Heat Wave in India
Documentation of State of Telangana and Odisha (2016)

Dr. Sushma Guleria
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PREFACE

Documentation of disasters, associated risk events and phenomenon is critical to reviewing the current state of affairs pertaining to mitigation, preparedness or impact of a disaster event. Disaster Management Act 2005 has mandated NIDM for the purpose of drawing lessons and delineating suitable recommendations for policy planning, risk mitigation and a holistic approach to disaster risk management. Heat waves have become a serious challenge in India more particularly in recent years, not only for the health, environment or water related agencies but equally or even more for the disaster management authorities and climate change adaptation programmes.

The present report is an outcome of study undertaken by the faculty members of NIDM, Dr. Anil K Gupta and Dr. Sushma Guleria, which included systematic data collection, literature review, field visits and consultations, and relevant interpretations. Cooperation and support of State agencies, viz. Telangana Relief and Disaster Management Department, and Odisha State Disaster Management Authority, have been significant and acknowledged. Data inputs from National Disaster Management Authority are also acknowledged.

(B.H. Anil Kumar)
Executive Director
NIDM

ABOUT THE DOCUMENT

"Heat waves claimed 4,620 lives since the last 4 Years, 90% deaths in Andhra Pradesh and Telangana" in the recent past have been reported to be caused by heat waves. A Press Trust of India news reel of 23rd April 2017, according to the Ministry of Earth Sciences, in 2016, reported that nearly 1,600 people died due to erratic weather conditions, of which 557 casualties were due to severe heat wave. Heat wave has been recently reported as disaster phenomenon linked to hydro-meteorological backdrop of environment and processes, along with lack of proactive risk perception, preparedness and poor emphasis on risk mitigation of heat syndrome and its severe health consequences. Occupational environment where poor and marginalized, construction workers, vendors, including women and men, besides general public, are exposed to heat stress in urban areas, industrial estates, on roadways, in villages and countryside. Changes in lifestyle – more particularly clothing, food, beverages; lack of risk perception and poor preparedness of local governments, people and institutions including contractors and civil societies; and abeyance from traditional wisdom – culture and practices, in the backdrop of climate change impacts, phenomenon like El nino as well, urban heat syndromes, etc. have multiplied and complexified the risk of heat impacts on people and other life forms in such areas.

It is not that the recent years only saw the heat related damaging effects, but significant initiatives of planned approach to counter heat waves and mitigate the associated risks have also been taken at various levels – states, cities, district and national levels. Climate change adaptation and resilience – cities, health, environment, water, all these aspects include heat related risk management as a core concern. Heat (Risk) Action Plan has been developed, first on pilot basis, and then being tried replications. States like Odisha, Telangana, Andhra Pradesh, have taken strides of coordinated district and sub-district level preparedness through a state action plan and monitoring mechanism. National level heat action plan study has also been instituted by research groups with some international agencies, as a model study.

The present study was instituted through the faculty members of environment and climate change areas of the National Institute of Disaster Management, as mandated under the

Disaster Management Act, 2005. Detailed information and data have been collected from the states, especially the states of Odisha and Telangana, and consultative study have been undertaken through workshops/personal meetings with the concerned officials and stakeholders in select states.

Current practices of heat action planning and related issues within India and other countries have been reviewed for recommending the appropriate framework, along with standard operating procedures for key departments, agencies and stakeholders.

Dr. Anil K Gupta
Head, Division of Environment & Climate DRM
NIDM

ACKNOWLEDGEMENTS

The research based policy document on heat wave, developed using the contextual findings of the study on heat wave incidences in India during years 2015 and 2016, with special reference to the states of Telangana and Odisha, has embodied the contents assimilating the literature, data and references across a range of sources – official and academic, published and unpublished. Support and contributions from the State Governments – Disaster Management Authority/ Relief and Disaster Management Departments of Odisha and Telangana, have been significant and is gratefully acknowledged. Their support during the field visit and state level consultations were also important, which facilitated cross sectional viewpoints on various aspects of risk, mitigation and response strategies in short and long term perspectives.

Authors are also thankful to the expert reviewers, namely, Prof. V. K. Sharma, Sr. Professor of the Indian Institute of Public Administration, New Delhi

and Vice Chairman, Sikkim State Disaster Management Authority, and Prof. Jugal Kishore, Director Professor & Head, Community Medicine Department, Vardhman Mahavir Medical College & Safdurjung Hospital, New Delhi, regarding the improvement of contents, quality, coherence and presentation. The contents are also enriched with the references and information from the Heat Action Plans developed as pilots, e.g. Ahmedabad, National Plan model developed under the CDKN project, national workshop deliberations under the aegis of the NDMA, IFRC-Red Cross, WHO, Indian Medical Council, and Association of Occupational and Environmental Health, New Delhi.

The study has been carried out and published under the overall supervision and guidance from the Executive Director of the Institute, Mr. B. H. Anil Kumar, IAS, with inputs from past directors, namely, Mr. Sanjiv Jindal (JS-DM), Mr. Bipin Malick (then Additional Secretary – Home and ED NIDM), Prof. Santosh Kumar (then ED I/C), and Prof. Chandan Ghosh. Their support is gratefully acknowledged. Thanks are also due to Mr. Ashish Sharma (2nd In Command – Admin), Mr. Anil Shekhawat (Deputy Commandant, Trg.) and Mr. Santosh Tiwari (Librarian) of NIDM administration for facilitating completion of the process and printing of the study report.

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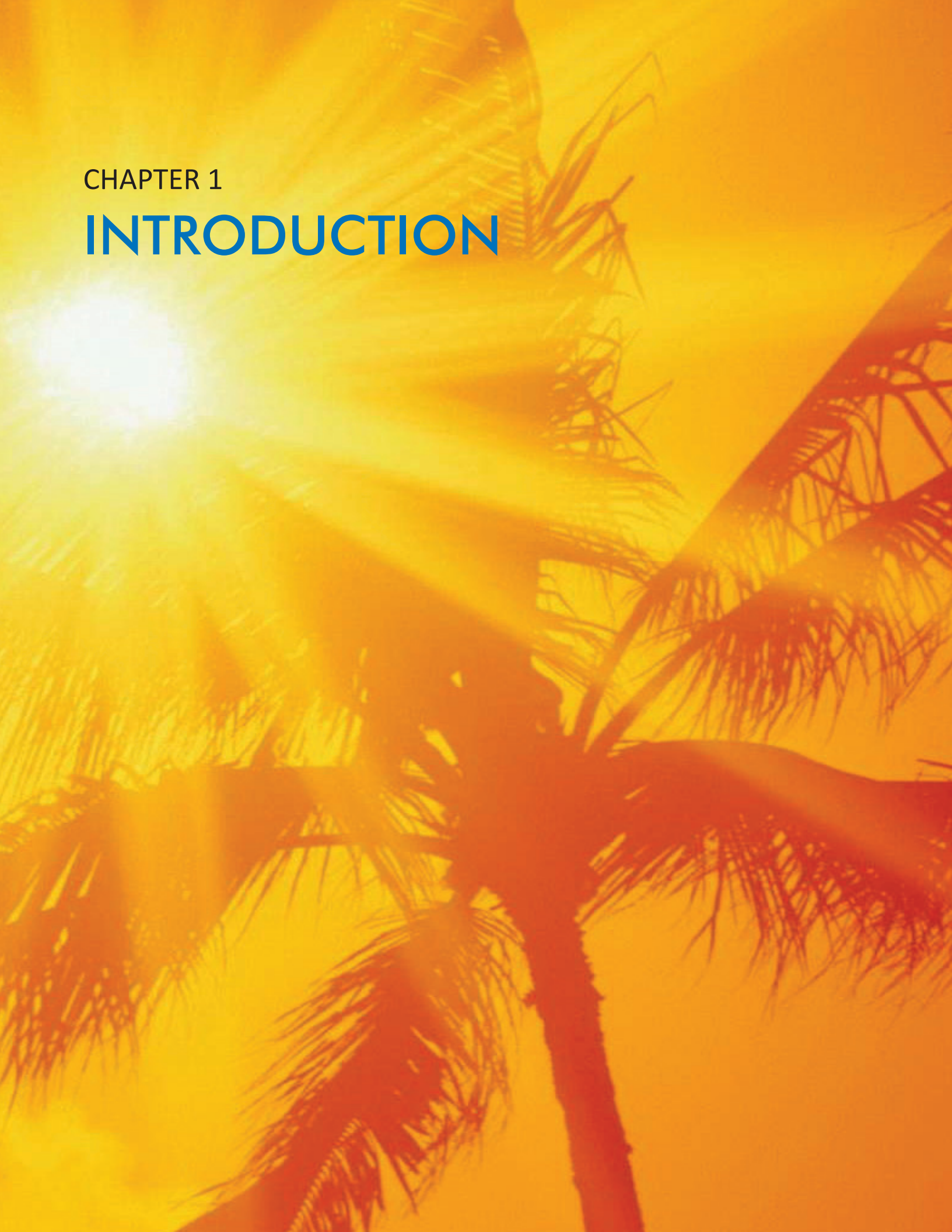

CHAPTER 1

INTRODUCTION

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INTRODUCTION

Heat Wave as an extreme weather event has recently has become a concern for disaster management in India due to widespread and severe impact on health and environment. For last few years, heat wave during the summer season is increasingly affecting morbidity and mortality in the country. Looking at the current scenario, effective response is important for saving peoples life and health, besides evolving strategies for future risk mitigation and management of heat waves conditions. Extreme weather conditions have become so obvious and impacted lives all across the world particularly over the last decade and more. Hence, ways and means to understand and cope with extreme heat events have become essential to coping strategies for communities.

Heat waves in summer, cold waves in winter and extreme rainfall when it is least expected have almost become the norm, as witnessed over the recent past. Climate Change is known to cause increase in average temperatures and has increased possibilities of severe heat wave events. Extreme heat can lead to dangerous, even deadly, health consequences, including heat stress and heat stroke. Though media has now turned 'moon-eyed' about this emerging threat, it is another grim reminder about the vagaries of nature and our callous outlook. Heat waves are known to be "Silent killers" amongst the natural disasters of hydro-meteorological origin. Impact of rising temperatures and increasing frequency, duration and intensity of hot spells poses challenge to human safety and sustainability. Governments and communities need to effectively prepare for responding and adapting to climatic risks in a systematic but proactive way. Countering heat waves and climate change is a major social challenge and will require both rapid mitigation of carbon emissions and wide spread adoption of urban climate adaptation strategies at personal, business and government levels about which we keep harping time and again.

The 2010 Indian heat wave can be considered a wakeup call that inter-governmental agency action, preparedness and community outreach becomes imperative to save lives lost due to such extreme events. In India, 2014 surpassed 2010 as the warmest year in a global temperature record that stretches back to 1880s. The 10 warmest years on record have all occurred since 1997, a reflection of planetary warming that scientists predict is a consequence of anthropogenic emissions and poses profound long term risk to civilization. The important question which emerged and needed attention is “How hot is too hot” and if we can adapt or cope?

The death toll due to heat waves is crossing a certain mark and the situation has tightened its grip on states of Odisha, Telengana, Andhra Pradesh and other states as well. The question remains whether we are adequately preparing to deal with such eventualities. From the view of hazard mitigation, rising number of heat wave related deaths is expected to serve as danger signal and corroborate the need to develop innovative methods to control summer-time losses.

What is a Heat Wave?

Heat wave as a hazard causing disaster scenario, is little more than the physical phenomenon of high heat conditions, and is characterized as a complex of hydro-climatic risks coupled with social, occupational and public health risks. A Heat Wave is a period of abnormally high temperatures, more than the normal maximum temperature that occurs during the summer season in the North-Western parts of India. Heat Waves typically occur between March and June, and in some rare cases even extend till July. The extreme temperatures and resultant atmospheric conditions adversely affect people living in these regions as they cause physiological stress, sometimes resulting in death. As such there is no universal definition for heat wave. It is generally defined as a prolonged period of excessive heat.

The Indian Meteorological Department (IMD) has the following criteria for Heat Waves as given in the figure 1:

- Heat Wave need not be considered till maximum temperature of a station reaches at least 40oC for Plains and at-least 30oC for Hilly regions
- When normal maximum temperature of a station is less than or equal to 40oC Heat Wave Departure from normal is 5oC to 6oC and Severe Heat Wave Departure from normal is 7oC or more
- When normal maximum temperature of a station is more than 40oC Heat Wave Departure from normal is 4oC to 5oC and Severe Heat Wave Departure from normal is 6oC or more

- When actual maximum temperature remains 45oC or more irrespective of normal maximum temperature, heat waves should be declared.

Higher daily peak temperatures and longer, more intense heat waves are becoming increasingly frequent globally due to climate change. India too is feeling the impact of climate change in terms of increased instances of heat waves which are more intense in nature with each passing year, and have a devastating impact on human health thereby increasing the number of heat wave casualties.

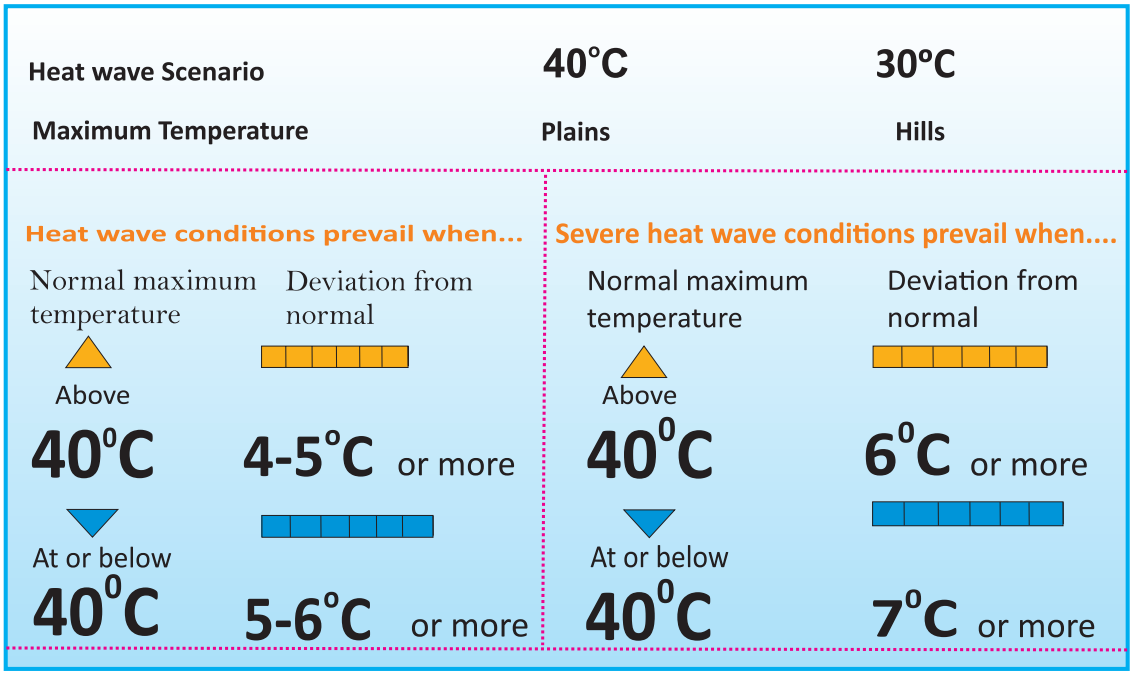


Figure 1: Identifying a heat wave in India

While definitions vary across and even within countries, heat waves 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 heat wave 'when the daily maximum temperature of more than five consecutive days exceeds the average maximum temperature by 50oC, 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) as may be seen in figure 2. 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 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 as shown in figure 2.

