]. Below, a compilation of various studies regarding the heat stress values (Wet Bulb Globe Temperature - WBGT) for various work sectors in India is given.

TABLE 3 HEAT STRESS AND WORKER PROFILES FOR SELECTED INDUSTRY SECTORS IN INDIA

Sector	Range of heat stress values (WBGT) measured (°C)	Estimated worker population in 1,000s (as per Indian National Sample Survey, 2000)	Reference
Agriculture	34.4–42.2	237,786	Nag et al., 1980
Glass manufacturing	30–40	NA	Srivastava et al., 2000
Ceramics	43–54	NA	Parikh et al., 1978
Mining	25–31	2,263	Mukerjee et al., 2004
Tanning	28–41	1,081	Conroy et al., 2005
Textiles	27–39	10,480	Sankar et al., 2002

[11] Many jobs in Indian cities, particularly in construction, transport and small trade, are performed outdoors.
[12] Indoor heat exposure can result from home-based activities such as cooking with bio-fuels (often neglected) and manufacturing activity.
[13] Ayyappan, R., Sankar, S., Rajkumar, P., & Balakrishnan, K. (2009). Work-related heat stress concerns in automotive industries: A case study from Chennai, India. Global Health Action, 2.

TABLE 4 HEATWAVES IN INDIA (PER YEAR)



[Source: IMD]

Climate change is expected to exacerbate heat health risks.

India is experiencing the impacts of climate change in terms of increased heatwaves which are more intense in nature, and which can have a devastating impact on human health. There has been an increase in heatwave and severe heatwave days from 2001-2010 compared to the previous four decades (Pai et al., 2013) and a recent Indian Institute of Technology, Bombay (IIT-B) study predicts an increase in intensity, duration, frequency and areal extent of heatwaves from 2070 onwards[14].

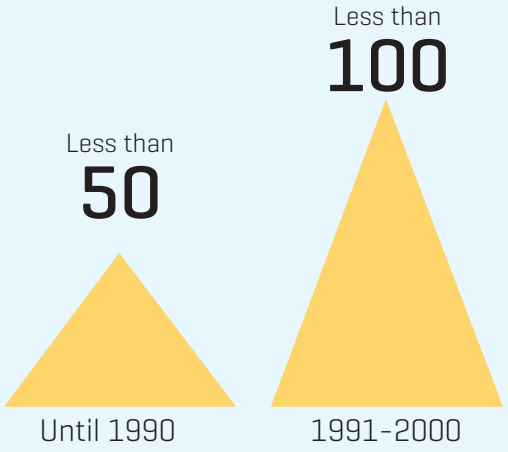
According to IMD, the frequency of severe heatwaves increased sharply in the past 15 years due to climate change, urban heat island and other factors.[15]

The National and State Governments face considerable challenges in tackling this issue, even when they have recognized the gravity of the situation and have been trying to address it. Most affected states have no plans in place to prevent mortality and morbidity associated with heatwaves.

Adaptation to Heat

Historically, many traditional and indigenous methods were used during the early Mughal era to cope with high temperatures in the Indian Sub-continent. Some of these methods were adapted to suit modern conditions by the early European colonists. Some of these adaptations included construction of high ceilings and spacious but lowered varhandas to provide more shade. Thick layered thatch roofing also was used to keep temperatures inside the house lower during nights. They also used various techniques for home cooling like the wet tattie – 2 to 4-inch-thick screens made up of long roots of the Khas plant. With respect to clothing, light and lose fitting clothes made from cotton were worn. Colonists used hats to protect themselves from direct sunlight and followed lifestyle modifications in order to adapt to the tropical heat of the Indian sub-continent. Physical activity, intensive work or exercises were performed during early mornings or late evenings. Large breakfasts and light afternoon meals were the norm during the summer. These practices need to be reflected upon in the current context.

