NRDC

संकल्प सेवा समर्पण

Municipal Council Churu

MAHILA HOUSING TRUST
Towards Responsible Urban Development
MHT

Churu

HEAT ACTION PLAN

Table of Content

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Abbreviation

CMCC:	Centro Euro-Mediterraneo sui CambiamentiClimatici
CMIP6	Coupled Model Intercomparison Project Phase 6
CNRM:	Centre National de Recherches Météorologiques
ECMWF	European Centre for Medium-Range Weather Forecast
GDP	Gross Domestic Product
HAC	Heat Action Committee
HAP	Heat Action Plan
HVRA	Heat Vulnerability Risk Assessment
IMD	India Meteorological Department
IPCC	Intergovernmental Panel on Climate Change
LST	Land Surface Temperature
LULC	Land Use Land Cover
MHT	Mahila Housing Trust
NCDC	National Centre for Disease Control
NDMA	National Disaster Management Authority
NDMF	National Disaster Mitigation Fund
NDRF	National Disaster Relief Fund
NOAA	National Oceanic and Atmospheric Administration
NRDC	Natural Resources Defense Council
ORS	Oral Rehydration Solution
RCP	Representative Concentration Pathways
ULB	Urban Local Body
SDMA	State Disaster Management Authority
SDMF	State Disaster Mitigation Fund
SDRF	State Disaster Relief Fund

Image: Pexels.com

1. Introduction

1.1 Global Warming and Escalating Heat Risks: A Focus on India

Since the Industrial Revolution, the global average temperature has risen by over 1.2 °C, contributing to a rise in heat-related events, extreme weather conditions, and mortality worldwide.[1] Between 2000 and 2016, India experienced a cumulative increase of approximately 125 million people exposed to heatwaves, with 2015 alone accounting for a record spike of 175 million exposures compared to typical hot years[2]. In India, rapid industrialization and urbanization have contributed to more frequent, prolonged, and intense heatwaves.[2] Changes in Urban Land Cover Change (ULCC) have elevated both land surface and air temperatures, disrupting local surface climates.[3] The year 2024 was the hottest ever recorded, surpassing 2023 and marking the first time annual average global temperatures exceeded 1.5°C above pre-industrial levels.[4] Notably, 2016 and 2020 rank among the hottest years in over a century in India, with the past decade (2015–2024) being the hottest on record[5].

Over 80% of India's workforce is employed in the informal sector, where protections like climate-controlled environments, social insurance, and formal labor rights are largely absent.[6] A study found that earnings dropped by 19% for every 1 °C rise in wet bulb temperature—a key indicator of heat stress.[7] The consequences of heat stress are not just environmental or health-related—they are also deeply economic. Beyond reduced productivity, many workers are unable to work at all during extreme heat, deepening income losses.[8] The consequences of heat stress are not just environmental or health-related—they are also deeply economic. A study by Duke University estimated that between 2001 and 2020, India lost 259 billion labor hours annually due to humid heat, leading to productivity losses worth $624 billion, or nearly 7% of the country's 2017 GDP. [9]

Over 80% of India's workforce is employed in the informal sector, where protections like climate-controlled environments, social insurance, and formal labor rights are largely absent.

Rising temperatures are not only breaking historical records but also causing long-term harm to human health, aggravating pre-existing conditions such as dehydration, cardiovascular and kidney diseases, and mental health disorders.[10] The National Disaster Management Authority (NDMA) has documented a sharp increase in heatwave events in recent years. Over 84% of Indian districts are now prone to extreme heatwaves, highlighting the growing heat vulnerability across the country.[11] As extreme heat worsens, urgent, science-led, and community-focused action is essential. This Heat Action Plan (HAP) aims to protect vulnerable groups and integrate heat adaptation into key systems. With early warnings and coordinated efforts, India can build long-term resilience and save lives.

1.2 Enhancing Heat Resilience through Heat Action Plans in India

Ahmedabad launched India's first HAP in 2013. Several states have since followed suit with measures such as early warning systems, public awareness campaigns, training for health professionals, and efforts to reduce heat exposure among vulnerable groups. While these state-level HAPs mark critical progress, many lack localized assessments and tailored interventions to address region-specific vulnerabilities effectively.

Still, HAPs have emerged as vital tools for embedding heat resilience into broader development and climate adaptation strategies. Evidence from Ahmedabad shows that structured preparedness can save lives—its HAP contributed to an estimated 1,190 fewer deaths annually in 2014–15 compared to the 2007–10 baseline.[12] These results underscore the importance of expanding and refining HAPs nationwide to protect communities from the escalating risks of extreme heat.

To strengthen HAPs, it is crucial to integrate hyperlocal vulnerability assessments that capture community-specific risks and ensure that marginalized groups are prioritized. Funding mechanisms must be established to support targeted interventions, with clear allocations for immediate response and long-term resilience. Additionally, building local capacities through training and resources will empower communities to take ownership of their climate resilience, while amplifying the voices of vulnerable populations ensures that their needs and solutions are central to the plan's design and implementation.

1.3 Understanding the Local Context: Heat Vulnerabilities in Rajasthan and Churu

Rajasthan is at the frontline of India's escalating climate crisis. With its arid terrain, extreme temperatures, and scarce water resources, the state is highly vulnerable to the impacts of extreme heat. The summer of 2024 marked a stark reminder of this reality: Sri Ganganagar recorded an unprecedented 49.6°C—breaking a 75-year record for May—while Churu reached a blistering 50.5°C, exceeding the monthly normal by 7.5°C.[13] These alarming figures are part of a broader and accelerating pattern of climate-exacerbated heatwaves that are impacting both lives and livelihoods across the state. The gravity of the situation prompted the Rajasthan High Court to take suo motu cognizance (action taken by a court on its own without a formal complaint) of the rising death toll from extreme heat, urging the central government to recognize heatwaves and other extreme weather events as national calamities.[14] Despite the presence of a state HAP, the Court noted significant implementation gaps and called for urgent, sustained efforts to strengthen on-the-ground action.[15]

Churu reached a blistering 50.5°C, exceeding the monthly normal by 7.5°C.37 These alarming figures are part of a broader and accelerating pattern of climate-exacerbated heatwaves that are impacting both lives and livelihoods across the state

Geographically, Rajasthan is the western state of India and is predisposed to heat stress (Fig 1). Although it occupies 10.4% of India's landmass and supports 5.5% of the population, the state has access to only 1.16% of the country's water resources.[15] Much of the region lies within the Thar Desert, where minimal vegetation, sandy terrain, and high solar radiation combine with erratic rainfall to create harsh living conditions. These environmental vulnerabilities are

Figure 1: Rajasthan & Churu representation on India map (Source: NRDC India)

compounded by deep socio-economic inequalities. Communities—particularly in rural and semi-urban areas—struggle with limited access to safe water, sanitation, health infrastructure,

and cooling options. Informal workers, women, and those living in poorly constructed housing face disproportionate exposure, with few protections from heat-related health impacts or economic disruptions.[17]

Churu district and the city epitomize this confluence of risks. Often referred to as the "gateway to the Thar," Churu experiences the highest mean frequency of 6.6 heatwave days among all districts in the state in May alone.[16] Historically, residents in the region adapted to the harsh climate using traditional coping mechanisms, but that resilience is increasingly being overwhelmed. In recent years, communities have observed a stark transformation: where once homes could stay bearable without cooling devices, today, fans and coolers are considered essential—yet remain out of reach for many low-income households. [17]During May and June, furnace-like winds sweep across Churu's parched landscape, driving people indoors and compounding the challenges of daily life.[18] In Rajasthan, these losses are borne most heavily by those engaged in informal labor, who often work outdoors without shade, hydration, or adequate rest, placing their health and incomes at serious risk. Folk musicians in Churu, are grappling with the dual challenges of climate change and landlessness, which threaten their centuries-old art form, *Pabuji ki Phad*.[18] This traditional oral epic, once performed under the open sky with hand-painted scrolls narrating the legend of the folk deity Pabuji, is now fading as rising heat and unstable livelihoods force artists to abandon or modify their performances for survival.[19]

Churu experiences the highest mean frequency of 6.6 heatwave days among all districts in the state in May alone

Photo: Pabuji ki Phad.; religious scroll painting of folk deities in Rajasthan, which is used for a musical rendition of the only surviving ancient traditional folk art form. (Source: Wikimedia commons)

Given these trends, strengthening Rajasthan's Heat Action Plan requires an integrated approach that goes beyond early warning systems and emergency response (Fig 2). Hyperlocal vulnerability assessments must inform action, especially in districts like Churu where ground realities vary significantly across communities. Targeted funding mechanisms should support both short-term interventions—like public cooling spaces and hydration points—and long-term resilience through urban greening, water access, and climate-resilient infrastructure. Most critically, the plan must prioritize building local capacities, raising community voices, and ensuring that those most at risk—particularly informal workers and women—are central to the planning, implementation, and evaluation of heat-related interventions.

1.4 Churu's Roadmap to Heat Resilience: Context, Goals, and Strategic Approach

Rajasthan has long been among India's most heat-affected regions, with exposure risks compounded by its arid geography, low and erratic rainfall, and socio-economic vulnerabilities. Recognizing this, local governments have begun to take action. In April 2023, the city of Jodhpur partnered with the Jodhpur Nagar Nigam North (JNNN), Natural Resources Defense Council (NRDC) and Mahila Housing Trust (MHT) to release their ward-level HAP grounded in local data and community engagement.[20] This initiative formalized Jodhpur's approach to extreme heat and marked a significant step toward institutionalizing local climate resilience.

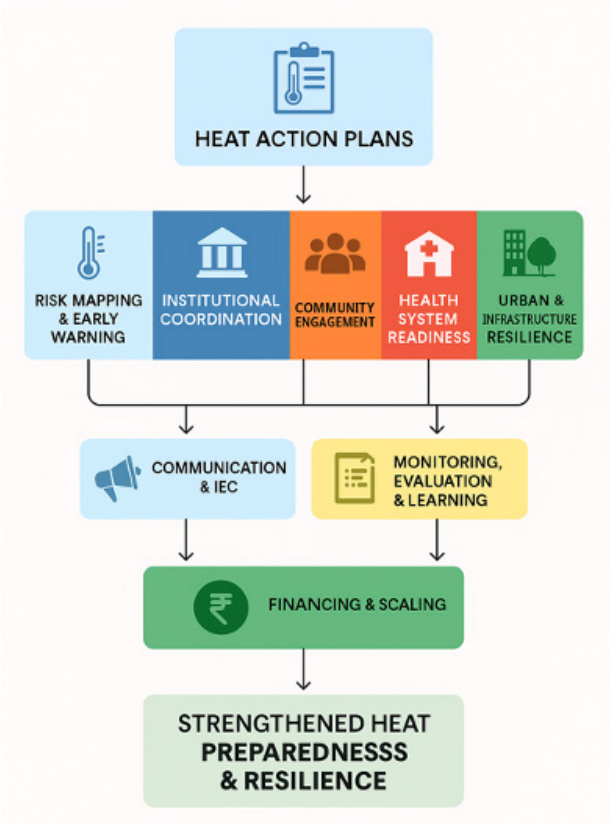
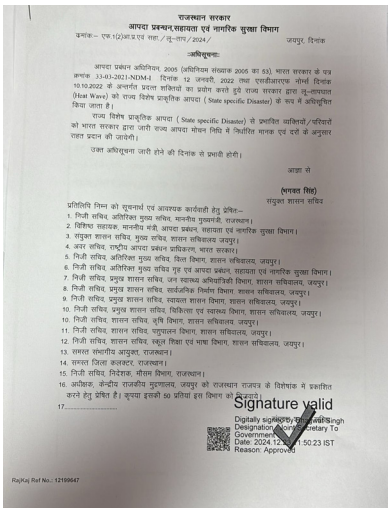


Figure 2: Schematic Representation of Strengthening HAP framework (Source: NRDC India)

Building on Jodhpur's momentum, a state-level heat preparedness workshop was convened in Jaipur in October 2024 by NRDC and the National Disaster Management Authority (NDMA), in collaboration with the Rajasthan State Disaster Management Authority (SDMA). The workshop (Picture 1, 2 & 3) brought together Urban Local Bodies (ULBs), district magistrates from 40 districts, public health professionals, and sectoral experts to advance heat planning across Rajasthan.[21] The technical sessions built in the workshop, focused on key priorities such as improving heat risk forecasting, tracing the evolution of HAPs, conducting vulnerability assessments, strengthening governance, engaging communities, and scaling health sector and financing responses. Experts from Council Energy Environment & Water (CEEW), MHT, National Centre for Disease Control (NCDC), Sustainable Futures Collaborative (SFC), India Meteorological Department (IMD) Jaipur, and United Nations Environmental Programme (UNEP) shared insights to guide integrated and locally grounded heat resilience strategies across Rajasthan. These collective efforts reflect a growing recognition that proactive, community-informed, and well-resourced heat governance is essential to safeguard Rajasthan's most vulnerable populations in the face of rising temperatures.