In 2015, the heat wave in India is known for more than 2,300 deaths, making it the 5th worst globally in terms of number of deaths. Most of the deaths were reported in Andhra Pradesh, Telangana, Punjab, Odisha and Bihar. In 2016, global temperatures continued to soar (figure 2). The month of April 2016, for example, saw highest recorded average global temperature. India too witnessed one of the severe heat wave conditions during April 2016 which contributed to many heat related deaths as can be seen in the figure 3.

Global Heat wave conditions in April 2016

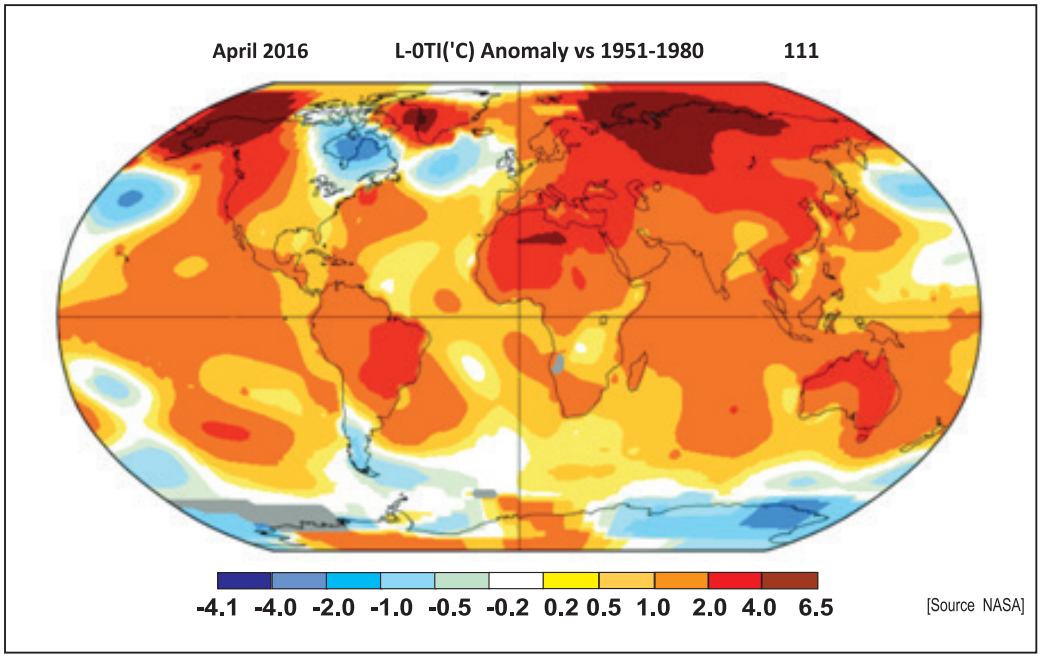


Figure 2: Global Heat wave conditions in April 2016

The combined average temperature over global land and ocean surfaces for April 2016 was 1.10°C (1.98°F) above the 20th century average of 13.7°C (56.7°F)—the highest temperature departure for April since global records began in 1880. This value surpassed the previous record set in 2010 by 0.28°C (0.50°F). This was also the fourth highest monthly temperature departure among all 1,636 months on record, behind March 2016 (1.23°C/2.21°F), February 2016 (1.19°C/2.14°F), and December 2015 (1.12°C/2.02°F).

In India, unlike March-April 2015, in 2016, people didn't get much relief from high temperatures due to the absence of thunderstorms and rain. Temperatures in some areas had crossed 45°C and was consistently above normal in many parts of West Bengal, Odisha, Bihar, Jharkhand, Uttar Pradesh, Maharashtra, Telangana and Andhra Pradesh. Between mid-March and mid-April 2016, maximum temperatures (excluding northeastern states and Jammu and Kashmir) have been above normal by 2-4°C with the greatest impact in north-central and eastern India.

Ten highest Mortality Heat events across globe (2001-2010)

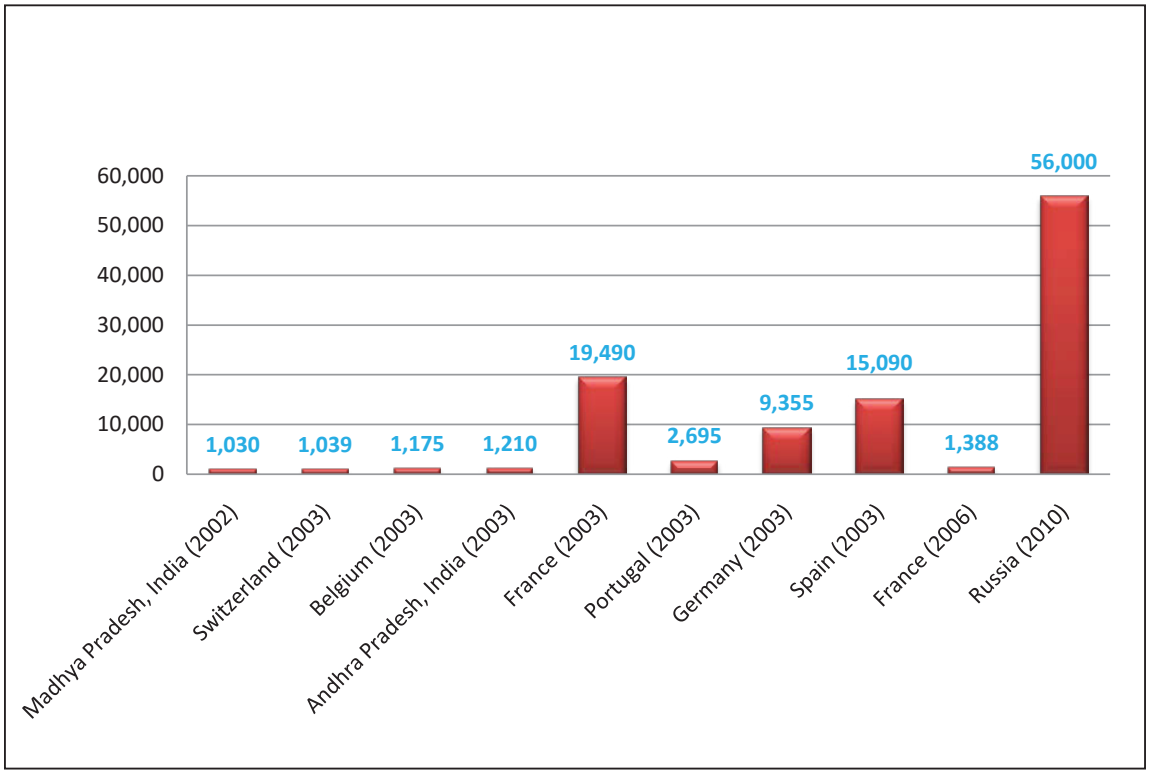


Figure 3: Ten highest Mortality Heat events across globe (2001-2010)

More than 370,000 people died due to exposure to extreme weather and climate conditions (20 per cent higher than 1991-2000) and death due to heat wave alone amounted to 136,000 in 2001-2010, compared to less than 6,000 in 1991-2000 (the increase of more than 2,000 per cent was due to heat wave in Europe in 2003 and in Russia in 2010). Some 44 % of countries recorded hottest temperature between 2001-2010, compared to 24 % in 1991-2000. In terms of the India's heat records, the reason attributed was due to a combination of seasonal climatology, prevailing circulation (wind, cloudiness) and long-term trends associated with global warming.

Heat Wave Risks:

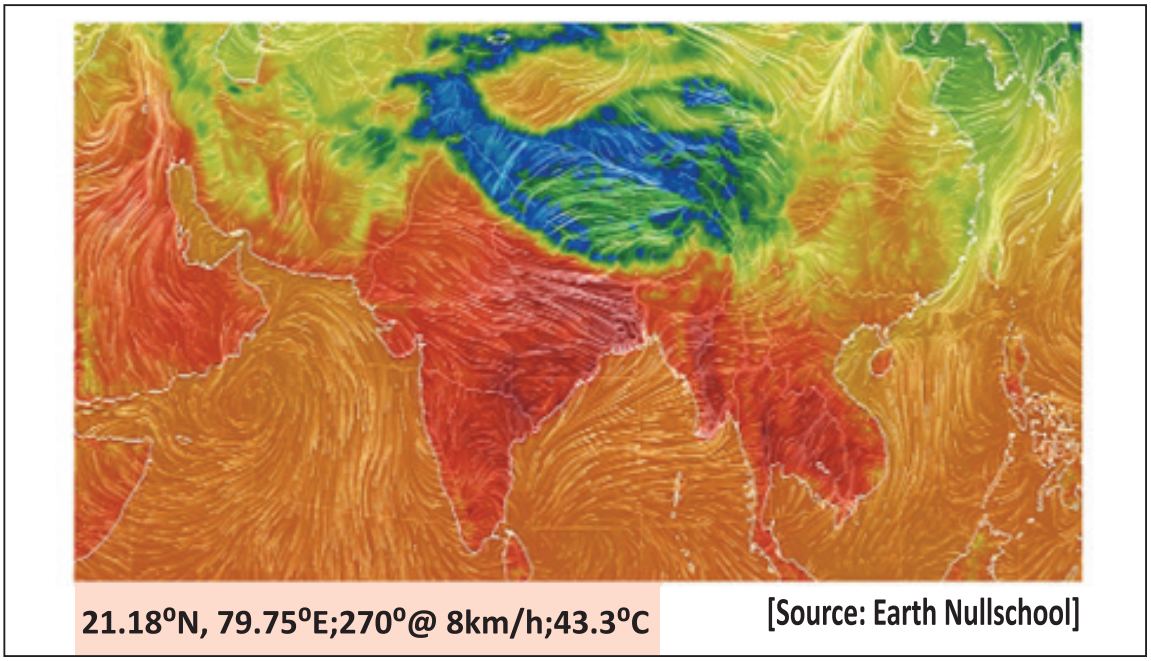


Figure 4: Heat wave conditions in April 2016 in India

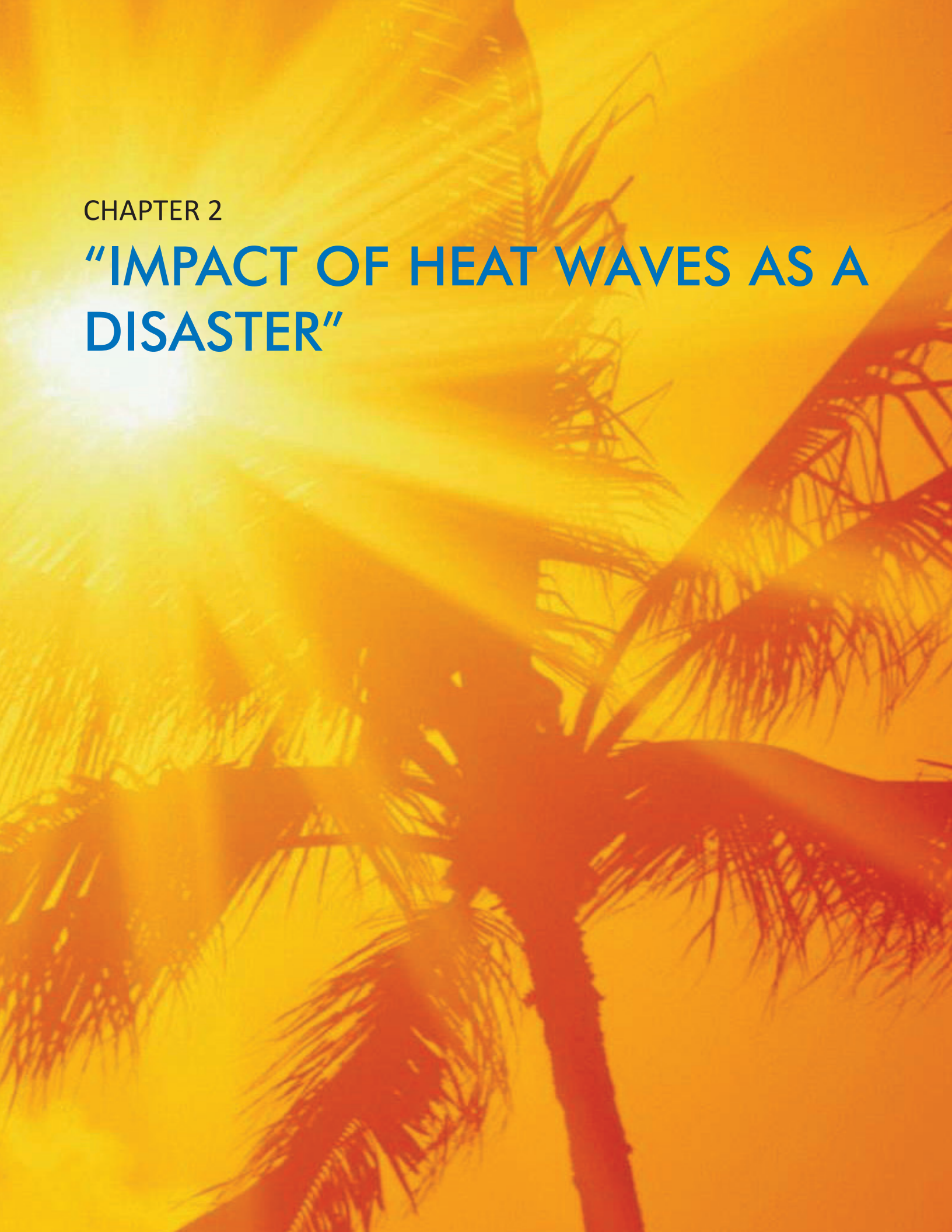
The level of heat discomfort is determined by a combination of factors:

- meteorological - air temperature, humidity, wind and direct sunshine;
- cultural - clothing, occupation and accommodation; and
- physiological - health, fitness, age and the level of acclimatization (ability to adapt)

Therefore, it becomes imperative to conduct vulnerability assessment so as to:

- Collect reliable data on morbidity
- Understand the practices and cultural behaviour for designing appropriate strategy

- Mapping of community level capacities and resources for intervention in designing
- Understanding the perception and utilization of different actions initiated by Government
- Identifying the most vulnerable population and development of targeted action plans
- Mitigation and Preparedness measures for vulnerable population
- Redesigning the appropriate livelihood or working environment for vulnerable population during summer
- 'Heat friendly' city planning methods and measures



CHAPTER 2

"IMPACT OF HEAT WAVES AS A DISASTER"

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IMPACT OF HEAT WAVES AS A DISASTER

Heat wave occurs mostly over an interior plain area when dry and warmer air is transported in a region with clear skies and hence maximum insulation during the summer season. Bay islands, Lakshadweep, Tamil Nadu, Kerala, Coastal and South Interior Karnataka are not affected by heat waves due to the occurrence of maritime air over these regions. Heat waves generally develop over Northwest India and spread gradually eastwards & southwards but not westwards (since the prevailing winds during the season are westerly to northwesterly). But on some occasions, heat wave may also develop over any region in situ under the favorable conditions.