TABLE 5 SEVERE HEATWAVES IN INDIA (PER YEAR)



[Source: IMD]

[14] Among the new areas likely to see severe heatwaves are coastal (both east and west) areas and large parts of south India.
[15] TOI, 21 May 2016

2.3 International Experience with Heatwave Management

Heatwave management planning has been initiated in several countries. Serious impacts on health from heat events and their projected increase due to climate change have prompted many countries and institutions to undertake heatwave management planning. A summary of such initiatives is presented in Box 2. Such plans have commonly emphasized the need for:

- Institutional role clarity, preparedness and collaboration
- Special attention to vulnerable populations
- Stakeholder communication on preventive and adaptive behaviors
- Real-time surveillance and early warning systems (EWSs)
- Short and medium-term strategies for reduced indoor heat exposure
- Long-term preventative measures related to urban building design, energy and transportation

BOX 2 HEATWAVE MANAGEMENT PLANNING-SELECT INTERNATIONAL INITIATIVES

The **World Health Organization (WHO) Guidance on Heat Health Action Plans (HHAPs), 2008** provides a strategic framework for country level HHAPs aimed at preventing, reacting to, and reducing heat health risks. The eight core elements identified for successful HHAP implementation are:

- Agreement on a lead body to coordinate a multi-purpose collaborative mechanism between bodies and institutions and to direct the response if an emergency occurs
- Accurate and timely alerts - heat health warning systems trigger warnings, determine the threshold for action and communicate the risks
- A heat-related health communication plan provides information about what is communicated, to whom and when
- A reduction in indoor heat exposure including medium and short term strategies and advice on how to keep indoor temperatures low during heat episodes
- Care for vulnerable population groups
- Preparedness of the health and social care system such as staff training and planning, appropriate health care and the physical environment
- Long-term urban planning to address building design, energy and transport policies that will ultimately reduce heat exposure
- Real-time surveillance and evaluation

In addition, the **WMO-WHO Joint Guidance on Heat Health Warning Systems (HHWSs) (2015) describes** the following elements of HHWS:

- Weather forecasts of high temperatures that may also include humidity
- A method to assess how future weather patterns may affect a range of health outcomes
- The determination of heat-stress thresholds for action
- A system of graded alerts/actions for communication to various stakeholder groups

Canada and about 20 European nations have initiated heatwave management planning at the federal, provincial and/or local levels. There is an important health focus to these systems.

While Australia does not have a national heatwave management plan at the moment, provincial and local governments have been encouraged through federal guidance. Key elements emphasized in planning include: clarity of roles among stakeholder groups; heat health alert systems; public communication; and, improved heat health intelligence.

Health Canada (HC) has focused on: heat health science; heat monitoring and health surveillance; vulnerability assessments; best practices for developing Heat Alert and Response Systems (HARS); and, communicating with the public to enable behavior change. HARS that sub-national governments are encouraged to develop emphasize: community mobilization and engagement (via a coordinating agency); alert protocols; community response planning through broad stakeholder engagement; communication planning; and periodic system evaluation.

BOX 3 QUEBEC'S HEAT-HEALTH WATCH SYSTEM

Set-up in Montreal in 2004, over time this system has been expanded throughout the province of Quebec, Canada and was fully operational by 2010. Efforts have been undertaken to strengthen surveillance systems in real time and for regular reporting for extreme heat issues, as well as for other climate-related health risks such as floods, winter storms and zoonotic and vector-borne diseases. A portal for storing and sharing 150 layers of surveillance information has been developed. It contains several indicators (e.g., housing, urban heat, age, disability etc.) and a multi-criteria tool to identify at risk areas and populations. Several lessons have been learned through efforts to improve surveillance – the surveillance portal developed was most useful to end-users because of its development with a user's group, training of officials prior to extreme events and emergency is important and there are challenges in making the decision to go to full intervention mode before or during extreme heat events.

European nations have broadly followed WHO's Guidance on HHAPs. The Heatwave Plan for England, for example, prioritizes: long-term multi-agency strategic planning to combat climate change; alert systems; institutional preparedness; public communication; partnership with service providers; community engagement; and, monitoring and evaluation.

Research suggests that heat warning systems can be effective in protecting health. It is important to learn from these experiences for efforts to address heat health risks facing people in India.

New York Case Study

In August 2014, New York City officials from the Mayor's office, the Department of Health and Mental Hygiene, the Office of Emergency Management, along with 30 additional partners conducted a heatwave tabletop exercise. Some of the areas of discussion during this exercise included preparedness efforts, communication outreach to the public and health providers, surveillance for heat-health planning, and development of temperature thresholds. As a result of this, various weaknesses in the city's emergency response plan to extreme heat were identified. Officials discovered that the city needs to find new ways of rapidly delivering food and medicine to affected areas and to vulnerable residents. Efforts to address these challenges are ongoing. New York City officials have also benefited from the experience of India including the Ahmedabad Heat Action Plan.

