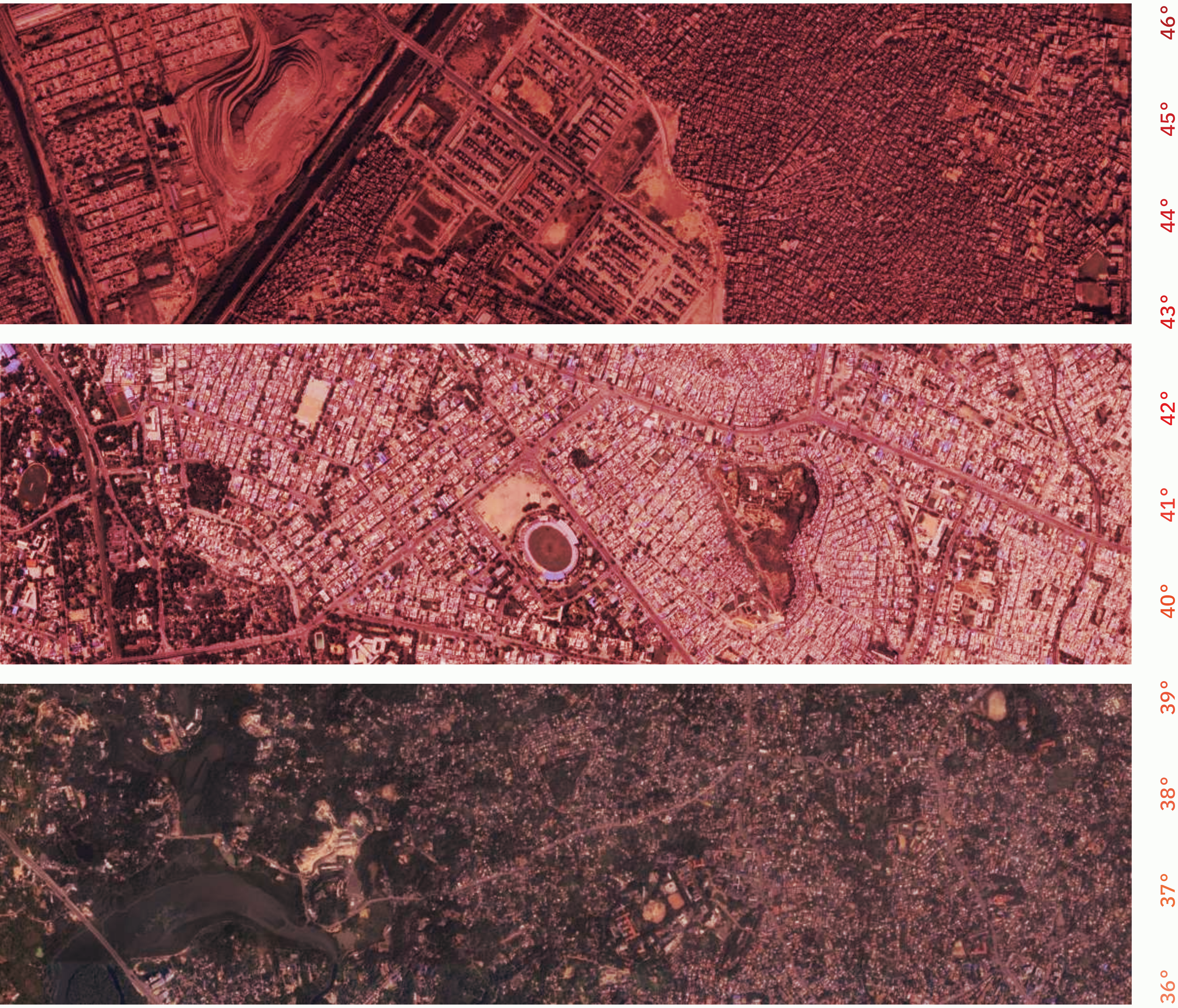
Is India Ready for a Warming World?

How Heat Resilience Measures Are Being Implemented for 11% of India's Urban Population in Some of Its Most At-Risk Cities



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ABSTRACT

This is the first assessment of the implementation of extreme heat policies in multiple cities in India. Using an ensemble of climate models from CMIP6, it focuses on just over 11 percent of India's urban population (Census of India, 2011) in some of its most at-risk cities to future heat as the climate warms. Through interviews with 88 government officials in disaster management, health,city planning, and labour departments, as well as city and district administrators, we find that while all cities reported implementing short-term response measures to prevent the loss of lives during heat waves, there was a significant gap in their long-term preparedness for future heat. Inconsistent and weakly targeted long-term heat actions suggest that India will likely see heat waves with higher mortality levels more frequently in the coming years as short-term life-saving responses and communities' adaptive capacities are overwhelmed by rising temperatures. We show that this pattern of policy implementation arises because of a mix of weakly institutionalised heat action plans, limited public support for long-term measures, and an interconnected set of institutional constraints, based on which we identify policy recommendations to make ongoing heat actions more responsive to future heat.

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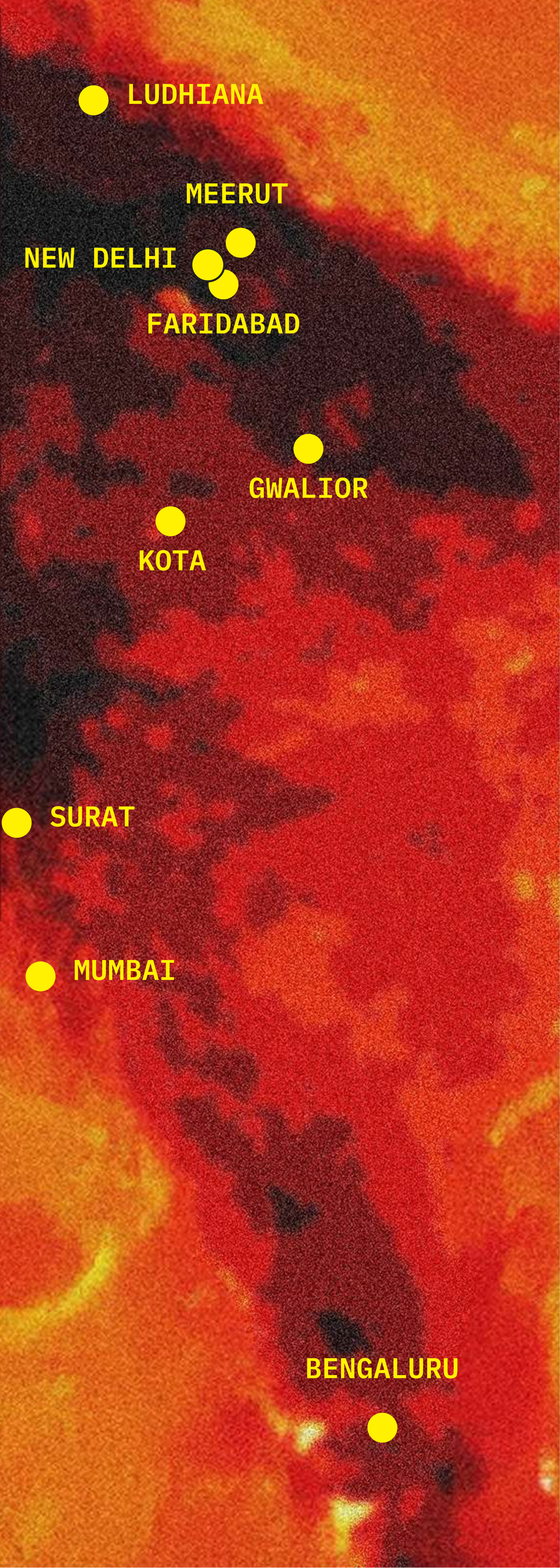
EXECUTIVE SUMMARY

In this report, we study the implementation of policies and actions aimed at reducing extreme heat risks in nine Indian cities in nine states, covering a little over 11 percent of India's urban population. We picked these cities based on how vulnerable they were to increases in extreme heat events as the planet warms. Using CMIP6 climate model output, we established which Indian cities with a population over 1 million (according to Census 2011) would experience some of the greatest increases in days with dangerous heat index values (a measure of the combined effect of temperature and humidity) compared to the historical average. Rapid shifts in the extreme heat index distribution induced by climate change may overwhelm communities' adaptive capacity and lead to substantial increases in heat-attributable mortality and morbidity. This study is particularly urgent given recent indications that the climate may be warming faster than previously anticipated.



Approach

We conducted 88 interviews with city, district, and state government officials charged with implementing heat actions in these nine cities. Because heat adaptation requires a coordinated, cross-sectoral response, we conducted interviews with representatives of disaster management, health, city planning, and labour departments, as well as city and district administrators.

To assess how prepared these cities are for extreme heat in the coming decades, we catalogued short-term measures meant to save lives while paying special attention to heat solutions that are thought to bring long-term benefits. The latter include changes to urban form and the built environment - expanding urban tree cover, reducing density by increasing open space with building setbacks and parks, and changing design norms for heat-trapping buildings - and improvements in institutions that manage heat risk, from capacity-building efforts for government officials to the mandatory reporting of heat deaths to higher levels of government. Many of these actions take years to mature through refinement before they improve lives on the ground.

This is the first study to assess the implementation of extreme heat policies and actions across multiple cities in India. This study is novel in its focus on long-term policies and their implementation challenges. We believe the issues and patterns highlighted in this report will be useful to cities, in India and elsewhere, that are attempting to complement their short-term responses with long-term heat risk mitigation through structural and institutional responses.

Findings

All cities report short-term emergency measures: These include actions like access to drinking water, changing work schedules, and boosting hospital capacity before or during a heat wave. If these measures are being implemented correctly, verification of which is beyond the scope of this study, this could be read as a positive story in achieving a minimum baseline of life-saving actions across cities in just over a decade since India's first heat action plan (HAP) was published in 2013.

Long-term actions are focused on the health system: Long-term solutions, meant to reduce the mounting, cumulative risk of heat waves due to global warming, were most commonly reported for the health system. As a result, what emerges is a picture of very weak mainstreaming of long-term heat concerns in other crucially important sectors. Health system preparedness, while foundationally important to heat resilience, is meant to deal with the consequences of heat overwhelming the adaptive capacity of societies rather than prevent such situations from occurring.

A significant proportion of reported long-term actions are poorly targeted: Long-term solutions were both less common and less likely to be effective because they were not targeted at heat vulnerable populations. Actions such as the expansion of urban shade and green cover, the creation of open spaces that dissipate heat, and the deployment of rooftop solar that could help with active cooling, among others, were driven by the developmental objectives of existing sectoral programmes without adequate attention to populations and areas that experience the greatest heat risk.

Many important long-term actions are entirely absent: These include making household or occupational cooling available to the most heat-exposed; developing insurance cover for lost work; expanding fire management services for heat waves; and electricity grid retrofits to improve transmission reliability and distribution safety. Other foundational actions such as the expansion of local weather stations for more granular data on heat variation within a city, mapping urban heat islands, and training heat plan implementers were only seen in some cities.

Short-term actions are inexpensive, the shift towards long-term climate adaptation will require more finance: Over two-thirds of respondents reported adequate funding for heat actions and that they were drawing from a diverse range of existing sources spanning local, state, and national funds. This is a consequence of a focus on short-term actions that are relatively inexpensive and temporary. Long-term structural changes, such as those mentioned above, will require dedicated financial resources.

Based on this distribution of inconsistent and weakly targeted long-term heat actions in our sample, India will likely see heat waves with higher mortality levels more frequently in the coming years as short-term life-saving responses and communities' adaptive capacities are overwhelmed by rising temperatures.