The impacts of heat are increasing as it is taking immense toll on peoples' lives as can be seen in figure 4. In addition to cities and villages, specific industrial operations (e.g., mining, thermal power, furnace, refineries) 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 increase 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 phenomenon 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. 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. However, the most severe impact of heat is felt on water resources that evaporate fast during heat wave conditions. This, thereby, increases the vulnerability of humans, natural habitat and economic activities including agriculture (crops and livestock). Heat waves are, thus, reported as silent killers.

Mortality rises sharply within a day or two after extreme temperatures implying a short window of opportunity for effective action. Vulnerable populations do not always recognize that they are at increased risk making these events more dangerous. At the same time, physiological and behavioral adaptations and changes in public health preparedness can reduce heat wave-related fatalities. The benefits of heat wave planning can be great. Much of the reduced mortality in France during the heat wave in 2006 compared to an event in 2003 has been attributed to early warning systems; and, the cost of running a heat wave warning system for Philadelphia was 'practically at the 'noise' level compared to the economic benefit of saving 117 lives in three years'.

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*** which is 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 1-30oC hotter than surrounding areas. 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.

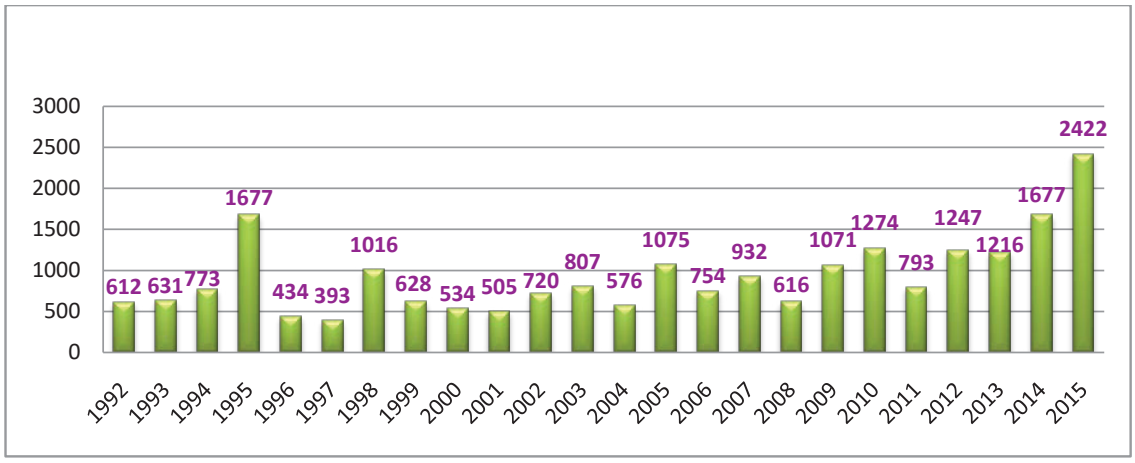


Figure 4(a). Rising number of heat wave deaths since 1992 (Source of data: National Disaster Management Authority)

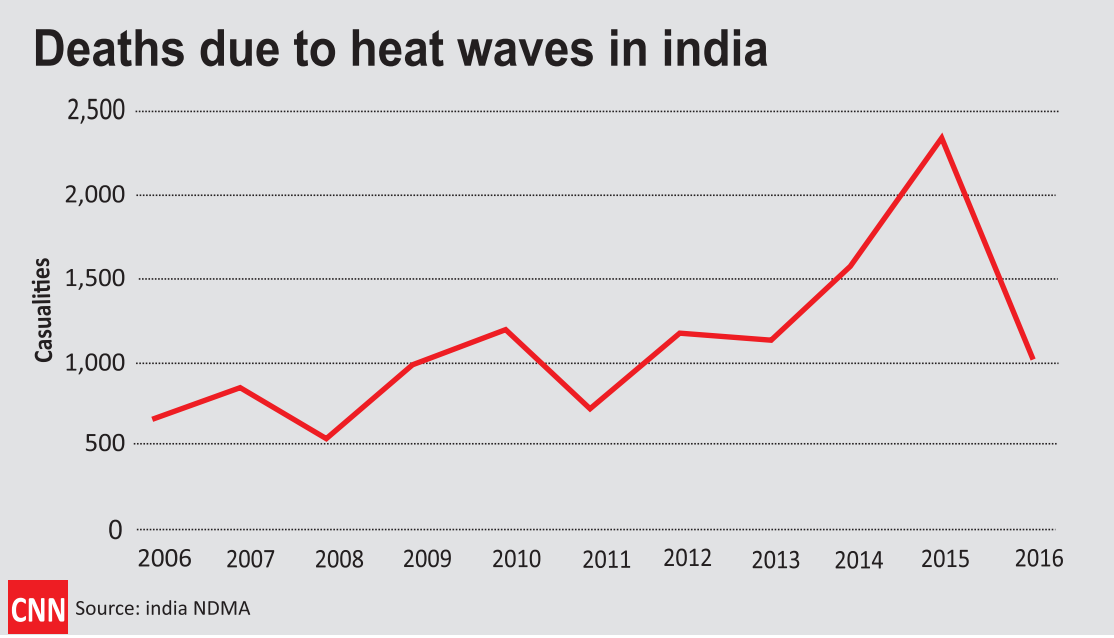


Figure 4(b). Heat wave deaths in India during past 10 years
Heat waves in India

Heat wave deaths in India during past 10 years
Heat waves in India

330 million people were impacted by the heat waves that took about 160 lives. Such sweltering heat conditions are not uncommon phenomenon in India, nor, are deaths resulting from these extremely heat conditions. It is being noted that India's climate is warming up at a much faster rate than previously expected. Analysis at the temperature trends in the country are observed for both annual and seasonal patterns from 1901 till recent years. These studies reflect that the country has been getting warmer continuously, consistently and rapidly. In the future, though, according to the Intergovernmental Panel on Climate Change (IPCC), more frequent and intense heat waves in Asia (including India) will negatively impact vulnerable communities and thereby increase mortality. Research focusing solely on India also concludes that heat waves will last longer, be more intense and occur more often in the future

Heat Wave 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. In 2015, the country witnessed the fifth deadliest heat wave in history (EM-DAT, 2015) as shown in the Table 3. 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 urban heat island 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.

Causes of Increasing Heat Wave Incidences

The heat waves intensities are also linked to sparser pre-monsoon season rain showers in many areas, as there has been much less moisture than normal of that area, leaving large parts of India arid and dry. The sudden end of pre-monsoon rain showers, an uncommon trend in India, has contributed to the heat waves. This weather pattern, coupled with the El Niño effect, which often increases temperatures in the Asia, combined to create the record high temperatures. High humidity compounded the effects of the temperatures on the citizens.

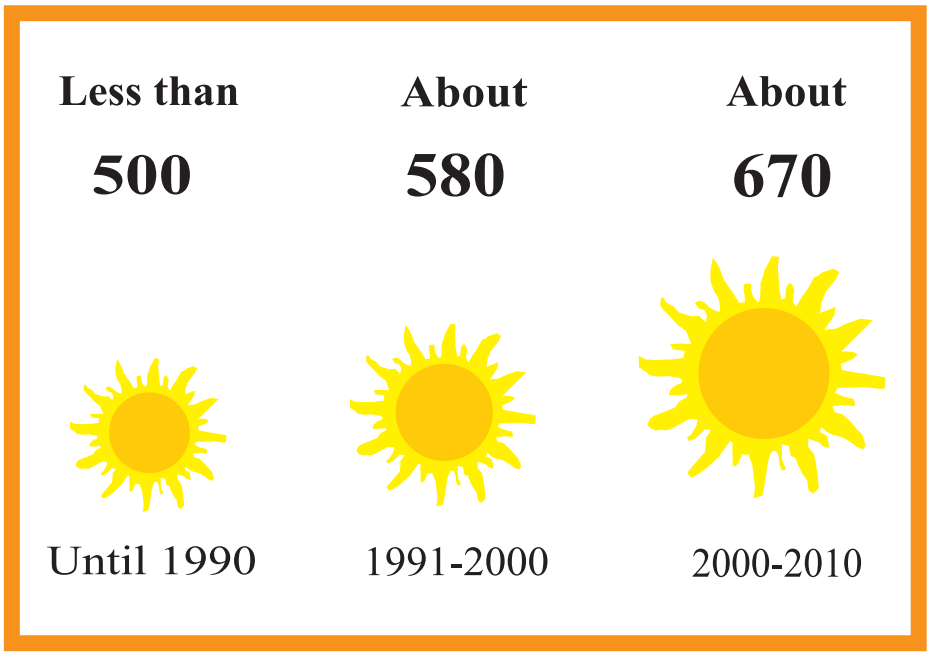


Figure 5: Heat waves in India/year (Source: Indian Meteorological Department)

El Nino is a climate cycle in the Pacific Ocean which affects many weather systems over the globe. It is a phenomenon associated with warmer water of the western tropical Pacific ocean shifting eastward along the equator towards the western coast of South America by mid December. The year following this December phenomenon is considered an 'El Nino year' as it exhibits the effects of the warming of the pacific ocean as was noticed in the year 2015. Usually during an El Nino year, India suffers from drought with areas dependent only on rainfall with poor irrigation as it dries up the South West monsoon. Apparently, in 2015, there were high pressure regions in Arabian Sea and Indian Ocean near the south Indian peninsula which acted as a catalyst for the North East monsoon and hence, Tamil Nadu and other parts of South peninsula received more rainfall than in the last three years. Most of India is otherwise dependant on South West monsoon.

Generally, El Nino and the Indian Monsoon rains are inversely related. Trade winds coming from South America normally blow westward towards Asia during Southwest Monsoon and warming of the Pacific Ocean results in weakening of these winds. Therefore, moisture and heat content gets limited and results in reduction and uneven distribution of rainfall across

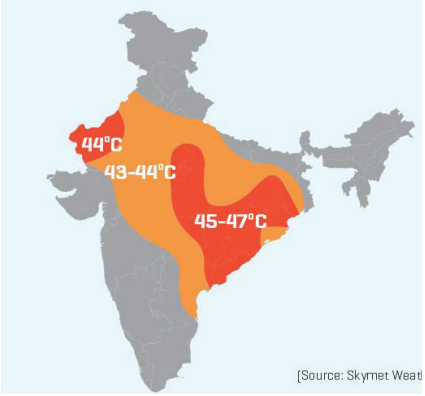
the Indian sub-continent. *The most prominent droughts in India, six of them, since 1871 have been El Nino triggered droughts,* including the recent ones that occurred in 2002 and 2009. Nevertheless, it is important to note that all El Nino years do not lead to drought in India. The year 1997-98 is a stark reminder as it was a strong El Nino year but that did not cause drought in India, in fact, rainfall was in excess. On the other hand, a moderate El Nino in 2002 resulted in one of the worst droughts. Going by historical data of 135 years from 1880 to 2014, about 90% of all evolving El Nino years have led to below normal rainfall and 65% of evolving El Nino years has brought droughts. From this fact, one thing is clear that El Nino years adversely affect the weather in India in terms of Monsoon rain, with very few exceptions. During an El Nino year, the rainfall is generally below the normal average, which has its negative bearing on crop production and increase in the temperatures.

Further, as per the National Oceanic and Atmospheric Administration (US-NOAA, 2016) went on to beat 2015 as the hottest year on record globally, the Ministry of Earth Sciences (MoES) reiterated that for India too "this was one of the warmest years of the century". In fact, in 2016, the months of January, February and March were relatively warmer.

"In 2015, the annual mean temperature for the country was 0.67 degree Celsius above the 1961-1990 average, thus making it the third warmest year on record since 1901. However, with the rising mercury levels soaring in 2015, especially in the month of March, it turned out to be one of the warmest years of the century." "2015 was the hottest year ever recorded and as per forecasts, had a summer with above normal temperatures, due to the El Nino effect. 2016 too looked like it would be among the hottest years. Globally, the reason cited for such warm temperatures was the El Nino factor. The other *nine warmest years on record are 2009, 2010, 2003, 2002, 2014, 1998, 2006 and 2007.*

According to a study done by researchers from IIT Bombay, TISS and Monash University, Australia, the frequency and intensity of heat waves is going to increase in the future. In a paper published in the April 2015 issue of the Journal of Regional Environmental Change, they wrote "heat waves are projected to be more intense, have longer durations and occur at a higher frequency and earlier in the year." Apart from predicting that heat waves will become more common in south India, the scientists say that "In northern India, the average number of days with extreme heat stress condition during pre-monsoon hot season will reach 30. The intensification of heat waves might lead to severe heat stress and increased mortality thus, calling for immediate attention and mitigation and coping strategies.

Another reason for the rise in heat was due to sparser pre-monsoon season showers, which brought less moisture than normal to the area, leaving large parts of India arid and dry. The sudden end of pre-monsoon rain showers, an uncommon trend in India, has contributed to the heat waves. Additionally, the monsoon season is later and further south than the normal trend. This weather pattern, coupled with the El Niño effect, which often increases temperatures in Asia, combined to create the record high temperatures. High humidity compounded the effects of the temperatures on residents. The "Loo", a dry wind originating from Pakistan and northwest India, has contributed to increasing the temperature in India.



