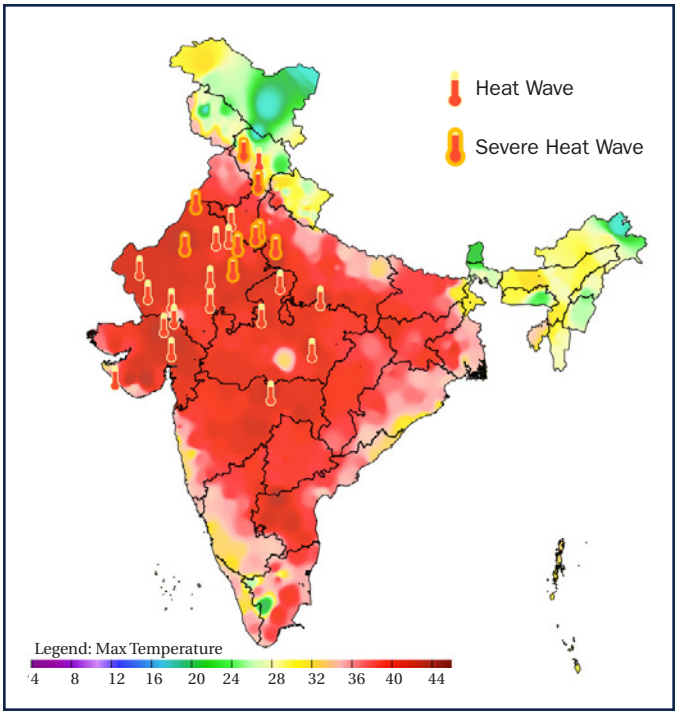
EXPANDING HEAT RESILIENCE ACROSS INDIA: HEAT ACTION PLAN HIGHLIGHTS 2022

As climate change fuels more frequent, intense, and longer heat waves, record-breaking, brutally hot weather is already a major health threat for vulnerable communities in India and other parts of the world.[1] Heat stress refers to physiological ailments and symptoms caused by exposure to high temperatures and often humidity. Heat stress already affects 68 million people worldwide as of 2021.[2] New analysis finds that if global temperatures increase by 2°C (3.6°F) over pre-industrial levels, a billion people will endure extreme heat stress.[3] This finding underscores the importance of limiting global warming relative to pre-industrial temperatures to less than 2°C, and preferably to 1.5°C as outlined in the Paris Agreement; 1.0°C of warming has already occurred.[4] The India Meteorological Department (IMD) in its annual Seasonal Outlook for 2022 forecast a higher probability of heat waves occurring over west-central and some parts of northwest India.[5] Heat Action Plans (HAPs) are essential to protect communities and save lives from extreme heat. Drawing lessons from Ahmedabad's groundbreaking 2013 Heat Action Plan, city, state, and national-level authorities in India are ramping efforts up to implement extreme heat warning systems and preparedness plans.[6] This factsheet presents the most recent highlights on heat resilience for the 2022 heat season in India, typically extending from March to June. In March 2022, large parts of western and central India have already touched 40° C, and many cities are facing severe heat waves (Figure 1).[7]

Figure 1: Extreme Heat in March – a Map of Maximum Temperatures Over Indian States on March 31, 2022.[8]



Note: IMD declares a heat wave when the maximum temperature exceeds 40°C in a region with low elevation or when temperatures reach at least 4.5°C above the normal average temperature. IMD declares a severe heat wave if the departure from normal temperature exceeds 6.4°C (Source: India Meteorological Department, 2022).

HEAT ACTION PLANS (HAPs) BUILD RESILIENCE AND PROTECT COMMUNITIES

HAPs are comprehensive extreme heat early warning systems and preparedness plans. Key objectives of HAPs include improving public awareness and community outreach; facilitating interagency coordination; context-specific capacity building among health care professionals; reducing heat exposure; and promoting adaptive measures.

