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REGIONAL WORKSHOP ON IMPACT-BASED FORECASTING:

Training-of-Trainers and National Demonstration Planning for Temperature-Related Hazards

SAHF IBF Working Group Implementation Plan Project

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Kathmandu, Nepal

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Understanding exposure and vulnerability in the context of temperature-related hazards

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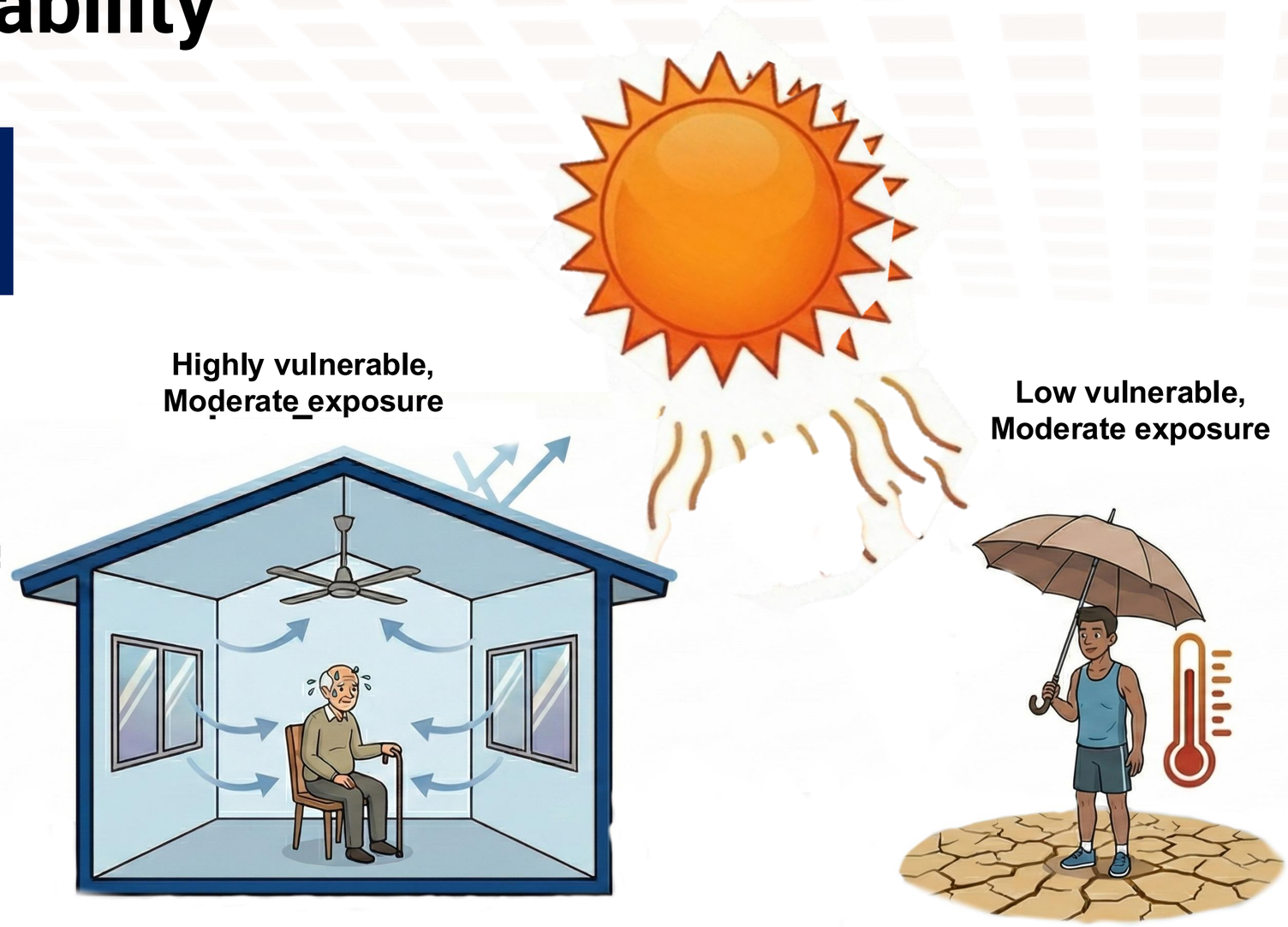
RIMES