California Case Study

A Heat Adaptation Workgroup convened by the California Climate Action Team's Public Health Workgroup recommended the development of an action plan for heatwaves in California. Their recommendations were primarily aimed at state government agencies but are also applicable to local and regional levels. The recommendations included identification of a lead agency which would discuss and implement various strategies for tackling heat wave health impacts. The workgroup recommended multi-disciplinary efforts and partnerships between various constituents of the health sector with social service agencies, business, labor, utilities and representatives of vulnerable populations. It also acknowledged the need for further research on heatwave impacts on health, economic, ecological, and social determinants and on evaluation of warning systems.

3. Need for a National Heat Action Plan Roadmap

This Roadmap is envisaged to spur the development of a National Heat Action Plan (NHAP). While heatwave management issues have been undertaken at the national, state and sub-state levels in the recent past (Box 4), there is the need for systematic and comprehensive planning to prepare for future heat events in the country.

Systematic, comprehensive planning, with its potential for enabling a strategic and coordinated approach to heatwave management, would maximize preparedness for, and responses, to extreme heat events.

Such planning is needed given the current reactionary approach to reducing risks to health It would also serve to

BOX 4 HEATWAVE MANAGEMENT PLANNING IN INDIA-INITIAL EXPERIENCE

Heat health issues are recognized in India's National Action Plan on Climate Change (2008), the Ministry of Environment, Forest and Climate Change's (MoEFCC) 4X4 Climate Assessment (2010) and select State Climate Change Action Plans. In addition, the NDMA and States such as Andhra Pradesh (AP), Telangana, Gujarat, Maharashtra and Odisha have developed heat action plans along with the guidelines on dealing with heatwave crises.

The first systematic attempt at heatwave management planning in the country, indeed in South Asia, culminated in the creation of Ahmedabad Heat Action Plan (2013-15). The Ahmedabad Heat Action Plan, developed by the Ahmedabad Municipal Corporation (AMC) in partnership with domestic and international experts and agencies (e.g., IIPH, CDKN, NRDC), has four key strategies:

- **Building public awareness and community outreach** to communicate the risks of heatwaves and implementing practices to prevent heat-related deaths and illnesses
- **Initiating an EWS and inter-agency collaboration** to alert residents of high and/or extreme temperatures that are forecasted
- **Capacity building** among healthcare professionals to recognize and respond to heat-related illnesses, particularly during extreme heat events and;
- **Reducing heat exposure and promoting adaptive measures** by launching new efforts including mapping high-risk areas, increasing outreach and communication on prevention methods including accessing potable drinking water and cooling spaces during extreme heat days

Other notable initiatives include:

The Department of Science and Technology (DST), Government of India (GoI), along with its partners in its National Knowledge Network Programme on Climate Change and Human Health (launched in 2011), has undertaken relevant studies. These inter alia have examined the impact of air quality and heat stress on health and assessed health vulnerabilities and productivity impacts related to heat stress in select occupational sectors.

The India Meteorological Department (IMD) has come up with a temperature outlook for the summer season, and forecasts city and town heat conditions similar to those for rainfall and cyclones. The outlook, comprising of an early warning system for heatwaves and specific advisories, will be valid for the April-June period. An extended range forecast of up to 15 days of summer temperatures with a five-day update will be part of this exercise. IMD, along with Earth System Science Organisation (ESSO) will cover as many as 100 cities/towns.

Based on the successful model of Ahmedabad's Heat Action Plan, the regional plans in Bhubaneshwar and Nagpur have been supported by **CDKN**.

TARU has examined Urban Heat Island stress in cities like Indore and Surat and demonstrated solution through cool roof initiative at community level.

promote planning for long-term resilience, enhance health system responsiveness; and increase communication and community engagement activities.

The process for development of the heatwave management roadmap for India included consultations with many experts, review of national and international initiatives such as Ahmedabad Heat Action Plan, DST Projects, TARU Initiatives, UK, Canada, Australian Heat Initiatives and others), interaction with organizations working in the field (IMD, DST, IIPH, NIDM, Health Departments, and others), participation in various forums and workshops to gain insights (UCHAI Advisory Meetings, WMO meeting in Colombo) and field visits (Gujarat, Bihar).