Photos: Inaugural Session speakers Sri Anand Kumar, Dr. Krishna Vatsa, Ms. Rakhee Sadhu, Shri Bhagwant Singh, and Mr. Chinmaya Acharya (Photo 1) ; Workshop participants in Rajasthan (Photo 2 & 3) (Source: NRDC India) ; Gazette by Rajasthan government declaring Heatwave as state specific disaster (Photo 4) (Source: SDMA, Rajasthan)



source: NRDC India

Following the state-level HAP training held in Jaipur, the Rajasthan Government took a critical policy step to strengthen its heat response framework. In December 2024, the Department of Disaster Management, Relief, and Civil Defence officially notified heatwaves and heatstroke as a "State-Specific Natural Disaster" (Photo 4).[22] This designation acknowledges the rising toll of heat-related illnesses and fatalities and enables affected individuals and families to receive financial compensation under the State Disaster Response Fund (SDRF) guidelines set by the Government of India. The move is a pivotal step in institutionalizing heat resilience and ensuring timely, targeted relief for vulnerable communities facing extreme temperatures.

1.4.1 Rationale for developing Urban Local Body (ULB) level heat action plan

ULBs are pivotal to the effective implementation of HAPs, serving as the primary coordinators across departments. Their role is essential in ensuring a localized, integrated response that spans sectors such as health, disaster management, water supply, infrastructure, and urban planning. Positioned at the frontline of city governance, ULBs can drive hyperlocal, data-informed strategies that safeguard public health and build long-term urban resilience.

Photos 5 & 6: Meeting of MHT team with Ms. Abhilasha Singh, Commissioner of Municipal Council Churu, and Mr. Abhishek Surana, District Collector of Churu in April 2025 (Source: MHT)

In April 2025, the Mahila Housing Trust (MHT) team met with Ms. Abhilasha Singh, Commissioner of Municipal Council Churu, and Mr. Abhishek Surana, District Collector of Churu, to present the city's heat vulnerability assessment and discuss the HAP (Photo 5 & 6). Key suggestions and next steps from the meeting included:

- **Heat Early Warning System:** Churu administration expressed interest in establishing a city-level heat early warning system modeled on the Jodhpur HAP.
- **Cool Roofs Initiative:** Proposal for ward-wise application of solar reflective white paint (cool roofing) to reduce surface heat exposure.
- **Cooling Stations:** Request for MHT's technical support in designing cooling stations, including:
  - » Preparation of design concept notes
  - » Identification of proposed locations
  - » Basic infrastructure requirements
- **Training Module**: Development of a training module outline focused on heat risk management and climate change adaptation.

1.4.2 Approach for Churu Heat Action Plan

In Rajasthan, heatwaves have been officially notified as a state-specific disaster. Accordingly, the Churu HAP adopts an institutionalized, multi-stakeholder, participatory approach that follows an evidence-based methodology. The plan is designed to be locally driven, operationalized through collaborative efforts, and continuously enhanced through the structured framework illustrated below (Fig. 3).

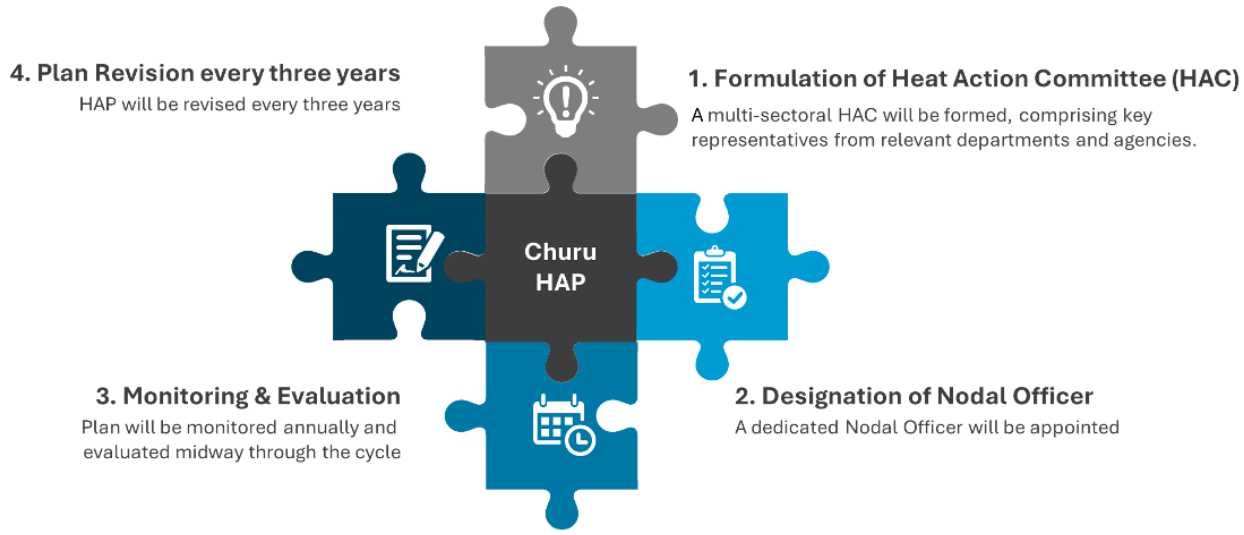


Figure 3: Framework for Churu HAP (Source: NRDC India)

- **Formulation of a Heat Action Committee (HAC):** A multi-sectoral HAC will be established, comprising key representatives from relevant departments at city, district and state level (Table 1).

Designation	Role in Committee
Chairperson, Municipal Council Churu	Chairperson
Churu MPs	Member
Churu MLAs	Member
Divisional Commissioner, Bikaner	Member
District Collector, Churu	Member
Sub-Divisional Magistrate (SDM), Churu	Member
Commissioner, Municipal Council Churu	Member
Secretary, Municipal Council Churu	Member
Chief Health Inspector, Municipal Council Churu	Member
Executive Engineer, Municipal Council Churu	Member
Assistant Fire Officer (AFO), Municipal Council Churu	Member
Secretary, Disaster Management, Relief & Civil Defence Department, Government of Rajasthan	Member
Principal Secretary, Urban Development and Housing Department, Rajasthan	Member
Nodal Officer, Heat Action Plan, Municipal Council Churu	Member
Ward Councilor (High Risk Ward)	Member
Chief Medical & Health Officer (CMHO), Churu	Member
District Transport Officer	Member
Labour Welfare Officer (LWO), Churu	Member
Ajmer Vidyut Vitran Nigam Limited	Member
Deputy Conservator of Forests (DCF), Churu	Member
Head, India Meteorological Department, Jaipur	Member
District Education Officer	Member
Joint Director, Animal Husbandry Department, Churu	Member
Rajasthan Livestock Development Board	Member
Department of Women and Child Development, Rajasthan	Member
District Agriculture Department, Churu	Member
Churu Traffic Police	Member
State Disaster Response Force (SDRF), Rajasthan	Member
Public Health Engineering Department, Churu	Member
NRDC	Member
MHT	Member

Table 1: Heat Action Committee Task force table for Churu

- **Designation of a Nodal Officer:** A dedicated Nodal Officer will be designated within the District Administration to coordinate the implementation of the HAP, ensure integration across departments, and oversee monitoring and reporting.
- **Monitoring and Evaluation:** The HAC will meet prior to the onset of the heat season (February/March), meet fortnightly during the season to monitor implementation, and hold emergency meetings in response to heatwave alerts. A post-season review will be conducted in July/August to evaluate the overall response.
- **Triennial Plan Revision:** The HAP will be revised every three years, incorporating updated climate data, revised vulnerability assessments, and stakeholder feedback, ensuring alignment with evolving national and state climate and health policies.

Image: Pixabay.com

2. Temperature Trends & Heat Vulnerability Risk Assessment (HVRA)

2.1 Localized Climate Insights for HAPs

Despite Rajasthan's acute vulnerability to extreme heat, most district- and city-level HAPs fall short of incorporating detailed assessments of local heat risks and long-term climate trends. To address this gap in Churu, a data-driven approach was used as a first step—analyzing historical climate data from 1980 to 2024 alongside projections through 2050—to provide a clearer picture of past trends and future risks. This analysis focuses on the critical heat months of March to June (MAMJ), which define the region's extreme heat season. Without such granular, place-specific insights, HAPs risk missing the localized patterns that shape on-the-ground vulnerability. A 2023 review by the Centre for Policy Research (CPR) of 37 HAPs revealed that only two included explicit vulnerability assessments, underscoring the pressing need for deeper, localized planning across Rajasthan.[23]

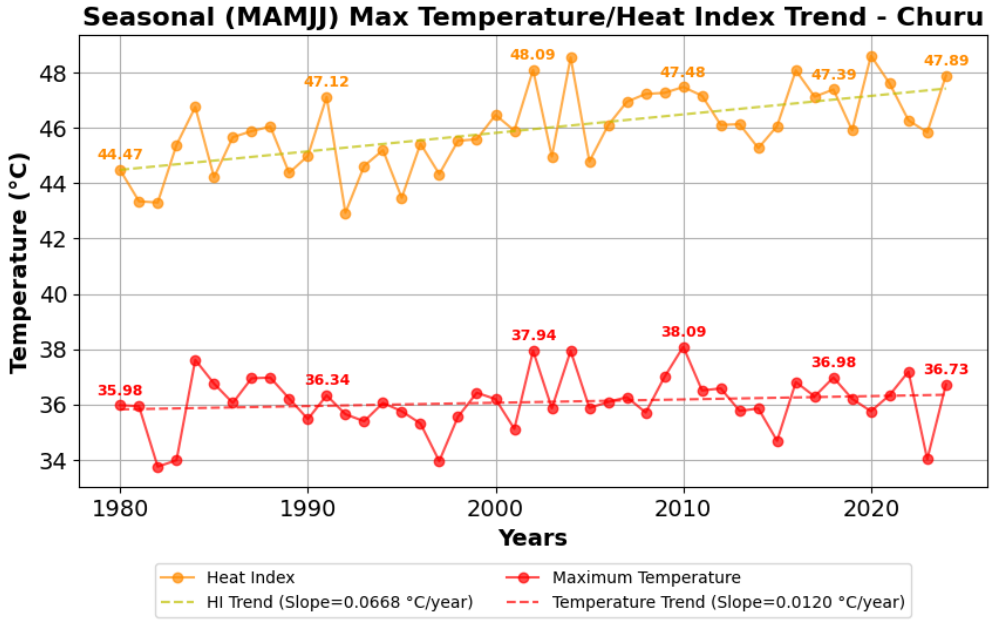
To address this gap in Churu, a data-driven approach was used as a first step—analyzing historical climate data from 1980 to 2024 alongside projections through 2050—to provide a clearer picture of past trends and future risks

2.1.1 Mapping Climatology of Churu

Characterized by a hot semi- arid climate, Churu experiences intense dry heat and wide diurnal temperature variations.[24] To evaluate both daytime and nighttime heat extremes, we used ERA5 reanalysis data (1980–2024), which reveals a consistent warming trend aligned with broader regional patterns across northwest India.[25]

While humidity is not a dominant factor due to the arid climate, we still analyzed it alongside temperature to assess perceived heat using the NOAA Heat Index (HI) formula. This approach, which combines air temperature and relative humidity, offers insights into heat stress levels

Figure 3: Seasonal – March to June (MAMJ) Heat Index & Mean Temperature for Churu (1980-2024) (Source: NRDC India)



and is widely used in climatology and public health research.[26] Studies have shown that elevated heat index values are more closely correlated with human thermal discomfort, heat-related illnesses, and mortality than ambient temperature alone.[27]All datasets—daily maximum and minimum temperatures and relative humidity—were analyzed to understand evolving heat conditions in Churu.

The analysis reveals a clear upward trajectory in both Maximum Temperature and Heat Index values in Churu over the 44-year period.

- The maximum summer temperature in Churu has increased at a rate of approximately **0.0120°C per year**, totaling about **0.53°C** over four decades.

- More notably, the heat index, which combines temperature and relative humidity to express perceived heat stress, shows an even steeper rise of **0.0668°C per year**, amounting to an increase of **~2.94°C** between 1980 and 2024.

  Such amplified heat stress has significant public health implications. Such shifts could disrupt agricultural cycles and strain water resources, exacerbating the vulnerability of the local population.

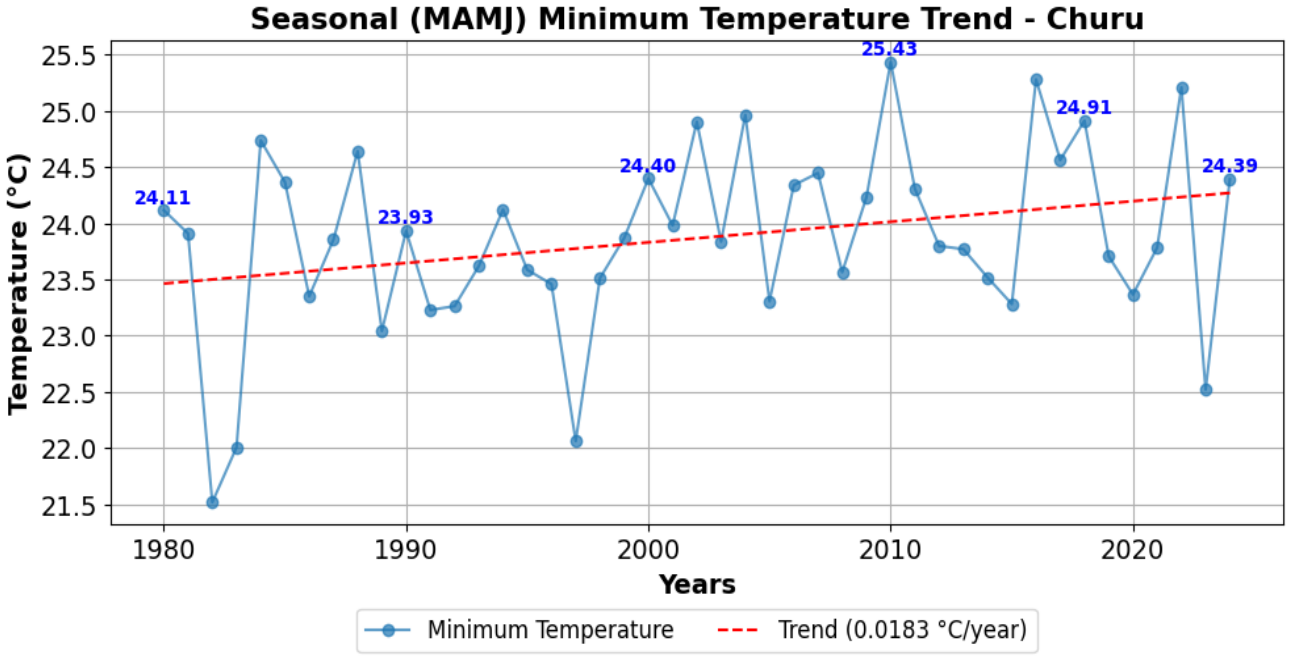


Figure 4: Seasonal – March to June (MAMJ) Minimum Temperatures in Churu from 1980-2024 (Source: NRDC India)

Minimum temperatures in Churu also show a notable increase (Fig 4). The **seasonal average minimum temperature (Tmin)** has risen by a total of **~0.81°C** over the observed period of 44 years.