Understanding Vulnerability

Vulnerability = Sensitivity + Lack of Coping capacity

- ✓ Who is more affected when temperature rises or drops?
- ✓ Which systems fail first?
- ✓ Which livelihoods are sensitive to temperature anomalies?
- ✓ If the temperature vulnerability is **multi-sectoral?**



Vulnerability assessments often look at age and income, among other data, and are sometimes overlaid with analysis of tree canopy cover, rooftop albedo and daytime and/or nighttime temperatures.

Power/Energy

- High cooling dependency
- Grid fragility / load pressure

Economy & Labor

- Daily wage earners
- Outdoor workers
- Informal settlements

Human Health

- Age group (elderly, children)
- Chronic illness prevalence
- Poor housing / ventilation
- Access to cooling/heating

Urban / Environment

- High-density settlements
- Poor quality housing
- Limited tree cover

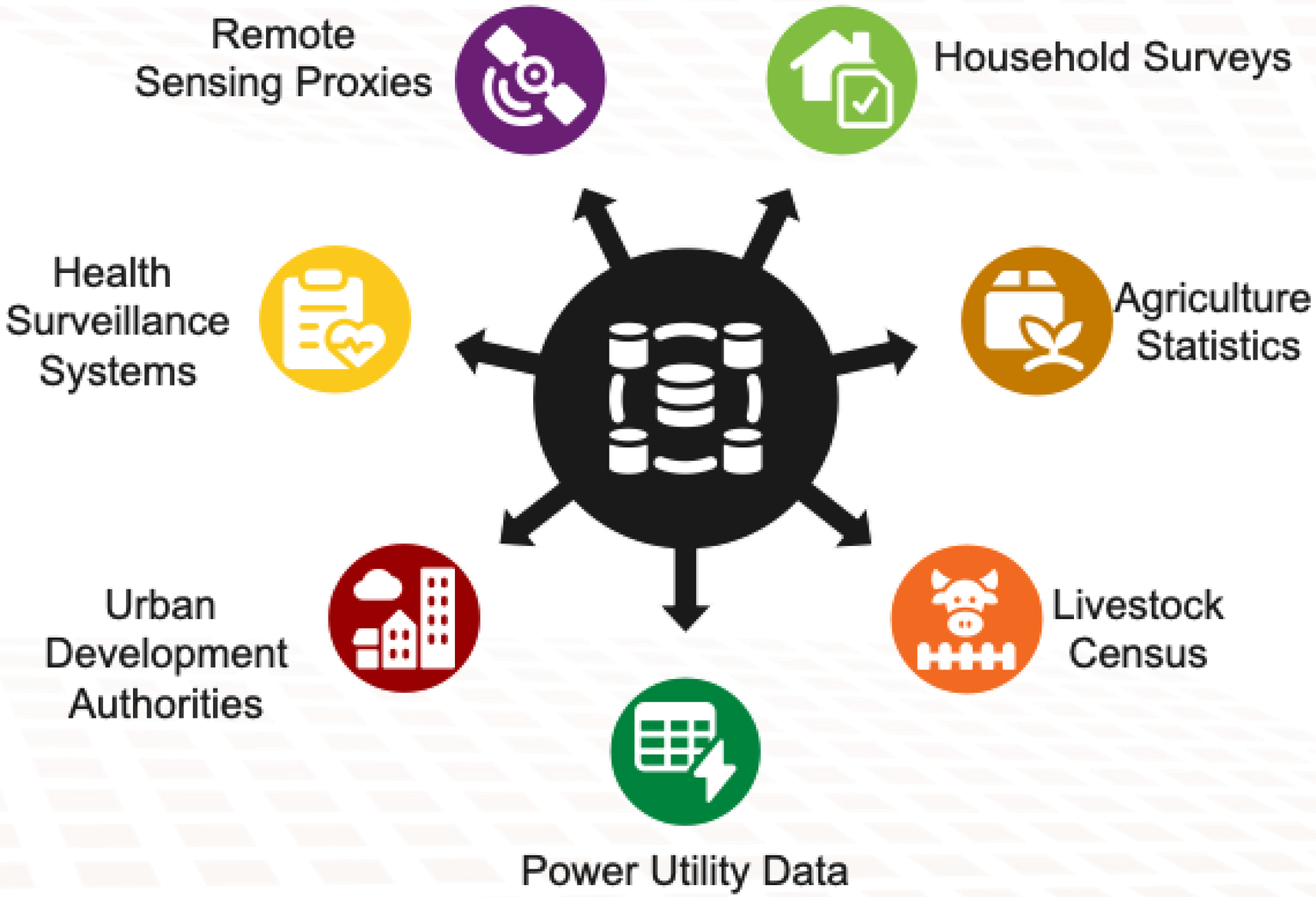
Agriculture

- Crop heat sensitivity
- Irrigation dependency
- Water availability

Livestock

- Poultry density (mortality risk)
- Cattle heat stress sensitivity
- Fodder crisis

Vulnerability Data Sources



Findings from the last group work

Preferred vulnerability indicator	Preference	Rationale (why it matters for heat + cold impacts)
Elderly (>65)	High	Higher physiological sensitivity; higher risk of severe illness and mortality during extremes.
Children under 5	High	Immature thermoregulation; rapid dehydration/hypothermia risk; dependent on caregiver actions.
People with disability	High	Mobility/functional constraints reduce ability to take timely protective actions and seek care.
Chronic illness	High	Pre-existing conditions (e.g., cardio-respiratory) reduce tolerance and worsen outcomes.