An expert group was formed to guide the process. The members were:

- **Dr. Sangeet Srivastava,** Assistant Professor, The Northcap University, Gurgaon, Delhi NCR
- **Dr. Anuradha Shukla,** Chief Scientist, Central Road Research Institute (CRRI), New Delhi
- **Ms. Meena Sehgal,** Fellow, The Energy and Resources Institute (TERI), New Delhi
- **Dr. Anil K Gupta,** Head, Division of Policy Planning, National Institute of Disaster Management (NIDM), New Delhi
- **Dr. Rais Akhtar,** Adjunct Faculty, International Institute of Health Management Research (IIHMR), New Delhi
- **Dr. Shyamala Mani,** Professor, National Institute of Urban Affairs (NIUA), New Delhi
- **Dr. Anand Krishnan,** Professor, Centre for Community Medicine, All India Institute of Medical Sciences (AIIMS), New Delhi

The recommendations and insights from these activities have been synthesized in the proposed roadmap.

This Roadmap identifies the potential goal, objectives; intervention framework and priority areas for reflection during such action planning. It will also guide sub-national planning efforts.

4. National Heat Action Plan Roadmap

With the increasing threat of heatwaves and potentially large impacts on health, there is the need for national action to help people reduce risks to their health. Development of a national heat action plan should be a first step towards creating a conducive environment for planning, implementation and monitoring of heatwave management initiatives guided by relevant ministries, departments, agencies including citizens' groups, civil society organizations (CSOs), non-governmental organization, the private sector, academia and other key stakeholders. Learnings from the current initiative will be crucial in developing such plans and can help to scope out the possibilities for a national movement to protect the country from the more severe heatwaves expected in the future.

4.1 NHAP: Potential Planning Framework

Effective heatwave management requires that individuals, families and other related stakeholders are prepared for and able to manage the possible impacts. Short- and long-term interventions therefore need to be considered at the planning stage to improve:

(a) Preparedness for extreme heat events

In the short-term

- Planning in hotspot locations
- Clarifying institutional roles and arrangements
- Deployment of Early Warning Systems
- Risk rating protocols and implementation
- Stakeholder capacity building

In the long-term

- Climate and heat risk reduction through policy development, regulation and heat standard setting for all urban planning

(b) Strategies for an ongoing heatwave

- Heat alert and the local response
- Public awareness and community outreach
- Prevention of heat related illnesses and deaths
- Identification of heatwave illness and treatment as per clinical guidelines
- Monitoring and surveillance of morbidity and mortality
- Emergency response readiness
- Community engagement

(c) Response following the onset of such events

In the short-term

- Risk communication and alert protocols
- Rapid mobilization protocols for system response
- Timely medical care and treatment
- Health surveillance and monitoring

In the long-term

- Trend analyses
- Risk profiling of states and cities
- Response system strengthening

Figure 7 presents a Framework for Heatwave Management.

FIGURE 7 FRAMEWORK FOR HEATWAVE MANAGEMENT

PRE-RESPONSE

Short Term

- Heat Action Plans
- Early warning systems
- Communicating risks
- Building capacity for better system response and preparedness
- Clarity of role and coordination among agencies
- Pooling resources

Long Term

- Climate risk reduction in alignment with heat reduction
- Policy development
- Regulation
- Setting heat standards and implementation for urban planning, infrastructure, industries, services like transport, building design, road, water resource management, etc

RESPONSE

Heatwave

- Activate a heat alert and the local response
- Public awareness and community outreach
- Prevention of heat related illness
- Identification of heatwave illness and its treatment as per clinical guidelines
- Recordings of morbidity and mortality
- Emergency response readiness
- Community engagement

POST-RESPONSE

Short Term

- Care and treatment for saving lives
- Monitoring and health surveillance
- Risk communication and alerts
- Promoting coordination for integrated response

Long Term

- Analysis of trends
- Risk profiling of cities and region
- Strengthening support system for better response

4.2 NHAP: Potential Goal and Objectives

To implement the Framework for Heatwave Management the NHAP's goal need to be framed that could be 'to protect the population from heatwaves and related impacts on health.'

The following objectives may support this goal:

- To promote heatwave management planning in 'hotspot' locations (vulnerable states, cities)
- To strengthen preparedness for heatwave management in hotspot locations

Preparing for, alerting populations to, and preventing avoidable health impacts of heatwaves underlie the two objectives.