Ahmedabad's HAP was the first plan in India and South Asia.[9] A study estimated that Ahmedabad, one of India's largest cities, avoided approximately 1,190 deaths a year after implementing its HAP in 2013.[10] City, state, and national level authorities continue to draw lessons from it as they ramp up implementation of extreme heat warning

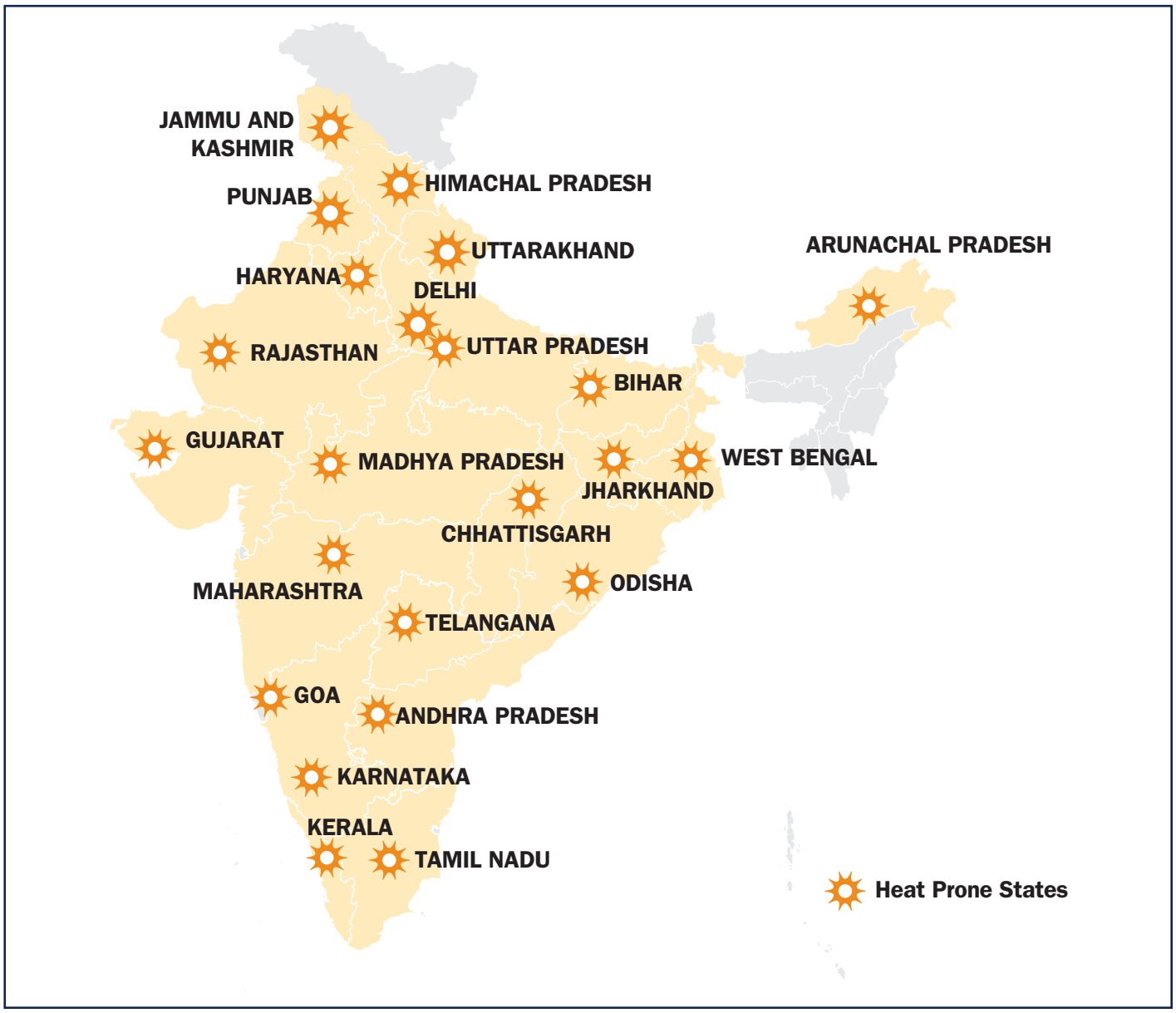
systems and preparedness plans.[11] The Ahmedabad HAP was highlighted as a leading example of urban heat adaptation in the recent Intergovernmental Panel on Climate Change (IPCC) Working Group II report on climate impacts and adaptation.[12]

India's national government is working with 23 heat wave prone states (Figure 2) and over 130 cities and districts to develop and implement HAPs across the country.[13] Natural Resources Defense Council (NRDC) and Public Health Foundation of India (PHFI) - Indian Institute of Public Health-Gandhinagar (IIPH-G) are working together to help develop, launch, and implement HAPs.