Figure

The human thermo-regulatory system has limits. Our muscles generate heat, which must sweat out to maintain our core temperature of about 36.70C. Evaporation of sweat helps human bodies to keep cool when it is hot, however, when there is excessive sweating it leads to dehydration with consequent rise in internal body temperature which many times can prove fatal. More or less, populations' with constant exposure to extreme weather might be acclimatized to heat and humidity but there is an upper level of heat tolerance limit. However, acclimatization to heat can only offer limited protection. When temperature soars beyond the tolerance limit, precautionary measures like avoiding the sun and physical exertion, maintaining hydration, and resting in a cool place are suggested.

A large section of mostly daily wage laborers and others engaged in outdoor work and/ or exposed to indoor heat in Indian cities is more likely to be affected by heat waves. India is experiencing the impacts of climate change in terms of increased heat waves which are more intense in nature, and which can have a devastating impact on human health. There has been an increase in heat wave and severe heat wave days from 2001-2010 compared to the previous four decades and a recent Indian Institute of Technology Bombay (IIT-B) study predicts an increase in intensity, duration, frequency and areal extent of heat waves from 2070 onwards. According to the India Meteorology Department (IMD), the frequency of severe heat waves increased sharply in the past 15 years due to climate change, urban heat island and other factors. 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 heat waves.

Health Impacts of Heat Waves

Four main medical disorders resulting from excessive exposure to heat waves are heat syncope, heat cramps, heat exhaustion and heat stroke. The signs and symptoms are as follows:

- **Heat rash:** Also known as sunburn phenomenon with pinkish skin resulting in burning of skin and pain sensation.
- **Heat syncope:** Giddiness, vertigo headache and sudden onset drowsiness/ unconsciousness.
- Heat Cramps: Edema (swelling) and Syncope (Fainting) generally accompanied by fever below 39*C i.e.102*F.
- **Heat Exhaustion:** Fatigue, weakness, dizziness, headache, nausea, vomiting, muscle cramps and sweating.
- **Heat Stoke:** Body temperatures of 40*C i.e. 104*F or more along with delirium, seizures or coma. This is a potential fatal condition.

It is also learnt that there is a sharp rise in number of cases of acute gastroenteritis and food poisoning due to spoilage of food and reduction of its shelf life due to high temperatures. Alcohol and its fermentation/conversion can also lead to poisoning. There is also rise in number of cases of anxiety, palpitations, nervousness and behavioural change linked to extreme temperature rise. The occupational profile of most of the victims was ascertained as agricultural laborers, coastal community dwellers, and people living below poverty level (BPL) category with mostly outdoor occupations.

Common heat health impacts include dehydration, cramps, exhaustion and heatstroke. The European heat wave of 2003 led to more than 70,000 excess deaths in France, Germany, Italy, Spain and other countries and the Russian heat wave in 2010 resulted in over 55,000 excess deaths (EM-DAT, 2015). Significant deaths have also been reported in countries such as Australia, Japan, Mexico and the USA in recent years. 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. More vulnerable population groups thus include the elderly, the very young, the mentally ill, those with certain pre-existing health problems (particularly heart, kidney, and lung or liver diseases) and housing and economic circumstances that increase health risks. 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'.

India Meteorological Department report says that heat waves (40oC+ temperatures) are recurring more frequently and with greater intensity every year in India. 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. Tables 1 gives an insight into the classification of heat index and their health repercussions whereas Table 2, 3 and 4 present heat wave related impact for the states of Andhra Pradesh Telangana and Odisha in India. These three states have been the most severely hit with the detrimental impact of heat waves in recent years. The information has been received from the respective State Governments as can be seen in Figure 6.

Heat Index	Category	Health Effects
27 – 32°C	**Warm**	Caution- Fatigue possible with prolonged exposure and/or physical activity. Continuing activity could result in heat cramps
32 – 41 °C	**Hot**	Extreme caution- Heat cramps and heat exhaustion possible with prolonged exposure and/or physical activity
41 – 54 °C	**Very Hot**	Danger- Heat cramps or heat exhaustion likely and heatstroke possible with prolonged exposure and/or physical activity
> 54 °C	**Extremely Hot**	Extreme danger- Heatstroke highly likely with continued exposure

Table 1 : Classification of Heat Index (HI) and health impacts

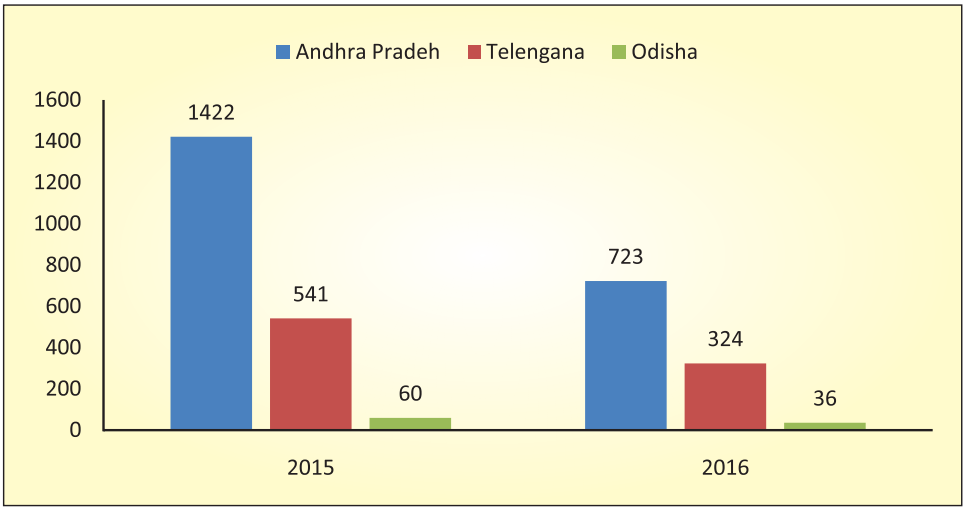


Figure 6: Death toll in Andhra Pradesh, Telanagana and Odisha in 2015 & 2016

Classification of Heat Index (HI) and health impacts

As a consequence of climate change, the increase in the frequency and intensity of extreme weather events predicted for future is arousing a growing concern, in the scientific and public health communities. Heat Index, also known as the apparent temperature, is what the temperature feels like to the human body when relative humidity is combined with the air temperature. Evaporation is a cooling process and has important considerations for the human body's comfort. When the body gets too hot, it begins to perspire or sweat to cool itself off. If the perspiration is not able to evaporate, the body cannot regulate its temperature. When the atmospheric moisture content (i.e. relative humidity) is high, the rate of perspiration from the body decreases and the human body feels warmer in humid conditions.

Impact on Agricultural

Apart from, impact on human life and health especially, the Heat Wave has also been found to profoundly affect crop production both in terms of quantity and quality. Primarily, crop loss is encountered due to flower drop and higher mortality in new plantations. Kharif crops are more

impacted than Rabi crops owing to variability in rainfall associated with Heat Wave. Since, Kharif crops are sown in May to June and harvested in September to October, any extreme change in temperature is bound to affect the productivity. Within Kharif, particularly rice production is significantly affected with decreased grain yield which is a matter of concern as rice is a staple diet in many States experiencing heat wave impacts.

Impact on livelihood

Serious challenges arise when extreme heat events linger for prolonged periods, as cessation of activities for weeks is often not an option. Especially, for state where majority of individuals might be working in unorganized and informal sectors that have to earn their daily livelihood. Thus, on the advent of long spells of Heat Wave they either have to stay indoors and compromise their source of income or run the risk of succumbing to Heat Wave related illness upon continuing to work. This necessitates exploring alternate options for such kind of vulnerable population for income generation to sustain a healthy life. Thus, necessitating the need to revisit and strengthen the existing Heat Wave response plan in order to make it more specific and strategic.

Sl. No	Name of the District	Preliminary Deaths reported by the District Collectors	Total No. of Death cases inquired by the mandal level 3-member committee	Deaths confirmed by the 3 member Committee.	Total No of Sunstroke Deaths eligible for Financial Assistance under Apath-bandhu Scheme	No. of Death cases ex-gratia paid
1	NALGONDA	91	91	91	91	0
2	KHAMMAM	410	226	42	42	0
3	MAHABUBNAGAR	144	144	44	42	0
4	KARIMNAGAR	126	118	29	25	0
5	MEDAK	51	39	33	30	28
6	ADILABAD	55	51	38	38	0
7	NIZAMABAD	17	17	12	7	0
8	WARANGAL	15	15	15	15	0
9	HYDERABAD	8	4	0	0	0
10	RANGAREDDY	28	25	20	17	0
	TOTAL	945	730	324	307	28

Table 2 : Sunstroke Deaths in Telangana State During Summer - 2016 (Report as on 31/05/2016)

Sl. No	DISTRICT	2010	2011	2012	2013	2014	2015
1	MEDAK	NA	NA	7	24	2	35
2	MAHABUBNAGAR	NA	NA	2	27	0	42
3	NALGONDA	0	1	0	209	22	139
4	KARIMNAGAR	NA	NA	22	91	0	120
5	RANGAREDDY	NA	NA	0	11	0	36
6	ADILABAD	NA	NA	44	43	7	26
7	NIZAMABAD	5	0	2	36	0	18
8	KHAMMAM	NA	NA	42	35	0	95
9	HYDERABAD	0	0	0	0	0	10
10	WARANGAL	6	NA	25	40	0	20
TOTAL		11	1	144	516	31	541

Table 3 : Year-wise Death Cases of Heat Waves during 2005-2015

Year-wise Death Cases of Heat Waves during 2005-2015

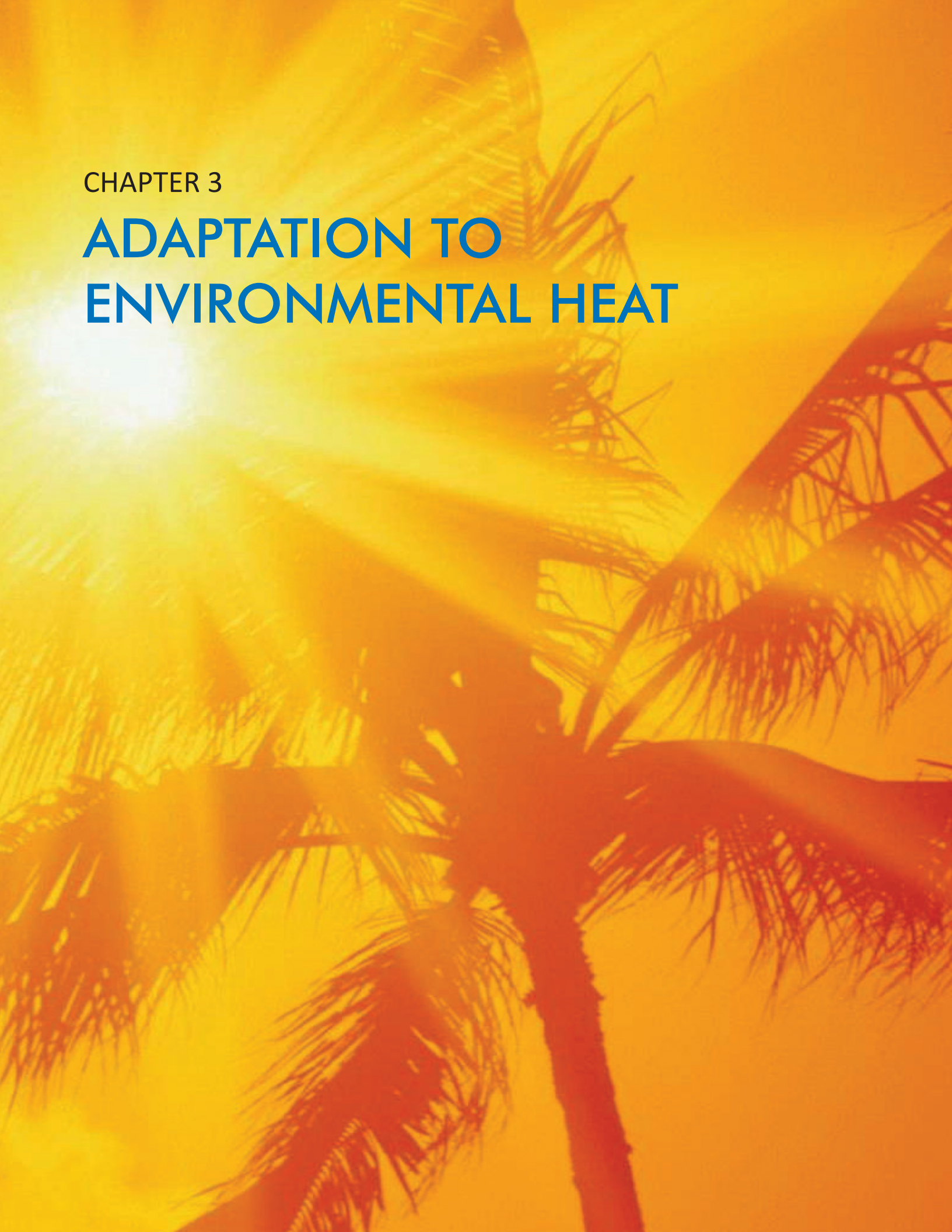
Every year India experiences severe heat waves in summer, but in the year 2015 and 2016, casualties were abnormally high. Most of the deaths were concentrated in Andhra Pradesh, Telangana, Punjab, Uttar Pradesh, Odisha and Bihar. More than 20,000 people have died of heat-related causes in India since 1990s. In the recent past, the most severe period of heat weather occurred in 1995, when 1,677 people died due to a series of heat waves. 793 people died in 2011 while 1,247 died in 2012 due to heat related causes. In 2013, 1,216 people died due to the heat. With over 2,500 deaths, the heat wave has proven to be the most deadly since 1979. The casualties crossed the mark of previous years rapidly in 2015 and 2016 subsequenstly.