- The highest Tmin recorded in the dataset occurred in 2010, reaching **25.43°C**. This was also the year when major heatwave occurred across the North & West India.

- More recent years (2015 onward) continue to show a persistent night-time warming trend.

  This pattern of night-time warming is particularly concerning. It limits nocturnal cooling, thereby reducing the body's ability to recover from daytime heat stress. Research indicates that elevated minimum temperatures are strongly associated with increased heat-related morbidity and mortality, particularly among vulnerable populations.[28] Night-time heat is also linked to disrupted sleep and cardiovascular stress, which can accumulate over successive hot days.

2.2. Climate Change Projections: Analysis of RCP 8.5 Scenarios

Alongside historical analysis, future climate projections for 2025–2050 were assessed to anticipate emerging heat risks. These projections use Representative Concentration Pathways (RCPs), developed by the IPCC, to represent possible greenhouse gas emission trajectories. RCP 8.5—once seen as a "business-as-usual" scenario—is now considered a high-end pathway associated with continued emissions growth and more severe warming outcomes, as recent studies suggest.[29]

2.2.1 Climate Models and Projection Methodology

To project the future climate trajectory for Churu, this analysis draws on the CMIP6 ensemble under the RCP 8.5 scenario.[30] Specifically, we employed outputs from two global climate models—**CMCC** and **CNRM** known for their ability to simulate monsoonal and semi-arid climates relevant to northwestern India.[31] These models have been widely used in regional assessments and have shown reliable performance in simulating key temperature metrics over South Asia.[32] To ensure local relevance, the model outputs were localised using observed temperature data for Churu (1980–2014) from the respective models. Temperature anomalies were then calculated using 1980–2000 as the baseline reference.

2.2.2 Analysis of the Temperature Trends

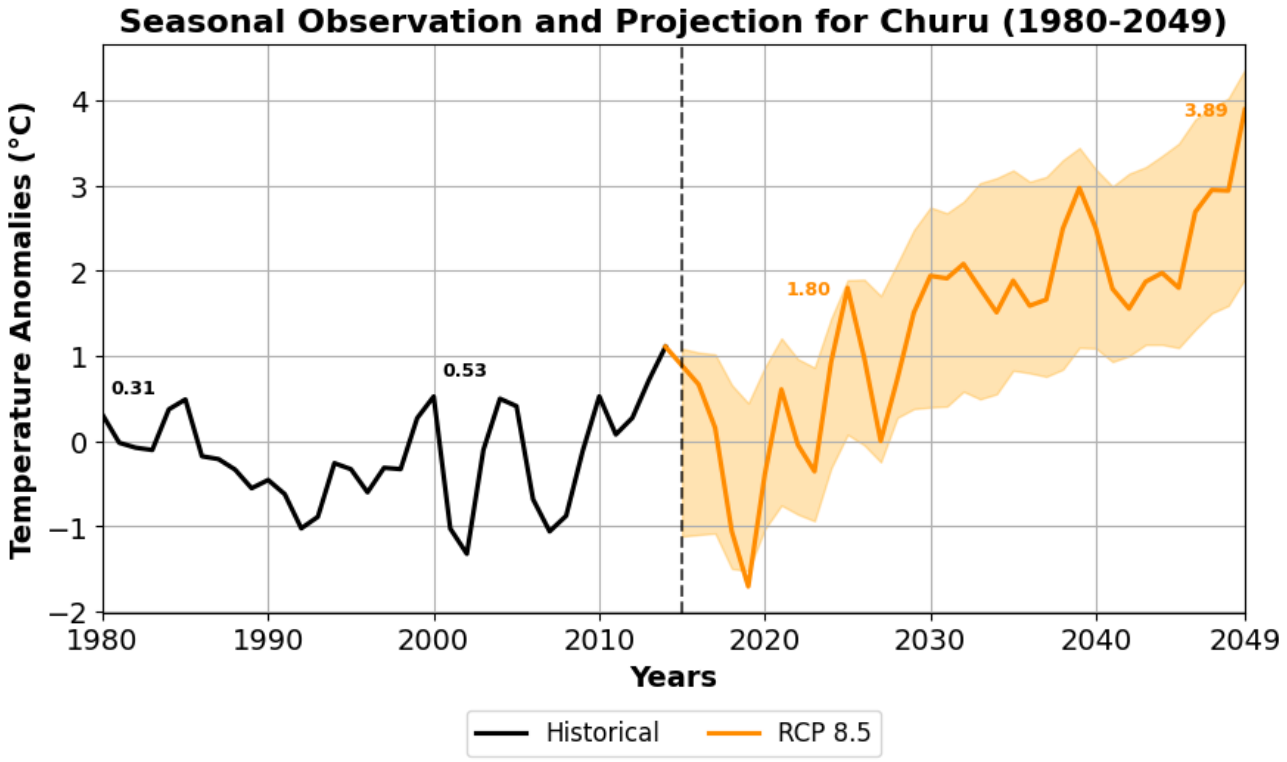


Figure 5: CMIP6 Max Temperature projections for Churu (1980–2050). The black line shows the historical simulation, and the red line indicates future projections for RCP 8.5 scenario. (Source: NRDC India)

The historical period (1980–2014), shown in black, reflects relatively modest interannual fluctuations in seasonal temperature anomalies. The anomalies begin in the early 1980s with values like 0.31 and rise to 0.53°C around 2010. (Figure 5) This trend indicates a gradual but consistent warming pattern over three decades, aligned with global and national warming observations.

Post-2014, the projection curve under RCP 8.5, shown in orange, shows a marked acceleration in warming. The maximum seasonal temperature anomaly is projected to reach approximately 1.80°C by 2025 and is expected to continue in a steep upward trajectory, reaching about 3.89°C by 2049. The shaded region represents the model ensemble uncertainty range, which also expands over time, indicating increasing variability and uncertainty in seasonal temperatures as climate change intensifies. The projected warming trend suggests longer and more intense summer seasons, elevated nighttime temperatures, and an increased likelihood of heatwaves.[33]

The past and projected anomalies support broader research findings on Rajasthan's climate trajectory. A warming of up to 4.27°C for the region under RCP 8.5 (high emissions scenario) by the end of the century has been projected, accompanied

by an increased number of extreme temperature days and persistent hot spells.[34] These projections validate and reinforce the importance of localized adaptation strategies such as early warning systems, improved urban design (e.g., cool roofing), and heat-health response plans.

2.3 Heat Vulnerability Risk Assessment (HVRA)

A widely used method for analyzing vulnerability involves developing vulnerability indices that integrate socio-economic, environmental, and infrastructural elements.

Assessing heat vulnerability is crucial for effective resource allocation, as it helps identify the most vulnerable areas of the city and prioritize interventions accordingly. Three key factors are considered: exposure, sensitivity, and adaptive capacity (Fig. 6). These factors are analyzed based on their theoretical significance to heat vulnerability, existing literature, and available data. The IPCC Sixth Assessment Report defines vulnerability as "the propensity or predisposition to be adversely affected," which encompasses both sensitivity to harm and the ability to cope or adapt.[35] A widely used method for analyzing vulnerability involves developing vulnerability indices that integrate socio-economic, environmental, and infrastructural elements. This spatial analysis reveals regions with varying vulnerability levels, ranging from the most to the least affected. These indices assist policymakers in designing targeted climate risk management and adaptation strategies, ensuring that resources and interventions are directed where they are most needed.

Exposure reflects the degree to which communities are subjected to elevated temperatures and heat-related stress. It is evaluated using parameters such as Land Surface Temperature (LST) and population density.

Sensitivity denotes the extent to which a community is likely to be affected by the adverse impacts of heat. Key parameters used to assess sensitivity include female population, illiteracy rate, child population (below 6 years), sites of labour chowks, built-up index (NDBI), land-use / land cover.

Adaptive Capacity reflects the ability of a community to anticipate, respond to, and recover from heat-related challenges. This is measured through parameters such as access to parks, access to urban health centers (UHC), normalized difference water index (NDWI), normalized difference vegetation index (NDVI), access to roads.

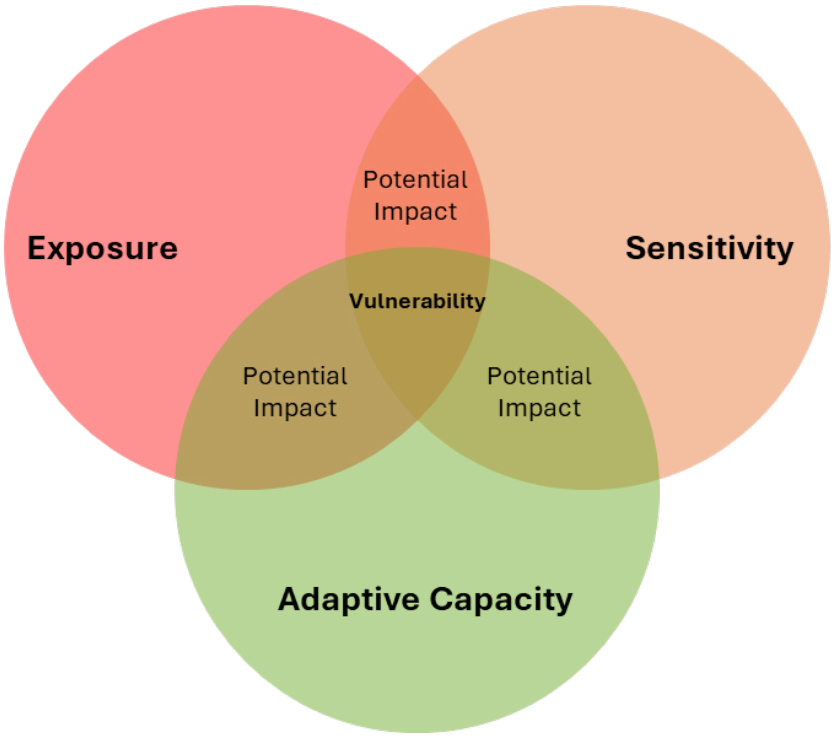


Figure 6: Framework for Assessing Heatwave Vulnerability (Source: NRDC India)

2.3.1 Selection of Parameters for Exposure, Sensitivity and Adaptive Capacity
The table 2 below provides a comprehensive overview of the selected factors and their respective parameters for the heat vulnerability risk assessment in Churu:

Factors	Sr No.	Parameters	Units	Resolution	Data Period	Source
Exposure	1	Land Surface Temperature	°C (Celsius)	30 meters	10 Year Mean (2015-2024)	Landsat 8, USGS
	2	Population Density	No. of persons per square km	Ward-level	2011	Census 2011
Sensitivity	3	Female Population	No. of persons per ward	Ward-level	2011	Census 2011
	4	Illiteracy Rate	No. of illiterate people per ward	Ward-level	2011	Census 2011
	5	Population below 6 Years	No. of Children per ward	Ward-level	2011	Census 2011
	6	Sites of Labour Chowks	No. of labour chowks per square km	Ward-level	2024	Municipal Council Churu
	7	Built-Up Index (NDBI)	Built-up area per square km	30 meters	2024	Landsat 8, USGS
	8	Land-use / Land cover	Land Cover per square km	Ward-level	2021	Existing Land-use Plan
Adaptive Capacity	9	Access to Parks	No. of parks per square km	30 meters	2021	Existing Land-use Plan
	10	Access to Urban Health Centers	No. of UHC per square km	Ward-level	2024	Municipal Council Churu
	11	Normalized Difference Water Index (NDWI)	Zonal Pixel Ratio	30 meters	2024	Landsat 8, USGS
	12	Normalized Difference Vegetation Index (NDVI)	Zonal Pixel Ratio	30 meters	2024	Landsat 8, USGS
	13	Access to Roads	Length of roads per square km	Ward-level	2021	Existing Land-use Plan

Table 2: Selected Parameters for Heat Vulnerability Risk Assessment in Churu

2.3.2 Results of the Heat Vulnerability Risk Assessment

Churu is divided into 60 wards. To assess the heat vulnerability risk across wards, individual composite indices were evaluated for exposure (refer to Fig.8), sensitivity (Fig. 9), and adaptive capacity (Fig.10). These indices were then integrated using a methodological approach (Fig. 7) to calculate the overall vulnerability score for each ward.