NATIONAL LEADERSHIP

The IMD and the National Disaster Management Authority (NDMA) lead India's efforts to prepare for and respond to heat waves. NDMA and IMD have been working with 23 out of India's 28 states that have been identified as heat wave prone to develop heat action plans. NDMA has organized national level annual workshops with key stakeholders – state and city administrators, state disaster management authorities, academic institutions and civil society groups working in the area since 2017. In 2019, NDMA updated its Heat Guidelines, which provide a roadmap for states and cities to develop HAPs.[14] The guidelines, first published in 2016, included a new focus on

Figure 2: 23 Heat Wave Prone States Identified in 2019.



(Source: India Meteorological Department, 2019)

the role of the built environment. For example, cool roofs offer a simple and cost-effective solution to urbanization challenges. Cool roof surfaces, painted with solar reflective paint, covered in tiles, or with white membranes, are better at reflecting sunlight and absorb less heat.[15] Ahead of the 2021 heat season, NDMA encouraged cities to implement cool roofs as part of their HAPs to minimize heat wave impacts, accelerate access to affordable, sustainable cooling through rapid cool roof deployment, and scale and institutionalize implementation of cool roofs.[16]

As leaders prepare for the 2022 heat season, NDMA held a virtual national workshop on prevention, preparedness, mitigation, and management of heat waves in March 2022. The annual workshop brought together academic researchers, policy makers, national-level ministries, non-governmental organizations (NGOs), inter-governmental organizations (IGOs), state governments, and other stakeholders to discuss ways to tackle heat-related issues. The goal is for no Indian to suffer and die prematurely from extreme heat. This will be challenging in a warming world, given the alarming projections from the new IPCC report. Absent transformative changes in our global energy system, there will be worsening wildfires, floods, coastal storms, heat waves, air pollution episodes, and infectious disease outbreaks.[17] Leaders need to further prepare India for a hotter future by addressing the heat resilience of the built environment and focusing on health protections for heat-vulnerable groups, including the elderly, pregnant women, the poor, and those with reduced access to green spaces.[18] In cities, the 'heat island' effect, whereby building materials and paved surfaces retain and then re-radiate the sun's heat, can increase urban heat health risks even further.[19] Long-term urban planning is necessary to save lives and keep communities healthy. There should also be location-specific studies as well as further research in lower-income countries.

NDMA is currently supporting two studies in India to strengthen adaptation and build community-level resilience to extreme heat. The first study is working to identify and map the exposure of vulnerable populations to extreme heat, which will enable targeted approaches to reach them. The Indian Institute of Public Health, Hyderabad (IIPHH) is conducting the study in two cities – Hyderabad and Kolkata, across representational climatic conditions-and expects it to conclude in 2022. Although sections of the population susceptible to heat have been identified, improving granular identification and mapping of vulnerable groups in consultation with representatives of these vulnerable groups will guide policy recommendations to address the groups' needs, and help in developing measurable policy targets and appropriate communication strategies.

The second study supported by NDMA is assessing the effectiveness of India's HAPs and reviewing international HAP best practices. The Visvesvaraya National Institute of Technology, Nagpur is conducting the study and expects it to conclude in 2022. The goal of this study is to clearly identify the components of a "model HAP," including four intervention areas: meteorological, epidemiological, public health, and urban/regional planning. This study has finished reviewing all HAPs across India and 46 HAPs from Bangladesh, Afghanistan, and Nepal as well as countries in North America and Europe. The study has preliminarily identified that the lack of focused hot-spot based interventions as well as changes in land-use planning, and implementation of HAPs are major shortcomings. This research can help cities develop context-specific HAPs that better adapt existing HAP models. The findings and recommendations from both studies will then be incorporated into the heat action planning activities of NDMA and state disaster management agencies (SDMAs).