FIGURE 1: Distribution of reported heat actions across nine cities

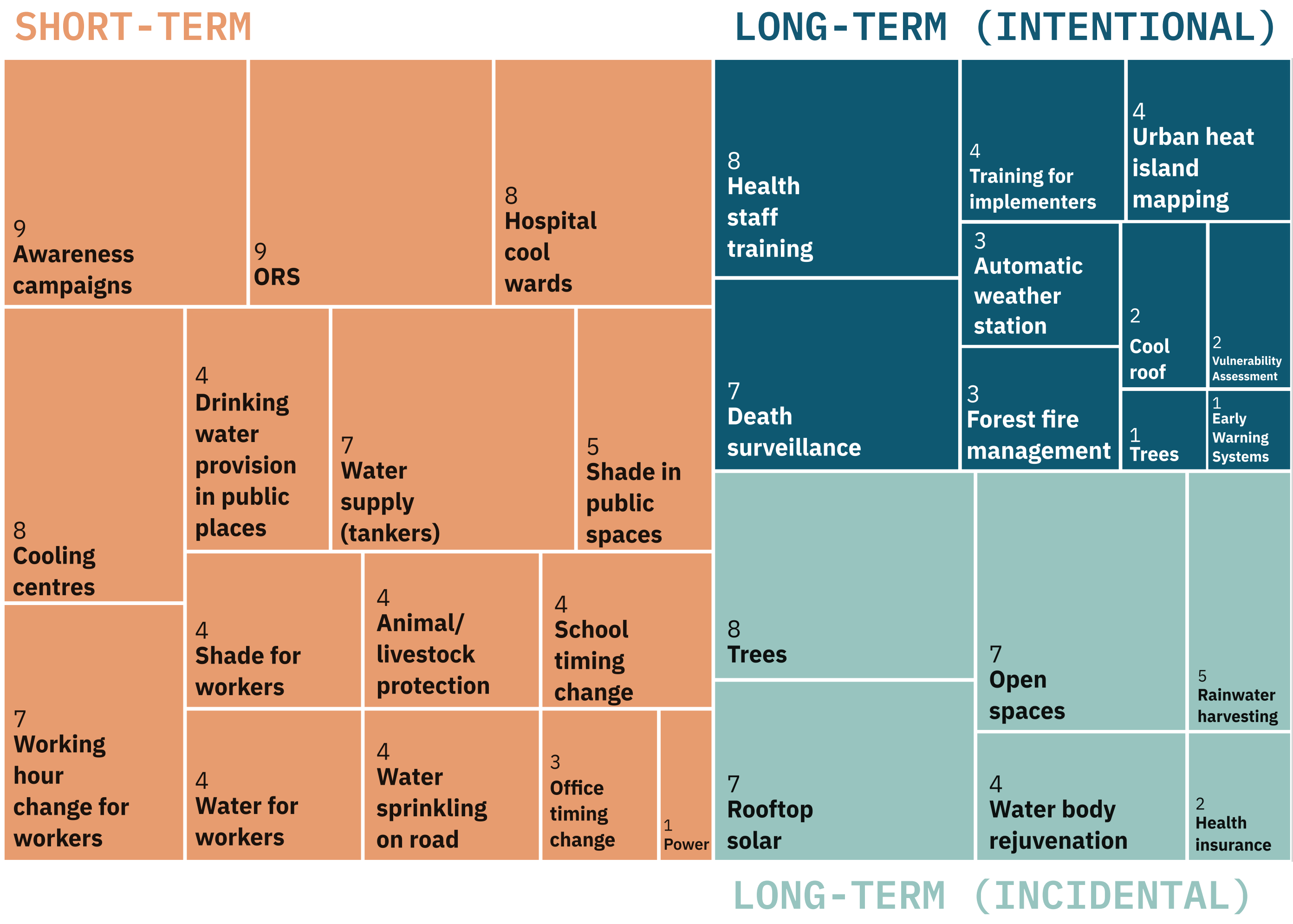


Fig 1. Reported heat actions (n=150 solutions) largely focus on short-term actions, while a significant proportion with potential long-run benefits fall in the 'incidental' category, meaning they do not target areas or populations at highest risk. 'Intentional' actions are few and sporadic when health system measures, which are meant to deal with the effects of a heat wave rather than reduce their initial impact, are removed. The figure in the diagram above, represents the number of cities, out of nine, in which the action is observed.

Analysis

In our interviews with policymakers and implementers, we found that this distribution of heat action was driven by the following factors:

1. Guidelines and directives from higher levels of government drive short-term response measures, heat action plans (HAPs) seem to have a weaker effect on policy: Many of the life saving short-term actions reported across cities are a product of emergency directives from higher levels of government issued before or during a heatwave, including state and national disaster management and health authorities. HAPs, which often contain long-term measures, seem to have a weaker effect on shaping the range and scope of heat actions because they are weakly institutionalised.

2. Public demand focuses on short-term action: Officials reported limited public demand for long-term actions. Such actions are invisible and therefore less politically salient. Demand instead focused on reducing immediate impacts through short-term actions such as maintaining water supplies.

3. Institutional constraints limit the possibilities for long-term action: The top problem identified by respondents was coordination between government departments, both within and between municipal, district, and state government departments. Over half of all responses identified an inter-linked mix of personnel shortages, competing priorities, weak technical capacity, and insufficient acknowledgement of the heat problem as constraints .

FIGURE 7: Barriers to heat action by sector

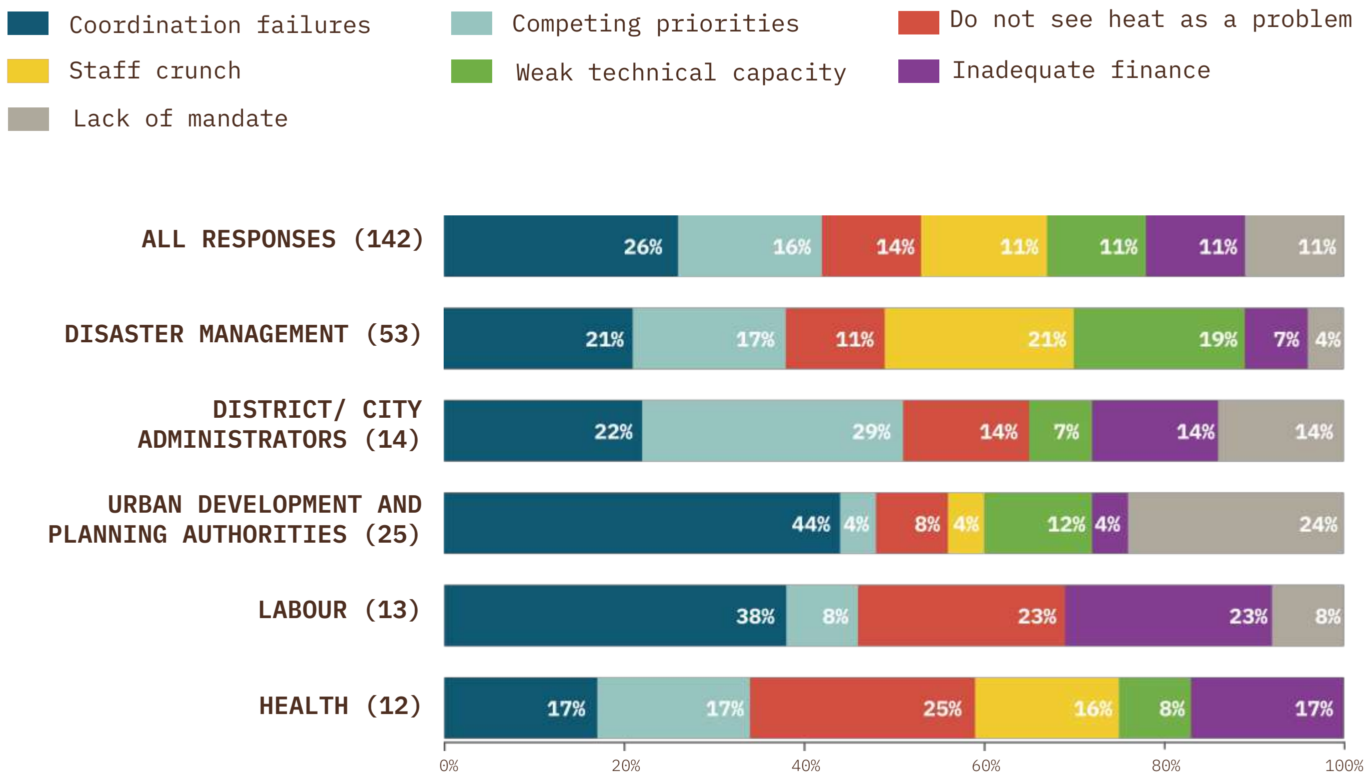


Fig 7. Coordination problems emerged as the single largest institutional constraint, followed by competing priorities limiting the focus on heat. A substantial portion of implementers did not see heat as a policy problem. Rows represent department-types interviewed in nine cities, brackets contain responses per department-type. The top row averages responses across all respondents.

POLICY RECOMMENDATIONS

Institutional Changes

1. Strengthen HAPs in local governments:

HAPs could help institutionalise long-term actions. They could also make crucial targeting mechanisms such as vulnerability assessments and the identification of urban heat islands mandatory. To do this, HAPs at both state and city/district levels need to be endowed with adequate bureaucratic heft. This could be achieved through anchoring them in specific heat or omnibus climate legislation in the states, building an implementation monitoring system anchored within the central/state government (using heat action expenditure data and health outcome data), and, most importantly, allocating national or state public finance towards long-term risk mitigation efforts.

2. Draw on disaster mitigation funds that provide for extreme heat risk mitigation:

As of late 2024, sub-national governments were allowed to draw on National and State Disaster Mitigation Funds to execute projects that mitigate heat wave risks. States should harness this line of finance to set up a pipeline of long-term risk reduction projects. This will, however, require boosting technical capacity in local governments to design and execute effective projects.

3. Heat officers need appropriate institutional backing:

Nascent conversations about creating Chief Heat Officer-type positions should also consider how to equip them with adequate authority to solve the underlying institutional problems we have identified. In their absence, CHOs will likely face the same hurdles ‘nodal’ heat officers face today. The recommendations in this report, taken together, can help create appropriate institutional conditions.

Capacity Building

1. Create a targeted capacity building programme for HAP implementation across India's most heat-vulnerable cities:

A sustained, multi-year capacity building effort aimed at 'last-mile' implementers, i.e. those in charge of executing departmental actions at the city/district level, in India's ten most heat-vulnerable cities could rapidly improve India's heat resilience prospects. We recommend starting with a small group with high potential impact and expanding over time to other cities.

2. Establish trained disaster management support staff capacity at the district/city level:

We recommend creating permanent and funded specialist positions in the most heat-vulnerable districts and cities, with training for long-term risk mitigation.

Technology

1. Create a highly-targeted active cooling programme:

The rapid increase in temperatures and massive gap in long-term heat resilience strongly suggest that at-risk urban populations will turn to air conditioning to protect their lives. State and national governments should deploy a subsidy or large-scale purchase programme that allows these families to buy energy-efficient ACs. They must be targeted at portions of Indian cities with the highest heat risk, determined by the vulnerability assessment of its HAP. This could reduce heat-risk as well as energy bills and emissions that are likely to be generated by the business-as-usual national cooling trajectory. Governments must also invest in ongoing R&D efforts to scale next-generation cooling technologies while investing in transmission and distribution infrastructure and renewable energy expansion. This programme must complement existing efforts at passive cooling, which will play a pivotal role in reducing air conditioning usage times.

2. Use climate projections to inform implementers about future heat impacts and expand the scope of solutions:

Only two out of 42 respondents asked had access to climate projections.Most implementers therefore did not know what the most dangerous days in a +1.5°C world would look like in their cities. We recommend a national programme, anchored by national technical institutes, to make this information available to key state, district, and city officials in the regions most vulnerable to rapid warming.

INTRODUCTION

In this study, we assess whether India is ready for the extreme heat of a +1.5°C world by analysing the implementation of heat actions in nine cities that are some of the most at-risk to future heat. While we catalogue all actions taken, we pay particular attention to actions with long-run resilience benefits.

Projections indicate that extreme heat events in India will not only increase in severity but also in duration, particularly in monsoon months when high humidity levels amplify health risks (Perkins et al., 2023; Vargas Zeppetello et al., 2022; Rao et al., 2023). These trends will have far-reaching consequences.

Heat-related mortality is projected to rise sharply (Vicedo-Cabrera et al., 2018), with global heat deaths expected to increase by 370 percent for people over 65 years of age by mid-century in a +2°C warming scenario (Romanello et al., 2023). India's working population is especially vulnerable, with one estimate suggesting that three-fourths of the labour force is exposed to extreme heat (World Bank, 2022). By 2030, heat stress could reduce India's working hours by 5.8 percent, equivalent to 34 million full-time jobs (ILO, 2019). Low-wage informal workers could suffer a pincer movement with declining wages and increasing health expenses due to prolonged heat exposure (Das et al., 2024) increasing the potential for poverty traps.

Addressing these growing risks requires structural, long-term risk reduction because short-term disaster responses, even if well executed, cannot be expected to address future increases in the intensity and frequency of heat waves. This shifts the onus onto more complex and expensive actions such as restructuring the built environment to be less heat trapping, stimulating a shift to a less heat-exposed economy, augmenting health system capacity, and building state institutions with the ability to execute cross-sectoral heat policy, among others.