4.3 NHAP Development: Priority Areas for Consideration

Achieving the goal will require actions in the following priority areas during NHAP development:

- Institutional engagement and coordination
- Research for evidence building and prioritization
- Agenda mainstreaming and intervention programming
- Resource mobilization
- Capacity building and communication
- Monitoring, evaluation and learning (MEAL)

4.3.1 Institutional Engagement and Coordination

Context

Heatwave management planning needs broad engagement of the public and other (government, non-governmental organizations, private sector) agencies operating in climate science, disaster relief and management, health, meteorology, urban development and water supply domains.

Engagement with 'non-public' secondary stakeholders offers opportunities for harnessing a wider expertise pool and, at an opportune time, mobilizing financial resources.

Given the number and range of agencies likely to be involved and the complexity of heatwave management issues, coordination is important. Such coordination is best undertaken by a designated anchor agency through a mix of structured stakeholder participation, dialogue, knowledge events and online and offline partner networks.

Stakeholder engagement and coordination is also critical for implementation. As with other public emergencies, coordinated responses, which in turn are predicated on the robustness of institutional arrangements (particularly role clarity), are crucial to mitigating heatwave impacts on the ground. A suitably empowered anchor agency mandated to coordinate planning and implementation is desirable.

Implications for the NHAP Development Process

Implementation of heat action plans can be led through four different approaches. These approaches are:

- Municipal led approach similar to the Ahmedabad Heat Action Plan
- State led approach similar to the Maharashtra State initiative
- State-wide disaster management led approach similar to the State of Odisha initiative
- National led Pan-India approach

A national process must engage, in addition to private sector and civil society organizations and research and academic institutions, the ministries of (in alphabetical order): Drinking Water and Sanitation (MoDWS); Earth Sciences (MoES, under which lies the IMD); Environment, Forest and Climate Change (MoEFCC); Health & Family Welfare (MoH&FW); Home Affairs (MoHA, under which lies the National Disaster Management Authority (NDMA)); New and Renewable Energy (MNRE); Panchayati Raj (MoPR); Road Transport and Highways (MoRTH); Rural Development (MoRD); Urban Development (MoUD), Water Resources (MOWR) and others.

The process must also identify one ministry to lead the implementation plan as an Anchor Agency. Ministries that are positioned to act as Anchor Agencies are: The Ministry of Health and Family Welfare (MoHFW), Ministry of Environment, Forest and Climate Change (MoEFCC), Ministry of Earth Sciences (MoES), Ministry of Home Affairs, and Ministry of Urban Development.

Keeping the urban focus initially, early identification of the lead national institution is crucial for aligning support, resources and knowledge. Given the Indian context of heat risks to health and heatwave management, six national institutions have key roles and responsibilities (Table 6):

Anchor agency options could also include:

- An autonomous society (AS) drawing governing body (GB) membership from collaborating ministries; or,
- A steering group (SG) in one of the collaborating ministries, possibly the MoH&FW or the MoUD, with representation from specially created heatwave management cells in related ministries.

The mandate of the anchor agency could be extended to implementation (beyond planning) and to also address cold wave risks to health.

An autonomous society, by virtue of its structure, may be better-placed to attract expertise, raise financial resources from a wide range of sources, engage with stakeholder groups, lead heatwave management planning in partnership with state and local governments and address related issues of health concern (i.e., implementation and cold waves).

Departments and agencies with corresponding mandates to the national ministries listed above and similar anchoring arrangements could be considered for state and city level initiatives.

NHAP: Potential Deliverables

The NHAP should:

- Clarify the roles and responsibilities of all major national-level stakeholder groups (including the anchor agency) in ensuring preparedness for, and timely response to, heatwaves
- Provide a clear mandate and structure for the anchor agency including institutional form
- Provide a framework for regular and sustained stakeholder interface (including the establishment of a pool of experts to support continuous knowledge management and capacity building)
- Develop 'model' institutional arrangements, with special emphasis on role clarity and coordination arrangements both for preparing for, and responding to, heat events, for consideration at the state and city levels

TABLE 6: SECTORS AND ROLE OF LEAD INSTITUTIONS

Sector/Areas	Sub-Sectors	Exposure	Sensitivity	Lead National Institution	Role/Responsibility
Urban	Transport, building road and other infrastructure and services	High	High	Ministry of Urban Development	To address heat sensitive urban planning, infrastructure, services and management issues
Health	Health system for care and treatment	High	High	Ministry of Health & Family Welfare	To ensure care of heat illness and support preparedness, monitoring and surveillance
Environment	Ecology, forest and other natural systems and habitat	High	High	Ministry of Environment and Forest; and Ministry of Earth Sciences (through IMD)	To help reduce the climate risk in alignment with heat reduction To integrate heat data with larger preventive systems at government and citizen levels
Water	Ground water, surface water, rainwater	High	High	Ministry of Water Resources, River Development and Ganga Rejuvenation	To help manage water resources in alignment with heat risks
Disaster	Earthquake, fire, heatwave, drought	High	High	Ministry of Home Affairs (though NDMA)	To respond and coordinate efforts during heatwave disasters
Industries	Service manufacturing sectors	High	High	CII/FICCI/Others	To help implement heat management framework