NDMA, IMD, and IIPHG previously helped develop a report, the first of its kind, on city-specific heat wave temperature thresholds for heat-related health hazards across 103 cities across India.[20] Further insights come from IMD Seasonal Outlooks, which are vital as they give communities lead time to prepare for extreme heat. This helps the states to take appropriate measures in mitigating the adverse health impacts of extreme heat exposure. IMD issues temperature forecasts and warnings in the following ranges: short to medium range (lead time/validity of 1 to 5 days); extended range (lead time/validity up to 4 weeks); and seasonal range (lead time/validity up to 3 months).[21]

The IMD forecast has evolved into a well-structured temperature forecast and heat wave warning/advisory system, starting from seasonal (valid for the heat season – March to June, issued on March 1st annually) to extended range fortnightly to five-day state/met subdivisions to cities. IMD uses a three-tier structure for issuing heat early warnings at the national, regional, and local levels.[22] The daily five-day forecast is critical to interagency coordination, allowing for planning and preparation to ensure water availability and stocking of icepacks and oral rehydration solutions in clinics. IMD and the regional meteorological offices provided five-day forecasts of daily maximum temperatures to over 350 cities in 2021, an increase from 100 in 2016.

In the summer of 2021 IMD introduced new services, in which the IMD website shared maximum temperatures and heat waves observed in real-time through an online map. IMD issued expanded impact-based heat wave warning bulletins that forecast minimum temperatures, humidity, and wind speeds twice per day. Humidity is an

important factor because high humidity limits the loss of heat from the human body via perspiration, making hot days even more dangerous.[23] In 2021, IMD also started issuing forecasts for "warm or very warm nights"- considered when the daytime maximum temperature is more than 40 °C and the minimum temperature is 4.5 °C higher than normal (6.4 °C higher for very warm nights). Warm nights are indicative of high heat retention and may be correlated to urban heat island effects.[24] The information generated was available on a dedicated page on IMD's website.[25]

In 2021, IMD moved from a simple to impact-based early warning system, which includes an estimated impact of extreme heat on human health, including for vulnerable groups. IMD has introduced geographic information system (GIS) tools for dissemination to states, including an interactive GIS map for both heat waves and warm nights.[26] IMD recently announced that it has mapped vulnerability to heat waves at a district-level, for the heat prone states identified nationally.[27] The national highway and railway networks have also been included for targeted early heat warnings, where the heat wave forecast is communicated to specific nodes and administrators for each of these transport networks. For local and state governments to consider the impact of relative humidity during heat waves, IMD is providing 12-hourly relative humidity forecasts from March to June. The impact of heat waves becomes more severe with an increase in the relative humidity.[28] In 2020, IMD launched its Mausam Mobile App to communicate forecasts more easily to the public. Warnings in the app include IMD alerts and severe weather forecasts.[29]

Hydration Stations in Ahmedabad, Part of the City's Local Efforts to Respond to Extreme Heat.

(Source: Natural Resources Defense Council, 2017).

HIGHLIGHTED STATE LEADERSHIP

Across India, extreme temperatures are becoming more frequent, and are occurring in geographies that do not have a history of heat waves, such as Himachal Pradesh and Kerala.[30] As many as 23 States were affected by heat waves in 2019, up from 19 in 2018.[31]