The timeline for effective action is shrinking rapidly. June 2024 was the first time global mean temperatures crossed the 1.5°C warming threshold for 12 consecutive months (Cannon, 2025). This signals that the global community will not meet Paris Agreement's aspirational goal of limiting end-of-century warming to 1.5°C (Bevacqua et al. 2025). Recent studies further suggest that the planet could breach 2°C for the first time by 2045 (Hansen et al., 2025).

Over the last decade, the Indian state at all levels, from city to district and state, has responded to this emerging threat with Heat Action Plans (HAPs). The first HAP was created for Ahmedabad city in 2013, after a lethal heatwave in 2010 (Hess et al., 2018). These are cross-sectoral plans that allocate tasks to government departments to be carried out before, during, and after a heat wave. The policy framework for heat action varies by state. In our sample of nine cities, seven cities had operated through HAPs. Meerut had both a district and state HAP in operation, Surat had both a city and state HAP, while Bengaluru, Faridabad, Kota, and Mumbai all operated through state HAPs.

Apart from detailing crisis response measures, HAPs should ideally provide ways of embedding heat actions within ongoing developmental efforts, an approach being explored in other countries (Meerow et al., 2024, Keith et al., 2022). Though very few Indian HAPs make these links at present (Pillai & Dalal, 2023), data from our study (see p. 19) shows that local officials routinely use state and national schemes for urban rejuvenation, water distribution, and tree planting. In the present policy landscape, HAPs and other climate plans can serve the crucial function of channeling ongoing developmental expenditure towards climate resilience goals by targeting vulnerable populations.

HAPs are generally weakly institutionalised and function more as guidance documents than legally enforceable policy prescriptions, and lack adequate grounding in local conditions (Pillai & Dalal, 2023). In this report, we study actions listed in HAPs as well as actions executed independently of them.

This study is the first systematic multi-city analysis of heat action implementation in India. It focuses on nine cities in nine states and covers just over 11 percent of India's urban population (Census of India, 2011) in some of its most at-risk cities.

It catalogues all heat actions but focuses on long-term measures that must be initiated now to reduce future heat risk. We also assess institutional and political factors that are driving or hindering action to understand whether implementation patterns are likely to persist and to identify what needs to change to adapt to a much hotter world.

THE COMPLICATED, VARIED TERRAIN OF HEAT GOVERNANCE IN INDIA

Heat governance in India is split between national, state, and city /district governments. The broad framework for local policies is provided by national guidelines for heatwave preparedness issued by the National Disaster Management Authority (NDMA, 2019) which are followed to different degrees by states, districts, and cities as they establish local HAPs, and by guidelines by the Ministry of Health and Family Welfare for the health sector (MoHFW, 2024; NCDC, 2024). During or just before heatwaves, they are supplemented by rapid response directives from national or state government departments - that are independent of HAPs - to prevent the imminent loss of life.

Units of governance, such as cities, are often also responsible for implementing the heat plans of other units, such as those of the districts or states they are located in. The extent of these 'overlaps' varies by state and it is unclear how conflicts are resolved and actions prioritised in such cases. For example, in our sample, all state HAPs list responsibilities for cities, despite cities like Surat having their own city-specific HAP. Meerut's district HAP also prescribes actions for the municipal government. Gwalior and Ludhiana, on the other hand, did not have HAPs. Parallel policies also shape the complexity of implementation; two cities in our sample, Bombay and Bengaluru, have their own city-level Climate Action Plans.

Heat governance is also influenced by differences in public administration between states. All nine cities have municipal governments but the degree to which powers are devolved to them varies (MoHUA, 2021).

METHODS

To examine how Indian cities are preparing for future heat waves, we focused on understanding whether and how local government officials implement heat action plans (HAPs) and supplementary directives from higher levels of government, and the pressures and challenges they face. Our study draws on 88 semi-structured interviews conducted across five key departments: disaster management (28 percent), health (14 percent), labour (9 percent), urban planning departments (22 percent), and district and municipal administrative heads (10 percent) - in nine cities across nine states, covering 11 percent of India's urban population (Census of India, 2011) in some of its most at-risk cities. We also interviewed seven civil society and para-governmental organisations, taking the total to 95 interviews. Interviews were used to identify and triangulate solutions implemented and challenges faced in each city, and to determine their frequency across the sample. We use anonymised quotes from the interviews to reinforce frequency-based findings in the sections below.

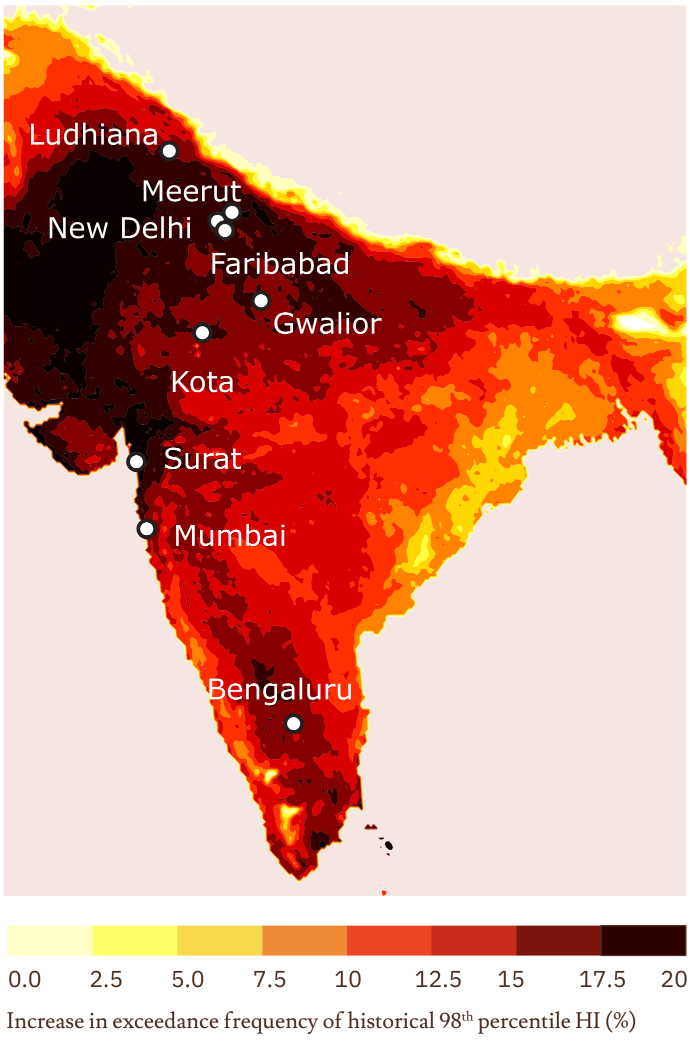
Case Selection

Cities were selected based on their deviation from historical climatological conditions and their population size.

To understand which cities were most vulnerable to increasing temperatures, we first calculated hourly heat index across India using hourly ERA5 reanalysis data from 2013-2022 (Hersbach et al. 2020) and used this baseline to define the local 98th percentile for the heat index (HI). The 98th percentile HI was prioritised in case selection as it represents extreme HI days with a higher likelihood of significant mortality and morbidity (Guo et al., 2014; Kovats & Hajat, 2008). Next, we added projections (using an ensemble of climate models from CMIP6) of temperature and relative humidity to this historical time series of heat index at each place in space to quantify future changes in the heat index distribution for various climate scenarios. This procedure was used to quantify how frequently each place in India would exceed its historical 98th percentile threshold under 1.5°C, 2°C, and 2.5°C warming scenarios.

Map 1 on the right shows the percentage increase in frequency at which the local 98th percentile of Heat Index (HI) will be exceeded in a +1.5°C world. It captures increases over a +1.2°C baseline.

MAP 1: Percentage increase in extreme Heat Index (HI) days for each place in space in India at +1.5°C.



Map 1. Percentage increase in extreme Heat Index (HI) days (98th percentile) above the historical threshold (2013–2022) for each place in space at 1.5°C. The map captures increases over a +1.2°C baseline.

Our models focused on the +1.5°C scenario because this represents the new normal that heat policy must acknowledge. We also focused on cities with some of the largest increases in extreme event frequency, and on the extent of change from their historical baseline rather than absolute heat index days because aggressive changes in conditions are more likely to lead to mass-casualty events than absolute highs.

We focused on the +1.5°C scenario because this represents the new normal that heat action policy must acknowledge for the coming decades. Global warming of 1.5°C relative to the historical baseline will be a feature of climate over the next two decades absent deployment of carbon drawdown technologies that are currently not available at scale (Bevacqua et al., 2025; Cannon, 2025). This creates an urgent need to assess long-term adaptation measures, many of which have long gestation periods and need to be initiated now to reduce risks in a hotter world.

Regions projected to be the most dangerous in a +1.5°C scenario remain the most dangerous in +2°C and +2.5°C warming scenarios. Places already at risk will face even greater risk as global temperatures rise. This trend suggests that rectifying the underlying challenges to implementation in these regions will create the conditions for long-term, multi-decadal resilience.

Our initial sample included all Indian cities with populations exceeding one million (Census of India, 2011), totalling 46 cities. This placed the focus on large urban centres, where heat risks are amplified by the urban heat island effect. Cities with the highest projected percentage increase in extreme HI days under a 1.5°C scenario were shortlisted. To maximise institutional and contextual diversity, only one city per state was selected when multiple cities from the same state met our criteria.

Our final sample (listed in decreasing order of percentage increase in extreme HI days in a +1.5°C world) included Surat, Mumbai, Meerut, Faridabad, Kota, Delhi, Gwalior, Ludhiana, and Bengaluru, collectively representing 42.7 million people (Census of India, 2011), which is slightly over 11 percent of the total urban population (37,71,06,125) of India in 2011.

Of these nine cities, Surat and Meerut were guided by local HAPs (Surat had a city-level HAP, while Meerut had a district-level HAP). Four cities (Faridabad, Kota, Delhi, and Mumbai) were covered by state HAPs, whereas two (Gwalior and Ludhiana) had no HAP in place.

Implementers were asked about the heat actions undertaken and the barriers they encountered in their implementation, drawing on a literature review of adaptation barriers, including those specific to extreme heat. Based on this literature, we structured our inquiry around three broad categories of variables - political emphasis, technical knowledge, and institutional structure - that collectively shape implementation prospects.

Political support is widely recognised as a crucial factor in agenda-setting, resource allocation, and interdepartmental coordination (Tribbia & Moser, 2008; Uittenbroek et al., 2012; Pasquini et al., 2015). The absence of adequate political leadership has also been cited as a significant barrier to action in heat governance literature (Howarth et al., 2024; Meerow & Keith, 2021).

FINAL SAMPLE

Nine cities in nine states home to 42.7 million people (Census 2011)

Public mobilisation and pressure have also been instrumental in driving adaptation efforts but remain contingent on widespread awareness of heat risks (Boda & Jerneck, 2019).

Similarly, a lack of public support for heat-related initiatives has been identified as a significant barrier (Kieth et al., 2023; Howarth et al., 2024; Meerow & Keith, 2021). Change agents or local bureaucratic champions can help mitigate this and have been found to play a crucial role in advancing implementation on the ground (Biesbroek et al., 2018; Moser, 2009).

Other drivers of action on ground include experiences handling disasters in the past. Research suggests that past disasters often create “windows of opportunity” for policy implementation (Penning-Rowsell et al.,2006).

Technical knowledge is a key determinant of adaptive capacity, as implementers must access and apply both local and expert knowledge to address evolving risks such as extreme heat (Glaas et al., 2010; Meerow & Keith, 2021). Studies on heat governance indicate that planners frequently struggle to access and integrate relevant climate data into decision-making processes (Keith et al., 2020). Given that heat risks and adaptation strategies continue to evolve, external actors - including civil society organisations and research institutions - have been identified as critical intermediaries in bridging knowledge gaps and translating complex climate data into actionable policies (Glaas et al., 2010).

Institutional barriers, particularly funding constraints, remain among the most persistent obstacles to adaptation (Biesbroek et al., 2018; Bolitho & Miller, 2016; Bosomworth et al., 2013). Even in cases where political leadership and technical expertise are present, unclear roles and responsibilities can hinder effective implementation (Waters et al., 2014; López-Dóriga et al., 2020; Zaidi & Pelling, 2015; Keith et al., 2020). Poor coordination and fragmented governance, especially in multi-sectoral areas such as heat resilience, further complicate implementation efforts (Lee et al., 2023; Azhoni et al., 2017; Keith et al., 2020; Downes & Storch, 2014; Bolitho & Miller, 2016; Sailor et al., 2016). Heat is often treated as a health issue and managed by health departments in some places, yet addressing it effectively requires coordination across multiple ministries and agencies, making the coordination challenge even more complex (Zaidi & Pelling, 2015). Additionally, adaptation efforts often compete with more immediate socio-economic concerns, such as poverty and inequality, making it difficult to prioritise adaptation actions (Adger, 2000; Nielsen & Reenberg, 2010; Biesbroek et al., 2013; Moser, 2009).