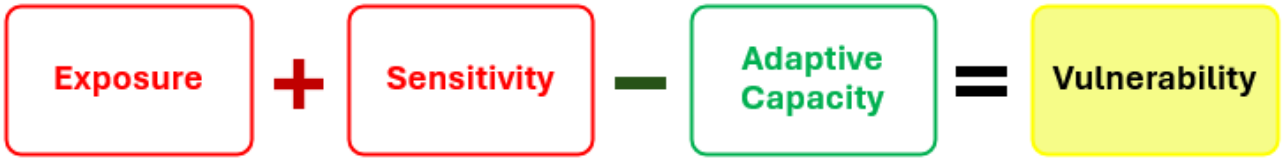


Figure 7: Heat Vulnerability Assessment Function Equation

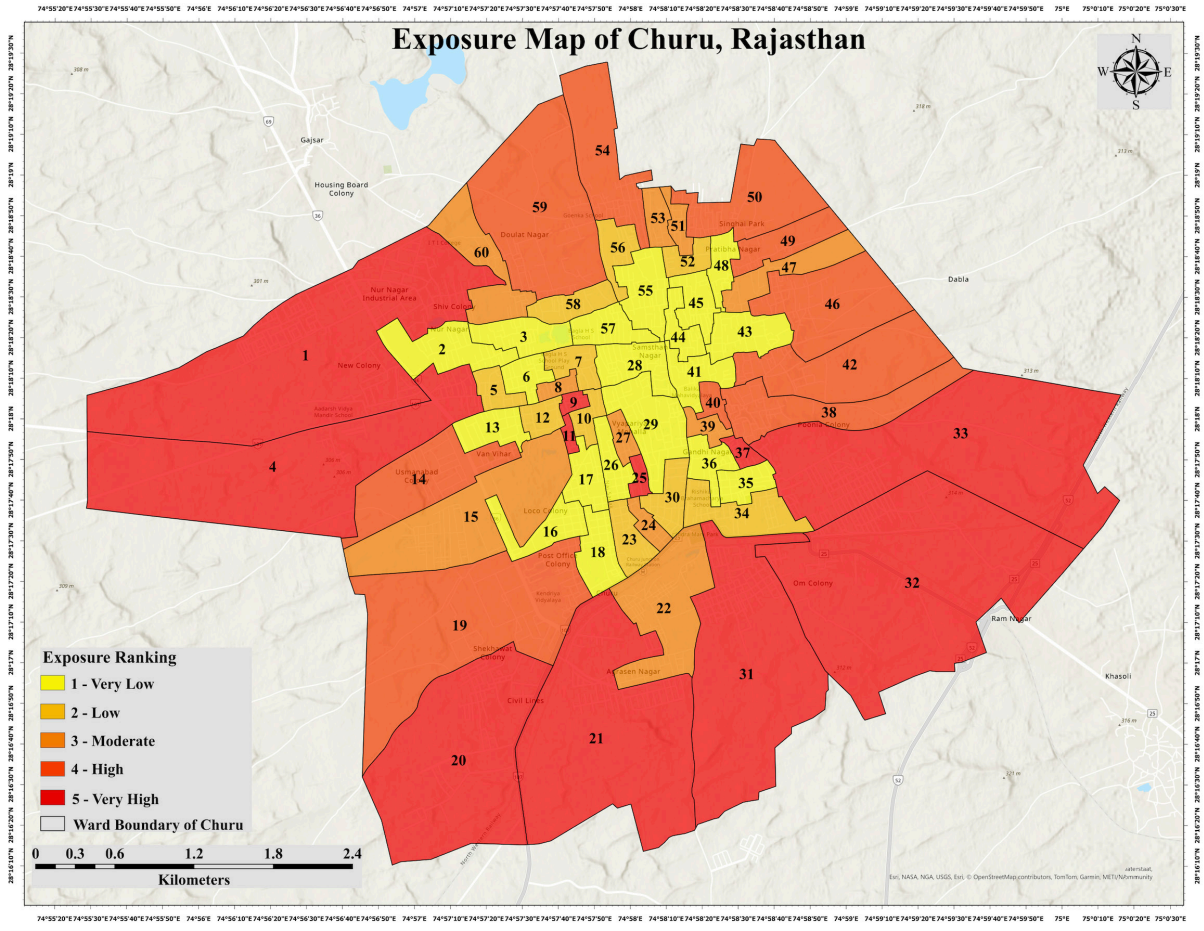


Figure 8: Exposure Composite {Color Scale: yellow – 1 (lowest) to red –5 (highest)}

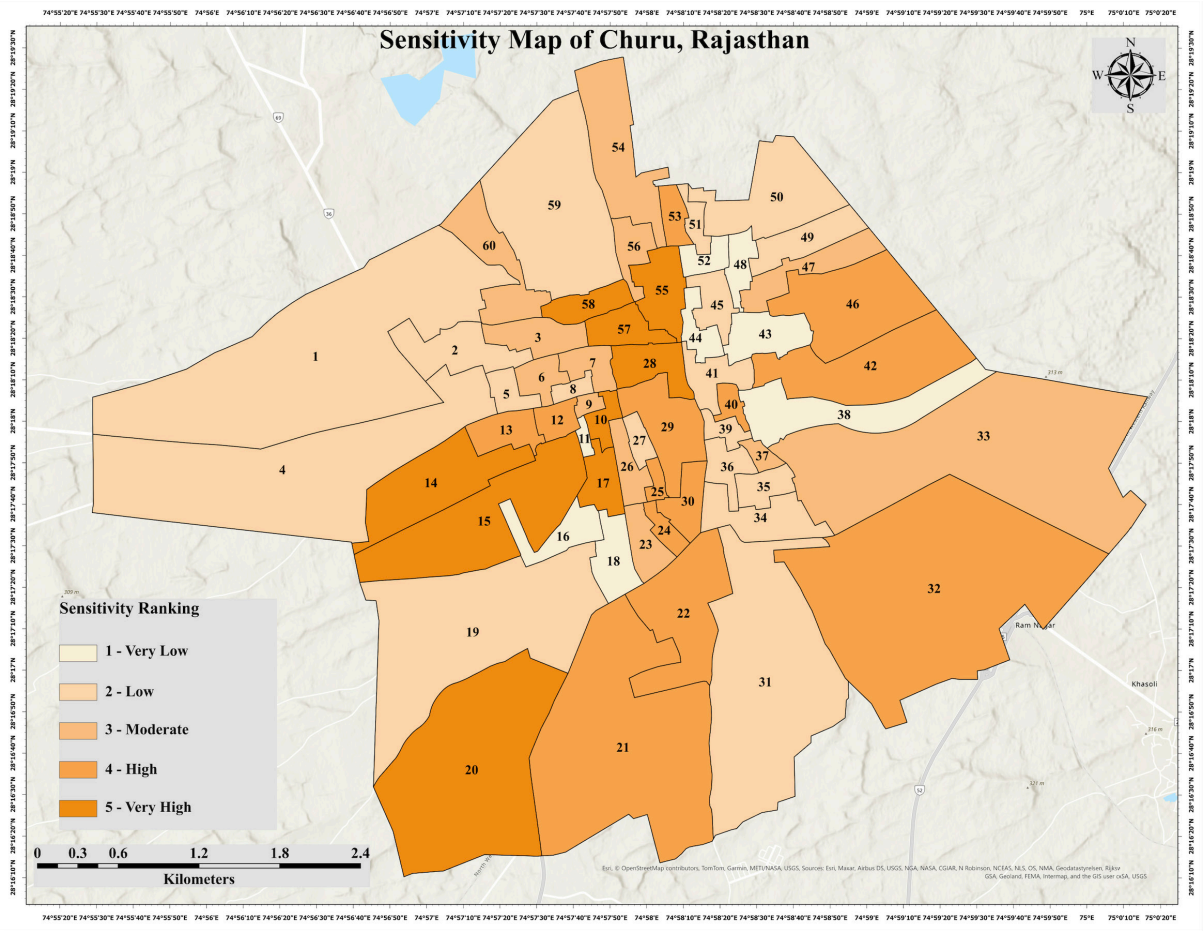


Figure 9: Sensitivity Composite {Color Scale: pale brown – 1 (lowest) to dark brown –5 (highest)}

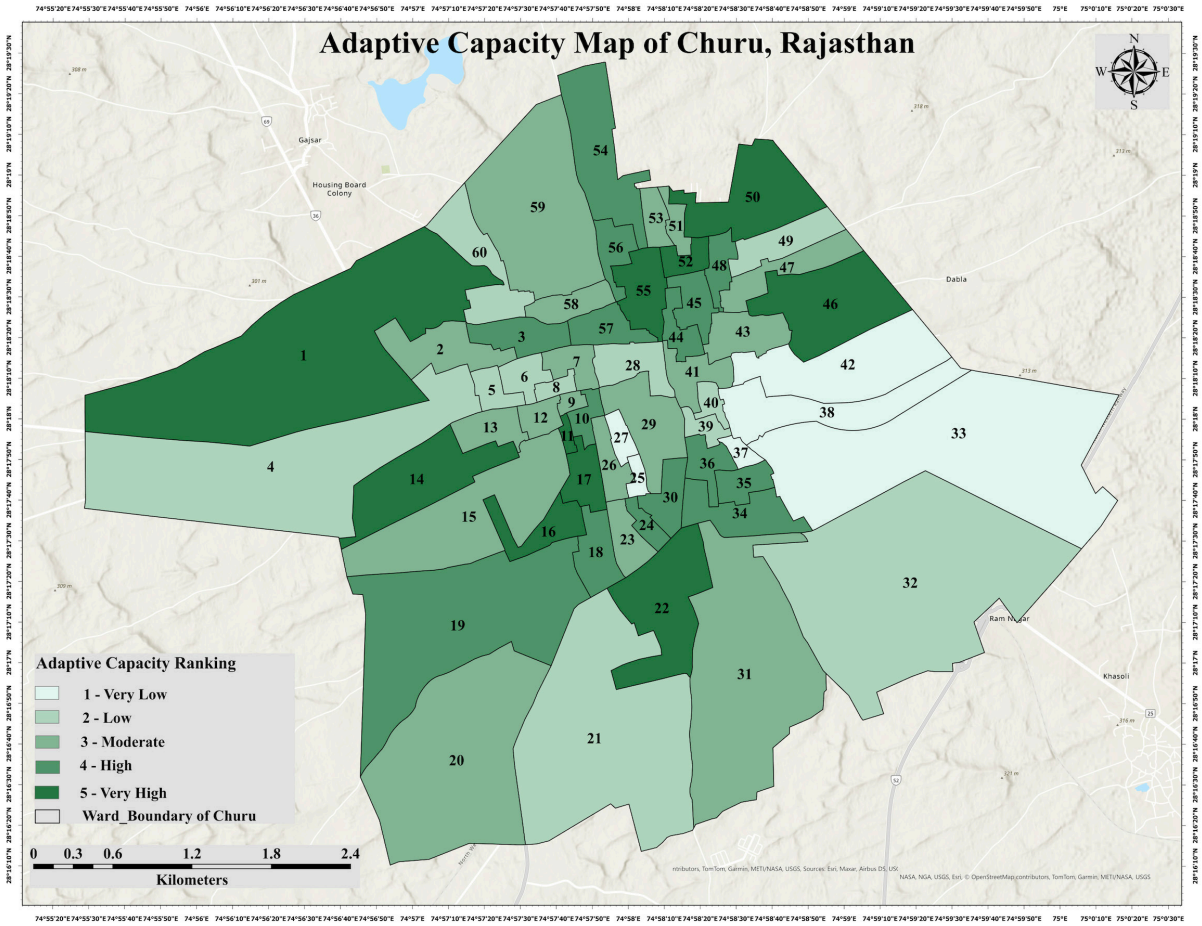


Figure 10: Adaptive Capacity composite {Color Scale: light green – 1 (lowest) to dark green –5 (highest)}

