

Report | October 2026

# Living with Heat in Bhutan

Author Madhurima Sarkar-Swaigood

Heat-health Risks, Vulnerability, and  
Emerging Responses



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**Organisation:** The Global Heat Health Information Network (GHHIN), established by WMO, WHO and NOAA, brings together policymakers, scientists and practitioners to strengthen global action on heat and health. The GHHIN South Asia Hub, hosted by the Council on Energy, Environment and Water (CEEW), along with its partners the Natural Resources Defense Council (NRDC), the Sustainable Futures Collaborative (SFC), the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), and BRAC James P. Grant School of Public Health (BRAC JPGSPH), was established in April 2026 to translate global knowledge into context-specific solutions across South Asia. Aligned with GHHIN's goals to Connect, Accelerate and Catalyse, the Hub supports knowledge exchange, capacity building, research and policy action on heat and health, with a focus on vulnerable communities.

**GHHIN South Asia Hub Secretariat:**

**Council on Energy, Environment and Water**

ISID Campus, 4 Vasant Kunj Institutional Area

New Delhi – 110070, India

+91 11 4073 3300

[info@ceew.in](mailto:info@ceew.in) | [ceew.in](http://ceew.in) |  @CEEWIndia |  ceewindia

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# About Global Heat Health Information Network South Asia Hub

The **Global Heat Health Information Network (GHHIN)**, established in 2016 by the **World Meteorological Organization (WMO)**, the **World Health Organization (WHO)**, and the **US National Oceanic and Atmospheric Administration (NOAA)**, is a key platform for strengthening global collaboration on heat and health. The GHHIN is a voluntary, multidisciplinary community of policymakers, scientists, practitioners, and institutions that provides science-based thought leadership and builds consensus among diverse actors with shared values. It aims to accelerate heat action by fostering partnerships, advancing evidence and actionable knowledge, developing standardised guidance and risk metrics, and catalysing policy and action at the global, national, and local levels to minimise the societal consequences of extreme heat. Through global and regional forums, knowledge exchange, training, collaborative research, and the development of tools and guidance, GHHIN supports governments, organisations, and professionals in translating scientific evidence into practical action to **protect communities from the avoidable health risks of extreme heat**.

Recognising the need to translate global knowledge and collective action on heat and health into context-specific solutions, the **Council on Energy, Environment and Water (CEEW)**, along with its partners, the **Natural Resources Defense Council (NRDC)**, the **Sustainable Futures Collaborative (SFC)**, the **United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP)**, and the **BRAC James P. Grant School of Public Health (BRAC JPGSPH)**, was selected to host the **GHHIN South Asia Hub**, established on 7 April 2026. The Hub works in tandem with the **South Asia Climate and Health Desk**, hosted by the **Indian Institute of Tropical Meteorology (IITM)** and the **India Meteorological Department (IMD)**, to ensure that early heat warnings and scientific evidence inform effective solutions for communities.

Hosted by **CEEW in New Delhi**, the Hub is directly aligned with GHHIN's global goals of **connecting, accelerating, and catalysing action**. It provides the region with a shared platform for exchanging knowledge, shaping policy, and building capacity on heat and health. The Hub brings together practitioners, policymakers, and researchers from governments, academia, and civil society to facilitate **coordinated and evidence-based action on heat risks**, particularly among communities facing the greatest exposure (GHHIN and CEEW 2026).

This country synthesis report is one of the key knowledge products produced by the GHHIN South Asia Hub. Other knowledge products can be accessed here: <https://heathealth.info/southasia/>

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# Executive summary

In Bhutan and across South Asia, increases in the frequency, intensity and duration of extreme heat events have become a climate, health and development challenge at once, affecting the overall wellbeing of communities. Rising global temperatures drive the hazard; rapid unplanned urbanisation and entrenched inequality determine who it harms.

Global mean temperature for January–August 2025 stood at 1.42 degree ( $\pm 0.12^\circ\text{C}$ ) above pre-industrial levels, and each of the eleven years from 2015 to 2025 ranked among the eleven warmest in the 176-year observational record (WMO 2025). Heat-related deaths have risen 63 per cent since the 1990s, averaging 546,000 year 2012–2021 (Romanello et al. 2025). By 2070, around 520 million people across South Asia could experience at least one month of dangerous heat each year, and under a 1.5°C warming scenario the region could lose 5.3 per cent of total working hours to heat stress by 2030 (World Bank 2026; ILO 2019).