While these barriers were the primary focus, additional factors, namely the diffusion of ideas and practices between states and challenges to maintaining institutional memory emerged during data collection.

DATA COLLECTION

Interviews were conducted between August 2024 and January 2025. Data was collected through semi-structured interviews with key departments at the city, district, and, in some cases, state-level officials responsible for planning and implementing heat actions in each city. These departments were identified by reviewing state and district/city HAPs, where they existed. Additional departments were identified through snowball sampling (interviewees identify other interviewees). In cities without a formal HAP (Gwalior, Ludhiana), our entry points were the District Disaster Management Authorities. Implementers were asked questions (see Annex 1 for the complete list of questions) about all heat solutions implemented, including solutions to contain cascading impacts, with a focus on long-term measures (such as urban greening, institutional performance, changes to town plans) that have long gestation periods and are likely to mature only years after commencing implementation. They were further asked questions on how implementation functioned in practice, specifically in relation to institutional and political variables discussed above. Where required, a letter of introduction from the National Disaster Management Authority (NDMA) facilitated access to respondents. Interviewees were assured anonymity and recordings were made where permitted.

LIMITATIONS

A key limitation is our reliance on self-reported actions without on-ground verification. It is unclear whether these reported actions are implemented consistently or effectively in practice. We sought to limit inaccuracies through triangulation, considering an action only if mentioned by at least two independent respondents in each city, except for a few sector-specific measures, such as cooling wards in government hospitals, which surfaced only in the relevant department's responses because they were sectorally driven.

Another limitation is inconsistent departmental coverage across cities. Some departments could not be interviewed in all cities (notably labour, water, and some state agencies like the State Disaster Management Authorities and Town and Country Planning Departments). The urban focus of this study also meant that rural departments (such as agriculture and rural development) were outside its scope.

The semi-structured nature of interviews also meant that not all respondents answered every question due to time constraints and variations in interview flow. However, important questions were asked of nearly all respondents, allowing us to arrive at an analysis based on the descriptive statistics below. Each chart lists the number of responses to allow the reader to interpret the validity of conclusions. Where we felt that lines of evidence lacked adequate cross-city or cross-sectoral representation, we excluded them from our findings.

FIGURE 1: Distribution of reported heat actions across nine cities

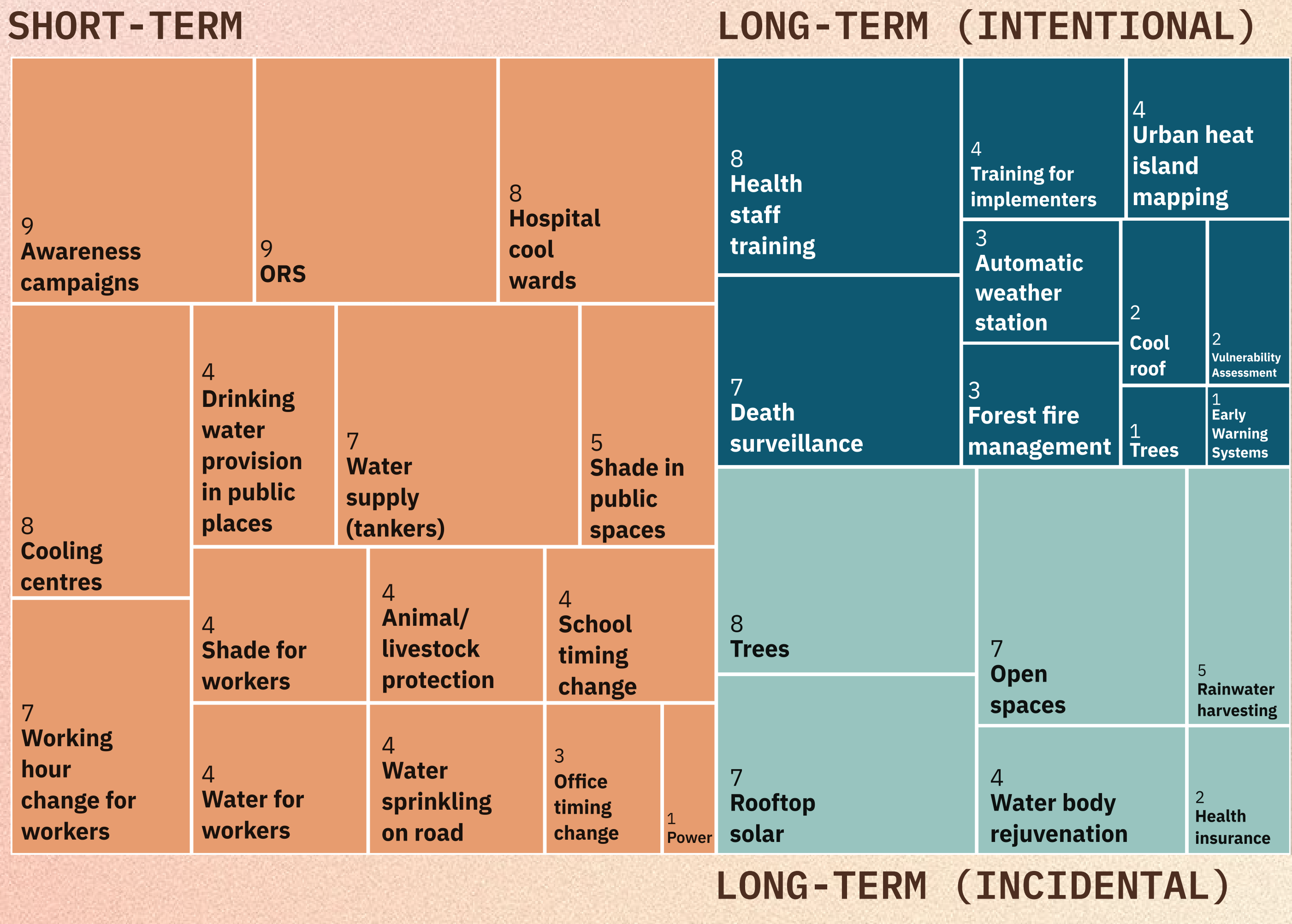


Fig 1. Reported heat actions (n=150 solutions) largely focus on short-term actions, while a significant proportion with potential long-run benefits fall in the 'incidental' category, meaning they do not target areas or populations at highest risk. 'Intentional' actions are few and sporadic when health system measures, which are meant to deal with the effects of a heat wave rather than reduce their initial impact, are removed. The figure in the diagram above, represents the number of cities, out of nine, in which the action is observed.

THE CURRENT STATE OF HEAT ACTION IMPLEMENTATION

Our findings identify several clear trends across the nine cities in our sample. Figure 1 shows that actions are skewed towards short-term response measures meant to kick in just before and during a heat wave to prevent heat-related mortality and morbidity.

At least seven of our nine cities report widely used and reactive heat response measures such as awareness campaigns, increasing hydration levels (through water and oral rehydration salt (ORS) availability), repurposing hospital wards for the treatment of heatstroke patients, creating temporary cooling centres with some shade, water and cooling provisions, and changing work times for workers.

As we discuss in the limitations section above, it is unclear whether all of these actions are being implemented consistently and correctly. However, it is clear that the objective of preventing deaths through preparedness and response measures seems to have gained traction within local bureaucracies across a large swathe of the country. Given that heat policy in India is relatively un-institutionalised and new (with the first HAP notified in 2013), we see this as a success if they are actually being implemented on the ground.

The top-right quadrant of Figure 1 shows that these cities are also reporting what we would classify as 'intentional' long-term actions, i.e. actions that will have a tangible long-term effect on reducing risk through institutional or physical effects if implemented. In the disaster management practice, these are often also called risk mitigation actions. Many of these actions are related to health system preparedness measures (health staff training and death surveillance measures in eight and seven cities respectively). Other actions, such as improving the granularity of temperature data through automatic weather stations, training policy implementers in government, and mapping urban heat islands are all seen in four cities or fewer.

With the exception of health system preparedness from the list of intentional long-term actions, what emerges is a picture of very weak mainstreaming of long-term heat concerns in other crucially important sectors.

Health system preparedness, while foundationally important to heat resilience, is meant to deal with the consequences of heat overwhelming the adaptive capacity of societies rather than prevent such situations from occurring.

The bottom-right quadrant, what we call 'incidental' long-term actions, are measures which notionally yield heat resilience gains but are not designed or implemented with heat in mind. Government tree planting drives in cities, for example, are driven by the logic of beautification (Interviews 1, 49, 51). The same actions, if designed with intention, would yield greater benefits. For example, if tree planting were designed with heat resilience in mind, trees would be planted in the hottest, densest, and usually least well-off, areas of the city that are shade poor, likely under the logic of an urban heat island map. Of the sample cities, only one reported a heat-intentional action like this (Ludhiana), seemingly due to the initiative of a senior district official.

Similarly, rooftop solar programmes that could generate electricity for cooling during the day, attempts to create open spaces, and the renovation of water bodies all obey their own sectoral logic and are not directed at the areas of highest heat risk in those cities.

Several critical long-term actions that could strengthen resilience were entirely absent. These include expanding fire management services, developing insurance schemes for lost work, targeted capacity building for high-risk sectors, electricity grid retrofits to improve transmission reliability and distribution safety, and ensuring access to household or occupational cooling for those most exposed. As heat extremes intensify, these measures will be essential to bolstering adaptive capacity beyond short-term responses.

What emerges is a simple goal: to move actions from the bottom-right quadrant (long-term incidental) to the top-right (long-term intentional). We make policy recommendations with this in mind (see p. 30).

We also see variation between cities in actions implemented but a relatively consistent pattern in the nature of actions implemented, with a consistent skew towards short-term actions.

FIGURE 2: Variation in heat action across cities

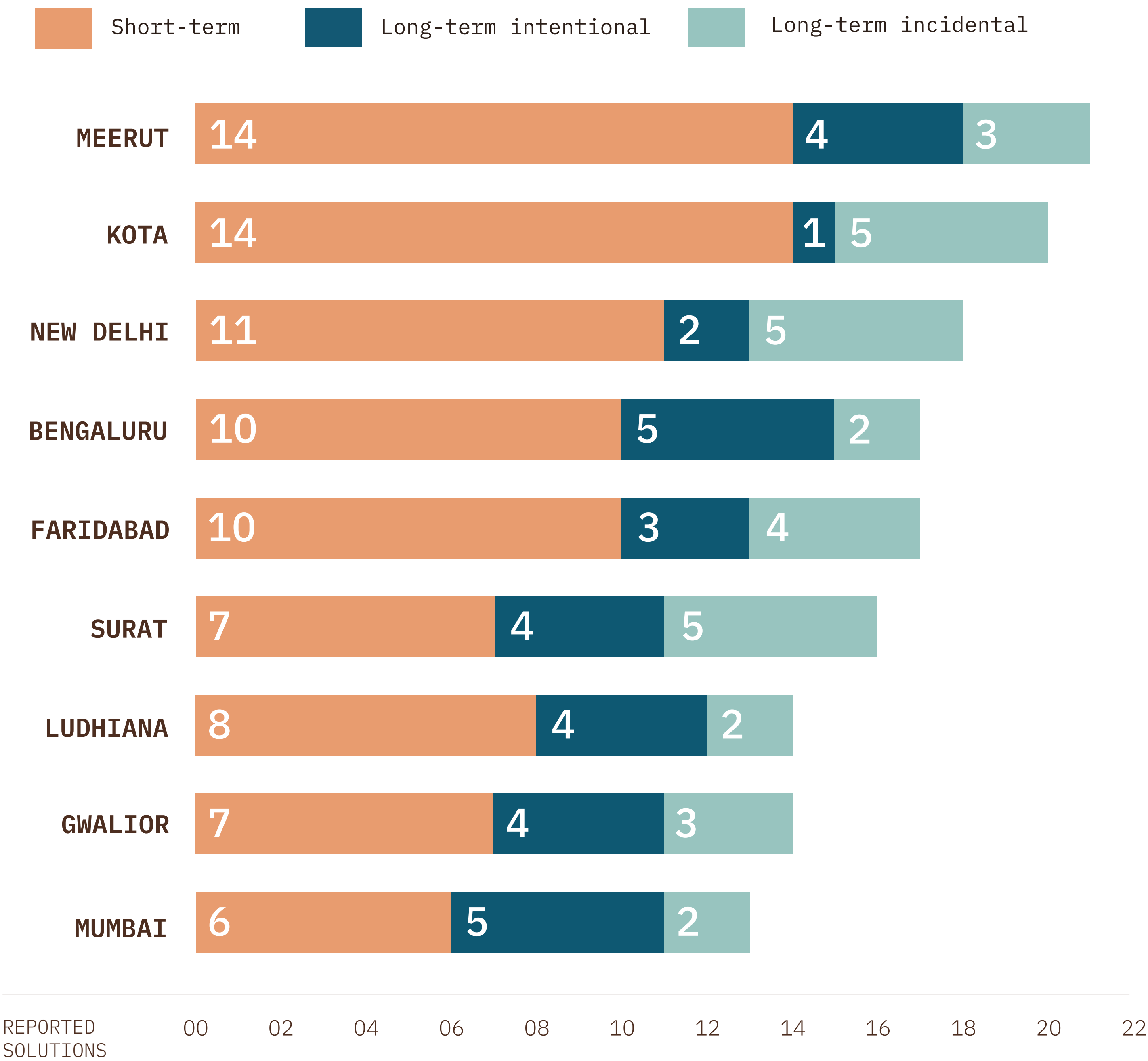


Fig 2. There is limited variation in the nature of implemeneted heat solutions across nine cities. The figure in each bar represents the number of reported solutions in each category. The x-axis is the total number of solutions in that city.