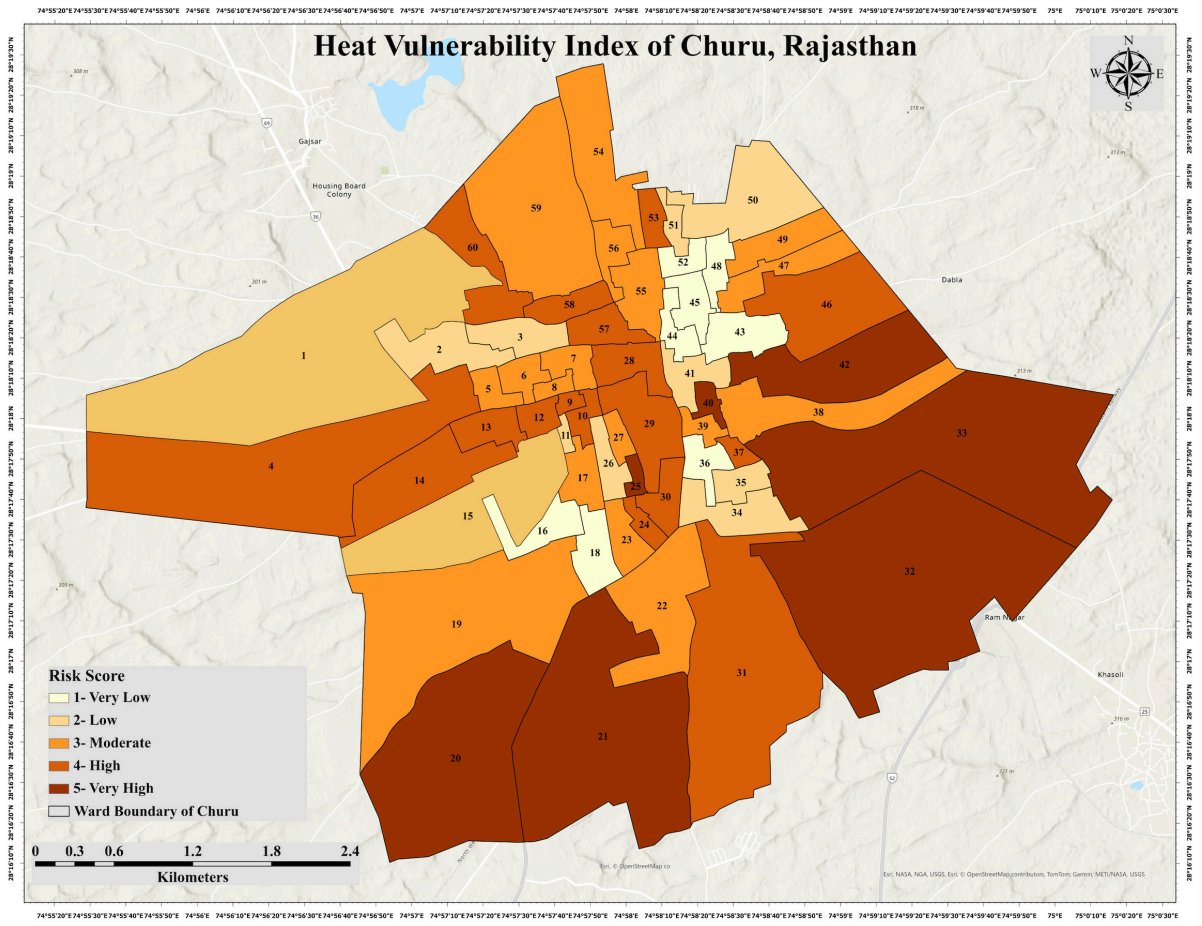


Figure 11: Heat Vulnerability Index Map {Color Scale: pale brown – 1 (lowest) to dark brown–5 (highest)}

Risk Category	Risk Score	Ward Number	No. of wards
Very High	5	20, 21, 25, 32, 33, 40, 42	7
High	4	4, 9, 10, 12, 13, 14, 24, 28, 29, 30, 31, 37, 46, 53, 57, 58, 60	17
Moderate	3	5, 6, 7, 8, 17, 19, 22, 23, 27, 38, 39, 47, 49, 54, 55, 56, 59	17
Low	2	1, 2, 3, 11, 15, 26, 34, 35, 41, 50, 51	11
Very Low	1	16, 18, 36, 43, 44, 45, 48, 52	8

Table 3: Ward-Wise Risk Categorization in Churu Based on Heat Vulnerability Assessment

The ward-level analysis highlights significant variation in heat-related vulnerability across Churu (Fig. 11). Wards 20, 21, 25, 32, 33, 40, and 42 exhibit moderate to high levels of exposure and sensitivity to extreme heat. In terms of adaptive capacity, these wards score moderately to low, indicating that residents face considerable risks with limited means to respond or recover. This underscores the urgent need for focused and area-specific interventions to enhance resilience and protect vulnerable populations.

2.3.3 Traditional Heat Adaptation Practices

Traditional Coping Mechanisms in Rajasthan: Clothing, Housing, Diet, and Architecture

In Rajasthan's harsh desert climate, traditional practices evolved over centuries to provide resilience against extreme heat. These adaptive strategies—rooted in deep local knowledge—offer valuable insights for modern climate resilience planning.

Clothing: Practicality Meets Culture

People in Rajasthan traditionally wear loose-fitting, breathable cotton garments in light shades. Such attire reduces heat stress and dehydration, showcasing how culture and climate co-evolve. These include:

- **Angarkha and lehariya turbans** (for men) and **odhnis and lehengas** (for women), allowing airflow while shielding from the sun.
- **Layered clothing**, paradoxically, protects against heat by minimizing direct exposure and insulating against the hot air outside.

Diet: Cooling Foods and Traditional Millets

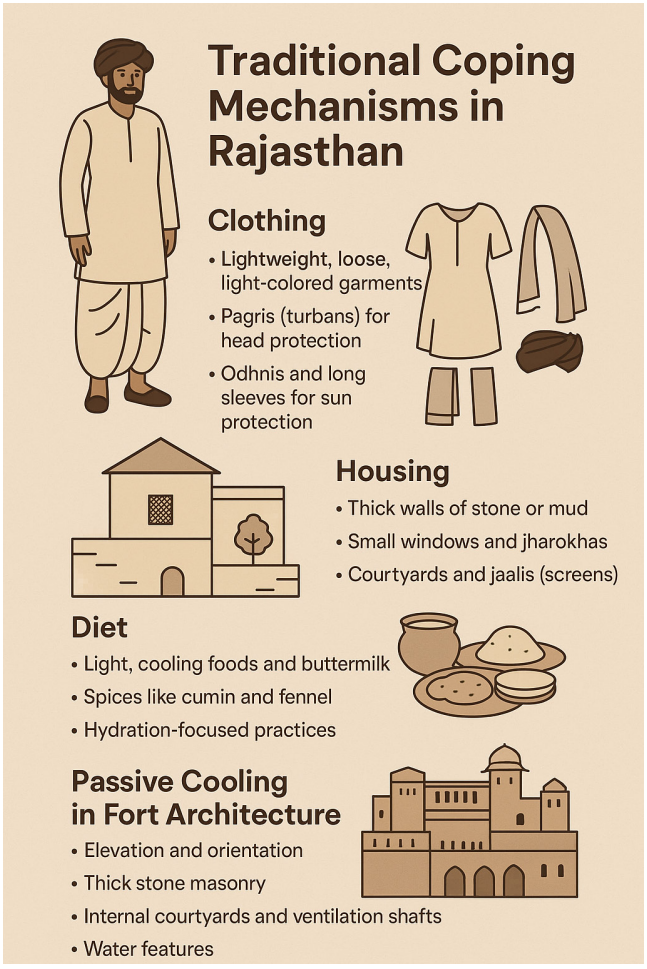
Dietary habits in Rajasthan are another vital defense against heat. These diets are not only nutritionally dense but also suited to maintaining thermal balance in the body.

- **Bajra (pearl millet)** is a staple grain with high fiber and cooling properties. Its slow-digesting nature helps sustain energy and hydration in extreme heat.
- **Buttermilk (chaas)**, **bael juice**, **raw mango drinks (aam panna)**, and **earthen-pot water (matka)** are commonly consumed to regulate body temperature.
- Foods are usually cooked with minimal oil and spices in summer to aid digestion.

Heat-Resilient by Tradition: How Rajasthan's Built Environment Tackles Extreme Heat

Traditional architecture in Rajasthan is a masterclass in climate-adaptive design, deeply rooted in local ecology and crafted to withstand the region's intense desert heat.

- Homes and havelis were built with thick stone walls, earthen floors, and mud plaster that naturally insulated interiors, while features like inner courtyards, jaali windows, verandas, and jharokhas enabled passive cooling and cross ventilation.
- Lime plaster lining the inner walls acted as a natural cooling agent, absorbing humidity and releasing it slowly to maintain comfort.
- This architectural wisdom extended beyond homes—carved façades, open chowks, meandering streets, and communal spaces were intentionally designed to maximize shade and airflow.



(Source: NRDC India)

- A hallmark of this approach is the use of local yellow sandstone, which replaced heat-absorbing materials like metal and glass, reflecting solar radiation and trapping nighttime coolness.
- Even Rajasthan's iconic forts in Jodhpur, Jaipur, and Jaisalmer embodied this climate consciousness, strategically built on elevated terrain with layered stone walls, shaded corridors, internal water storage, and ventilation shafts.

These structures—whether residential or defensive—stand as enduring examples of how architecture, community, and ecology were harmonized to create environments that naturally resist extreme heat.

Image: Flikr.com

Image: Pexels.com

3. Preparedness and Response Plan

Certain wards within the city exhibit heightened susceptibility to heat-related health risks due to varying socio-economic and infrastructural factors.

Based on the temperature trend analysis and vulnerability assessment presented in the earlier sections, Churu has experienced a marked increase in extreme heat events, especially since the 1980s. Certain wards within the city exhibit heightened susceptibility to heat-related health risks due to varying socio-economic and infrastructural factors. Considering these findings, it is essential to implement a decentralized, ward-level heatwave response strategy. This chapter presents the framework for early warning systems, coordination mechanisms among relevant agencies, and public outreach measures to reduce heat-health impacts.

3.1 Early warning system and alert mechanism

In Rajasthan, heat has been declared as a state specific disaster. For Churu's HAP, we will align with localized thresholds and criteria issued by the India Meteorological Department (IMD). IMD's methodology integrates multiple meteorological parameters—such as relative humidity, wind speed, heatwave duration, and long-term climatological patterns—making it more nuanced and contextually relevant for public health planning. This locally adaptive approach will enhance the timeliness and accuracy of heat alerts, enabling better preparedness and response at the city and ward level.

Colour Code	Alert	Warning	Impact	Suggested Actions
Green (No action)	Normal Day	Maximum temperatures are near normal	Comfortable temperature. No cautionary action required	Normal day-to-day activities can continue without special precautions.
Yellow Alert (Be Updated)	Heat Alert (Maximum temperature between 40-43°C or departure from normal is 4.5-6.4°C)	Heat wave conditions at isolated pockets which persists on for 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	a) Avoid heat exposure; b) Wear light-coloured, loose, cotton clothes; c) Cover your head; d) Use a cloth, hat, or umbrella
Orange Alert (Be prepared)	Severe Heat Alert for the day (Maximum temperature between 44-46°C or departure from normal is ≥6.5°C)	a) Severe Heat wave conditions persist for 2 days b) Though not severe, but Heat wave persists for 4 days or more	High temperature. Increased likelihood of heat illnesses 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 diseases	a) Avoid heat exposure – keep cool, avoid dehydration b) Drink sufficient water – even if not thirsty c) Use ORS, homemade drinks like lassi, torani (rice water), lemon water, butter milk, etc., to keep yourself hydrated
Red Alert (Action Req.)	Extreme Heat Alert for the day (Maximum temperature ≥47°C)	(a) Severe Heat Wave persists for more than 2 days (b) Total number of heat/severe Heat wave days exceeding 6 days	Very high likelihood of developing heat illnesses and heat stroke in all ages	Extreme care needed for vulnerable people

Table 4: IMD Colour coded Heat warning Framework

3.2 Inter-agency coordination chart (for dissemination of alerts and warnings)

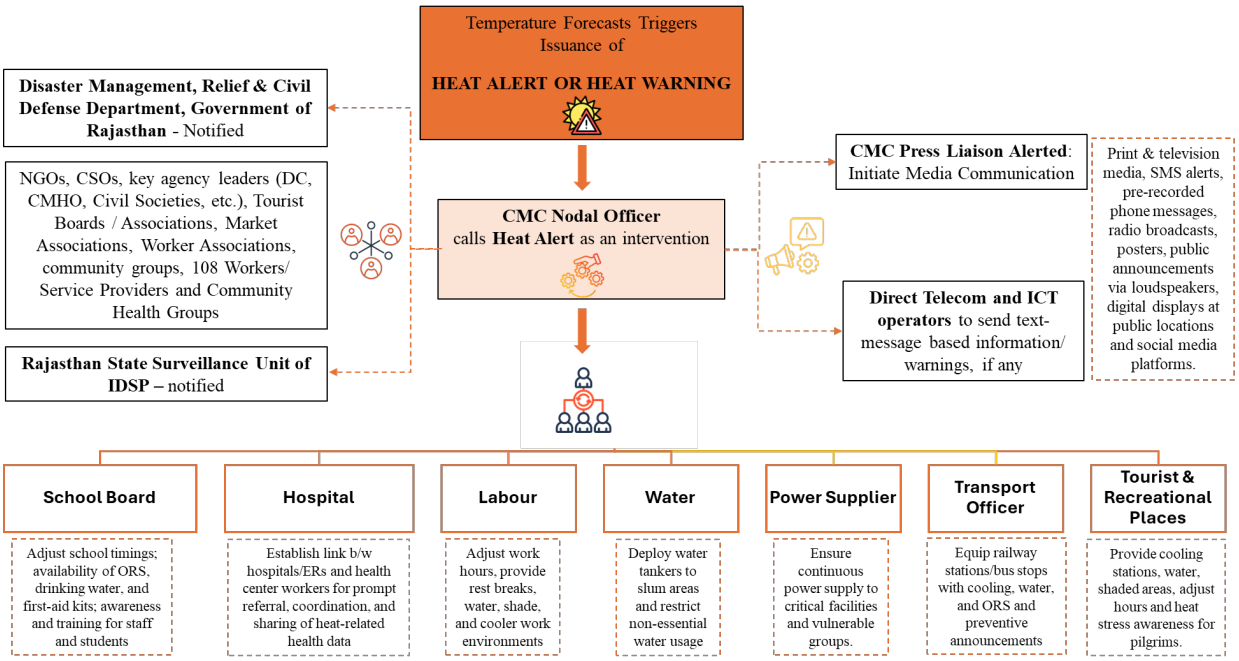


Figure 12: Interagency Coordination Framework initiated by Municipal Council Churu Nodal Officer upon Alert Activation

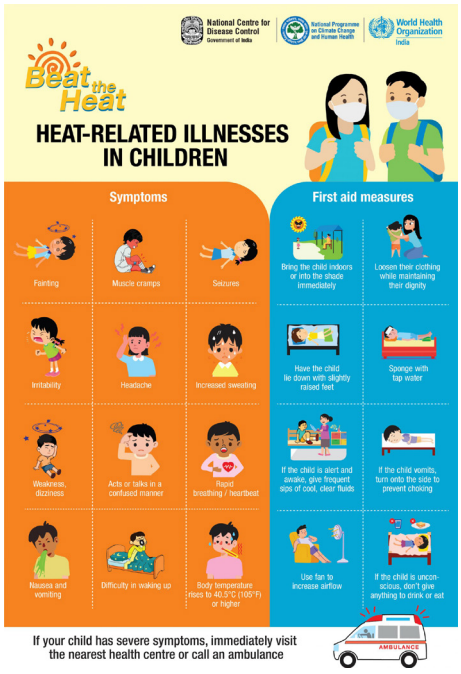
The Municipal Council Churu shall appoint a Nodal Officer to oversee the overall coordination and effective implementation of the HAP (Fig 12). This officer will be responsible for facilitating timely communication among relevant departments and ensuring coordinated action before, during, and after heatwave events. The Nodal Officer will also ensure that adequate support staff and resources are made available through the Nodal Office to carry out HAP-related activities as needed.