Poverty levels	High	Financial constraints limit access to heating/cooling, healthcare, safer housing, and adaptation.

Findings from the last group work

Occupational Exposure

Outdoor workers face high thermal exposure risks.

Built Environment

Urban factors influence thermal impact significantly.

Socio-Economic Factors

Poverty and poor housing exacerbate thermal vulnerability.

Indicator Prioritization

Need for a concise indicator set for operational use.

Vulnerable Populations

Elderly, children, and chronically ill are most at risk.

Phased Platform

Gradual platform development for practical implementation.

Calculation of the Vulnerability

Define Purpose and Scope

Clarify focus hazard, identify area and population, define objectives.

Engage different stakeholders including meteorological services, health departments, local government, social welfare, and community groups.

Engage Key Stakeholders

Select Vulnerability Indicators

Choose indicators covering different dimensions including demographic health, socio-economic, and infrastructure dimensions.

Collect data from different sources such as census, municipal records, health databases, and field surveys.

Collect and Compile Data

Assign Weights to Indicators

Consult experts to determine the relative importance of each indicator.

Convert all indicators to a comparable 0–1 scale using min–max normalization.

Normalize Indicator Values

$$nv_i = \frac{(v_i - v_{min})}{(v_{max} - v_{min})}$$

With v_i being the value of the indicator, v_{min} the minimum value of this indicator and v_{max} the maximum value of this indicator.

Calculate Composite Vulnerability Index

Multiply normalized indicator values by their assigned weights.

$$VI_0 = \sum_i w_i * nv_i$$

Classify index values into Very Low, Low, Moderate, High, Very High.