As part of the Global Heat Health Information Network (GHHIN) South Asia Hub’s knowledge products, this country synthesis focuses on Bhutan: the changing pattern of heat exposure, from the southern lowlands to valleys that were previously cooler, the populations and places most at risk, the institutions and policies now responding, and the community and nature-based approaches already being tested on the ground.

## Key findings

- 1. Heat is already high in the southern lowlands:** Warming has been observed in Bhutan since the 1960s, with annual temperatures rising by just under 1 degree over the twentieth century and daily minimum temperatures rising faster than maxima (WBG and ADB 2021). Daily maximum temperatures already exceed 30 degree in the south, and prolonged heat stress is expected at least once every five years in lower-altitude areas (GFDRR 2020; World Bank n.d.a). Pemagatshel records around 16 days above 30 degrees a year, followed by Sarpang at about nine, Samtse and Samdrup Jongkhar at about eight, and Zhemgang around seven (World Bank n.d.a).
- 2. Heat intensifies and expands inland under every pathway:** The same southern dzongkhags that are hottest today gain the most additional hot days. Under SSP2–4.5 for 2040–2059, Pemagatshel rises to about 33 hot days a year and Sarpang to about 20; under SSP5–8.5, Pemagatshel reaches about 40 and Samdrup Jongkhar about 20, with Pemagatshel gaining roughly 25 additional hot days on the historical period (n.d.a). Northern high-altitude districts may warm by 2–3 degree by mid-century and by more than 4–5 degree in places by 2100, while valleys that were previously cooler like Punakha, Wangdue Phodrang, Monggar, Trashigang and lower Thimphu and Paro, move into higher maximum temperatures, exposing populations not previously exposed to heat (ESCAP n.d.a; ESCAP 2026).
- 3. The health burden is real but barely recorded:** Observed clinical records of heat illness in Bhutan are sparse, and the national picture therefore rests on modelled estimates (Royal Government of Bhutan and UNDP Bhutan 2025; Chhetri, Zangpo and Gyeltshen 2024). For 2014–2023, the 2024 Lancet Countdown as reported by WHO shows adults over 65 exposed to around nine heatwave days a year, a rise of about 350 per cent on 1986–2005, and heat-related deaths among that group up about 340 per cent since the 1990s—an increase that would have been roughly 140 per cent without climate change. Heat exposure cost workers more than 19 million potential labour hours a year, equivalent to around US\$23.9 million in lost income, of which agriculture bore about 87 per cent (WHO 2025).
- 4. The burden falls unevenly and disproportionately on women:** Because agriculture accounts for most heat-related income loss, outdoor rural workers are most at risk (WHO 2025). Almost 60 per cent of employed women work in agriculture compared over 34 per cent of

men. Women perform about 71 per cent of unpaid household and care work. Access to climate-smart agriculture decision-making stands at 25.5 per cent for men against 11.7 per cent for women (NCWC and UNDP Bhutan 2020). Infants, adults over 65 and people with chronic cardiovascular disease or diabetes face higher physiological risk, while poorer households are least able to afford cooling, water storage or irrigation (WBG and ADB 2021; WHO 2025).

#### 5. **Urban heat is a separate and growing pathway:**

In Thimphu municipality, built-up area rose from 50.58 per cent to 67.57 per cent between 2001 and 2021 while vegetation fell from 44.76 per cent to 25.4 per cent. Hot urban heat island zones covered 11.83 per cent of the municipality in 2021 and very hot zones 4.22 per cent, projected to reach about 14.26 and 6.08 per cent by 2031 (Pasang et al. 2025). In Phuntsholing, modelled informality is around 31 per cent and air-conditioning penetration about 0.5 per cent, with heat-attributable deaths projected to rise from 1.8 to 4.5 and heat-related costs from USD 8.6 million to USD 11.2 million between 2025 and 2050 ("Heat Cost–Benefit Analysis tool"; Hera Now n.d.).