ANDHRA PRADESH

Andhra Pradesh continues to step up efforts to combat extreme heat. Key aspects of the state's HAP include reducing heat-related morbidity and deaths by issuing heat-health warnings, with particular emphasis on vulnerable groups, and raising awareness among the public and health workers.[32] Based on IMD's seasonal outlook, the state identified its high risk and vulnerable areas. Andhra Pradesh focuses on communication to a range of media. For example, the state launched an awareness campaign to inform citizens to avoid peak heat times between 11 am and 5 pm and to take extra precautions for pregnant women in rural areas. In the case of extreme heat, school times will be adjusted or cancelled. Several of the districts distributed oral rehydration salts (ORS) to commuters and made drinking water available in public places. The state has 1,168 automatic weather stations – approximately one for every hundred square kilometers – to better monitor heat conditions.[33] Andhra Pradesh appoints nodal officers, government officers who take the lead in coordination of administrative municipal heat responses and alerts, when called, at the district and mandal levels. The state has a strong early warning system and disseminates the warnings to districts, mandals, and villages. Andhra Pradesh also uses maps and GIS tools for dissemination. Going forward, the state will continue to raise public awareness, establish communication links between state departments and the fields, and utilize online emergency operations center applications/tools. Regarding forecasting, Andhra Pradesh may use European Centre for Medium-Range Weather Forecasts (ECMWF) to support its weather forecasts. It is also considering introducing nighttime temperature forecasts, wind speed and direction, and soil types (for impact on agriculture) into heat wave forecasts, and having special forecasts for describing heat-health risks among animals and birds.

BIHAR

The Bihar State Disaster Management Authority (BSDMA) co-organized the "National Webinar on Preparedness, Mitigation & Management of Heat Wave for 2022" with NDMA. Bihar can experience droughts and floods simultaneously.[34] Fire incidents can also occur; as a state with a large forest area, Bihar is considered highly prone to forest fires.[35] It is resource challenged, given its smaller land size yet dense population. The local government is responsible for identification of extremely heat vulnerable areas, procuring water from private sources, incident reporting, running information and education campaigns, and implementing mock drills for slum areas and farmers. To build heat resilience, the state is working to increase its green coverage, which can reduce the urban heat island effect.[36] For example, new road projects must plant and maintain trees. Protecting livestock is a key focus of the Bihar HAP.[37] The Bihar HAP has 16 key stakeholders and starts annual preparation in January. The Chief Minister monitors the HAP. BSDMA focuses on protecting the heat-vulnerable and has an early warning system. Through spatial analysis, Bihar is attempting to identify heat wave prone districts. The state has worked to develop a mass text messaging system on heat advisories; the early warning system can reach a million people at once. Bihar has a disaster awareness program for children that includes heat waves. This year, HAP awareness will also involve hyperlocal dugdugis (drum beating) announcements in villages.

Previously planned efforts by the state during heat season include information dissemination on heat waves using various forms of media; close coordination with IMD officials in affected regions; holding orientation and training programs, with the health department, for stakeholders such as hospital staff and district disaster management authority officials; implementing timed office closings by changing working hours for laborers under government schemes, closing markets in the afternoon, and constructing permanent roof structures in markets; adding sprinklers for cool mist on railway platforms, having ice bags available at health centers, and possibly making rainwater harvesting compulsory; using light colors in government buildings, schools, offices, and housing societies; and increasing drinking water and public shelter spots.

The state is also focusing on long-term measures to address climate change, and with the support of the UN Environment Program (UNEP), will pursue a climate resilient and low-carbon development pathway. This increases the capacity of Bihar's government departments to deal with climate-related issues. The state's ongoing Jal Jeevan Hariyali program aims to combat climate change, increase conservation, and preserve water resources.[38]

GUJARAT

Ahmedabad, in the western state of Gujarat, has been the leading city in India for its work on building resilience against extreme heat.[39] Ahmedabad's HAP serves as a

template for many cities and states across India, and internationally.[40] The Gujarat State Disaster Management Authority (GSDMA) prepared a Gujarat State Action Plan for Prevention and Mitigation of Heat Wave 2020, as per the 2019 NDMA guidelines.[41] As part of its HAP, Gujarat created detailed district, taluka, and village-level HAPs, which included mapping responsibilities to specific administrative line departments, according to the alert level. Long-term state plans include adopting cool roof technology and carbon neutrality for all buildings, to avoid adding new climate-warming emissions to the atmosphere, and to continue reducing heat-related illness. Cool roofs are one of the simplest and most cost-effective ways to fight the heat; they can help maintain lower indoor temperatures than traditional roofs, reduce dependence on air conditioners, and mitigate the urban heat island effect.[42] The HAP will be integrated into Gujarat's action plan on climate change.