Sl. No	Districts	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	District Total
1	Angul	49	3	2	1	3	6	1	19	4	1	7	4	3	2	1	-	5	1	9	**121**
2	Balasore	163	10	3	0	0	0	2	0	1	1	2	4	7		6		1	2	5	**207**
3	Bargarh	46	0	0	1	-	4	0	4	1	1	5	4	10	2	4	5		3	2	**92**
4	Bhadrak	38	7	0	0	2	4	3	3	1	3	0	0	3	-	3	-	1	1	0	**69**
5	Bolnagir	85	0	8	0	0	0	0	5	2	2	0	0	3	-	1	-	5	3	4	**118**
6	Boudh	48	2	0	0	0	0	0	0	0	0	0	0	-	-	1	-	-	1	-	**52**
7	Cuttack	254	3	1	5	4	5	3	12	1	6	0	4	1	-	2	3	3	4	4	**315**
8	Deogarh	26	0	0	0	0	0	0	3	0	0	0	0	-	-	-	1	-	1	1	**32**
9	dhenkenal	367	14	7	0	1	1	4	16	1	7	9	8	12	8	4	-	2	6	3	**470**
10	Gajapati	6	0	0	0	0	0	0	1	0	0	0	0						0		**7**
11	Ganjam	64	5	0	2	4	2	4	23	3	8	7	9	8	1	9	1	3	11	2	**166**
12	Jagatsinghpur	50	2	0	0	7	7	3	12	1	1	6	5	3	1	3	-	-	1		**102**
13	Jajpur	115	10	1	2	2	13	2	0	0	0	3	5	1		8		2	4	4	**172**
14	Jharsuguda	61	0	0	0	0	0	1	3	0	1	0	1	1			1		0	1	**70**
15	Kalahandi	20	1	1	0	2	1	0	1	0	0	0	0	-	-	1	-	-	1		**28**
16	Kandhamal	1	0	1	0	0	0	0	0	0	1	0	1	-	-	-	-	-	0	-	**4**
17	Kendrapara	63	1	0	5	2	0	6	9	0	2	2	2	3	1	6	-	6	8	2	**118**
18	Keonjhar	11	4	0	0	0	0	0	6	1	0	1	5	3	-	1	-	2	2	3	**39**
19	Khurda	123	7	0	1	2	2	3	39	1	2	6	18	6		1		1	0	2	**214**
20	Koraput	0	0	0	0	0	0	0	0	0	1	0	0	-	-	-	-	-	0	-	**1**
21	Malkangiri	4	1	0	0	1	0	0	1	0	0	0	0						0		**7**
22	Mayurbhanj				0			3		0	0			3				5		1	**73**
23	Nawrangpur	0	1	0	0	0	0	0	0	0	0	0	0	1	-	-	-	-	0	-	**2**
24	Nayagarh	126	10	0	1	2	6	3	22	0	2	6	4	3					0		**185**
25	Nuapada	2	0	0	0	0	0	0	0	0	2	0	0	1	-	1	-	-	1	-	**7**
26	Puri	24	0	0	0	0	0	2	6	0	0	3	2	-	-	-	-	-	2	-	**39**
27	Rayagada	1	0	0	0	0	0	0	1	0	0	0	1	-	-	-	-	-	2	-	**5**
28	Sambalpur	146	1	0	5	2	7	3	17	4	1	6	4	6	4	2	1	2	3	3	**217**
29	Subarnapur	10	0	0	0	1	4	0	7	0	0	3	0	-	-	7	-	1	1	-	**34**
30	Sundargarh	118	5	4	2	5	4	2	12	0	5	4	4	26	3	11	2	1	0	1	**209**
	Total	**2042**	**91**	**29**	**25**	**41**	**68**	**45**	**236**	**21**	**47**	**71**	**89**	**104**	**22**	**83**	**16**	**40**	**60**	**47**	**3177**

Table 4 : Number of Deaths Caused Due to Sunstroke ODISHA - 1998-2016

Number of Deaths Caused Due to Sunstroke
ODISHA - 1998-2016

In 2016 alone, nearly 30 people died in Odisha due to sunstroke as the heat wave swiped the state. Titlagarh in the western district of Bolangir was the hottest, with the mercury touching 45oC during May/June. As many as 18 places across the state recorded temperatures above 40oC - Talcher (43.6), Bhawanipatna (43.5), Malkangiri (43.4) and Bolangir (43) experienced severe heatwave conditions. Temperatures, though, dropped a bit in coastal districts with capital Bhubaneswar, which recorded 42.9 oC. The relative humidity also fell to 83 % in the city. The maximum cases of deaths due to alleged sunstroke came from Khurda district followed by Cuttack, Angul, Balasore, Ganjam, Keonjhar and Nayagarh respectively.



CHAPTER 3

ADAPTATION TO ENVIRONMENTAL HEAT

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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 traditional techniques for home cooling like the wettattie – 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. People 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.

Drinking water supply arrangements, oral rehydration salts and intravenous fluids are made available at public places like railway stations and bus stations, emergency medical camps are set up across various heat wave prone states. Citizens are issued advisories such as not to leave their homes at noon unless absolutely necessary. Further, rescheduling of timing in educational institutions, working hours, especially of those doing physical labour, veterinary measures, bus timings, etc. can be modified, once heat wave warnings are issued during peak summer months for better adapting to severe heat wave situations.

Further, prolonged summer periods, increased temperature and climatic changes require designing adaptive measures and building resilience in the informal economy sector (vulnerability assessment and alternate livelihood generation of the vulnerable population) along with the preventive actions. Under these circumstances, adaptation is a key response strategy to minimize potential deaths and other adverse health effects of Heat Waves.

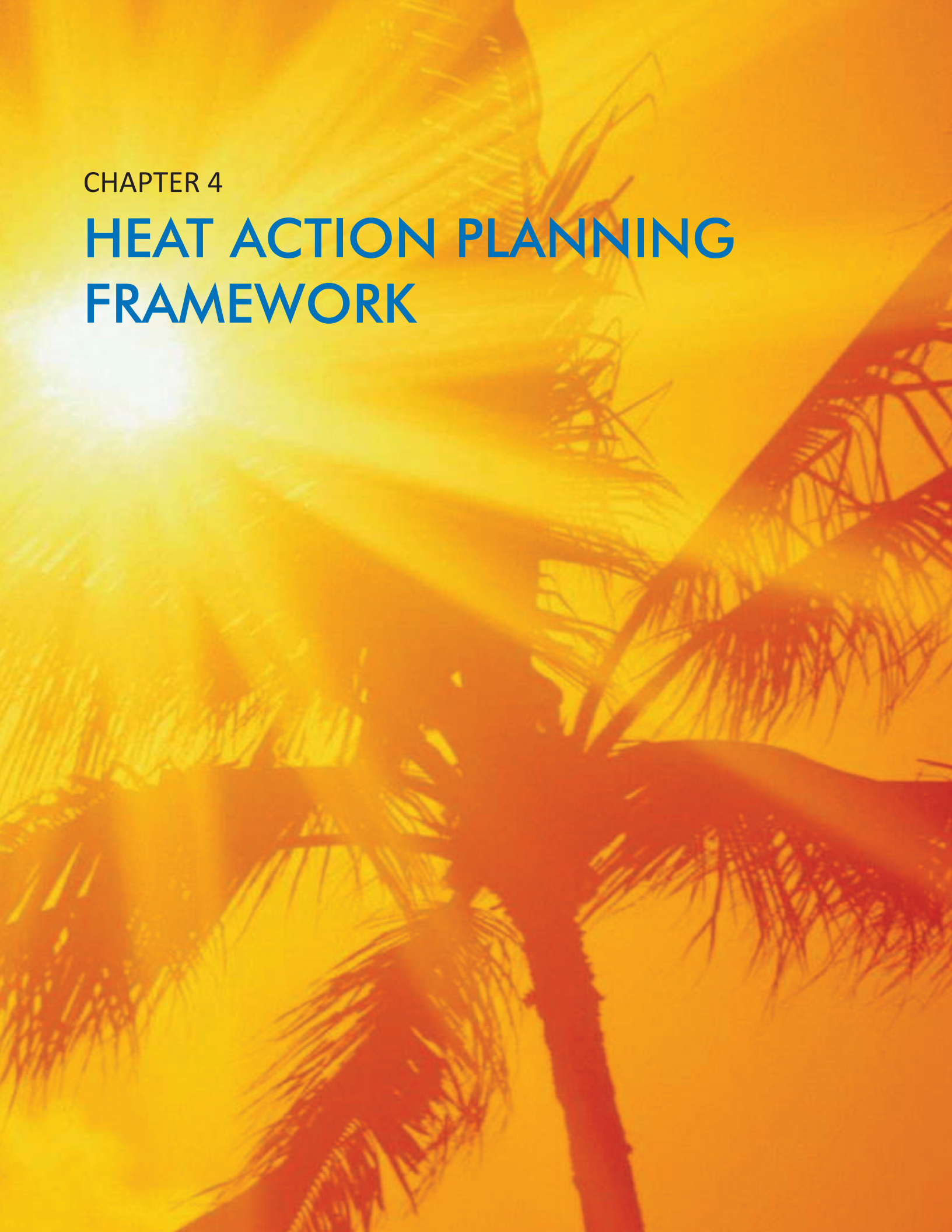
Heat Wave Safety measures:

- As far as possible, avoid going out in the hot sun, especially between 12.00 P.M. and 3.00 P.M.
- Drink sufficient water at frequent interval, even if not thirsty. Always carry drinking water while travelling.
- Wear light colored, loose, cotton clothes. Use protective goggles, umbrella, cap, towel or cloth to cover head, shoes and chappals while going out in sun.
- Avoid strenuous activities in scorching sun, when the outside temperature is high.
- If you have to work outside, use damp cloth or an umbrella to cover your head.
- Eat light meals and fruits rich in water content like melons, cucumber and citrus fruits. Avoid foods that are high in protein such as meat and nuts, which increase metabolic heat. Avoid eating outside and stale food.
- Use home-made and traditional healthy beverages like lemon water, butter milk and juices, etc.
- Never leave children and pets alone in parked vehicles.
- Keep animals in the shade and give them sufficient water to drink.
- Keep your home cool, use curtains, shutters or sunshade, etc. Open windows at night. Maintain adequate ventilation.
- Listen to local weather forecasts and be aware of upcoming temperature changes.
- In case of illness and fainting, consult a doctor/ seek immediate medical help.

What to do in Heat Stroke:

- Get the person indoors or into a cool/shady area, make him lie down with feet slightly elevated.
- Wipe the body with damp cloth with a wet cloth or spray cold water to the skin.
- Give the person ORS to drink, lemon water, salt-sugar solution or juice to re-hydrate the body.
- Do not give anything to eat or drink to a person if he is not fully conscious.
- Take the person to the nearest health centre if symptoms does not improve in one hour.

Though the number of cases directly or indirectly may be linked to the package of compensation announced. Setting up criteria for death due to heat stroke and study its further impacts needs real time scenario survey and ground assessment. Further, though climate change has a major role to play in, rather than looking for permanent solutions at the time of crisis, to treat the cases and prevent the heat epidemic spread further is the real need of hour.



CHAPTER 4

HEAT ACTION PLANNING FRAMEWORK

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HEAT ACTION PLANNING FRAMEWORK

There are many national and international examples for us to learn and adopt an appropriate framework for developing heat wave risk mitigation and response plan, commonly known as Heat Action Plan. Heat wave action plans have commonly emphasized on the need for strong institutional role to drive planning, collaboration amongst various stakeholders and its rigid implementation, real-time surveillance and Early Warning Systems (EWS) and mass education on preventive and adaptive measures. 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 adaptive strategies.

Ahmedabad Heat Action Plan (AHAP)

In India, the first systematic attempt at heat wave 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 heat waves 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. 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 heat waves 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.

Customized heat alert plan for states and public awareness through the government mechanism are the steps needed throughout the nation. The year 2015 prominently known the worst year with respect to heat wave impact in India. Most of the deaths were 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 Inter-governmental 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.

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 neighboring 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 suggests 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”.

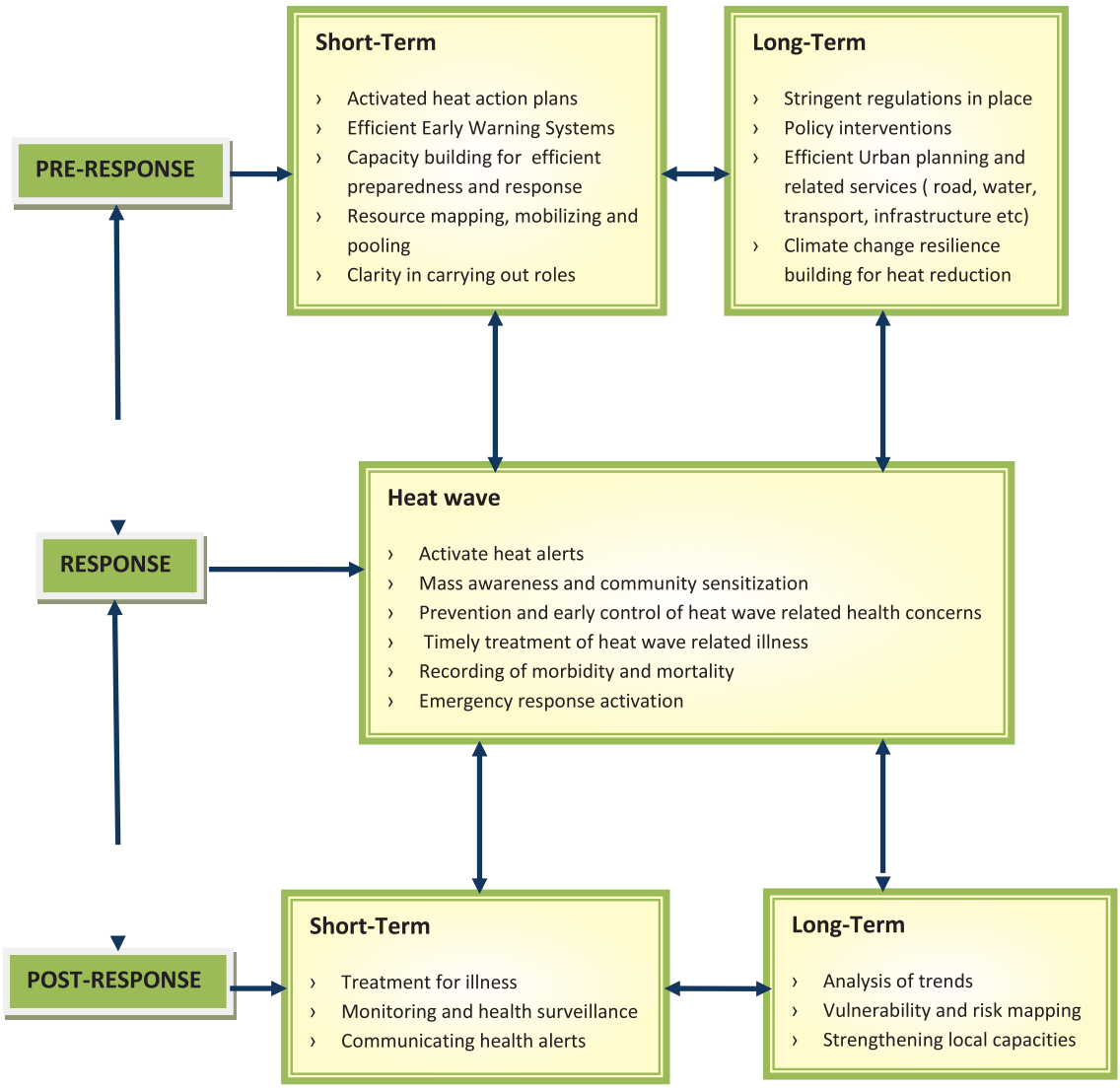

Figure 7 Framework for Heat Wave Risk Management

Planning Framework

Heat wave management issues have been undertaken at the national, state and sub-state levels, there is still the need for systematic and comprehensive planning to prepare for future heat events in the country which, in turn, would maximize preparedness for, and responses, to extreme heat events. It indeed is imperative to come up with such a futuristic

framework considering the current reactionary approach to reducing risks to health due to heat waves.