6. **Mandates exist but are not joined up:** National Adaptation Plan assigns the responsibility for assessing heatwave and heat-stress risk and for developing heat early warning, with the labour ministry and Khesar Gyalpo University of Medical Sciences as collaborating partners (Royal Government of Bhutan 2023). The Regulation on Occupational Health, Safety and Welfare 2022 requires acclimatisation time, work-rest schedules, drinking water and a heat stress prevention programme at hot workplaces (Department of Labour 2022). However, informal farm and care work, where much of the burden sits, falls outside it. No national or city heat action plan was found, and heat early warning remains undeveloped, unlike comparatively advanced flood and glacial lake outburst flood systems (Royal Government of Bhutan and UNDP Bhutan 2025; Royal Government of Bhutan 2023)., Ministry of Labour and Human Resources.

## What Bhutan needs next to be heat resilient needs

The findings above identify where heat exposure and burden are concentrated. The next step is to strengthen how existing mandates are translated into coordinated, seasonal action. Responsibilities for heat-related risks already fall across health, labour, hydrometeorological services and human settlements. The key gap is coordination across these areas, supported by routine monitoring and agreed triggers for action. The report identifies four priorities.

- **Establish heat-health surveillance and monitoring:** Observed clinical records of heat illness in Bhutan are sparse, so the national picture rests on modelled estimates rather than routine diagnosis. The Ministry of Health, working with the National Center for Hydrology and Meteorology, can begin recording heat-related presentations at health facilities in the southern dzongkhags, and take forward the loss and damage indicators already proposed, hospital visits during and after events, days of lost productivity and cooling energy costs as a routine reporting system. Sex-disaggregated clinical and labour data would strengthen it further.
- **Join existing mandates into a heat action plan:** Responsibilities for heat already exists across the Ministry of Health, the Department of Labour (under the 2022 occupational health regulation), hydrometeorology, disaster management and human settlements, but no instrument connects them. A national heat action plan, with city plans for southern border towns such as Phuntsholing where modelled informality is around 31 per cent and air-conditioning access close to zero, would convert assigned duties into coordinated seasonal action.

**Bhutan's heat risk is expanding beyond the southern lowlands while heat-health preparedness remains limited.**

- **Extend early warning from floods to heat:** Bhutan's flood and glacial lake outburst flood early warning is comparatively advanced, with control-room systems and hydrometeorological modernisation already in place. Heat early warning, though a National Adaptation Plan activity, remains undeveloped. Building heat triggers and public health thresholds onto existing infrastructure is faster and cheaper than building a parallel system.
- **Apply a differentiated vulnerability lens to heat-health action:** Heat exposure and its impacts vary across population groups, including by age, sex, occupation and income. Heat-health measures should therefore prioritize groups facing higher exposure or limited capacity to adapt, including older persons, outdoor and agricultural workers, and women engaged in unpaid care and agricultural work. This should include measures to identify and address heat-related illness that may not be captured through routine clinical surveillance. The 2022

occupational regulation applies to regulated workplaces; additional measures are needed to extend protection to informal agricultural and care work through health, labour and social protection systems.

The GHHIN South Asia Hub will help address these priorities in Bhutan by convening stakeholders, strengthening the regional evidence base, facilitating knowledge exchange, and building capacities for heat-health action. By connecting Nepal, Bhutan, Bangladesh, and India around shared priorities and solutions, the Hub will foster institutional collaboration and cross-country learning, supporting countries to advance sustained and anticipatory heat-health resilience across South Asia.

**Bhutan can strengthen heat preparedness by building heat action into existing health, labour and early warning systems.**



Agriculture accounts for about 87% of Bhutan's heat-related income losses.

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# 1. Introduction

Extreme is increasingly being recognised as a major and multifaceted climate risk worldwide, affecting public health and productivity. The increase in frequency, intensity and duration of extreme heat worldwide is largely driven by the convergence of rising global temperatures, whereas its risks are driven by rapid urbanisation and existing health vulnerabilities and socioeconomic inequalities. The warming signal is unambiguous. Global mean temperature for January–August 2025 stood at 1.42 degrees Celsius ( $\pm 0.12^{\circ}\text{C}$ ) above pre-industrial levels, and each of the eleven years from 2015 to 2025 ranked among the eleven warmest in the 176-year observational record (WMO 2025). Since the 1990s, heat-related deaths have increased by 63 per cent, averaging 546,000 deaths per year over the period 2012–2021 (Romanello et al. 2025). Under current policies and near-term trajectories, exceeding 1.5 degree of global warming is now widely considered unavoidable. However, the magnitude and duration of this overshoot remain contingent on the pace and scale of mitigation and adaptation action (UNEP 2026).