The Gujarat Institute of Disaster Management (GIDM) developed a training module, "Extreme Heat Prevention and Management," which can be used by participants to protect people's health from extreme heat during summers.[43] The training module is available in Gujarati. GIDM recently developed and released a comic book to raise awareness on heat waves for children (Figure 3), available in both English and Gujarati. [44]

MAHARASHTRA

With the first regional HAP developed in India for the Nagpur area in 2016, Maharashtra went on to develop a statewide HAP in 2017.[45] The Nagpur Municipal Corporation updated its HAP in 2019 from the original plan developed in 2016, along with five neighboring districts. The HAP consists of heat mitigation measures in accordance with the guidelines issued by NDMA. The HAP identified slum-dwellers, street-dwellers, laborers, and rickshaw-pullers as the most vulnerable groups as they are exposed to extreme heat on a regular basis.[46] This year with heat wave conditions facing Mumbai and neighboring districts, the Brihanmumbai Municipal Corporation (BMC) appealed to citizens to stay safe and hydrated and avoid going out in the afternoon especially between 12 noon and 3 pm to prevent a serious ailment or death due to heat stroke.[47] The BMC is also suggesting that people

Figure 3: Comic Book to Raise Awareness on Heat Waves for Children.

(Source: Gujarat Institute of Disaster Management, 2022).[44]

carry water while going out in the afternoon; drink water regularly, even if not thirsty; avoid strenuous activities outside; avoid tea, coffee, soft drinks, high-protein and stale food; take oral rehydration salts and homemade drinks like lassi, torani (rice water), lemon water and buttermilk that help to rehydrate the body; use a hat or an umbrella; use a damp cloth on head, neck, face, and limbs if working outdoors; use fans; and bathe in cold water frequently.

Five major cities in Maharashtra, including Mumbai, are implementing Climate Action Plans to adapt, mitigate, and build resilience to climate change.[48] The plans will focus on sustainable transport, green energy and buildings, air quality, improving green cover, water, and waste management. Mumbai's climate plan proposes several ways to deal with rising heat: increase green cover, set up warning systems and cooling centers in vulnerable areas, and adopt new building design policies. It recommends increasing vegetation cover and permeable surface by 30 to 40 percent by 2030 and increasing per capita open space from the current 1.8 square meters to 6 square meters by 2040 in an equitable way.[49] Mumbai also recently announced that it is aiming to reach net-zero emissions by 2050, making it the first city in South Asia to set such a timeline and 20 years ahead of India's current target.[50]

ODISHA

Odisha continues as a pioneer in disaster preparedness in India, from cyclones to heatwaves. Building on its 2015 HAP, the Odisha State Disaster Management Authority (OSDMA) tackles heatwaves through an early warning system that considers both temperature and humidity levels to issue heat alerts.[51] A state-level preparatory meeting on heatwave management is held annually by the chief secretary of the state administration and involves key departments and stakeholders. OSDMA issues directives to key departments to prepare and take precautionary measures and disseminate alerts and warnings to institutions and the public once heat alerts are received from IMD. OSDMA coordinates awareness campaigns and information, education, and communication (IEC) actions. Temperature forecasts and heat alerts are sent as bulk messages on mobile phones, including to the media for wider broadcast. Electronic screens at busy traffic intersections and marketplaces display warnings and heat information. Odisha developed a website and a mobile phone app that provides heat alerts and helps users identify, via maps, heat shelters and drinking water sources along highways. To build capacity among healthcare workers, Odisha has set up dedicated sections in hospitals to provide treatment for heat-related illness and increases staffing during heat alerts. OSDMA also facilitates capacity building for stakeholders and involves civil society organizations in awareness-building activities.

OSDMA conducts studies to identify threshold temperatures for different cities and regions in the state.[52] Given Odisha's distinct geophysical regions, it is important to determine region-specific thresholds that combine temperature and humidity, which together cause heat wave-related morbidity and consequent mortality. According to OSDMA, there is also the need to assess community vulnerability and then to design preparedness and cooling strategies.