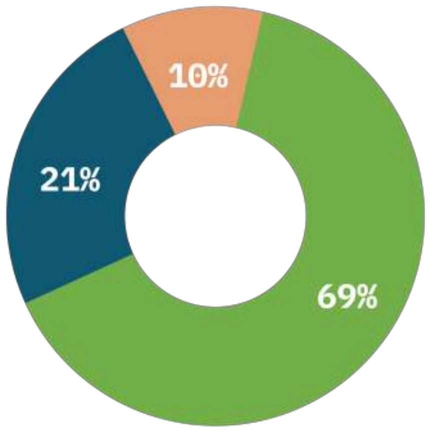
Figure 2 above suggests a relatively even distribution of short-term, long-term incidental, and long-term intentional actions across our sample cities.

We do not distinguish between actions based on their suggested efficacy in the literature, relaying all actions reported by bureaucrats. There is however wide variation in the efficacy of reported actions. For example, Surat reported a heat illness surveillance campaign that went to hundreds of households every day to understand the prevalence of heat symptoms. Four cities also reported measures with no known scientific underpinning, such as the use of water sprinklers mounted on trucks for sprinkling on road (Interviews 13, 18, 33, 36, 39, 47, 49, 50, 56), a listed action in several HAPs, which will likely worsen water scarcity without reducing local temperatures.

EVIDENCE OF SHORT-TERMIST LEANINGS IN REPORTED FINANCIAL CONSTRAINTS

Figure 3 below shows that over two-thirds of respondents across our nine cities did not report facing funding constraints for the actions they were currently implementing. We interpret this as consistent with the focus on short-term responses because these actions are relatively inexpensive and already provided for in existing departmental budgets, primarily in disaster management, health, and urban development schemes at local and national levels. Funding for awareness generation materials, rerouting water supplies, and changing work timings fall within the routine rhythms of implementing departments. As the focus on intentional long-term actions increases in the coming years, we expect instances of inadequate financing, currently at just over a tenth of respondents, to increase if not met by new budgetary lines for long-term heat preparedness.

FIGURE 3: Reported financial constraints



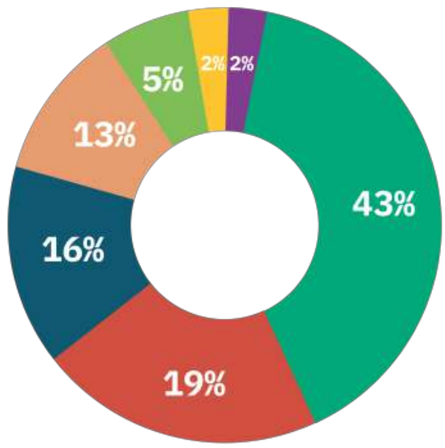
Adequate funding
Some funding but inadequate
No funding reported

Fig 3. Short-term and incidental actions do not require large amounts of additional funding, leading to limited pressure on the operational budget. Percentages in the pie chart are based on the total number of responses (n=62 responses) across all respondents in the nine cities.

Local government officials seem to be using a financial 'pooling' approach to fund heat actions, as Figure 4 demonstrates. Implementers are mixing and matching from across a range of financial instruments including departmental budgets, state and national schemes, and private financing. Private financing seems to be viable in areas where companies see benefits in putting forward corporate social responsibility (CSR) programmes for tree planting and increasing drinking water access during a heat wave. This pooling approach seems logical for the sort of multi-sectoral mobilisation heat resilience demands. It also reveals the continued importance of national programmes that can be deployed towards climate adaptation (Shekhar et al., 2023), which includes Centrally-Sponsored Schemes (CSSs, designed by the central government and implemented by the states, usually with co-financing) and programmes such as Atal Mission for Rejuvenation and Urban Transformation (AMRUT), the Smart Cities Mission (both for urban redevelopment), and the Jal Jeevan Mission (water supply amelioration).

The impacts of new lines of disaster mitigation financing through State Disaster Mitigation Funds (SDMFs) is also evident in the state funding section of Figure 4. This funding line, suggested by the 15th Finance Commission and implemented by the National Disaster Management Authority (NDMA), could emerge as a fulcrum for long-term preparedness. The move from incidental to intentional long-term actions could be catalysed by a dedicated heat risk mitigation fund through monies allocated to the National and State Disaster Mitigation Funds (N/SDMFs), which we discuss further in the recommendations.

FIGURE 4: Reported sources of funding



Departmental budget (District, ULB)
State government funding (SDMF, SDRF, Van Kavach)
Central government funding (Amrut, Jal Jeevan Mission, SMART City, NPCCHH)
Private finance (Donations, Corporate Social Responsibility)
Finance commission funding
Multilateral development banks
Source unknown

Fig 4. Existing funds from local, state, and national levels are being used to fund routine heat actions. Percentages in the pie chart are based on the total number of responses (n=62) across nine cities.

HEAT THREATS ARE POSITIONED DIFFERENTLY ACROSS CITY GOVERNMENT DEPARTMENTS

Our data suggests unevenness in how different areas of urban government are perceiving and responding to the challenge of extreme heat. Here we discuss three areas of crucial importance for long-term resilience - health departments, cross-departmental access to climate information, and urban development and city planning departments. We show that the health sector leads in long-term preparedness actions but is at risk of being overwhelmed in the long-run by failures in long-term resilience planning in other departments. This is particularly true of urban planning departments who are not part of the heat conversation and face political constraints to action.

All departments are hampered by a lack of access to climate projections for a 1.5 or 2°C world, thereby constraining their ability to foresee risk and limit the severity of future outcomes.

1. Health system actions are at the forefront of long-term heat preparedness, weakly mainstreamed in other areas:

As discussed above, heat responses in India are largely health-system focused, with emphasis given to improving hydration, and identifying and managing heat-related illness. These efforts included two crucial long-term advancements: eight cities reported heat-specific training for health workers and seven reported the creation of systems to monitor heat deaths. The latter (heat death monitoring) is a necessary intermediate step towards studying how extreme heat interacts with the social structure in cities.

It must be paired with more all-cause mortality studies at finer spatial scales, better general clinical awareness of heat stress symptoms, and mechanisms to collect and integrate patient data from public and private sector health facilities to enhance the accuracy of monitoring estimates. If done correctly, it could inform the targeting of all other heat policy measures.

Eight cities also reported increasing hospital capacity for heat illnesses, which we categorise as an important short-term response measure, but one that will only have long-term value if this becomes routine practice in seasonal hospital administration. A recent survey of 5,690 health facilities by the Ministry of Health and Family Welfare echoed our findings, with 99 percent establishing ORS corners and 74 pecent training staff in clinical management and surveillance.However, it also highlighted critical gaps in emergency preparedness: only 32 percent of facilities had adequate cooling measures, leaving 68 percent without sufficient active cooling capacity (MoHFW, 2024).

These improvements in health system design, while crucially important, are designed to absorb the impacts of a catastrophic heat wave rather than reduce them in the long-term. They will need to be complemented by changes to the structure of cities and buildings, increases in shade, improving access to efficient cooling to vulnerable populations, and more stringent enforcement of labour regulations and work stoppages (See Annex 2 for complete list of solutions).

Gaps in heat planning and institutions in non-health sectors will likely worsen the strains on health systems, requiring further development of their heat wave capacity. These capacities will be overwhelmed as heat waves intensify and increase in duration.

2. Insufficient access to climate information across government departments:

Access to climate information, such as projections and granular data about variations in extreme heat within a city, can increase the effectiveness of heat actions.

Engagement with the possible severity of future heat in cities, for example, could drive demand for long-term heat resilience by motivating policymakers, especially when this information is framed in terms of local risks, such as threats to water security and higher incidence of heat strokes (Singh et al., 2018). We tested how prevalent this imagination of an unliveable future was among implementers by asking them if they had access to climate projections or the range of extremely hot temperatures the hottest parts of their cities would likely experience in a +1.5°C world. We found that only two of 42 respondents asked this question had access to this crucial piece of climate information. This suggests a clear policy gap and is a major recommendation of this study.

We also note slow progress in local expansion of weather information services, with only three of nine cities reporting the installation of automatic weather stations. More granular data on how much heat varies across neighbourhoods, combined with non-governmental sensor networks, and modelling to estimate variations across space, is crucial for targeting implementation actions to areas and populations with relatively higher long-term heat risks as the climate warms. Correlated with death and morbidity data, it can help reveal the limits of how communities adapt to extreme heat.

3. Urban planning constraints:

This limited view of a dangerous present and future could explain why planning and urban development authorities sit outside the heat resilience conversation in our nine cities, and likely in other Indian cities. Around a quarter of city planners and urban development authorities we interviewed reported that they did not have the legal mandate to act on heat, which would include the mainstreaming of heat in city plans and bye-laws (see figure 7 on reported barriers to heat action on p. 25).

Coordination failures, including the silo-ed nature of work across departments and the inability to access the latest HAP were most frequently reported by participants (over 40 percent of responses) as key constraints.

Several respondents also argued that the incomplete implementation of existing city master plans, which is a widespread phenomenon across the country (NITI Aayog, 2021), undermines heat resilience because heat-reducing features such as green spaces and water bodies are constrained by political considerations around land availability (Interview 2, 17 46, 56, 86).

Respondents noted that the pressures on land availability were being driven by informal settlements, encroachments into open spaces, the rapid concretisationt of open spaces, and the expansion of housing stock, all of which decreased land availability for public goods aligned with climate adaptation. They also noted that existing architectural practices, such as the widespread use of cheaper glass, steel and concrete building structures, driven by economic and aesthetic considerations, decreased long-term heat resilience.

4. Shade expansion is incremental and misaligned with heat objectives:

While all nine cities reported programmes to expand urban trees, we found only one (Ludhiana) had developed a plan to align tree planting drives with heat considerations. Such programmes were generally aimed at beautification or environmental concerns like increasing biodiversity and ground generally aimed at beautification or environmental concerns like increasing biodiversity and ground water levels (Interview 26, 38, 49, 88) though nearly all respondents acknowledged the heat resilience co-benefits that came with increasing urban tree stocks. This is partially driven by an inability to target tree planting drives correctly since vulnerability assessments and Urban Heat Island maps are not part of the planning process in horticulture and tree departments in these cities (again, with the exception of Ludhiana). Land scarcity in the hottest, densest parts of the city were also reported as a major barrier (Interview 14, 17, 26, 46, 65, 83, 86). Consequently, there is increased reliance on ultra-dense urban plantations, often called Miyawaki forests (reported in five cities), which might have localised cooling effects but are unlikely to provide meaningful shade cover to urban residents.

Trees were however reported as widely popular among the public and politicians (Interview 2, 12, 18, 39, 41, 60). They are also supported by CSSs like the Nagar Van Yojana, national campaigns like 'Ek Ped Maa ke Naam', and state schemes like Van Kavach in Gujarat, opening up the possibility of long-term urban heat resilience gains if the barriers mentioned above are removed. Tree-cover expansions are also supported by civil society organisations (Interview 2, 13, 15, 26, 41, 51, 57, 60, 63, 83) keen to capitalise on their popularity and environmental benefits, and by companies seeking to fulfil their corporate social responsibility commitments. Moving trees from incidental to intentional long-term actions in Figure 1 could be relatively less complicated than changing the built form of cities, discussed in the previous section.