Effective heat wave 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 as shown in figure 7.

Such a framework will help promote heat wave management planning in vulnerable sites and facilitate in prevention and preparedness towards avoiding health impacts. This would also call for Institutional coordination, advance research and mainstreaming, resource mobilization, communication, monitoring and evaluation and adequate capacity building.
The potential outcome of such a framework can include:

- Clarity in roles and responsibilities of all major stakeholder groups in ensuring preparedness for, and timely response to heat waves
- Scope for regular stakeholder interface, knowledge sharing and capacity building
- Draw lessons from case studies of global and national experiences
- Prioritize vulnerable states and cities with implementable interventions
- Generate inventory of potential knowledge partners and area fir future research

Preparation of Heat Action Plan (HAP)

Heat Wave is a phenomenon culminating from multiple factors comprising both man-made and natural causes. It is being observed that the problem of intense and long heat spells is growing consistently over the last two decades almost assuming the proportion of a disaster. Further, with climate change and global warming the situation is going to be exacerbated in future. Needless to say, this poses a perpetual and major public health threat for the state with potential repercussions on human life and productivity. Thus, there is a need for efforts to design context specific and cost-effective strategies which are informed by scientific evidence and knowledge generation. Based on the heat wave action plan prepared individually by States of Gujarat (Ahmadabad), Andhra Pradesh (Telangana) and Odisha, following can be used as a template for developing a heat wave plan.

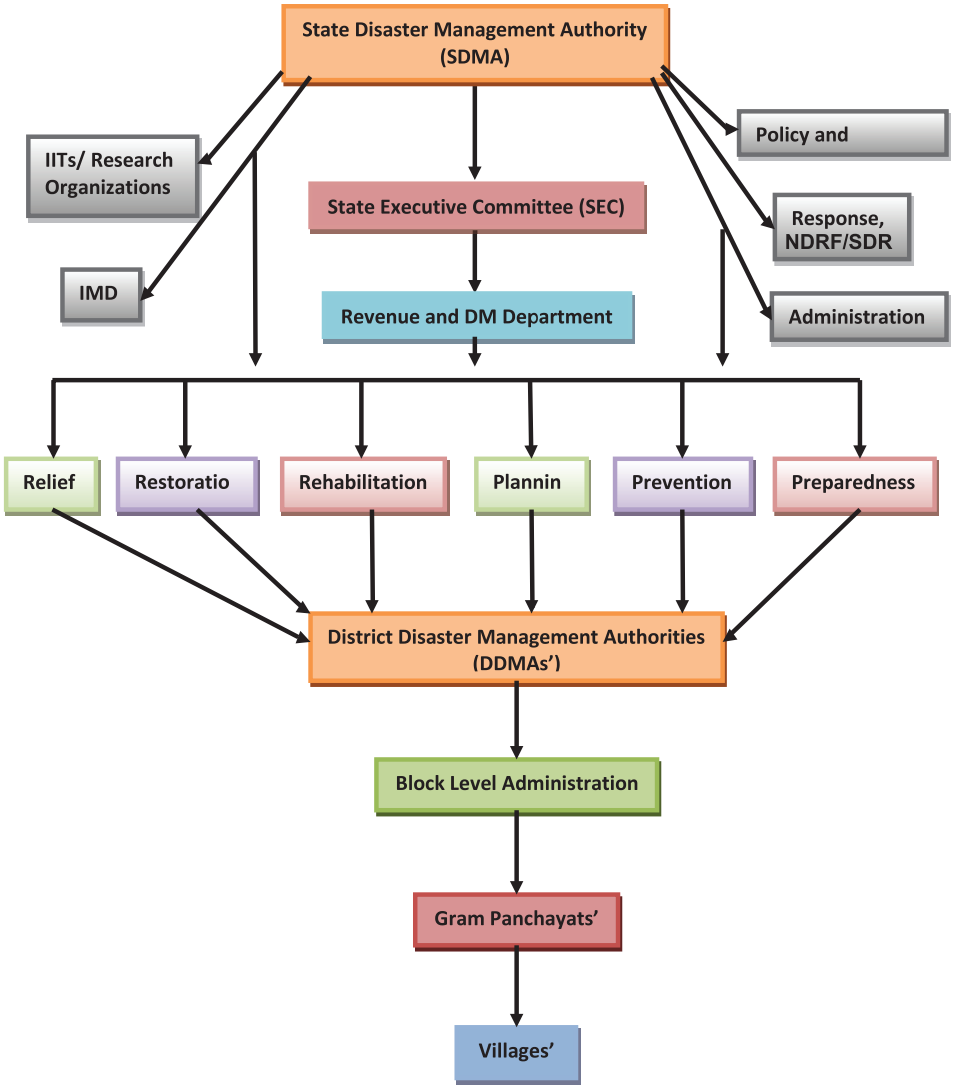

Figure 8 : Institutional framework for heat wave management

The Heat Wave Action Plan can be divided into two parts

Part - I - Purpose of Heat Wave Action Plan
Part - II - Implementation of Heat Wave Action Plan

Other than the nodal department, departments such as IMD, Information & Public Relations, Medical, Labour, Animal Husbandry, Transport, RTC, education, IT, NGO'S etc., can play

crucial role in implementing the plan. Institutional set up for heat action plan and its efficient management can be seen in Figure 7.

It is proposed that strengthening of the heat action plan can be carried out in the following phases –

Phase I- Mapping and documenting the current initiatives and activities undertaken against Heat Waves

Phase II- Assessment of the magnitude of the Heat Wave related morbidity and mortality

Phase III- Determination of threshold values (thermo-hygrometric index) which cause Heat Wave related adverse health outcomes and support IMD in developing an Early Warning System (EWS) based on the threshold values.

Phase IV- Community vulnerability assessment to identify the most vulnerable sections of the society to Heat Wave and suggest alternate models for resiliency building which are contextual.

Phase V- Strengthen the existing Heat action plan by incorporating the EWS, alternate livelihood strategies for vulnerable populations and involvement of various stakeholders/ sectors to support in the implementation of Heat action plan.

Phase VI- Review and update the Heat Action Plan annually by incorporating the EWS and inputs of various stakeholders/ sectors and evaluate its implementation

Further, following actions may be undertaken:

- Set up “cooling centers,” such as religious sites, public buildings, malls, during a heat alert
- Run temporary night shelters for those without access to water and/or electricity and shelter
- Hold on daily basis meet-ups to discuss situation analysis reports and fresh breaking developments during a heat alert, and ensure that communication channels are functional and operating
- Distribute fresh drinking water at public places and also at religious spaces, bus and train stations etc. along with distribution of ORS packets, keep adequate stocks and ensure availability of all medical supplies to all hospitals/PHCs/UHCs
- Train field level workers and build their capacities in heat wave awareness generation campaigns
- Ensure all the hospital in government sector update their admissions and emergency case records to track heat-related cases and also train hospital staff to improve on

recording the cause of death

- Clear and stringent instructions to adopt heat-focused examination procedures at local hospitals and urban health centers
- Instruct emergency services to create displays on ambulances/vehicles during local events to build public awareness about heat related concerns
- If need be, deploy additional staff at hospitals and PHCs/UHCs to attend to the influx of patients during a heat alerts, if feasible and also increase community health worker outreach to at-risk neighborhoods during a heat alert
- Generate reports of the public health impact for Nodal Officers, every week/month during a heat alert and also make the District Surveillance Officers visit UHCs/PHCs to confirm about proper preparations for heat related illness case audits during heat season
- Conducted sensitization to District Surveillance Officers and District Epidemiologists on Heat wave and its repercussions

(a) In case of extreme heat wave declaration, the planning may include:

- Identifying vulnerable populations and the health risks (this aspect can be segregated based on gender wise/ children/aged/differentially-able etc detailing and differential impacts can be assessed)
- Developing effective response planning for a heat wave action plan that addresses heat-health risks
- Implementing the Heat Action Plan and activating heat alerts and,
- Evaluating and updating the Heat Action Plan regularly based on previous action responses.

(b) Status of Early Warning System and inter agency co-ordination:

- **Indian Meteorological Department (IMD)**
- Communicate heat wave alerts/warnings promptly as shown in Figure 8, 9 & 10
- Communicate Max temperatures district-wise periodically
- Update heat wave details regularly and its effective communication which may vary from district to district depending upon severity and number of those affected

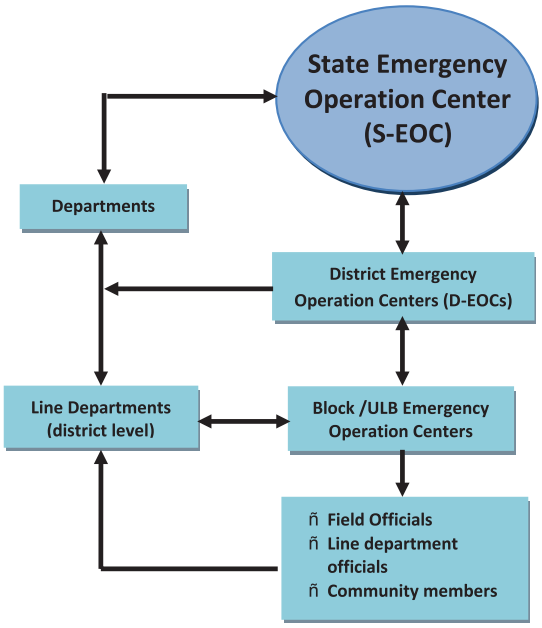

Figure 9: Information flow pattern during heat alert (Source: Odisha State Disaster Management Authority)

Green (No action)	**Normal Day**	**Maximum temperatures are near normal**
Yellow Alert (Be updated)	**Heat Alert**	**Heat wave conditions at isolated pockets persists on 2 days**
Orange Alert (Be prepared)	**Severe Heat Alert for the day**	**(i)Severe heat wave conditions persists for 2 days (ii) Through not severe, but heat wave persists for 4 days or more**
Red Alert (Take Action)	**Extreme Heat Alert for the day**	**(i)Severe heat wave persists for more than 2 days. (ii) Total number of heat/severe heat wave days exceeding 6 days.**

Source: IMD

Figure 10: Establishing a colour code system for alert to public and disaster managers

Establishing a colour code system for alert to public and disaster managers

Color coding in health sector refers to the systematic process of displaying information using different colors for providing assistance in classification and identification. In the public health sector, where the aim is to improve the health indicators of the general population, application of color coding not only enables diagnosis of important health condition but even serves as a rationale to start an appropriate line of management. Multiple applications of color-coding are being used in the health sector for proper sensitization of health professionals and adoption of a standardized color-coding approach universally.

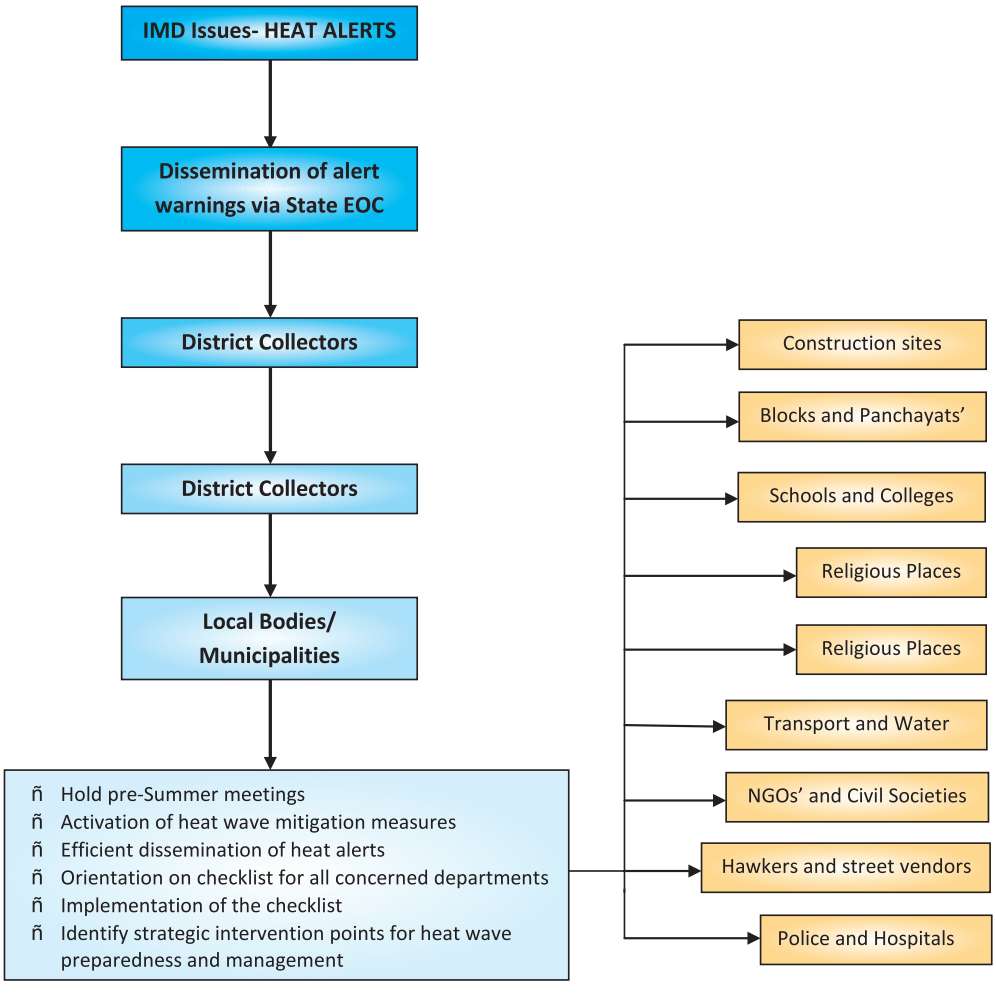

Figure 11: Information flow from State to districts during heat wave warnings/alerts

(c) Mechanism for public outreach:

As learnt from the Telangana heat action plan, they have got their IT department engaged with a start-up, namely Liger Technologies, to build the Telangana State Disaster Management Control Portal which has complete details of data such as maximum, minimum and average temperatures, humidity and wind speed recorded by 885 AWS sensors deployed across the state. The portal uses a Global Forecasting System to predict the occurrence of a heat wave. The portal uses GIS color coding to show parts of the State that could be potentially under a heat wave threat. Further, the portal also provides functionality of mapping the nearest hospitals, schools and public offices in the identified area to disseminate information. Under the communication tab, the portal enables linking cellular service providers to the public to send SMS warnings during heat wave conditions. This can be replicated by other states as well or they can come up with their own indigenous communication network to disseminate timely and efficient heat alerts and warnings to general public

(d) Medium for disseminating heat wave warnings:

(Bulk messages on mobile Electronic or print media for displaying warning)

Once a dedicated portal is in place, it can provide space for mapping the nearest resources such as hospitals, schools and public offices in the identified area for dissemination of heat wave related information. It is left to the decision of the states developing a user-friendly portal to ensure features easily understood and usable. The portal can be linked to cellular service providers to send SMS warnings during heat wave conditions. Further, adequate publicity through use of print and electronic media regarding 'Dos' and 'Don'ts' during summer months can be initiated along with educating the public for taking preventive measures from heat waves and sun strokes.