3.3 Information, education and communication strategies

This section presents key Information, Education, and Communication (IEC) materials aimed at issuing timely alerts for vulnerable populations and supporting outreach activities. The resources have been adapted from the National Centre for Disease Control (NCDC) and the Disaster Management, Relief & Civil Defence Department, Government of Rajasthan, ensuring they are context-specific and effective in addressing heat-related impacts.[36]

IEC Material in English

a) IEC-Heat related illnesses in Children

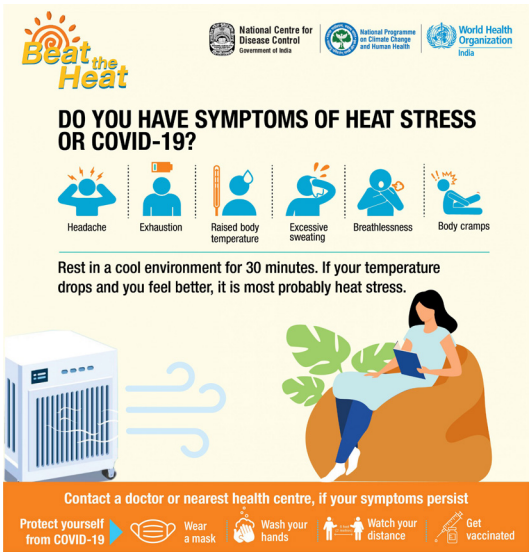


Source: NCDC

b) Beat the Heat – Do's & Don'ts

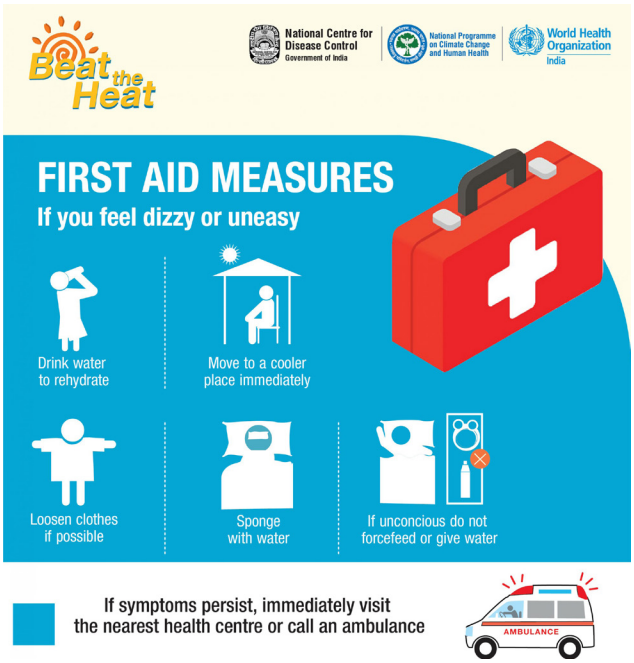
Source: NCDC

c) Clarifying symptoms of COVID-19 and Heat Stress



d) Safeguard Workers from the Heat

e) First Aid Measures



Source: NCDC

f) Safeguard yourself from the Heat

Source: NCDC

Source: Disaster Management, Relief & Civil Defence Department, Rajasthan

Source: Source: Disaster Management, Relief & Civil Defence Department, Rajasthan

Source: Disaster Management, Relief & Civil Defence Department, Rajasthan

Source: Disaster Management, Relief & Civil Defence Department, Rajasthan


Image: Pexels.com

4. Heat Risk Mitigation Measures

Embedding heat risk into urban planning and infrastructure is crucial, especially to protect vulnerable communities

Rajasthan has officially recognized heatwaves as a state-specific disaster, enabling the use of the State Disaster Mitigation Fund (SDMF)—established under Section 48(1)(c) of the Disaster Management Act, 2005—for targeted heat risk mitigation. This fund complements the State and National Disaster Response Funds (SDRF/NDRF) and supports investments in resilience for state-notified local disasters.

To address intensifying heat impacts, long-term strategies are essential. These include mitigating urban heat islands, promoting sustainable housing, expanding green infrastructure, and adopting climate-friendly cooling technologies. Embedding heat risk into urban planning and infrastructure is crucial, especially to protect vulnerable communities. Regular updates to the HAP, informed by post-season reviews, will further strengthen its relevance.

While structural solutions evolve, immediate coordination remains critical. Government bodies, civil society, and local institutions must work together to ensure preparedness and response. This includes timely early warnings, inter-agency coordination, and grassroots capacity building to safeguard lives and ensure uninterrupted services during extreme heat events.

The following table outlines the stakeholder responsibility matrix—detailing roles, timelines, and funding pathways across state, district, and municipal levels.

Sl. No	Strategy	Description	Implementation			Funding				
			Short/ Long Term	Implementing/ Supporting Authority	Timeline	Estimated budget	Municipal Fund allocation	SDRF/ SDMF support	NDRF/ NDMF support	Other funding source
PREPAREDNESS & RESPONSE										
1	Cooling Stations	Convert/Construct/Access existing structures into cooling stations by ensuring adequate shade, access to drinking water, and cooling facilities. Large public spaces such as malls, bus terminals, panchayat bhavans and railway stations can be temporarily repurposed as cooling centres in preparation for forecasted heatwaves.	Short Term	Municipal Council Churu	Pre Heat & Heat Season		Municipal funds	-	-	MP/MLA funds
2	Incorporation of Traditional Cooling Architecture	Encourage the use of traditional features like Jaali (perforated walls), courtyards, thick mud walls, lime-plastered surfaces, and high ceilings in new constructions and retrofitting for natural ventilation and thermal comfort. Distribute Mitti – Cool Clay Refrigerators, water pots (Matkas) and other non-electric cooling utensils to low-income groups especially elderly and pregnant women	Long Term	Municipal Council Churu, Rajasthan Housing Board	Pre Heat and Heat Season		Municipal Funds	-	-	
3	Cool Clothing and Footwear	Promote/ Distribute/ Light colored, loose cotton clothes, turbans/scarves for head protection and insulated shoes or cooling insoles for outdoor workers like sanitation, traffic police, street vendors also encouraging use of local cotton fabrics	Short Term	Municipal Council Churu, Health Department,	Pre Heat and Heat Season		Municipal Funds			State Labour Welfare Funds

Sl. No	Strategy	Description	Implementation			Funding				
			Short/ Long Term	Implementing/ Supporting Authority	Timeline	Estimated budget	Municipal Fund allocation	SDRF/ SDMF support	NDRF/ NDMF support	Other funding source
4	IEC campaigns/ Capacity Building/ Workshops	Awareness campaigns for dissemination of information via phones, posters, banners, signage, public speakers, LED TV displays at public places, pre-record messages, telephone heat hotline, social media posts with extreme heat warnings in vernacular languages. Set up public display of temperatures in wards at higher risk. Workshops at ward level for citizens and community leaders on heat stress management and prevention. Special campaigns for police personnel, traffic police, fire department workers, logistics workers, construction workers, school staff & children, Anganwadi workers, ASHA workers, volunteers etc.	Short Term	Municipal Council Churu, Health and Family Welfare Department, Police Department, Fire Department, Labor Department, Education Department	Pre Heat & Heat Season		Municipal funds	-	-	-
5	Public drinking water	Ensure access to safe drinking water by deploying mobile water tankers and filling community matkas at key locations like bus stops, hospitals markets. Using traditional storage methods like kunds, tankis are feasible. Promote water conservation awareness alongside accessibility. Construct permanent or temporary drinking water kiosks at public locations to help prevent dehydration during the heat season.	Short Term	Municipal Council Churu	Pre Heat Season, Heat Season		Municipal funds, Health Department	-	-	MP/MLA funds

Sl. No	Strategy	Description	Implementation			Funding				
			Short/ Long Term	Implementing/ Supporting Authority	Timeline	Estimated budget	Municipal Fund allocation	SDRF/ SDMF support	NDRF/ NDMF support	Other funding source
6	Cool Roof	Buildings of government, educational, healthcare facilities, residential buildings, commercial spaces to have cool roof coatings to regulate indoor temperatures.	Short Term	Municipal Council Churu	Pre-Heat Season		Municipal funds	-	-	-
7	Healthcare facilities	Designate cool, well-ventilated wards in hospitals and PHCs for heat-related illness. Develop a school health program. Primary health centres, emergency centres, ambulances, and hospitals to be well-equipped for the treatment of heat-related illnesses (ORS, IV fluids, evaporative coolers), ensuring comprehensive healthcare support. Veterinary hospitals should be stocked with adequate medical supplies. Communicate information on tertiary care and 108 service. Prepare handouts for paramedics on heat illness management with focus on vulnerable group - Elderly, Infants and young children, Pregnant and lactating women, People with pre-existing medical conditions. Roll out a Dynamic Ambulance Deployment Plan using heat risk maps and ensure coordination with police and fire services. Set up **mobile** medical camps in heatwave hotspots. Share relevant data with key agency leaders for informed decision-making.	Short Term	Municipal Council Churu	Pre-Heat Season, Heat Season		Municipal funds	-	-	-

Sl. No	Strategy	Description	Implementation			Funding				
			Short/ Long Term	Implementing/ Supporting Authority	Timeline	Estimated budget	Municipal Fund allocation	SDRF/ SDMF support	NDRF/ NDMF support	Other funding source
8	Heat-proofing and Strengthening Anganwadi Centres	Upgrade Anganwadi Centres as localized heat-resilient shelters for children, women, and caregivers. Measures include: - Provision of drinking water, oral rehydration solution, and ice packs to manage heat stress, Installation of fans, coolers, Use of reflective paint, green shade nets, set up temporary cooling zones, schedule activities during cooler hours, avoiding peak heat. Train Anganwadi workers in heat first aid and preparedness and link them to nearby PHCs and ASHA workers. Involve **gram panchayats** in regular monitoring and support.	Short Term	Municipal Council Churu, Women and Child Development Department Rajasthan	Pre Heat Season		Municipal funds	SDMF		MP/MLA funds
9	Change working hours	Adjust work schedules for outdoor and manual laborers by implementing early morning and post-sunset shifts, avoiding 12–4 PM. Enforce mandatory rest breaks and ensure access to shaded rest zones and cool drinking water at work sites. Introduce rotational duties and light-duty hours for vulnerable workers (pregnant, elderly). Use SMS/IVRS alerts to notify supervisors of red/ yellow heat days. Coordinate with local employers, contractors, and gram panchayats for enforcement. Link attendance- based incentives to compliance with heat safety norms. Display shift timings at common worksites.	Short Term	Municipal Council Churu, Rajasthan Labor Department	Heat Season		-	-	-	Labour Welfare Fund, MNREGA

Sl. No	Strategy	Description	Implementation			Funding				
			Short/ Long Term	Implementing/ Supporting Authority	Timeline	Estimated budget	Municipal Fund allocation	SDRF/ SDMF support	NDRF/ NDMF support	Other funding source
10	Cool Transit	Enhancing passenger comfort and safety at railway stations/ bus stops/ toll booth: Should be converted/ equipped with cooling facilities, drinking water, and ORS. Coordinate with transport unions to ensure rest periods for drivers and provision of portable fans or cooling towels. Intense IEC activities with regular announcements to build awareness of floating population. Leverage community shelters near major bus depots for emergency cooling if needed.	Short Term	Municipal Council Churu, Rajasthan State Road Transport Corporation	Pre Heat Season		Municipal funds, Respective Government dept fund	-	-	MP/MLA funds
11	Modify school timings	School timings should be adjusted to earlier hours to prevent heat stress during the summer months.	Short Term	Municipal Council Churu	Heat Season		-	-	-	-
12	Preparedness of schools	Schools should ensure an adequate supply of ORS, first-aid kits, and drinking water. Ensure classrooms have cooling aids (curtains, cross-ventilation, fans). Teachers conduct daily heat check-ins and report heat symptoms in children. Conduct heat safety workshops and awareness sessions for students. Allow flexible uniforms (e.g., cotton, no ties). Include Anganwadis and preschools under the same advisory.	Short Term	Municipal Council Churu	Pre-Heat Season		Municipal funds	-	-	-