Five of nine cities also reported incremental and temporary expansions of artificial shade, largely confined to bus-stops and temporary shelters erected near or on roads during a heat wave (Interview 8, 15, 32, 50, 86). Structural changes to create underground walkways (as in Singapore, Seoul) or permanent shade cover over promenades (as in Valencia) were not reported. Given the much higher cost of such actions, dedicated heat risk mitigation funding will likely unlock structural shade expansion across Indian cities.

WHAT IS DRIVING HEAT ACTION? AND WHAT IS HOLDING IT BACK?

The skew towards short-term health responses over long-term action seems to be driven by a combination of factors. First, the policy structure of India's response to extreme heat is typified by short-term rapid response directives from the National and State Disaster Management Authorities and from health departments at the national and state levels. They dictate how local bodies prepare for and respond to an imminent heat wave. This propels city governments into immediate action but can leave a gap in long-term planning. Second, public demand from heat resilience is focused on the immediate stresses of extreme heat, demands for water supply and labour breaks, rather than mobilisations for long-term climate action, which tilts the focus towards response over long-term planning.

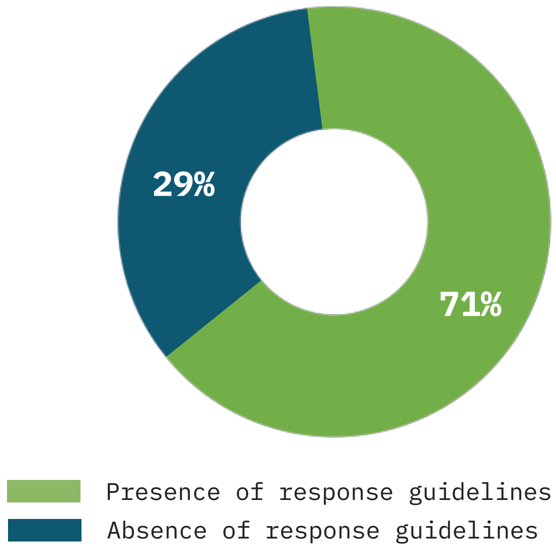
Third, a set of institutional constraints weaken the possibilities of long-term resilience building. Notably, city government officials report weak mandates, limited coordination, personnel shortages, competing priorities, low technical capacity, and insufficient recognition of heat threats as major constraints, in line with globally reported barriers to action discussed briefly in the introduction.

TOP-DOWN GUIDELINES DRIVE ACTION RESPONSE MEASURES, HAPS HAVE A WEAKER EFFECT ON POLICY

Local policy responses are highly sensitive to directions from higher levels of government transmitted through the bureaucratic chain of command. Just over 70 percent of respondents reported receiving guidelines or directives to prepare for an imminent heat wave and several respondents reported focusing on them during heat waves (Figure 5). These directives emphasise a range of response measures that vary from increasing hospital readiness to work breaks for heat-exposed labour, and 'dos and don'ts' to be disseminated to the general public. They therefore push life-saving responses to heat waves but have no long-term focus.

A snapshot of responses to heatwaves in North India in 2024 captures the tone of these rapid response directives. In Delhi, for instance the labour department issued guidelines to all shops, factories and construction worksites to ensure availability of clean drinking water, coolers/fans, and to change work times; the Lieutenant Governor of the state made paid work breaks at government construction sites mandatory; and the education department prohibited outdoor activities in schools (Government of NCT of Delhi, 2024a; Government of NCT of Delhi, 2024b; IT News Desk 2024). In Rajasthan, health authorities suspended leave for health workers and paramedical staff, and Uttar Pradesh issued guidelines for managing heat related illnesses

FIGURE 5:
Reported influence of national and state guidelines



The table below contains the number of respondents that received guidelines in each city.

08 DELHI	04 SURAT	06 MEERUT
03 KOTA	07 FARIDABAD	03 LUDHIANA
05 GWALIOR	02 MUMBAI	04 BENGALURU

Fig 5. National/state guidelines drive local heat action. Percentages reflect the number of respondents who received and acted on guidelines (n=59).

(PTI, 2024a; PTI, 2024b).

These actions leverage the accountability structures of the Indian state. They are also reminiscent of other areas of Indian climate policy, which frequently see agenda-setting and emphasis from the national government (Pillai & Dubash, 2023). This pattern aligns with the nature of India's post-independence federal structure, where the powerful central government has shaped state and local approaches in several areas of social policy (Tillin, 2019). As one city official noted, "Yes, we receive directives, and we implement them promptly. When we get instructions to act, we respond immediately. We don't delve too deeply into the reasons behind the heat; our focus is on protecting people when the heat is present" (Interview 22).

It is, however, unclear how effective these guidelines truly are, which is one of the limitations of this study. The expansive scope of the study, spanning nine cities and 150 reported heat actions, meant we were unable to individually verify each of the actions despite filing requests under India's Right to Information Act (2005). It is likely that implementation of these guidelines and the measures they contain is being overstated due to social (or professional) desirability bias. However, the overall shape of the findings, with a bias towards the short-term remains valid despite this since those actions were reported in very low numbers despite these distortions in the interview process.

India's sub-national heat action plans (HAPs) are at a nascent stage and will need further integration with existing institutions before they begin to truly add to possible gains made by supplementary national and state directives to manage heat waves.

The emphasis of national and state direction can be useful because it represents an easy way of setting a minimum standard for long-term actions across the country fairly rapidly. This is contingent on funding for these more expensive actions becoming available, as we discuss in our recommendations below. This was echoed by a district official in north India who said,

"There is nothing on long-term here. We are at the bottom of the pyramid. So long-term measures will be told to us by higher levels. We are the executing agencies."

(Interview 7)

POPULAR DEMAND FOCUSES ON SHORT-TERM ACTIONS

Over a quarter of the responses we received from city officials suggested that direct public demand emphasised short-term actions to relieve the immediate pressures of the heat wave, which included increased drinking water availability, household water supply, oral rehydration salt availability and access, and changes to work timings (Figure 6 below). We also recorded demands for more trees, which we have discussed above as occupying a sweet-spot in the landscape of heat mitigation actions in terms of their political attractiveness and implementability.

FIGURE 6:
Reported instances of popular pressure

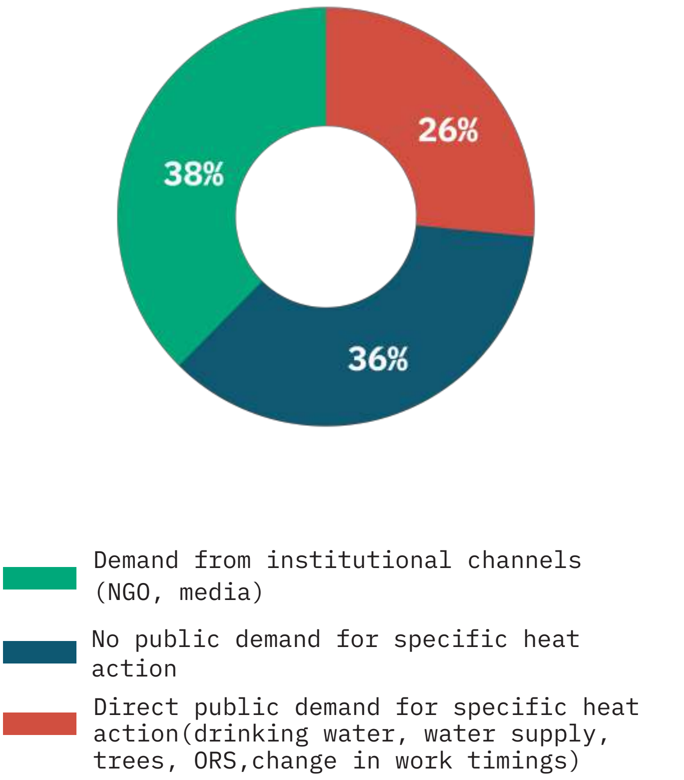


Fig 6. Demands on implementers push response and preparedness measures over long-term risk mitigation actions. Percentages in the pie chart are based on the total number of responses (n=72) across nine cities.

Respondents also reported facing demands through institutional channels, including the media and civil society, which accounted for 38 percent of responses and the largest source of heat demand. A similarly large percentage of responses, however, suggests there is no direct demand for heat action, suggesting variation between cities in how extreme heat concerns are transmitted from the public to city and state bureaucracies.

We have a much less clear picture of how elected representatives relay concerns about extreme heat. Two-thirds of the responses we received to this line of enquiry were inconclusive.

Three of 24 respondents (who answered this question) pointed to political pressure blocking action. While less prevalent in our overall data than ideal, this is an important strain of argument in our responses: respondents argued that the political pressures that accrue to high-value, contested, and scarce land make it hard to implement long-term, land-intensive actions such as expanding tree cover, increasing open spaces along streets and dense areas, and restoring water bodies (Interview 4, 13, 46). A town planner from north India summarised this challenge in informal settlements by saying, “The issue is implementation. Where there is an unauthorised colony, there are no parks. Planned areas are very low. In planned areas you can consider these things, but in unplanned areas you cannot do these things. The unauthorised area of a city is a major constraint in every city” (Interview 46).

Where elected representatives motivated action by officials, we found that it was in response to the threat of negative media coverage due to heat wave deaths. We found this concern across cities (Interview 1, 11, 13, 23, 33, 44, 73, 82). This indicates that past disasters could have an effect on future heat action. One disaster management official in north India noted that

"Deaths this year have helped provide services. It has helped create pressure. This is the first time I have heard of hospitals creating heat wards... four to five hospitals. Because it has started, it will continue."

(Interview 1)

Another disaster management official in the west of the country echoed a similar sentiment, “We have seen it in many places... many things happen after a big incident” (Interview 73). As one respondent succinctly summarised,

"What is visible sells."

(Interview 44)

This is in keeping with a broader problem with climate adaptation: infrastructure and other visible solutions are more likely to be popular than ‘soft’ solutions involving awareness building and nature-based solutions (Dolsak and Prakash, 2018; Pillai, 2022). This would suggest further reliance on top-down, guideline driven responses or rigorous HAP implementation to fill the gap created by general apathy towards long-term heat resilience actions.

INSTITUTIONAL CONSTRAINTS LIMIT THE POSSIBILITIES FOR LONG-TERM ACTION

The limitations to long-term planning and execution posed by weak political demand, political pressures on land preventing its deployment towards climate resilience, and local governments’ reliance on directives from higher levels of government discussed above are compounded by the challenges of driving multiple government departments towards a single goal. In this section below, we show that institutional constraints such as coordination failures, competing priorities, inadequate problem recognition, personnel shortages, weak technical capacity, inadequate finance, and insufficient legal/regulatory mandate all further limit the scope of action (Figures 7 and 8).