For 2022, the state government decided to restrict public transport services during peak hours of the summer season to ensure passengers do not face health issues due to the heat.[53] OSDMA announced that the timing of public transport services will be rescheduled so that bus travel during peak heat wave hours between 11 am and 3 pm is restricted. The Chief Secretary also directed districts to raise check dams using sand-packs in small streams, to store water near tube wells and sanitary wells for stray animals and birds, and to urge all households both in rural and urban areas to keep water pots available for the animals.[54]

Figure 4: Color Code Signals for Heat Alert and Suggested Actions.

Colour Code	Alert	Warning	Impact	Suggested Actions
Green (Noactlon)	NormalDay	Maximum temperatures are near nomal.	Comfortable temperature. No cautionary action re ulred.	Nil
Yellow Alert (Be updated)	Heat Alert	Heat wave conditions at isolated pockets persists on 2 days	Moderate temperature Heat is tolerable for general public but moderate health concern for vulnerable people e.g. infants, elderly, people with chronic diseases	· Avoid heat exposure. · Wear lightweight, light coloured, loose, cotton clothes. · Cover your head: Use a cloth, hat or umbrella
Orange Alert (Be prepared)	Severe Heat Alert for the day	(i) Severe heat wave conditions persists for 2 days (ii) Through not severe, but heat wave persists for 4 days or more	High temperature. Increased likelihood of heat illness symptoms in people who are either exposed to sun for a prolonged period or doing heavy work. High health concern for vulnerable people e.g. infants, elderly people with chronic hydrated diseases.	· Avoid heat conditions exposure- keep cool. Avoid dehydration. · Drink sufficient water- even if not thirsty. · Use ORS, homemade drinks like lassi, torani (rice water), lemon water, buttermilketc. to keep yourself hydrated
Red Alert (Take Action)	Extreme Heat Alert for the day	(i) Servere heat wave persists for more than 2 days. (ii) Toral number of heat/severe heat wave days exceeding 6 days.	Very high likelihood of developing heat illness and heat stroke in all ages	Extreme care needed for vulnerable people.

(Source: India Meteorological Department Standard Operating Procedure - Weather Forecasting and Warning Services, 2021).

COMBATTING HEAT IN CITIES AND DISTRICTS ACROSS INDIA

In addition to state and national efforts, HAPs led by city officials are vital in protecting local communities. City leaders have a clear mandate to protect residents and can employ local means of communication to reach the public. Municipal corporations can design programs tailored to their communities as well as provide early planning, coordination, capacity building, surveillance, and longer-term measures to combat the heat island effect and climate change. City leaders are often charged with issuing and disseminating public health-based heat alerts in association with a color-coded early warning system while the IMD issues "heat wave warnings" that are more rooted in meteorological definitions of various extreme heat levels. IMD looks to city and regional governments to issue more health communication-based "heat alerts" and for them to use their meteorological forecasts to strengthen community heat resilience.

KEY ELEMENTS OF HEAT ACTION PLANS

An effective HAP requires a combination of strong local leadership, interagency coordination, scientific expertise, broad communication strategies, and community engagement. Locally developed plans can be tailored to local conditions; while one size does not fit all, the HAPs in India have common features that are important to protecting communities from extreme heat.[55] The five core elements are:

1. COMMUNITY OUTREACH TO BUILD PUBLIC AWARENESS

- Locally developed and scientifically supported IEC pamphlets, hoardings/billboards, and videos to inform people on how to protect themselves from extreme heat.
- Social media channels, bulk text messages, emails, radio, and mobile applications such as WhatsApp, aiming to reach the public.
- Special efforts to reach vulnerable populations through focused sessions and direct communication by health care professionals in local clinics, ambulance service, and urban health centers.

2. EARLY WARNING SYSTEMS TO ALERT RESIDENTS AND INTER- AGENCY COORDINATION

- Early warning systems (such as color-coded alert categories as shown in Figure 4) that correspond to increasing heat-health levels/ the severity of an expected heat-hazard trigger a joint response by the relevant city and state authorities during extreme heat and alerts residents. For example, the Ahmedabad HAP uses a simple, color-coded, early warning "heat alert" system that alerts residents and city offices of predicted high and extreme temperatures.[56]
- Formal communication channels to alert state and city government agencies, including health officials and hospitals, emergency responders, local community groups, media outlets and other key stakeholders – with an identified nodal officer.
- Standard operating procedures (SOPs) for activities before, during and after heat season for each department to successfully implement a HAP that identify and define responsibilities of government departments.

