

# FROM HEATWAVES TO HAZARDS: VISUALIZING CLIMATE EXTREMES AND URBAN VULNERABILITY IN INDIA

## Background:

Urban India has witnessed a rise in climate-related hazards, especially heatwaves, which affect public health, productivity, and infrastructure. Despite growing concern, climate data often remains fragmented or under-communicated. This project aims to tell a compelling story through data to raise awareness and aid urban climate policy.

## Objective:

To develop a Tableau data story that visualizes historical temperature trends, identifies heatwave-prone cities, and correlates these trends with population density, slum exposure, and public health vulnerabilities.

## Methodology:

### 1. Narrative Structure:

- Opening: India's climate trajectory and the urban heat island effect
- Part 1: Historical temperature trends in 20 major cities (2001–2021)
- Part 2: Frequency and duration of heatwaves
- Part 3: Vulnerability Index – combining population, infrastructure, and income
- Part 4: Case examples of adaptation measures in Ahmedabad, Chennai, and Delhi
- Ending: Recommendations for policy and community-level action

### 2. Storytelling Features in Tableau:

- **Story Points** with descriptive headers and call-outs
- **City-wise line graphs** to show decadal temperature increases
- **Dot maps** for identifying heatwave hotspots by month
- **Interactive filters** for city, year, and vulnerability level
- **Tooltip narratives** embedded with annotations and comparative values

### 3. Data Preparation:

- Imputed missing temperature values using 3-year rolling averages
- Normalized vulnerability indicators on a 0–1 scale to create a composite index
- Grouped cities by climate zone and population size

## Data Sources:

- **Indian Meteorological Department (IMD)** – monthly average temperature and heatwave event records
- **Census 2011** – population density and urban slum data
- **NITI Aayog Urban Resilience Index** – infrastructure and heat action plan scores
- **National Health Profile** – heat-related illness data

## Tools and Technologies:

- **Tableau Desktop** – data story development and interaction design
- **Python (Pandas, NumPy)** – used for index computation and imputation
- **Excel** – secondary data preparation
- **Tableau Public** – (optional) to publish and embed the interactive story

## Results and Interpretations:

- **Temperature Trends Identified:** 16 out of 20 cities showed a significant temperature rise ( $\sim 1.5\text{--}2.0^{\circ}\text{C}$ ) over the last two decades, particularly in pre-monsoon months.
- **Heatwave Occurrence Mapped:** Nagpur, Delhi, and Jaipur emerged as high-frequency zones with rising duration and early onset of heatwaves.
- **Urban Vulnerability Profiled:** Cities with high slum populations and weak infrastructure (e.g., Kanpur, Varanasi) had the highest vulnerability scores.
- **Adaptation Lessons Visualized:** Ahmedabad's heat action plan showed a 20% reduction in heatstroke cases post-intervention, visualized through before-and-after heat impact maps.

## Conclusion:

This Tableau story converted complex climate data into an interactive urban heat risk narrative. It not only illustrated the severity of rising temperatures but also offered a structured, visual representation of local adaptation gaps and successes for a wider audience, including NGOs, urban planners, and climate advocates.

## Future Work:

- **Daily Temperature Integration:** Shift from monthly to daily data for higher granularity.
- **Real-Time Heat Alerts:** Embed heatwave alert feeds using external APIs.
- **Local Adaptation Case Tracker:** Create a repository of city-level adaptation efforts with measurable impacts.
- **Mobile First Design:** Optimize the story for mobile engagement during public campaigns.

## Suitability:

- **Academic:** Ideal for case studies in environmental science, urban geography, and sustainability education.
- **Corporate/NGO:** Applicable for CSR climate initiatives, NGO awareness campaigns, and government briefings on urban resilience.