4.3.2 Research for Evidence Building and Prioritization

Context

Plans needs to be grounded in the best available scientific understanding of risks, impacts, vulnerabilities and mitigation responses.

Global deliberations suggest the need for improved understanding of *inter alia* the temperature-heat/ mortality relationship, causes and effects of indoor heat, health-seeking behaviors, indicators for measurement of intervention effectiveness and the economic costs and benefits of intervention (HC, 2011). Such gaps exist in India too.

In the Indian context, it is also important to identify hotspot states and cities, their unique vulnerabilities, key vulnerable population groups and institutional preparedness levels therein, and delineate implementation strategies and intervention sets appropriate to specific contexts.

Implications for the NHAP Development Process

The Anchor agency will need to lead research on the above themes in partnership with the private sector, civil society and research and academic institutions.

Wider sharing of research findings and associated stakeholder discussions will benefit states and cities in their respective planning processes.

NHAP: Potential Deliverables

The NHAP should:

- Present a compelling case for heat wave management planning and intervention
- Draw lessons from relevant global and domestic experiences
- Prioritize hotspot states and cities
- Present implementation strategies and intervention sets for 'generic' contexts
- Identify areas for future research
- Inventory potential knowledge partners and implementation partners
- National Network for Heatwave Management

BOX 5 HEATWAVE MANAGEMENT IN URBAN AREAS

Remedial measures for abating the effect of heat wave considerably vary over rural areas to urban areas in India. In rural areas, provision of proper shelter, maintaining vegetation, water bodies, provision of basic health facilities can reduce the heat related morbidity. Mitigating the urban heat wave effects can be more complicated.

A number of urban planning interventions are available that can reduce urban heat with varying potential by city. These include but are not limited to greater solar reflectance of hard surfaces (e.g., painting rooftops in white), increased greenery and inclusion of water features, the decrease of anthropogenic heat emissions, and increased air flow through the city. Appropriate measures for identifying and quantifying the effectiveness of various planning, energy, building, and health policies, are being developed. A multitude of quantitative measures can be developed for modeling the urban local climate at a street, neighborhood, and city level. Diverse approaches are likely to be necessary for formulating solutions to the urban heat island effect at different scales. As a note of caution, the net result of the summer health effects of interventions should be taken into account in individual cities while developing relevant strategies. Some of them are:

- City authorities should work with a wide range of stakeholders to build a political alliance for urban health.
- As demonstrated by TARU in Surat and Indore, passive ventilation and cool roof technologies to increase thermal comfort could be built into the building byelaws.
- Attention to health inequalities within urban areas should be a key focus of planning the urban environment.
- Planning frameworks for cities should explicitly incorporate urban health goals and policies aimed at improving urban health in the context of heat.
- Progress towards effective action on urban health will be best achieved through local experimentation in a range of projects, supported by evaluation and self-reflection.
- Modifying building materials (porous construction materials).
- Usage of more reflective/ absorptive colors (based on the situation).
- Avoiding street canyons at the urban planning/design scale.
- Non-blocked street intersections.
- Developing wind corridors.
- Investing in water bodies, fountains, etc. at areas of mass movement.
- Promoting urban green.
- Improving green transport and energy systems.
- Reducing air pollution
- Staggering work hours for reducing the exposure and also reducing the travel related heat generation.

4.3.3 Mainstreaming and Intervention Programming

Context

The seriousness of heatwave-related issues and the relative under-estimation of their importance among primary and secondary stakeholders suggests the need for **heat action plan mainstreaming** among public institutions and for expanded intervention programming.

Explicit recognition and integration of issues by key institutions into policies and practices (mainstreaming) and the development of a package of interventions with clear roles, responsibilities and resources (intervention programming) is essential for a robust response to heatwaves. .