Categorize Vulnerability Levels

Validate with Stakeholders

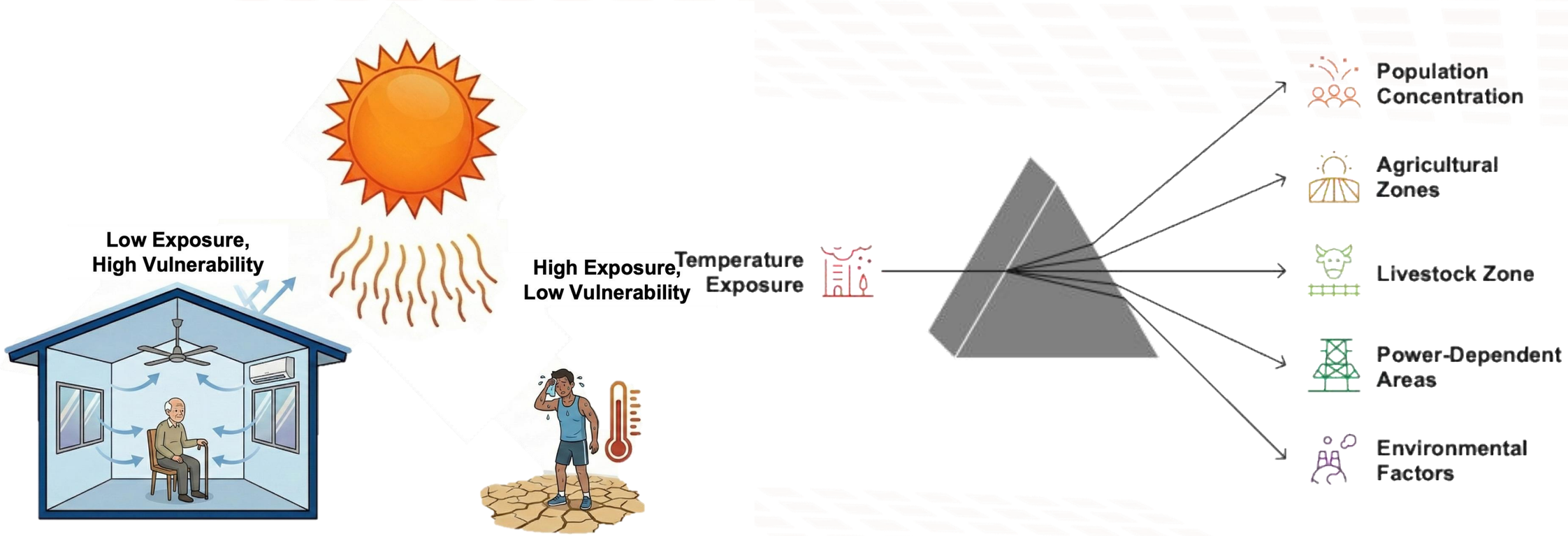
Review initial results with local authorities and community representatives.

Prepare maps, charts, and summary reports. Use results for early warning, planning, and targeted interventions.