FIGURE 7: Barriers to heat action by sector

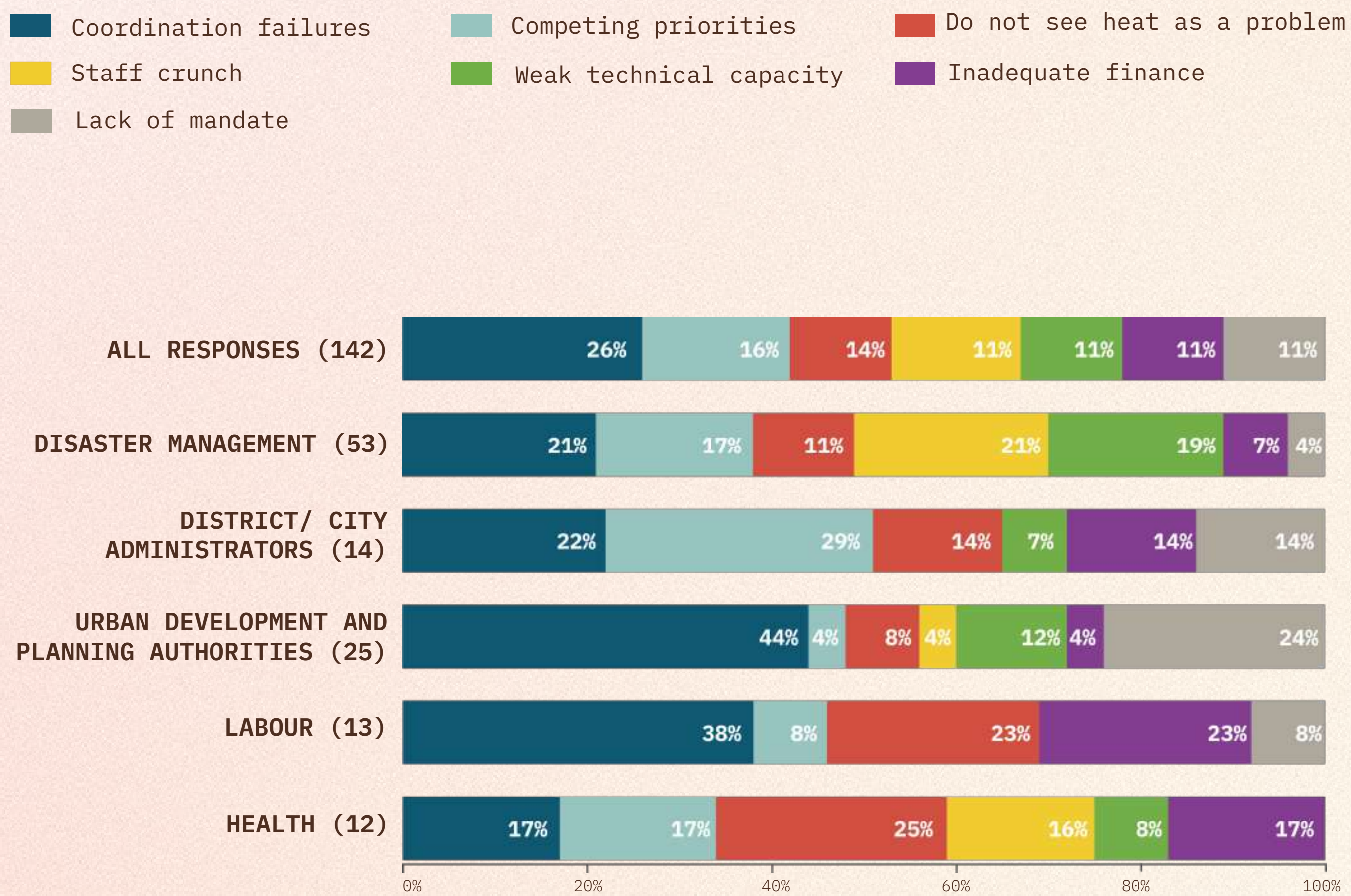


Fig 7. Coordination problems emerged as the single largest institutional constraint, followed by competing priorities limiting the focus on heat. A substantial portion of implementers did not see heat as a policy problem. Rows represent department-types interviewed in nine cities, brackets contain responses per department-type. The top row averages responses across all respondents.

FIGURE 8: Barriers to heat action by city

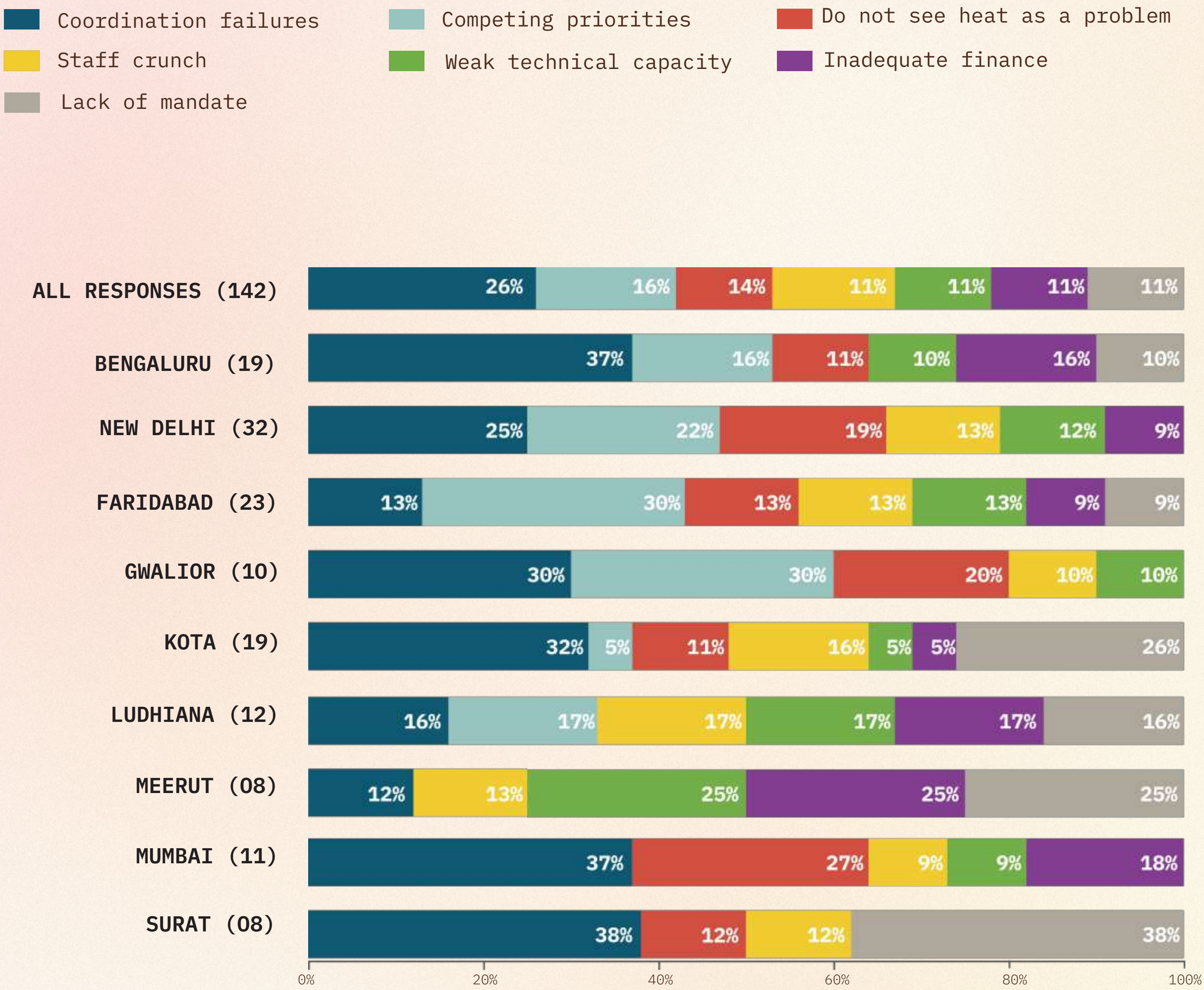


Fig 8. The distribution and number of barriers to heat action varies across cities, with some challenges more pronounced in certain locations. Brackets near each city mention responses reporting various barriers. The top row averages responses for each barrier across all respondents while subsequent rows report the prevalence of barriers by city.

COORDINATION FAILURES (26 percent of responses across sample):

Across departments and cities, coordination failures were reported as the single largest barrier to action, as seen in figures 7 and 8 above. We report instances of both horizontal coordination gaps (i.e. between departments at the same level of government) and vertical coordination gaps (i.e. between units in a hierarchical relationship, usually between state and local governments).

Disaster management departments, which generally drive heat responses in Indian cities, are limited by the challenge of coordinating across sprawling city governments.

Officials noted that they could issue advisories and argue for actions but the actual implementation of these measures was the remit of implementing departments that frequently did not see heat as a primary concern. A disaster management official in a north Indian city summarised this fundamental constraint quite simply: “the SDMA (State Disaster Management Authority) cannot do anything about this. It is the (line) department that will do it.” (Interview 20), an instance of both vertical (between levels of government, with line departments referring to city departments), and horizontal (between different departments).

The horizontal and vertical (where state HAPs are involved) coordination challenge also manifests in our data in the number of respondents who claimed never to have received a HAP despite holding positions or responsibility for heat resilience.

16 of 25 respondents who were asked said they did not know about the city or state s HAP or had not received the latest version.

Surprisingly, health departments across the nine cities do not seem to be suffering from coordination concerns as much (row six in Figure 7). This might be because health sector heat wave response measures are self-contained. Actions like increasing hospital readiness and conducting awareness drives and surveys do not require the involvement of other departments. Disaster management and district/city administrators (rows two and three in figure 7) who are in charge of coordinating the implementation of guidelines, directives and HAPs across city government machinery are more likely to face such problems, while planning officials (row 4 in figure 7) require multiple departments to align with their planning priorities. A town planner in a west Indian city pointed out that town plans inherently contained climate resilience potential because they carry provisions for green spaces and water bodies, but were insufficiently implemented (Interview 78).

A former health official and early champion for heat resilience in a west Indian state pointed to an underlying disciplinary challenge in coordinating towards health-related objectives, noting that “all municipal corporations are engineers’ domains” (Interview 30).

To solve these issues, one respondent proposed the creation of disaster management cells in every department, ostensibly with linkages to the parent disaster management department (Interview 13). Like all embedded strategies used to mainstream climate actions, it is unclear whether this approach of embedding smaller units in larger departments with long institutional histories and deeply entrenched priorities can change policy outcomes.

One possible solution lies in arming disaster or health departments at the state or city level with dedicated heat resilience funding and staff capacity that gives them both the convening power and authority to monitor implementation across departments. We return to this in our recommendations.

Failures in institutional memory emerged as a less often cited, but possibly consequential, challenge (Interview 63, 82). We see this as a coordination challenge over time (as opposed to coordination challenges across space) created by transfers in the senior bureaucracy. In one instance, we learned of a senior district officer and champion for heat resilience in Ludhiana attempting to overcome this challenge by training line departments to continue a heat-oriented tree planting project before their impending transfer. Transfers in the bureaucracy are frequently cited as an impediment to Indian governance and it is unsurprising that it re-emerges in our analysis (Banik, 2001).

LACK OF A LEGAL OR REGULATORY MANDATE
(11 percent of responses across sample):

In both figures 7 and 8, we see the consistent reporting of a lack of a legal or regulatory mandate to act on heat in all fields except health, where heat actions seem to be a routine part of annual actions and is substantiated by the emphasis on health-denominated actions in Section 4.

Particularly notable is that this featured in almost a quarter of responses from urban development and town planning officials. They rely on city building codes and town plans to decide what they can act on and when, and the absence of extreme heat and other climate hazards in those regulatory structures is a barrier to action. This underscores the need to mainstream climate concerns in the planning of Indian cities.

It is unlikely any of the long-term structural changes we have discussed here, from the relatively simple but politically fraught ones like expanding shade cover in dense urban heat islands to creating more expensive permanent shade structures or changing the heat-trapping nature of modern building design, will come to fruition without such institutional changes. Labour department officials, on the other hand, felt they were unable to change labour conditions because of a lack of enforcement of their sectoral laws that mandate provision of water, shade, and safe temperatures at workplaces.

COMPETING PRIORITIES
(16 percent of responses across sample):

Across our sample, just over a tenth of responses pointed to competing priorities reducing attention to heat resilience. Summer extremes are rapidly replaced by floods as city governments constantly deal with a host of other disasters and health challenges. A disaster management official in a north Indian city evocatively called for a more structured approach: “We are lurching from crisis to crisis. We have not thought about these things. We need to be thinking of higher-level interventions to solve this problem” (Interview 1). This is exacerbated by already full dockets in city governments, with the head of a women and child welfare (aanganwadi) centre pointing out that there was no time to work on emerging risks like heat:

"There is so much work left in the existing things we have to do, (leave aside) doing anything separately on our own (for heat)."

(Interview 53)

IMPLEMENTING OFFICIALS DO NOT SEE HEAT AS A PROBLEM
(14 percent of responses across sample):

Two sectors reported similar levels of inadequate problem recognition (disaster management and district/city government, between 11 and 14 percent each). While it is hard to identify why this is the case, this seems to correspond with extreme heat’s status as an emerging hazard. We expect these percentages will decline over time. More surprising, however, is that 25 percent of responses in the health sector failed to recognise heat as a problem. This might be because the sector deals with hazards that claim more lives in any given year, such as vector-borne or infectious diseases while heat exacts a smaller death toll each year on average.

PERSONNEL SHORTAGE
(11 percent of responses across sample):

The weight of competing priorities is potentially made worse by consistently reported staff shortages. Expectedly, this is felt particularly acutely by city/district administrators (row two in figure 7) who have to deal with last-mile implementation for the plans, policies, schemes and directives of the entire Indian state and is consistent with findings in the literature (Dasgupta and Kapur, 2020; Mangla, 2015). It is also felt by disaster management officials who, we suspect, are routinely overwhelmed by time-concentrated, high-intensity, coordination-intensive disasters, often followed by other ones.