Implications for NHAP Development Process

The planning process will need to:

- Reflect on opportunities and challenges for integration of heatwave management activities into institutions. For example, the NHAP could include a requirement that heat load and health factors be considered by relevant agencies in building approval processes and in the planning of water, road, transport and energy infrastructure.
- NHAP could also support heat health communication to be part of the communication agendas of public agencies and also the embedding heatwave impact and management issues into institutional capacity building and research and development (R&D) frameworks.
- Craft programmes on coherent intervention themes. The programme could consider support for: guidance on policy frameworks, planning and implementation, institutional arrangements, citizen engagement and mainstreaming; surveillance and EWSs; development of communication strategies and material; strengthening of care and treatment services; capacity building; R&D; innovation; etc.

NHAP: Potential Deliverables

The NHAP should include:

- A mainstreaming framework for key institutions that would identify in particular practices and functions where heatwave management could be embedded
- Programme guidelines detailing intervention components, implementation arrangements and financial support along with recommendations, as needed, about how they may be adapted at the state and city levels

4.3.4 Resource Mobilization

Context

At the moment, there are few resources earmarked for heatwave management. Emerging plans will need emphasis on resource mobilization and prioritization.

Implications for NHAP Development Process

The planning process will have to include an assessment of resource requirements and financing options. Potential financing options include public resources, bilateral and multilateral development partners and the private sector.

Innovative arrangements for pooling and administering resources drawn from various sources are important to reduce transaction costs and support smooth implementation.

Potential public sources of financial resources include: National Health Mission (NHM) and other programmes under the MoH&FW; the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) and Smart City Mission under the MoUD; and, resources available with the NDMA, IMD, MoRTH, MNRE and others.

Enabling frameworks to facilitate private sector and development partner engagement are necessary.

Consultations will identify and help plan for specific issues potential financing partners may be anticipating. The framework for private sector engagement will need attention to incentives, business models and risk sharing.

Planned interventions will need prioritization in light of short-, medium- and long-term resource envelopes. One option would be to focus on low-cost, high-return interventions in the short-run and adopt others in time.

NHAP: Potential Deliverables

The NHAP should include:

- A financing plan
- An intervention prioritization framework
- An enabling framework for private sector and development partner engagement
- Arrangements for resource pooling and administration

States and cities inclined to undertake heatwave management planning could draw on this information.

4.3.5 Capacity Building and Communication

Context

Capacity building and communication assume special significance given existing gaps in the understanding of heat health issues, the silent killer nature of heatwaves, the need for timely warning and interventions and documented challenges in reaching the most vulnerable.

Of particular importance is communication with citizens (individuals and families) to enable a better appreciation of how serious health risks can be and to better prepare for heatwaves with simple preventive (pre-heat event) and adaptive (during heat event) behaviors. Deeper citizen engagement, whereby individual and collective efforts to combat heat health risks are encouraged are highly desirable.

Implications for NHAP Development Process

Detailed stakeholder informed capacity building and communication needs assessments are required for proper agenda development. Understanding citizen's information needs, their media access, and communication habits is particularly important.

Capacity building planning will need to explore options such as training and field visits for a range of stakeholder groups, including representatives from departments of health and urban development, local governments, urban utility/ service providers, civil society, the media and research and academic institutions.

Communication planning, while responding to the needs of all stakeholders, should focus on reducing and managing risks to individuals and families with the most appropriate media mix. As part of communication planning, a separate Citizen Engagement Plan (CEP) may also be considered. The CEP is envisaged to mobilize citizens through regular interaction and information sharing to support individual and collective action.

Structures, personnel and technical support arrangements need to be provided for in capacity building and communication planning.

NHAP: Potential Deliverables

The NHAP should include:

- A comprehensive capacity building plan, including a summary of capacity building needs of all major stakeholders, options to increase capacity and arrangements for their implementation.
- A comprehensive communication plan, including a summary of communication needs of all major groups, direct and indirect communication methods for responding to identified needs and arrangements for implementation.
- A CEP which details the way forward in terms of reaching citizens with identified messages and ensuring individual and collective action in response to heat health issues (complementing institutional efforts in the direction).
- A budgetary assessment related to capacity building and communication activities with cost-effective analysis of different interventions.

4.3.6 Monitoring, Evaluation and Learning (MEAL)

Context

The limited understanding of heatwave management and heat health impacts and the early stages of development of systems to protect health in India suggest the need for MEAL systems. A robust MEAL system will ensure that the body of knowledge around the management of health risks from heat grows and informs future policies and practices. It would also support needed course corrections over time.