(e) Standard Operating Procedures (SOPs) for Inter Agency Coordination:

The Heat wave action plan must included and important 'instructional' component consisting detailed SOPs'/Roles and Responsibility matrix for Inter Departmental/Agency Coordination. The plan can then be implemented in three phases:

Phase - I Pre-Heat Season (January through March)
Phase - II During the Heat Season (March through July)
Phase - III Post-Heat Season (July through September)

Officer from the Disaster Management or related department can be designated as the Nodal Officer to head the Heat Wave Action Plan at State Level. Likewise, District Collector can be the Nodal Officer at District Level and nodal officers at Municipal levels especially in urban areas and/or from Urban Local Bodies can become the Nodal Officer for Municipal Corporations/Municipalities in their respective Municipalities. Members from the Panchayat heads can be identified for similar initiatives for the rural communities. The Nodal Officer will then be responsible for coordinating and communicating ahead of, and during, extreme heat events and adopt the steps given in three Phases. Time line for the implementation of heat action plan by various departments is shown in Table 4. The details of SOPs' are mentioned separately in the next chapter.

Department/Organization	**Immediate** (before and during Summer)	**Short term** (Six months of summer)	**Long term** (throughout the year)
SDMAs'			
IMD			
State- EOC			
Road and Transport			
Water resources			
Environment and Forest			
Health and Family welfare			
Women and child development			
Animal husbandry			
Fisheries			
Tourism			
Fire			
Housing (rural/ urban)			
Private partners			
Tribal affairs			
Panchayat Raj			
Education			
Public information			
Labour			
Energy			
Steel and Industries			

Table 5 : Implementation of HAP by various Departments

Implementation of HAP by various Departments

The Heat Action Plan aims to provide a framework for the implementation, coordination, and evaluation of extreme heat response activities in different States that reduce the negative health impacts of exposure to extreme heat. Such plan's primary objective is to alert the affected populations most at risk of heat-related illness that extreme heat conditions either

exist or are imminent, and to take appropriate precautions. Implementation of the Heat Action Plan involves three main strategies. The first is the heat alert systems and inter-agency communication efforts led by designated Nodal Officer. The second is key action taken under the Heat Action Plan by key stakeholders. The third is efforts to keep temperatures lower, focused on vulnerable communities, though cool roof strategies.

(f) Capacity Building:

Every person has an inherent capacity which needs to be honed and developed. This component needless to say thus, becomes an integral part of any new management strategy to be implemented. Locally generated, owned and sustained capacity is essential for success of any DRR initiative. For this, training as an effective tool for capacity building can be tapped. Sector specific programmes can be targeted for different officials regarding heat wave (Medical Officers, Community Health Staff, Health Care Professionals, Administrators, and Local level/ NGO Officials etc) on heat related illness and health hazards, its efficient reduction and management along with providing guidelines for the same.

(g) Public Awareness and Community Outreach:

Generating good Information, Education and Communication (IEC) material is another integral component for effective heat action plan to get implemented and bear positive results in terms of public awareness and community preparedness. IEC materials in the form of Pamphlets/Posters/Advertisements/TVCs/Radio jingles/ flexi boards) on Do's and Don'ts for heat related issues and their adequate dissemination is imperative. Similar material can be given to government hospitals, public sites, schools for display. These can include information on heat related illness, prevention tips and how to stay cool. IEC to create awareness among the Livestock farmers on the Animal Management during Heat waves can also be incorporated in the Heat Action Plan. States like Gujarat, Maharashtra, Andhra, Telangana and Odisha have already started initiatives for raising awareness about protection during heat waves, health safety measures and mitigation initiatives.

International Experience with Heat Wave Management

Heat wave 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 heat wave management planning. Canada and about 20 European nations have initiated heat wave management planning at the federal, provincial and/or

local levels. Canada 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. Under the HARS, sub-national governments are encouraged to develop progammes emphasizing community mobilization and engagement (via a coordinating agency); alert protocols; community response planning through broad stakeholder engagement; communication planning; and periodic system evaluation.
While Australia does not have a national heat wave 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.

European nations have broadly followed WHO's Guidance on HHAPs. The Heat wave 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.

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 heat wave 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.

A Heat Adaptation Workgroup convened by the California Climate Action Team's Public Health Workgroup recommended the development of an action plan for heat waves 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 e orts 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 heat wave impacts on health, economic, ecological, and social determinants and on evaluation of warning systems.

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

CHAPTER 5

STANDARD OPERATING PROCEDURES FOR DIFFERENT DEPARTMENTS

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STANDARD OPERATING PROCEDURES FOR DIFFERENT DEPARTMENTS

1) Revenue/ Relief Department

- Issue appropriate directives to the concerned departments for taking preparatory and precautionary measures for heat have management.
- Posters and IEC materials on safety tips relating to heat-wave must be prepared and distributed by Department of Health & Family Welfare for general awareness of the public. Additionally, advertisements on such safety tips to be given through local newspapers, radio and television channels.
- To instruct All India Radio, Doordarshan and other private television channels to organize discussions and other programmes for creating public awareness.
- Issue directives to Forest and Environment Department, Fisheries and Animal husbandry Department, Department of Women and Child Development, Department of Health and Family Welfare and Disaster Management division for awareness activities, provision of water and essential preparatory measures concerning Heat Wave management.
- Action plan for mitigating water scarcity problems in different towns and urban/rural areas, where acute scarcity of drinking water is felt, to be prepared. Required numbers of water tankers are to be deployed for supply of drinking water and defunct tube wells to be replaced / repaired. The Department of Water Resources to be mobilized for release of water in the canals.
- Essential medicines, saline and ORS packets to be stored in the District Headquarters, Hospitals, Community Health Centers and Primary Health Centers. Special arrangements

to be made and separate beds earmarked for treatment of heat-stroke patients in different Hospitals.

- The working hours for daily labourers can be re-scheduled i.e. from 6 a.m. to 11 a.m. and 3.30 pm to 6 pm wherever possible. Orders to be given to make provision of drinking water at the work sites.
- The time table of the schools to be re-scheduled from 6.30AM to 10.30 AM wherever possible.
- Make provision for ex-gratia relief to the bereaved family of each sunstroke victim must be provided by the respective State Government as per established norms.

2) State Disaster Management Authority (SDMA)

- Constitute State Steering Committee for strengthening the state heat action plan
- Convene State Steering Committee meetings to review and update the heat action plan annually and share the revised heat action plan with all relevant departments for further necessary actions
- Periodic coordination meetings with all the departments towards implementation of heat action plan
- Incorporate and update information related to heat wave in the existing website of the respective SDMA.
- Review of IEC initiatives and their accreditation
- Promote research on heat related morbidity, mortality and mitigation measures in collaboration with knowledge partners located in the respective state.
- Organize capacity building programs on heat wave prevention and management for different stakeholders.
- Mobilization of funds for heat action plan review, documentation and heat wave management.

3) India Meteorological Department (Regional Office)

- Issue early warning and disseminate heat alert to all the key stakeholders
- Issue bulk emails to the key offices and brief media using TV/ Radio/ FM/ Newspapers
- Provide meteorological data for heat wave study and research for better preparedness and mitigation initiatives

4) Housing/ Urban Department

- Give directives to Urban Local Bodies (ULBs) /Development Authorities to increase

access to public parks, water bodies, public libraries for general public.

- Create small, accessible green spaces by using vacant spaces such as side lots, parking medians, spaces between buildings and roads.
- Keep large public parks open during peak hours to provide cool resting spaces for the public.
- Give directives and ensure cool roofs initiative to paint roofs white, create green roofs and walls, and plant trees in neighborhoods to keep them cool.
- Develop a strategy to incorporate the green belt concept in urban planning, evaluate the efficacy of these initiatives and the highest priority locations for intervention.
- Provision of funds in the departmental budget for capacity building and heat wave management.
- Implement building codes that entail passive cooling practices such as increased reflectivity of building roofs, green roofs, increased natural ventilation and rainwater harvesting. Incentive mechanisms (e.g., reduced taxes) can be used to accelerate green infrastructure development.
- Promote green energy technology, energy efficient building promotion, and restricted use of heat producing equipment, and increasing use of renewable energy

Urban Local Bodies

- Display heat alerts and precautionary measures at strategic public locations
- Providing shelter and shades in open and high congregation places
- Opening of the parks during peak hours
- Providing drinking water through water kiosk at strategic points
- Water supply to slums through tankers.
- Public announcements through public address system.
- Restrict plying of city public transport
- Provision of vats (near tube wells) for drinking water for animals
- Provision for Water sprinkling to settle down the suspended particles on roads if possible
- Provision of funds for Heat Wave management.

5) Panchayat Raj Department

- Develop Vulnerability map.
- Sensitize vulnerable population about heat wave and its detrimental impacts
- Public announcement and /or distribution of pamphlets about the do's and don'ts

issued by the department of Health and family welfare and SDMA.

- Provision of water kiosks, tube wells, tankers at strategic locations.
- Provision of funds in department budget for capacity building and heat wave management.
- Encourage for alternative livelihood activities.
- Construction of ponds, artificial lakes for cooling the environment by evaporation

6) Department of Health and Family Welfare

- Capacity building of health care service providers (Doctor, Nurses, Pharmacist and health workers) about diagnosis and management of heat related illness.
- Maintaining data base and surveillance on heat related morbidity and mortality.
- Provision for Health facility readiness to manage heat affected patients (beds, staff, inventories, ambulance etc.).
- Special attention towards high risk patients like geriatric/ pediatric/pregnant women etc.
- Display do's and don'ts of Heat Waves at all public and community health centers for mass awareness
- Establishment of mobile base alert system through the ASHA/ Aaganwadi (ANM)/ health workers for effective and immediate assessment of heat stroke cases
- Coordinate with private hospitals to collect heat related morbidity and mortality data.
- Make provision of funds for heat wave management.

7) Labour Department

- Issue directives for flexible working hours to restrict heat exposure wherever possible
- Guideline for workers to protect from heat exposure and provision of First Aid, drinking water and cooling space at work site.
- Awareness activities for construction workers, factory laborers, manual laborers and workers whose occupations require intensive work outdoors during extreme heat about the risks, signs, and symptoms of heat stress
- Training on heat illness diagnosis and management for factory medical officers
- Advisory for one A/C relief chamber at factory facilities for emergency
- Ensuring health centers/dispensary are open during peak summer hours
- Ensure overseeing construction sites, quarries, factories and other vulnerable worksites, particularly during high temperature periods, to enforce labor laws related to heat safety.
- Provision of funds for heat wave management

8) Department of Education

- Restriction of school timing (6.00 am to 11.00 am) during summer
- Ensure Avoidance of physical activities during peak hours
- IEC activities on Heat Wave prevention and management in schools
- Promote School Safety Plan
- Encourage Plantation of trees and promote green campus
- Provision for safe drinking water
- Training to the teachers and mock drills among students about health risks due to heat waves and its management
- Provision of funds for heat wave management

9) Department of Energy

- Create awareness among people on energy conservation
- Develop a policy for power cuts depending on vulnerable areas and population
- Provision of power back up for life line services
- Provision of funds for heat wave management

10) Department of Water Resources

- Release water in canals during summer
- Raising schemes to revive water sources
- Awareness generation for water conservation programmes
- Promote rain water harvesting
- Provision of funds for Heat Wave management

11) Department of Industry/ Steel and Mines

- Issue directives for Heat Wave prevention and management for industries and mines
- Generate awareness through IEC activities
- Provision for water sprinkling to settle down the suspended particles
- Provision of funds for Heat Wave management

12) Department of Tourism/ Culture

- Ensure availability of heat relief measures at tourist places

- Display of heat wave precautionary measures for tourists during summer at tourist points and related information in website of department of tourism.
- Ensure the availability of drinking water and cool resting sheds
- Restrict the timing of the visit of tourist places during peak summer days
- Provision of funds for heat wave management

13) Department of Forest and Environment

- Directive for making water available for animals in reserved/ protected forests and make provisions, where necessary
- Issue directives to the Zoo Authorities for special arrangements for the animals in zoo to protect them from the effect of Heat Wave
- Provision of drinking water like ponds/water bodies for wild life
- Directive for provision of water to human habitations facing water scarcity inside reserved forests
- Provision of funds for heat wave management

14) Department of Fisheries and Animal resources

- Ensure construction of vats near tube wells/ repair for roaming livestock to provide them with drinking water

15) Civil Society Organizations/ Private Sectors

- To support the Govt. departments in generating awareness in community
- Support in setting up water kiosks on high ways, remote places
- Distribute IEC materials duly accredited by the state health departments
- Promoting healthy living style during summer
- Support the state government in establishing shelters and sheds

CHAPTER 6

KEY RECOMMENDATIONS

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Environment is getting affected because of increase in 'Consumption'- due to rise in population, 'lack of Conservation' and 'lack of Care'. Rising to this challenge of climate change and increasing heat waves, Municipal Corporations must work to prepare health systems and residence against dangerous heat waves. Every city should have Heat Action Plan (HAP) with the help of National and International academic experts and learning's from global best practices on early warning systems and heat adaptation. Further, following points have been summarized which can be incorporated while drafting policies, guidelines and preparing Heat Action Plans:

- Indigenous knowledge and traditional wisdom on protective methods against heat waves and strokes must be tapped, documented, researched. Sensitization and awareness generation against the same can then be initiated.
- Avoid wastages of food in hotels and private parties by taking simple measures to save food and water.
- Identify locations for building shelters and shades in urban areas. Heat alerts and emergency response plan must target vulnerable groups. Insulation and building standards need to be increased along with increasing heat tolerance for new infrastructure, retrofitting etc.
- Like Cyclone shelters and Multi-purpose shelters, in urban areas, shelter locations for the urban poor and slum dwellers must be identified and constructed.
- Building public awareness and community outreach to communicate the risks of heat waves and implement practices to prevent heat related deaths and illnesses disseminating public messages on how to protect people against extreme heat through media outlets and informal materials such as pamphlets and advertisements on heat

stress prevention. New efforts must be launched as part of the HAP to include the use of modern media such as SMS, Text Messages, Email, Radio and Mobile Applications such as Whatsapp. Special efforts must be made to reach the vulnerable populations through inter-personnel communication as well as other outreach methods.