This also stems from the fact that three out of the nine cities we visited lacked specialised support staff in district disaster management. An official in a north Indian city captured these pressures succinctly, “There is a huge shortage of staff. Like one person looking after the work of three, like when I came, I saw there was a huge file, and it was a file about all the letters which were never responded to” (Interview 13).

WEAK TECHNICAL CAPACITY
(11 percent of responses across sample):

Implementation challenges are made more pronounced because weak technical capacity combines with personnel shortages and competing priorities. This involves challenges both with grassroots implementation as well as technical capacity at lower levels of the bureaucracy ("The biggest problem is that the grassroot worker, who neither understands English, nor has any digital education. So whatever is made (heat advisories), we do it on our own according to what we understand" (Interview 13)) as well as technical capacity at lower levels of the bureaucracy ("What is a cool roof?") (Interview 46).

This gap in technical capacity will make it harder for local governments to access state, national, and international sources of adaptation financing because most of these projects, including the Green Climate Fund, carbon credit schemes, and the National and State Disaster Mitigation Funds all require the capacity to write up viable heat resilience projects, which combine relatively novel data streams (such as vulnerability and urban heat maps, mortality and morbidity data) with proven solutions to target the most vulnerable populations.

There were however instances of these capacity deficits being reduced.

In three cities, Mumbai, Bengaluru, and Surat, we found the active, embedded engagement of civil society organisations over extended periods of time had the effect of focusing the bureaucracy on climate action, which suggests that more active civil society involvement is necessary to reduce state capacity deficits.

In two instances, Surat and Ludhiana, we saw bureaucratic champions shaping the heat agenda.

INADEQUATE FINANCE
(11 percent of responses across sample):

Please see the discussion on finance in Section 3.

POLICY RECOMMENDATIONS

We make seven inter-linked policy recommendations covering institutional changes, capacity building, and technology:

Institutional Changes

1. Strengthen HAPs in local governments:

We show that top-down guidelines currently drive heat actions. HAPs could complement this policy approach by fleshing out which long-term actions should be focused on, and how to target them. They should, at minimum, require vulnerability assessments and urban heat island maps (for city plans). They could draw finances through the mitigation funds mentioned in recommendation #2 below. HAPs should be institutionally buttressed by being housed in statute (i.e. be put forward as part of a broader legislation on heat, or omnibus legislation on climate adaptation or public health), state-level legislative effort would help increase their weight in city and district governments where such legislation is passed. Finally, the implementation of HAPs and the guideline-driven response measures that feature so heavily in this report will require a robust monitoring system, which includes more robust health surveillance data and financial expenditure reports, all monitored at the national level by a competent technical institution.

2. Draw on disaster mitigation funds that provide for extreme heat risk mitigation:

As of late 2024, sub-national governments were allowed to draw National and State Disaster Mitigation Funds to execute projects that mitigate heat wave risks (Government of India, 2024). Several states have already declared heat waves to be state disasters. State, city, and district disaster management officials should harness this line of finance to establish a set of heat wave mitigation projects in their jurisdictions. This will, likely, however, run into the technical capacity constraints in both conceptualising and writing projects, discussed above. We recommend that this aspect of capacity be focused on in future capacity building programmes.

3. Heat officers need appropriate institutional backing:

We documented a range of institutional issues holding heat resilience efforts back, from a lack of personnel to low technical capacity and problem recognition. We also noted that many of these problems are endemic to local governance in India. Nascent conversations about instituting Chief Heat Officers (CHOs) in Indian cities should consider this institutional landscape. Elevating individuals to this role will lead to resilience gains only if they are given the authority to tackle the problems mentioned here. In the absence of such an institutional environment, CHOs will likely face the same hurdles nodal heat officers face today.

Capacity Building

1. Create a targeted capacity building programme for HAP implementation across India's most heat-vulnerable cities:

In previous sections, we have discussed pressing institutional constraints, which include a lack of technical capacity and inadequate problem recognition plaguing each of the sectors and cities we surveyed. This can be rectified through targeted, repeated heat risk capacity-building workshops for local implementers in a sustained, multi-year effort led by a large civil society organisation or multilateral agency, facilitated by the NDMA. Ideally, these trainings should be delivered to a mix of permanent and floating staff (usually senior officers). In the cities we visited, we found that heat actions were distributed between a handful of departments. A programme that targets these individuals in India's 10 most future heat-vulnerable cities would require convening around a few hundred officials every year. The NDMA is already carrying out a version of this through its annual workshops and recent city-level capacity building programmes. We recommend expanding this effort to include more line-departments at the local level.

2. Establish trained disaster management support staff capacity at the district level:

Three cities we visited lacked specialised disaster management capacity. In other cities, such capacity took the form of 'disaster experts' or 'disaster professionals'. This increases the burdens on senior district administrators in charge of disaster management and increases the likelihood of capacity being overwhelmed during a disaster. We recommend creating permanent, funded specialist positions in the most climate-vulnerable districts, with training for long-term risk mitigation.

Technology

1. Create a highly-targeted active cooling programme:

The rapid increase in temperatures and massive gap in long-term heat resilience strongly suggest that at-risk urban populations will turn to air conditioning to protect their lives and incomes. Low-income groups will likely turn to cheaper, inefficient ACs that drain household finances and accelerate global warming. State and national governments should deploy a subsidy or large-scale purchase programme that allows these families to buy energy-efficient ACs. These subsidies will be more effective if deployed nationally but must be targeted at portions of Indian cities with the highest heat risk, determined by the vulnerability assessment of its HAP. Governments must also invest in ongoing R&D efforts to scale next-generation cooling technologies that are considerably cheaper and more efficient. Electricity distribution and transmission infrastructure will also have to be upgraded to deal with higher peak summer loads, but does not feature as a long-term measure in our data.

2. Use climate projections to inform implementers about future heat impacts and expand the scope of solutions:

As we noted earlier, climate projections were not part of the planning process in any of the cities we visited. Only two out of 42 respondents reported having access to climate projections. Understanding the absolute, unlivable highs the hottest parts of the city could hit in the near- to medium-term future could motivate long-term planning. In our estimation, local governments generally do not have the technical capacity to carry out atmospheric modelling exercises in-house. We recommend making such projections available to them through national technical institutions such as the Indian Institute for Tropical Meteorology and the Indian Institutes of Technology through a national collaborative agreement anchored by the central government.

ANNEX 1:
INTERVIEW QUESTIONNAIRE

Interviews were conducted using a pre-decided questionnaire. Officials were asked questions based on the questionnaire provided below. While the initial questions were asked in the order listed, the sequence often shifted depending on the flow of the conversation. Officials were first asked to self-identify all implemented actions, after which interviewers followed up with specific questions about measures mentioned in their Heat Action Plan (HAP) or in media coverage on their heat actions.

STARTING QUESTIONS:

01 What is your role during a heatwave?

02 What heat actions are currently being implemented?

03 Which of these measures could have long-term effects?

FOLLOW UP QUESTIONS TO PROBE DRIVERS AND BARRIERS A BIT FURTHER:

01 Do heat measures receive support from elected representatives?

02 Do you receive directives from national or state governments for these actions?

03 What types of representations or demands do you receive from the public regarding heat?

04 Have any heat events in recent years influenced how you approach this issue?

05 Are there key advocates for heat action within your department or other departments?

06 Do you collaborate with any technical or civil society institutions on heat? If so, in what capacity?

07 Do you have access to clear information on how climate change will impact your work in the near future? If so, what is the source of this information?

08 How are heat actions funded?

09 How are responsibilities for implementing heat actions distributed?

10 How do you coordinate these actions within your department and with other departments?

11 How do you deal with existing departmental priorities and the new focus on heat?

12 What are the major barriers to implementing these actions?

ANNEX 2:
INDICATIVE LIST OF SECTOR WISE LONG-TERM ACTIONS NEEDED TO BUILD A HEAT-RESILIENT CITY

Below is an indicative list of long-term actions across various sectors to mitigate heat risk in a warming world. While not exhaustive, this list highlights key measures, which must be informed by heat vulnerability assessments to effectively target the most at-risk areas and populations in the city.

These solutions have been identified from a global literature review (US EPA, 2014, Keith & Meerow, 2022; UNEP, 2021 to name a few) of solutions that can help mitigate against long-term heat. Some of these solutions have also been taken from the draft version of India's National Framework for Heatwave Mitigation and Management.

SECTORS	INDICATIVE LIST OF SOLUTIONS
POWERS	○ **Heat-resilient grid infrastructure:** Evaluate electricity grid components' vulnerability to heat and implement upgrades to ensure reliability during extreme heat. (Keith & Meerow, 2022) ○ **Develop a targeted active cooling programme:** Implement subsidies or large-scale purchase programmes for energy-efficient ACs, prioritising high-risk areas identified in HAP vulnerability assessments. ○ **Increase investments in energy efficient cooling systems:** Increase investments in next-generation cooling technologies, renewable energy, and grid infrastructure needed to support a shift from passive to responsible active cooling. (Keith & Meerow, 2022)
LABOUR	○ **Awareness campaigns for heat-exposed workers:**Educate police, logistics, and construction workers on heat stress risks and prevention. ○ **Institutional capacity building:** Train employers to interpret forecasts, heat indices, and implement preventive measures across sectors like construction, SMEs, and manufacturing. ○ **Worker protections:** Strengthen enforcement of labour codes requiring water, shade and provision workplace cooling solutions, particularly for informal and female workers. ○ **Insurance for lost work:** Develop insurance for lost work due to heat.

SECTORS	INDICATIVE LIST OF SOLUTIONS
URBAN DEVELOPMENT & PLANNING	○ **Maintaining indoor ambient temperatures:** Cool roofs programme to regulate indoor temperatures in urban heat hotspots (Levinson, 2010); Green roofs programme to moderate daytime heat and overall urban air temperatures (US EPA, 2014). ○ **Rooftop rainwater harvesting:** Install systems in public and private buildings to prevent water shortages during heat waves Update building regulations: Incorporate shading, greening, and ventilation requirements into building codes. ○ **Update city master plans:** Incorporate greening and open spaces for setbacks, parks in city's master plan, along with identifying city's most at-risk areas using Urban Heat Island mapping. ○ **Training for planning community:** Equip architects, engineers, and planners with passive cooling techniques and building requirements suited to local climates. ○ **Ventilation corridors & cool pavements:** Enhance airflow, implement district cooling, and use heat-resistant, reflective pavements to lower temperatures.
HEALTH	○ **Community institution capacity building:** Train community health workers and care facilities to interpret heat forecasts and take preventive measures. ○ **Medical training:** Educate healthcare workers on heat-related illnesses and ensure last-mile dissemination of heat advisories in local languages. ○ **Heat-health surveillance:** Improve data collection and reporting on heat-related morbidity and mortality.
DISASTER MANAGEMENT	○ **Local weather networks:** Establish city-run Automatic Weather Stations (AWS) to enhance forecasting, improve resource allocation, and support urban heat planning. ○ **Early Warning Systems:** Every jurisdiction must establish information dissemination mechanisms that allow critical alerts, and necessary precautions, to flow to the relevant departments and the most heat-exposed and vulnerable people.

SECTORS	INDICATIVE LIST OF SOLUTIONS
FIRE MANAGEMENT	○ **Expand fire services:** Strengthen firefighting capacity to respond to heat-induced fires.
TRANSPORT	○ **Heat-resilient roads:** Implement road designs and materials that withstand high temperatures and minimise heat absorption. ○ **Public transport improvements:** Upgrade transit infrastructure with cooling-enabled last-mile connectivity.
WATER	○ **Last-mile water connectivity:** Improve drinking water access in heat-vulnerable areas through enhanced piped supply systems. Water body conservation: Restore lakes, ponds, and wetlands to support cooling and ecological resilience.
CROSS-SECTORAL MEASURES	○ **Urban greening initiatives:** Expand tree cover for daytime shade and develop grassy areas for nighttime cooling, especially in city's most at heat-risk areas. (Knight et al, 2021; US EPA, 2014) ○ **Regional awareness & training centres:** Establish centres in universities or educational institutions to educate communities on heat risks and adaptive measures. ○ **Vulnerability assessments:** Identify high-risk populations and areas requiring targeted heatwave interventions (Arsht-Rock, 2023). ○ **Local heat thresholds:** Develop region-specific benchmarks using historical temperature and health impact data. ○ **Localised climate projections:** Generate actionable forecasts to guide long-term heat resilience planning.

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