Implications for NHAP Development Process

The planning process will need to devote attention to:

- Identifying SMART (specific, measurable, achievable, relevant and time-bound) indicators for measuring the pace and quality of interventions;
- Periodically assessing performance against identified indicators through a mix of real-time Management Information System (MIS), Internal Review Mechanisms (IRMs, such as regular meetings and field visits) and term (baseline studies, annual reviews, mid-term assessments, end-term evaluations) and thematic studies; and,
- Facilitating wide-ranging stakeholder dialogue on experiences and lessons so that timely and informed decisions can be made at both strategic and operational levels.

Options for promoting learning and knowledge sharing through websites, blogs and knowledge events also need to be considered. These *inter alia* will ensure improved quality of engagement with the private sector, civil society and research and academic institutions.

NHAP: Potential Deliverables

The NHAP should include:

- A MEAL framework including multi-level indicators and their recommended means and frequency of measurement
- Arrangements for promoting learning and knowledge sharing

5. The Way Forward

This Roadmap may be taken forward in three stages.

In the next 3-6 months

An Anchor Agency may be identified and tasked with initiating stakeholder engagement on heatwave management using existing materials.

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Consultations and brainstorming with stakeholders will add to the analysis and issues identified within this report to support engagement during the NHAP development process.

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Additionally, 5-10 vulnerable states and cities may be encouraged to undertake heatwave management planning. City-level exercises, besides their inherent merit, may also highlight specific areas of state and city-level support that the NHAP needs to plan for.

In the next 6-12 months

The Anchor Agency, after securing the necessary mandate and resources, could take forward and complete the NHAP development process.

In the next 12-18 months

The Anchor Agency could focus on extending support for heatwave management planning to priority states and cities, monitoring the process and its effectiveness and making informed changes in approach as it works towards the NHAP's stated goals and objectives.

Abbreviations

AA	Anchor Agency
AHAP	Ahmedabad Heat Action Plan
AIIMS	All India Institute of Medical Sciences
AMC	Ahmedabad Municipal Corporation
AMRUT	Atal Mission for Rejuvenation and Transformation
AP	Andhra Pradesh
AS	Autonomous Society
CB	Capacity Building
CCA	Climate Council of Australia
CEP	Citizen Engagement Plan
CII	Confederation of Indian Industry
CRRI	Central Road Research Institute
CSO	Civil Society Organization
DST	Department of Science and Technology
EWS	Early Warning System
EM-DAT	Emergency Events Database
GB	Governing Board
GHG	Greenhouse Gases
GoI	Government of India
HARS	Heat Alert Response System
HC	Health Canada
HHAP	Heat Health Action Plan
HHWS	Heat Health Warning System
IIHMR	International Institute of Health Management Research
IIPA	Indian Institute of Public Administration
IIPH	Indian Institute of Public Health
IIT	Indian Institute of Technology
IMD	India Meteorology Department
IPCC	Intergovernmental Panel on Climate Change
IRM	Internal Review Mechanism
MEAL	Monitoring, Evaluation and Learning
MHA	Ministry of Home Affairs
MIS	Management Information System
MNRE	Ministry of New and Renewable Energy
MoDWS	Ministry of Drinking Water and Sanitation
MOEFCC	Ministry of Environment, Forest and Climate Change
MoHFW	Ministry of Health and Family Welfare
MoPR	Ministry of Panchayati Raj
MoRD	Ministry of Rural Development
MoRTH	Ministry of Road Transport and Highways
MoUD	Ministry of Urban Development
MoWR	Ministry of Water Resources, River Development and Ganga Rejuvenation
NASA	National Aeronautics and Space Administration
NDMA	National Disaster Management Agency
NIDM	National Institute of Disaster Management
NIUA	National Institute of Urban Affairs
NHM	National Health Mission
NHMAP	National Heatwave Management Action Plan
NOAA	National Oceanic and Atmospheric Administration
NGO	Non-Governmental Organization
NRDC	National Resources Defense Council
PHE	Public Health England
R&D	Research and Development
SG	Steering Group
SMART	Specific, Measurable, Achievable, Relevant and Time-bound
TERI	The Energy and Resources Institute
UCHAI	Understanding Climate and Health Associations in India
UHI	Urban Heat Island
WBGT	Wet Bulb Globe Temperature
WHO	World Health Organization
WMO	World Meteorology Organization

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