- Based on the India Meteorological Departments assessment, it came out evidently that culture and physical exposure of population has more impact on health than the climate becoming warm. Therefore, our lifestyles play a major role in the ways to adapt to changing weather patterns.
- Scientific capabilities must be utilized to the optimum best and efficiently by linking impacts of heat waves with other hazards. Do's and Don'ts on various hazards must be disseminated to the general public as an effective protection measure along with medical life saving tips.
- Destroying of natural shelters for vested interest have affected eco system services which call for research in this area and bring out policy papers for the same.
- Both global warming and Urban Heat Islands (UHI) contribute to the development of urban heat waves (UHWs). The inhabitants of urbanised areas suffer from heat waves more than their rural counterparts due to the urban heat island effect and the lack of adaptive opportunities in urban environment. People living in cities are dependent on facilities such as air-conditioning, cooled water, artificial lighting in shaded offices and the reliance on private car use etc. However, by using these technologies, urban inhabitants increase significantly the generation of anthropogenic waste heat and carbon emissions; all of which contribute to the urban heat island and global warming. Thus, UHI becomes an imperative planning issue which calls for initiating studies and research on micro-climate and corroborating the need to monitor temperatures in urban areas, record them and also study their trends. Urban greening infrastructure can be an effective method to cope with UHI problem. Urban forests have found to be effective for city heat mitigation. Combination of shading, reduced heat build-up in materials, humidity and wind management can provide heat refuge at street levels. This also calls for putting up adequate monitoring equipments, satellite maps in place. It has also been found that developmental patterns add to the rising temperatures. Vertical greenery, roof gardens can prove to be good alternate methods to bring down the temperature of built environment. Clearances to structures based on their plans, shading spaces must be ensured.

UHW- Mitigation and Adaptation strategy

VEGETATION
Parks, street trees, urban forests, public and private green areas, green roofs and walls

WATER
Waste water treatment and re-use, rain-water harvesting, prudent consumption

BUILT-FORM/MATERIALS
Urban albedo, cross-ventilation, proper zoning, thermal storage and emissivity

SOCIAL
Decrease vulnerability, increase adaptive capacity, heat energy harness, attitudinal and behavioural change

- Climate change is considered one of the main environmental issues challenging all contemporary cities. Albeit, urban development patterns and the growth of urban population represent the main contributors to climate change, affecting the energy consumptions and related greenhouse gas emissions. Cities are responsible for approximately three quarters of greenhouse gases worldwide. CO2 emissions must be reduced in the decades to come while measures need to be taken to reign in global warming, floods and extended heat waves. This calls for utmost attention and a breakthrough in current urban development patterns to counterbalance the climate-related issues. Needless to say, current initiatives to improve cities' smartness and resilience efforts are very fragmented. The concept of 'smart city' is rooted in the implementation of user-friendly information and communication technologies developed for urban spaces. Smart cities are forward-looking, progressive and resource-efficient while at the same time providing a high quality of life. They promote social and technological innovations and link existing infrastructures. They incorporate new energy, traffic and transport concepts that go easy on the environment. Their focus is on new forms of governance and public participation. The Government of India has launched a major programme on smart cities. With urbanization growing at a rapid rate in the country, and the prospect of almost half our population living in towns and cities by 2030, the design of cities, their infrastructure and governance systems acquire great importance for us as well. While most of our towns and cities have grown haphazardly, we have opportunities for ensuring that new urban habitat that we design and construct utilizes new knowledge and technologies, by which appropriate amenities are available to all the residents in every location as well as in a manner that it is cost effective and friendly to the environment. One issue that

would be paramount in the design of new cities as well as in the refurbishment of old towns and cities is the importance of integrating the impacts of climate change on future plans. Cities will need to be designed in a manner that makes them climate resilient. In simple terms, the infrastructure and systems in a city would have to enable adaptation measures being facilitated, by which they are able to reduce the risks from climate change impacts for both life as well as property. In several parts of the world adaptation measures have been taken in hand through clear-cut plans and institutional arrangements. Adaptation can be facilitated through mainstreaming climate adaptation action into sub-national development planning, early warning systems (such as for cyclones, heat and cold waves and coastal flooding etc.)

- Initiating an Early Warning system and Inter-Agency Coordination to alert residents of predicted high and extreme temperatures. Local Administrations, other Local Bodies must create formal communication channels to alert governmental agencies, the Met Centre, health officials and hospitals, emergency responders, local community groups, and media outlets of forecasted extreme temperatures.
- Capacity Building among Health Care Professionals must be enhanced so as to recognize and respond to heat related illnesses, particularly during extreme heat events. Such trainings must focus on primary medical officers and other paramedical staff, and community health staff so that they can effectively prevent and manage heat-related cases so as to reduce mortality and morbidity.
- Ensure reducing heat exposure and promote adaptive measures by launching new efforts including mapping of high-risk areas of the cities, increasing outreach and communication on preventive methods, access to potable drinking water, store basic medicines such as oral rehydration salts (ORS), Electral- Glucose and anti-vertigo medicines, Oral and Intra-venous fluid replacement is considered the best modality, avoid Paracetamol for bringing down temperature as it may interfere with the thermo-regulation of the body which can have serious health repercussions and adverse side effects for the same and cooling spaces during extreme heat days.
- Having science and technology in place is efficient but it has been observed that in-practice management of the same is poor in India. This calls for need to research the underlined causes such as poverty, malnourishment, congestion in urban areas and poor living conditions as the major concerns leading to detrimental impact of various hazards. For this, government machinery at the district level along with other stakeholders must be activated to revisit labour loss, improvised municipal systems and activate health systems.
- Collaboration with non-governmental organizations and other stakeholders can also be identified as a means to expand outreach and communication with any city's most

at-risk communities. Issue advisory on do's and don'ts at public places, rejuvenate ponds, conserve water, integrate DRR measures in development planning, construction sites can have shelters and provision of safe drinking water, have flexi working hours for daily wage laborers and pay daily wage laborers compensation during lean working periods so that they will not be forced to work in extreme weather conditions.

- State authorities can work with wide range of stakeholders to build a political will for heat related health concerns to be considered integral in health policies and programmes. Further, planning frameworks for cities should explicitly incorporate urban health concerns and aim towards improving urban health in he context of heat waves.
- Building bye-laws can have components of passive ventilation and cool roof technologies to increase thermal comfort and made mandatory in more vulnerable cities.
- Encourage investing in water bodies, fountains at areas of mass presence and promote greeneries in urban areas along with improving green transport and energy systems.
- Availability of water for animals in reserved/ protected forests must be ensured. Zoo Authorities should make special arrangements for the animals in zoo to protect them from the effect of Heat Wave. The officers of Forest and Environment department must assess the availability of water for drinking which should be provided through tanker to human habitations facing water scarcity inside reserved forests. Alongside, Construction near tube wells/ repair of vats may also be ensured for roaming livestock to provide them with drinking water.

REFRENCES

1. Indian Heat Wave scenario http://en.wikipedia.org/wiki/2015_Indian_heat_wave
2. Ahemdabad- Gujarat Municipal Corporations' Heat Action Plan
3. Telanagana – Andhra Pradesh State Heat Action Plan
4. Odisha State Heat Action Plan
5. Times of India news: http://timesofindia.indiatimes.com/india/Youre-experiencing-worlds-5th-deadliest-heatwave-ever/articleshow/47485972.cms
6. Heat Health Action Plans: World Health Organization, 2008
7. Heat waves and Health: Guidance on Warning System. World Meteorological Organization and World Health Organization.2015.
8. Hem H. Dholakia, Vimal Mishra and Amit Garg. Predicted Increases in Heat Related Mortality under Climate Change in Urban India. Indian Institute of Management, Ahmedabad. June 2015.
9. Every year could bring a heat wave if climate change continues. (2016). Reuters. Retrieved 3 August 2016, from http://www.reuters.com/article/us-climatechange-heatwave-emissions-dUSKCN0VX26N
10. Heat wave. (2016). Met Office. Retrieved 3 August 2016, from http://www.metoce.gov.uk/learning/learn-about-the-weather/weather-phenomena/heatwave
11. Heat wave (2016). National Disaster Management Authority. Retrieved 3 August 2016, from http://www.ndma.gov.in/en/media-public-awareness/disaster/natural-disaster/heat-wave.html
12. Global Analysis - April 2016 | State of the Climate | National Centers for Environmental Information (NCEI). (2016). Ncdc.noaa.gov. Retrieved 3 August 2016, from https://www.ncdc.noaa.gov/sotc/global/201604
13. Urban Heat Island Effect and Its Mitigation Strategies. TARU, 2014-2015.
14. Challenges 2015: concept Paper- Retrofitting Precincts for Heat wave Resilience: Challenges and Barriers in Australian Context by Gertrud Hatvani-Kovacs and John Boland, Published: January 2015

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About NIDM

The National Institute of Disaster Management (NIDM) is a premier institute of Government of India, established in October 2003 by carving out and upgrading the then National Centre for Disaster Management (at Indian Institute of Public Administration, established by Ministry of Agriculture). Since inception in 2003, the Management Committee of NIDM was chaired by the Union Home Secretary.

NIDM was notified as a Statutory Body in the year 2006, and mandated under the Disaster Management Act 2005 for capacity building including training, education, research, documentation, publication, policy assistance and awareness on all aspects of disaster risk management within India and outside. NIDM is steadily marching forward to fulfill its mission of a disaster resilient India by promoting culture of prevention and preparedness at all levels. NIDM's headquarters is located centrally in the 4th Floor, NDCC-II Building at Jaisingh road, New Delhi -110001.

The Institute (the General Body of NIDM) with the Union Home Minister as its President, has 42 Members comprising of Secretaries of various nodal Ministries and Departments of Government of India and State Governments and heads of national level academic, technical and research organizations, besides eminent experts and practitioners. Institute's Governing Body is chaired by the Vice-chairman of National Disaster Management Authority, and Union Home Secretary is its Vice-chairman. The Executive Director is responsible for managing day-to-day administration of the Institute. The vision and mission of NIDM as guided through its General Body (Institute) leads it as think tank and higher seat of professional and academic advances through its services in form of training, education, research, publications, documentation and advisory services.

Vision of NIDM

To be a premier Institute of excellence for training and research on disaster risk mitigation and management in india and to be recognized as one of the leading Institutions at the international level in the field. To strive relentlessly towards making a disaster free India by developing and promoting a culture of prevention and preparedness at all levels.

Functions /Mandates of NIDM

The DM Act has entrusted following functions to the Institute:

- Planning and promoting training and research in the areas of disaster management,
- Documentation and development of national level information base relating to disaster management related policies, prevention mechanisms and mitigation measures.

Specific functions entrusted to the institute are:

- Training: development training modules, organize training programmes [42(9) (a)]; provide assistance to training institutes in development of training programmes for stakeholders including Government functionaries [42(9)(d)].
- Research: Undertake research and documentation in disaster management [42(9) (a)] and provide assistance to the research institutes for development of research programmes [42(9) (d)].
- Human Resource development: formulate and implement human resource development plan covering all aspects of disaster management [42(9) (b)].
- Policy assistance: in national level policy formulation [42(9)(c) and provide assistance to state Governments in the formulation of State level policies, strategies and disaster management frameworks or assistance as may be required by the State Governments for Capacity-building of stake-holders including Government, civil society, corporate sector and peoples representatives [42(9) (e)].
- Education: including development education materials for disaster management for academic and professional courses [42(9)(f)], facilitate study courses and lectures [42(9)(h)].
- Awareness: among stakeholders including college and school teachers and students, technical personnel and others associated with multi-hazard mitigation, preparedness and response measures [42(9) (g)].
- Publication: undertake and provide for publication of journals, research papers, and books and establish and maintain libraries [42(9) (h)].
- Research Sharing & Dialogue: undertake, organize and facilitate conferences, lectures, seminars within and outside the country.

About NIDM New Delhi Campus

NIDM has been operational through its temporary campus at IIPA New Delhi. Since inception and is presently located in the NDCC-II Building. NIDM is building its own full fledged campus at sector-29, Rohini, New Delhi. The foundation stone of which was laid by Hon'ble Minister of State (Home) Shri Kiren Rijiju on 17th February, 2017. The campus is expected to be operational soon.

About NIDM Southern Campus

To cater specifically to the southern states of India, and in pursuance of the Andhra Pradesh Re-organization Act 2014, a Southern Campus of NIDM has been made functional at Vijaywada since 2016. Currently the Southern campus is operational from its interim unit at A.P. Human Resource Development Institute, Bapatla in Guntur district of Andhra Pradesh, till the construction of its own campus in Krishna district is completed.

Notes

Dos' and Don'ts for Heat Waves

Before

- Install temporary window reflectors such as aluminum foil- covered cardboard etc.
- Cover windows that receive morning or afternoon sun with drapes, shades.
- Listen to local weather forecasts and stay aware of upcoming temperature changes.
- Know those in your neighborhood who are elderly, young, sick or overweight who may become victims of excessive heat and need help.
- Get trained in first aid to learn how to treat heat- related emergencies.

During

- Avoid going out in the sun, especially between 12.00 noon and 3.00 p.m.
- Drink sufficient water and as often as possible, even if not thirsty.
- Wear lightweight, light-coloured, loose, and porous cotton clothes. Use protective goggles, umbrella/hat, shoes or chappals while going out in sun.
- Avoid strenuous activities when the outside temperature is high. Avoid working outside between 12 noon and 3 p.m.
- While travelling, carry water with you.
- Avoid alcohol, tea, coffee and carbonated soft drinks, which dehydrates the body.
- Avoid high-protein food and do not eat stale food.
- If you work outside, use a hat or an umbrella and also use a damp cloth on your head, neck, face and limbs.
- Do not leave children or pets in parked vehicles.
- If you feel faint or ill, see a doctor immediately.
- Use ORS, homemade drinks like rice water, lemon water, buttermilk, etc. which helps to re-hydrate the body.
- Protect face and head by wearing a hat or cloth.
- Keep animals in shade and give them plenty of water to drink.
- Keep your home cool, use curtains, shutters or sunshade and open windows at night.
- Use fans, damp clothing and take bath in cold water frequently.
- Persons with fluid restricted diets should consult a doctor before increasing liquid intake.

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