Communicate and Apply Results

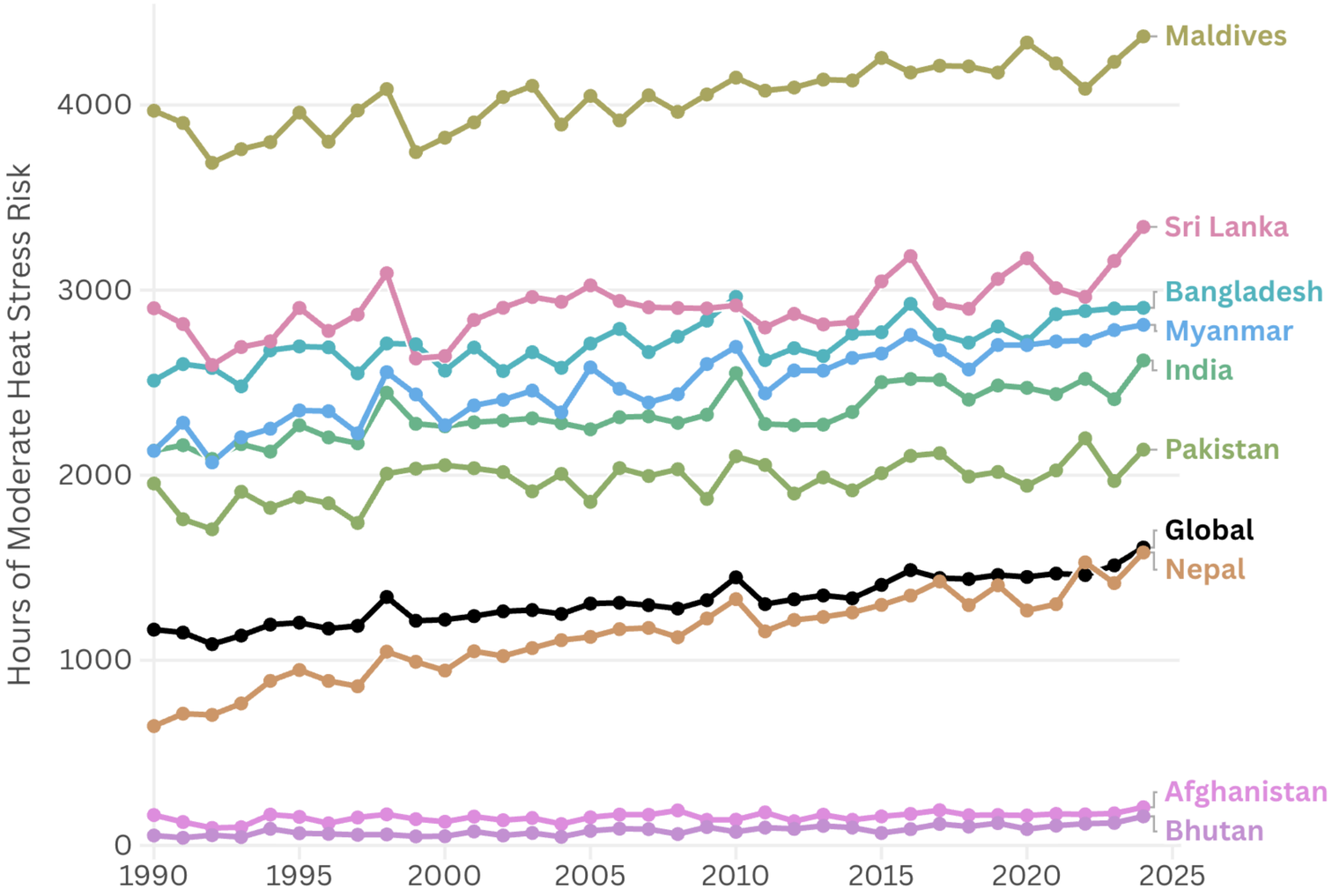
With the vulnerability index on the scale from 0 to 1, w_i is the weight of the indicator i, and nv_i the normalized value of the indicator i.

Exposure



Exposure = “What is physically located in harm’s way?”

Impacts of Exposure



https://lancetcountdown.org/explore-our-data/

Number of hours (averaged per person per year) during which high heat would have posed at least a moderate heat stress risk if undertaking light outdoor physical activity

Common Indicators for Exposure

Population & Social Exposure

- Population density
- Schools, hospitals
- Informal settlements

Agriculture & Livestock Exposure

- Rice/wheat/vegetable zones
- Poultry hotspots
- Irrigated vs rain-fed areas

Energy/Infrastructure Exposure

- Power load hotspots
- Water pumping stations
- Cold storage, markets

Environmental Exposure

- NDVI / vegetation cover
- Built-up density
- AQI / CO_2 hotspots
- Urban heat island cores
- Frequency of heatwave

Findings from the last group work

Preferred exposure indicator	Preference	Rationale (why it matters for heat + cold impacts)
Population density	High	More people exposed per area; crowding and limited services can amplify heat/cold stress impacts.
Poorly insulated housing	High	Increases indoor heat/cold exposure; reduced ability to maintain safe indoor temperatures.
Khatcha/temporary housing	High	Low-quality materials and ventilation/insulation increase exposure to temperature extremes.
Workers with high physical exertion	High	Prolonged outdoor/physical work increases exposure and strain during heat/cold events.
UHI (Urban Heat Island)	High	Urban surfaces retain heat, raising nighttime/daytime temperatures and prolonging heat exposure.
Public transport stops (shade)	Medium	Waiting areas can create concentrated exposure points; lack of shade/shelter increases thermal stress.

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THANK YOU!