3. CAPACITY BUILDING AMONG HEALTHCARE PROFESSIONALS

- Special training modules for health staff in urban health centers.
- Training programs for private general medical practitioners to equip first responders with knowledge of effective diagnosis and first-aid treatment for heat- related illnesses.
- List of "Do's and Don'ts" with help of local health professionals and disseminate to public through effective use of various media (print and social media, radio stations, TV ads).

4. ADDRESSING VULNERABLE GROUPS

- Focused efforts, such as awareness and drinking water, for children, elderly people, people exposed to prolonged periods of extreme heat due to their profession (e.g., construction workers, farmers, traffic police), who are more vulnerable to extreme heat.
- Affordable space cooling solutions and health care for vulnerable groups.
- Adaptive measures, such as cool roofs for vulnerable communities.

5. IMPLEMENTING ADAPTIVE MEASURES

- Communication on response methods, including drinking water, cooling centers, gardens, and shade spaces during extreme heat days.
- Land use strategies to reduce the urban heat island effect, including green infrastructure, cool roofs, trees, and vegetation, and increasing green spaces.
- Streamlining traffic and congestion reduction policies and strategies.

INTEGRATED RESEARCH AND ACTION FOR DEVELOPMENT

Integrated Research and Action for Development (IRADe) has developed and implemented climate adaptive HAPs through extensive studies on mapping heat-vulnerable populations and heat islands in the cities of Delhi, Bhubaneshwar, and Rajkot.[57] IRADe, along with the South Asia Heat Health Information Network (SAHHIN), have developed a toolkit to act as a platform to promote scientific interventions, prepare action plans and empower capacity building among stakeholders for South Asian countries. They have also organized several masterclasses and conducted medical stakeholder trainings.[58] The Global Heat Health Information Network (GHHIN) also offers heat-health masterclasses.[59] In 2020, IRADe collaborated with the local and state governments of the cities of Delhi, Rajkot, and Bhubaneswar to raise awareness and inform stakeholders on the impact of heat stress. Awareness activities in all three cities included highlighting the need for cool roofs to improve indoor thermal comfort during extreme heat, and the covering or shading of rooftops.

NEW RESEARCH ON EXTREME HEAT VULNERABILITY

Researchers from Mamta-Health Institute for Mother and Child, IIPH-PHFI-Bhubaneswar, Administrative Staff College of India, and PHFI-Gurugram conducted a heat vulnerability study across four cities.[60] This study included 500 households from each city: from Ongole in Andhra Pradesh, Karimnagar in Telangana, Kolkata in West Bengal, and Angul in Odisha. It assessed the extreme heat vulnerability of the population of the four different cities. The study assessed the multidimensional heat vulnerability index for each household to estimate the magnitude of their vulnerability to extreme heat and heat waves. A heat vulnerability index can help identify vulnerable populations and prepare vulnerability maps.

The study considered factors including, but not limited to, house and roof type, time spent outside, water shortages, power cuts, education, income, having hypertension and/or diabetes, water body access, and the ability to reduce time outside and drink more water during the summer.

Most of the households fell under moderate to high heat vulnerability levels across all the cities. Angul had the maximum share of households that were vulnerable to extreme heat, followed by Kolkata, Karimnagar and Ongole. Analysis revealed that household vulnerability is more significantly related to adaptive capacity than sensitivity and exposure. At the regional level, the urban households in the southern part of India have a relatively lower overall heat vulnerability as compared to those in the eastern belt of the country. This is because both exposure and sensitivity are comparatively lower among the urban households of the southern cities, even though their adaptive capacity to counter extreme heat is lower in southern cities, as compared to those in eastern cities.

Students are Vulnerable to Extreme Heat.

(Source: NRDC).

Endnotes

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