Sl. No	Strategy	Description	Implementation			Funding				
			Short/ Long Term	Implementing/ Supporting Authority	Timeline	Estimated budget	Municipal Fund allocation	SDRF/ SDMF support	NDRF/ NDMF support	Other funding source
13	Shelter for livestock and holistic preparedness	Build shelters for livestock with adequate shade and drinking water to reduce heat stress on livestock. Ensure additional mobile hospitals are ready in vulnerable villages and identify heat-vulnerable areas for animals. Pre-position mobile veterinary units with ORS for animals, antipyretics, saline, and glucose packs. Distribute handouts and visuals on symptoms of heat stress in animals to livestock owners and traditional healers. Conduct village-level training sessions on heat stress first aid and local remedies (e.g., neem paste, turmeric, buttermilk applications). Engage animal husbandry paramedics and gaushala staff. Share real-time livestock health and mortality data with district-level emergency teams for coordinated response. Promote cooling breeds and shade-giving plantation near animal enclosures.	Mid Term	Municipal Council Churu, Dept of Animal Husbandry Rajasthan	Pre-Heat Season		Municipal funds	-	-	MP/MLA funds

Sl. No	Strategy	Description	Implementation			Funding				
			Short/ Long Term	Implementing/ Supporting Authority	Timeline	Estimated budget	Municipal Fund allocation	SDRF/ SDMF support	NDRF/ NDMF support	Other funding source
14	Supply and Maintenance of electrical grid	Ensure pre- summer maintenance of transformers, feeders and overloaded substations. Communicate clear utility protocols to prioritize uninterrupted power supply to healthcare facilities, Anganwadis, cooling centers, water supply units, and public transport nodes. Develop a load-shedding exemption list for critical facilities. Encourage off-peak usage campaigns and staggered industrial operations in power-intensive sectors. Install backup inverters or solar panels at key health and hydration sites. Provide helplines or WhatsApp-based complaint channels for reporting outages during heatwaves. Collaborate with DISCOMs to ensure real-time monitoring of voltage drops and transformer heating, especially during peak load hours (12–5 PM).	Short Term	Municipal Council Churu, Ajmer Vidyut Vitran Nigam Limited	Pre-Heat Season		Respective govt dept fund	-	-	Revamped Distribution Sector Scheme

Sl. No	Strategy	Description	Implementation			Funding				
			Short/ Long Term	Implementing/ Supporting Authority	Timeline	Estimated budget	Municipal Fund allocation	SDRF/ SDMF support	NDRF/ NDMF support	Other funding source
15	Monitoring, Evaluation, and Research	Conduct epidemiological investigations of heat-related illnesses and deaths, analyzing data on risk factors and health outcomes from various sources. Compare morbidity and mortality trends before and after Heat Action Plan implementation to guide future updates. Organize annual review meetings and gather feedbacks from key stakeholders to assess performance, revise the plan accordingly, and ensure updated versions are publicly available. Establish heat illness and mortality tracking system and update datasets.	Short Term	Municipal Council Churu, Rajasthan State Disaster Management Authority, stakeholder govt. depts., academic institutions	Post-Heat Season		-	-	-	-
16	Preparedness by HAP Nodal Officer	Identify vulnerable areas and check medical supply inventories at health centres. Ensure availability and accessibility of cooling centres. Engage the community through education of workers and trainers. Prepare a rapid response team and distribute "Dos and Don'ts" to the public. Communicate a clear "Don't Panic!" message. Ensure deployment of Medical Mobile Vans and arrange for additional vans if needed. Actively review and revise the HAP annually with updated impact and mortality data. Encourage community participation in feedback loops through surveys or ward-level meetings.			Pre Heat, Heat and Post Heat					

Sl. No	Strategy	Description	Implementation			Funding				
			Short/ Long Term	Implementing/ Supporting Authority	Timeline	Estimated budget	Municipal Fund allocation	SDRF/ SDMF support	NDRF/ NDMF support	Other funding source
MITIGATION										
17	Cool Roof	Implement a cool roofs program using innovative technologies such as reflective paints to help regulate indoor temperatures, especially in urban heat hotspots.	Long Term	Municipal Council Churu	3-4 years		Municipal funds	-	-	PM Awas Yojna – U 2.0, AMRUT 2.0
18	Green Roof	Promote a green roofs program to reduce indoor ambient temperatures through the installation of vegetation-covered roofs, walls, and green corridors	Long Term	Municipal Council Churu, Urban Development and Housing Dept. Churu.	3-4 years		Municipal funds	-	-	AMRUT 2.0
19	Rainwater harvesting	Promote rainwater harvesting systems in both public and private buildings to help mitigate water scarcity during heatwaves.	Long Term	PHED – Water Works dept, Churu	3-4 years		-	-	-	Jal Jeevan Mission, Jal Shakti Abhiyan
20	Community cooling action plan	Develop a localized community cooling action plan that encourages passive cooling methods and the use of energy-efficient refrigeration and cooling systems. Encourage courtyard cool zones and mud wall retrofitting in homes.	Long Term	Municipal Council Churu, RWAs	3-4 years		-	-	-	National Health Mission (NHM)
21	Drinking water supply Program	Strengthen drinking water access by investing in programs to enhance piped water supply infrastructure	Long Term	PHED- Water Works Dept. Churu, Municipal Council Churu	3-4 years		Municipal funds	-	-	Jal Jeevan Mission, AMRUT 2.0
22	City level greening plan	Use drought-resistant native species (neem, khejri, rohida) for plantations along roads and public places. Incentivize community-maintained green pockets and shady bus stops.	Long Term	Urban Development and Housing Dept, Municipal Council Churu, forest dept.	3-4 years		Municipal funds	-	-	AMRUT 2.0, Green India Mission, Nagar Van Yojana

Sl. No	Strategy	Description	Implementation			Funding				
			Short/ Long Term	Implementing/ Supporting Authority	Timeline	Estimated budget	Municipal Fund allocation	SDRF/ SDMF support	NDRF/ NDMF support	Other funding source
23	Localized early warning dissemination program	Establish a localized early warning system and enhance inter-agency coordination by notifying the key agency leaders, Collector, Municipal Commissioner, Ward Councillors and DDMA. Leveraging mobile alerts, community networks, and local media to deliver timely and accessible information through bulk warnings to public via centralized email databases during heat alert.	Long Term	Churu Nagar Nigam, Meteorological Department	3-4 years		-	-	-	Respective Govt Dept funds
24	Planning for resilient city	Planning documents guiding urban development, building bye-laws and other control measures should be appropriately revised to include environmental well-being at center of the urban development and adoption of passive low-cost innovative cooling design strategies for all types of buildings. Highlight low-cost, passive design architecture.	Long Term	Town Country Planning Department, Public Works Department, St Rajasthan State Disaster Management Authority, Municipal Council Churu, Churu Development Authority	3-4 years		-	-	-	Respective Govt Dept funds
25	Community Preparedness	Strengthening health emergency and disaster management systems at the state, city, and district levels with a focus on capacity building, training, workshops. Improving data collection and response monitoring.	Long Term	Municipal Council Churu			Municipal funds	-	-	Respective Govt Dept funds

Image: Flikr.com

Annexures

This chapter presents the formats and guidelines for recording heat-related data, based on national templates from the Ministry of Health and Family Welfare (MoHFW) and the National Disaster Management Authority (NDMA). Building on MoHFW's 2015 *Guidelines on the Prevention and Management of Heat-Related Illnesses* and the 2021 *National Action Plan on Heat-Related Illness*, this section integrates updated formats—covering surveillance, hospital preparedness, and investigations of suspected heat-related deaths—into the Churu HAP.

Format 1 (A): Health Facility Format

Daily line List of Suspected Heatstroke CASES# at Health Facility

Name of health facility: **Block:** **District:**							**Date of reporting: _._/_._/_._**				
Type of health facility (Circle the applicable):1. PHC 2. CHC 3. Taluka/Rural Hospital/Block Hospital 4. Sub-district 5. District Hospital/Civil Hospital 6. Medical College & Hospital 7. Private hospitals with emergency facility 8. Other.....											
(A). Total no. of patients in department (Casualty/Emergency of Medicine + Pediatrics):											
Daily line List of Suspected Heatstroke CASES# at Health Facility											
S. No	**Hospital Registration No.**	**Name**	**Age***	**Sex (M/F)**	**Address**		**Outcome within date of reporting (tick the box)**				**Re-marks**
					Block	**District**	**Admitted**	**Died**	**Referred**	**Reco-vered**	
Total											

*Age in completed years

Name of person filling the form:

Designation:

Signature:

Name of Facility In-Charge:

Signature of Facility In-Charge:

Date:

#Suspected Heatstroke: Altered mental status (including disorientation, delirium, seizure, obtundation) **with elevated core body temperature ≥ 40°C/ ≥104°F,** without signs of stroke, history of infection, or signs of medication overdose **OR** Altered mental status (including disorientation, delirium, seizure, obtundation) with hot and dry skin and deranged vitals, i.e., tachycardia, tachypnoea and wide pulse pressure without signs of stroke, history of infection, or signs of medication overdose. *(definition is applicable during heatwave season, i.e., March to July)*

Standard Operating Procedures: Format 1(A)

Format 1 (A) is a daily line list format of suspected heatstroke cases to be filled at health facility.

It will be kept at health facility for record purpose.

It will be used to compile line list Format 1(B) and daily reporting Format 2.

- Suspected heatstroke (Case definition):Altered mental status (including disorientation, delirium, seizure, obtundation) with elevated core body temperature ≥ 40°C/ ≥ 104°F, without signs of stroke, history of infection, or signs of medication overdose OR Altered mental status (including disorientation, delirium, seizure, obtundation) with hot and dry skin and deranged vitals i.e., tachycardia, tachypnoea and wide pulse pressure without signs of stroke, history of infection, or signs of medication overdose. (definition is applicable during Heatwave season i.e., March to July)

- Institute and department who will compile suspected heatstroke cases:
  - » All public hospitals with casualty/emergency.
  - » All private hospitals with casualty/emergency.
  - » Reporting Departments will be casualty/emergency of medicine and pediatrics.
- Data collection period: In standard it will be from 01st March to 31st July, every year. Further direction will be communicated at the start of the year if required.
- Case identification:
  - » Person who will diagnose: A qualified medical doctor will diagnose HRI case as per case definition.
  - » Where will the data be recorded: A qualified medical practitioner will write the
  - » provisional diagnosis in the casualty/emergency register as suspected heatstroke.
- Data collecting person: Pharmacist, multipurpose health worker-male (MPHW-M), staff nurse -either of the employee will collect the data of suspected heatstroke cases that were diagnosed on previous day from emergency/casualty of medicine and pediatrics departments every day.
- Day of diagnosis and recording: The date of diagnosis will be considered as day zero. Cases diagnosed on day Zero should be recorded on the following day, i.e., day One in FORMAT 1 (A). Example: Cases diagnosed on Sunday (Day Zero) will be recorded on Monday (Day One).
- Data compilation: A hard copy of each completed and signed Format 1(A) should be stored in a file daily in a proper order. A soft copy of the line list should be maintained as a single excel sheet which should be updated weekly to include all Heatstroke cases. It should be ready to be submitted to DSU or SSU as per request.
- Reporting after a holiday: A report which should have been prepared on holiday (e.g. Sunday or gazetted holiday) must be compiled and filed on the next working day. For example, cases diagnosed on Saturday (Day Zero) must be recorded on Format 1 (A) on Monday (Day Two) along with a separate daily Format 1 (A) report of cases diagnosed on Sunday (Day One).
- Nil reporting is mandatory in the prescribed format. No columns will be left blank; in case of nil reporting, "0" should be written.

Format 1 (B): Health Facility Format

Daily line List of Suspected Heatstroke DEATHS# and Confirmed CVD DEATHS*

(From Medicine, Pediatrics and Casualty/Emergency department)

(To be kept at health facility for record)

Name of health facility: **District:**	**Block:**	**Date of reporting:** _._/_._/_._
Type of health facility (Circle the applicable): 1. PHC 2. CHC 3. Taluka/Rural Hospital/Block Hospital 4. Sub-district 5. District Hospital/Civil Hospital 6. Medical College & Hospital 7. Private hospitals with emergency facility 8. Other.....		
(A). Total no. of all-cause deaths in health facility (Casualty/emergency of Medicine and Paediatrics):		

Daily line List of Suspected Heatstroke DEATHS and Confirmed CVD DEATHS

S.No	**Registration number**	**Name**	**Age**	**Sex (M/F)**	**Address**		**Deaths (tick the box)**	
					Block	**District**	**Suspected Heatstroke death##**	**Confirmed CVD death**
Total								

Name of person filling the form:

Designation:

Signature:

Name of Facility In-Charge:

Signature of Facility In-Charge:

Date:

#Suspected Heatstroke: Altered mental status (including disorientation, delirium, seizure, obtundation) with elevated core body temperature ≥ 40°C/ ≥ 104°F, without signs of stroke, history of infection, or signs of medication overdose OR Altered mental status (including disorientation, delirium, seizure, obtundation) with hot and dry skin and deranged vitals, i.e., tachycardia, tachypnoea and wide pulse pressure without signs of stroke, history of infection, or signs of medication overdose. *(definition is applicable during Heatwave season, i.e., March to July)*

##Suspected Heatstroke Death: This is a death on account of suspected heatstroke patient.

*Cardiovascular death includes death resulting from an acute myocardial infarction (MI) or sudden cardiac arrest or heart failure (HF) or cardiovascular (CV) procedures or CV hemorrhage or death due to other CV causes.

Standard Operating Procedures: Format 1 (B)

- Format 1 (B)is a daily line list of suspected heatstroke deaths and confirmed cardiovascular disease (CVD) deaths.
- The total number of all-cause deaths in a health facility (casualty/emergency of medicine and pediatrics) should also be recorded.
- Institute and department who will report suspected heatstroke cases:
  - » All public hospitals with OPDs & casualty/emergency.
  - » All private hospitals are having casualty/emergency.
  - » Reporting departments will be casualty/emergency of medicine and pediatrics.
- Date of death and recording: Date of death will be considered as day zero. Cases that died on day Zero should be recorded on the following day, i.e., day One in FORMAT 1 (B). Example: Cases diagnosed on Sunday (Day Zero) will be recorded on Monday (Day One).
- Data compilation: A hard copy of each completed and signed Format 1 (B) should be stored in a file daily in a proper order. A soft copy of the line list should be maintained as a single excel sheet which should be updated weekly to include all suspected heatstroke deaths and confirmed CVD deaths. It should be ready to be submitted to the district or state nodal unit as per request.
- Nil reporting is mandatory in the prescribed format. No columns will be left blank; in case of nil reporting, "0" should be written.

Format 2: Health Facility Format for sending to District

Daily numbers of Suspected Heatstroke CASES# and All cause DEATHS*

(Compilation of Format 1, A & B)

(To be sent to District Nodal Unit daily)

Name of health facility: **Block:** **District:**				**Date of reporting: _._/_._/_._**			
Type of health facility (Circle the applicable): 1. PHC 2. CHC 3. Taluka/Rural Hospital/Block Hospital 4. Sub-district 5. District Hospital/Civil Hospital with emergency facility 8. Other..... 6. Medical College & Hospital 7. Private hospitals							
Department (Circle the applicable): Pediatrics 3. Casualty 1. Emergency Medicine 2. Emergency							
Date	**Total patients in the department**	**New Suspected Heatstroke Cases (A)**	**Total Suspected Heatstroke cases since 1st March 2020 (B)**	**All-cause deaths****			
				Suspected Heatstroke deaths## (a)	**Confirmed CVD deaths (b)**	**Others including unknown (c)**	**Total deaths (a+b +c)**
01-03-20							
02-03-20							

Form filled by (Name):

Designation:

Signature:

Name of Facility In-Charge:

Signature of Facility In-Charge:

Date:

****All-cause death:** All the deaths in casualty/emergency medicine plus pediatrics, regardless of cause.

#Suspected Heatstroke: Altered mental status (including disorientation, delirium, seizure, obtundation) **with elevated core body temperature ≥ 40°C/ ≥ 104°F,** without signs of stroke, history of infection, or signs of medication overdose **OR** Altered mental status (including disorientation, delirium, seizure, obtundation) with hot and dry skin and deranged vitals, i.e., tachycardia, tachypnoea and wide pulse pressure without signs of stroke, history of infection, or signs of medication overdose. *(definition is applicable during Heatwave season i.e., March to July)*

##Suspected Heatstroke Death: This is a death on account of suspected heatstroke patient.

***Cardiovascular death** includes death resulting from an acute myocardial infarction (MI) or sudden cardiac arrest or heart failure (HF) or cardiovascular (CV) procedures or CV hemorrhage or death due to other CV causes.

Standard Operating Procedures: Format 2 (Health facility format for sending to DISTRICT)

- Format 2 will be compiled from data of Format 1 (A) and Format 1 (B) by the nodal person at the health facility daily.
- Institute and department who will report HRI:
  - » All public hospitals with casualty/emergency.
  - » All private hospitals are having casualty/emergency.
  - » Reporting Departments will be medicine, pediatrics and casualty/emergency.
- Time of reporting to district nodal unit: Format 2 compiled from Format 1 (A) should be reported to District nodal unit on the following day (day one) by 12.00 hr (i.e. noon).
- Reporting person: A nodal person identified for the health facility will prepare the report.
- Data compilation: A soft copy in the form of an excel sheet shall be e-mailed daily to the district nodal unit through a proper channel. In places where the internet facility is not available, the report can be communicated by any possible means. A hard copy of each Format 2 should be kept in a designated file daily at the institutions/health facility.
- Data collection period: In standard, it will be from 01st March to 31st July every year. Further direction will be communicated during the start of the year if required.
- Nil reporting is mandatory in the prescribed format. No columns will be left blank; in case of nil reporting, "0" should be written.
- If not submitted on time: Late report must be submitted within 48 hrs.

Image: Pexels.com

Format 3 (A): District Format for Daily Compilation

Daily numbers of Suspected Heatstroke CASES# and All cause DEATHS*

(Compiled from Format 2**)**

(To be kept at District for record)

Cases and deaths due to HRI- District name 2020					**Date of reporting: _._/_._/_._**				
S. No.	**Name & type of Health Facility**	**Total patients of the day (Emergency Medicine + Emergency Pediatrics + Casualty)**	**New Suspected Heat-stroke cases (A)**	**Total Suspected Heatstroke cases since 1st March, 2020 (B)**	**All-cause deaths****				**Remarks**
					Suspected Heatstroke deaths## (a)	**Confirmed CVD deaths (b)**	**Others including unknown (c)**	**Total deaths (a+b +c)**	
	PHC1								
	PHC2								
	CHC								
	CH/DH								
	PVT1								
	PVT2								
	PVT3								
Total for District 1									

Total number of New Confirmed Heatstroke Deaths* in the District on _._/_._/_._: Total number of Confirmed Heatstroke Deaths in the District since 1st March 2020:** *[confirmed by death committee (heat death committee/three men committee)]*

Name of person filling the form:

Designation:

Signature:

Name of nodal officer:

Signature of nodal officer:

Date:

****All-cause death:** All of the deaths in casualty/emergency medicine plus pediatrics, regardless of cause.

#Suspected Heatstroke: Altered mental status (including disorientation, delirium, seizure, obtundation) **with elevated core body temperature ≥ 40 ºC/≥104 ºF,** without signs of stroke, history of infection, or signs of medication overdose **OR** Altered mental status (including disorientation, delirium, seizure, obtundation) with hot and dry skin and deranged vitals, i.e., tachycardia, tachypnoea and wide pulse pressure without signs of stroke, history of infection, or signs of medication overdose. *(definition is applicable during heatwave season, i.e., March to July)*

##Suspected Heatstroke Death: This is a death on account of a suspected heatstroke patient.

Standard Operating Procedures: Format 3 (A) (District format for compilation from health facility)

- Format 3(A) will be compiled by a nodal officer daily at District nodal unit.
- Format 3 (A)will be compiled from Format 2 from all health facility.
- Format 3 (A) adaptation: Modify relevant fields (in grey italic fonts) in given Format 3 (A) to add the name of your district, to list all the government facilities and private reporting units in a proper order- from the primary health centre (PHC), Community Health Centre (CHC), District Hospital (DH), Civil Hospital (CH) to Private. This will be the standard Format 3(A) for your district for daily data compilation during the whole reporting period of a year.
- Total patient of the day: Against each health facility, write the total patient of the day from emergency medicine, emergency pediatrics and casualty.

- Data compilation: District nodal unit should receive Format 2 from health facilities by 12.00 hr (i.e. 12.00 noon) daily. Format 3 (A) should be compiled daily from all submitted Format 2 reports. A date-wise soft copy of each daily Format 3 (A) report should be maintained digitally in a designated folder. A hard copy of the same should be printed and filed daily at the district level.
- Data collection period: In standard, it will be from 01st March to 31st July every
- year. Further direction will be communicated during the start of the year if required.
- No reporting by health facility:
  - » If a health facility report (Format 2) is not received on time, write "delayed" in the row for that facility.
  - » If the facility reports to the district after the deadline of 12:00 noon, Format 3 (A) should be updated to reflect the change. Format 3 (A) for the given reporting period can be updated till 48 hrs and should show the updated date of reporting, if applicable.
  - » If the health facility does not submit Format 2 at all or submits it after 48 hrs of reporting deadline, Format 3 of that reporting period should be updated; "delayed" should be changed to "not available".
- Reporting after a holiday: Format 3 (A) which should have been prepared on holiday (e.g. Sunday) must be compiled and prepared on the next working day. For example, facility reports (Format 2) submitted to the district on Saturday must be compiled on Format 3(A) on Monday, along with a separate Format 3(A) for facility reports submitted to the district on Sunday.
- Nil reporting is mandatory in the prescribed format. No columns will be left blank; in case of nil reporting, "0" should be written.
- Confirmed heatstroke death: a suspected heatstroke death is to be reported as and when the death is confirmed by the death investigation committee (heat death committee/three men committee) at the district level.

Format 3 (B): District Format for sending to State

Daily numbers of Suspected Heatstroke CASES# and All-cause DEATHS*

(Compiled from Format 3 A**)** (To be sent to State Nodal Unit daily while keeping a copy for record)

Cases and deaths due to heatstroke- District name 20_ _				**Date of reporting: _._/_._/_._**					
Date	**Total patients of the day (Emergency Medicine + Emergency Pediatrics + Casualty)**	**New Suspected Heatstroke Cases (A)**	**Total Suspected Heatstroke cases since 1st March, 20_ _ (B)**	**All-cause deaths****				**New Confirmed Heatstroke Deaths*****	**Total Confirmed Heat Deaths since 1st March 20_ _**
				Suspected Heatstroke deaths## (a)	**Confirmed CVD deaths (b)**	**Others including unknown (c)**	**Total deaths (a+b +c)**		
01-03-2020									
02-03-2020									

Name of person filling the form:

Name of nodal officer:

Designation:

Signature of nodal officer:

Signature:

Date:

****All-cause death:** All of the deaths in casualty/emergency medicine plus pediatrics, regardless of cause.

#Suspected Heatstroke: Altered mental status (including disorientation, delirium, seizure, obtundation) with elevated

core body temperature ≥ 40 oC/≥104 oF, without signs of stroke, history of infection, or signs of medication overdose OR Altered mental status (including disorientation, delirium, seizure, obtundation) with hot and dry skin and deranged vitals i.e., tachycardia, tachypnoea and wide pulse pressure without signs of stroke, history of infection, or signs of medication overdose. *(definition is applicable during heatwave season, i.e., March to July)*

##Suspected Heatstroke Death: This is a death on account of suspected heatstroke patient.

*Cardiovascular death includes death resulting from an acute myocardial infarction (MI) or sudden cardiac arrest or heart failure (HF) or cardiovascular (CV) procedures or CV hemorrhage or death due to other CV causes.

***Confirmed Heatstroke Death:** A suspected heatstroke death confirmed by the death

investigation committee (heat death committee/three men committee) at the district level.

Standard Operating Procedures: Format 3 (B) (District format for sending to State)

- Format 3 (B) will be compiled by a nodal officer daily at District nodal unit.
- Format 3 (B) will be compiled from the end row of Format 3 (A).
- Time of reporting to state nodal unit: Format 3 (B) compiled from Format 3 (A) should be reported to the state nodal unit on the following day (day one) by 04.00 PM.
- Reporting after a holiday: Format 3 (B) which should have been prepared on holiday (e.g. Sunday) must be compiled and prepared on the next working day. For example, facility reports (Format 2) submitted to the district on Saturday must be compiled on Format 3(B) on Monday, along with a separate Format 3(B) for facility reports submitted to the district on Sunday.
- Nil reporting is mandatory in the prescribed format. No columns shall be left blank; in case of nil reporting, "0" should be written.
- Confirmed heatstroke death: a suspected heatstroke death is to be reported as and when the death is confirmed by the death committee (heat death committee/three-man committee) at the district level.

Partner Acknowledgements

Municipal Council Churu

The Churu Municipal Council is the primary urban local body responsible for overseeing municipal administration and civic services in the city of Churu, Rajasthan. It plays a crucial role in planning and managing civic amenities such as water supply, sanitation, waste management, infrastructure maintenance, and public health services. There are 188 urban local bodies in Rajasthan. After enactment of 74th Constitutional Amendment Act, the Local Bodies, which were previously not the part of the Constitution of India, have now been assigned the Constitutional Status. There are 7 Corporations 34 Councils and 147 Municipalities. Total 188 ULBs in the State. As the municipal authority for Churu, it serves as a key institution in facilitating the city's sustainable development and ensuring the delivery of essential services to its population.

NRDC

NRDC India aims to build a healthier and more prosperous future for all Indians. An independent organization, it seeks to advance national and global climate goals through community-based solutions that prioritize public health and equity, creating jobs and boosting resiliency. NRDC India is inspired by and associated with NRDC (Natural Resources Defense Council) – a global organization with more than three million members and 700 experts across the globe. NRDC works to safeguard the earth—its people, its plants and animals, and the natural systems on which all life depends.

Mahila Housing Trust

Mahila Housing Trust (MHT) is improving urban built environments in poor communities through collective action. Since its establishment in 1994, it has mobilized women to exercise their civic rights and empowered them to take charge of their habitat improvement process. By forging unique relationships with poor communities and local governments, it has advanced access to basic services, promoted climate resilience, and deepened participatory governance.

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