Cities in Asia, particularly Southeast Asia, are increasingly exposed to hazardous humid extreme heat events (Agarwal, Nagpure and Ramaswami 2024). By 2070, around 520 million people across the region could experience at least one month of dangerous heat each year. The risk is particularly pronounced in cities where dense urban areas can remain more than 10 degrees Celsius hotter at night than the surrounding countryside, intensifying heat exposure and limiting overnight recovery (World Bank 2026). South Asia, meanwhile, under a 1.Celsius warming scenario, could lose 5.3 per cent of total

**Extreme heat is intensifying across Asia, amplifying health risks, productivity losses, and socioeconomic vulnerabilities.**

working hours to heat stress by 2030, equivalent to approximately 43 million full-time jobs (ILO 2019). In India, the largest country in South Asia and among the world's most populous, 57 per cent of districts, which are home to nearly three-quarters of the population, are already facing high to very high heat risk, according to CEEW research (Prabhu et al. 2025). Similarly, Bangladesh has experienced a 1.1 degree Celsius increase in maximum temperatures since 1980, while feels-like temperatures have risen by 4.5 degrees Celsius, contributing to growing physical and mental health burdens, including heat-related anxiety and depression (World Bank 2025).

Rising global temperatures have accelerated changes in the cryosphere, particularly in high-mountain regions, leading to reductions in snow cover, glacier retreat, and permafrost degradation (IPCC 2019). In the Himalayan countries of Nepal and Bhutan, rapid cryospheric changes threaten water security, ecosystems, and mountain livelihoods (IPCC 2022). While chronic heat stress impacts different ecosystems, at the same time, low-lying parts of these high-altitude countries are increasingly experiencing extreme heat, with temperatures in some areas now regularly exceeding 40 degrees Celsius (Bhandari et al. 2025).

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## 2. Heat Risk in Bhutan

This section examines the observed and projected patterns of heat in Bhutan, including its spatial distribution and potential changes under future climate scenarios, and considers the implications for health, labour and human settlements.

Bhutan has warmed by nearly 1°C since the twentieth century with heat adversely affecting water resources and agricultural livelihoods (Royal Government of Bhutan 2023 NCWC and UNDP Bhutan 2020).

### 2.1. Historical Trends in Extreme Heat

Warming in Bhutan has been observed since the 1960s. Annual temperatures rose by just under 1 degree over the twentieth century, and daily minimum temperatures have risen faster than daily maximum temperatures (2021). National hydrometeorological analysis for 1976–2025 shows annual average temperature higher by about 0.8 degree (Royal Government of Bhutan 2023 NCWC and UNDP Bhutan 2020).

Daily maximum temperatures already exceed 30 degree in the south, and prolonged heat stress is expected at least once in the next five years (GFDRR 2020; World Bank n.d.a). Communities already report livelihood stress from warmer weather. A study done in Punakha linked rising temperatures to water stress and falling agricultural productivity (Tempa 2026; The Climate Watch 2026). In a national gender and

climate survey of 600 households, over 90 per cent reported warmer and more unpredictable weather; more than three-quarters reported increased landslides and hail storms; and over eight in ten said climate change affects the natural resources they depend on. More than one-third of households noted that they were not well prepared for a disaster (NCWC and UNDP Bhutan 2020).

Bhutan's National Adaptation Plan already places heatwaves among threats to life, health, wellbeing and health infrastructure, alongside flash floods and landslides (Royal Government of Bhutan 2023). National loss and damage work likewise lists heatwaves under health and wellbeing impacts, while noting that health-related losses remain sparsely documented compared floods and storms (UNDP Bhutan 2025).

### 2.2. Spatial Distribution of Heat Risk Across Bhutan

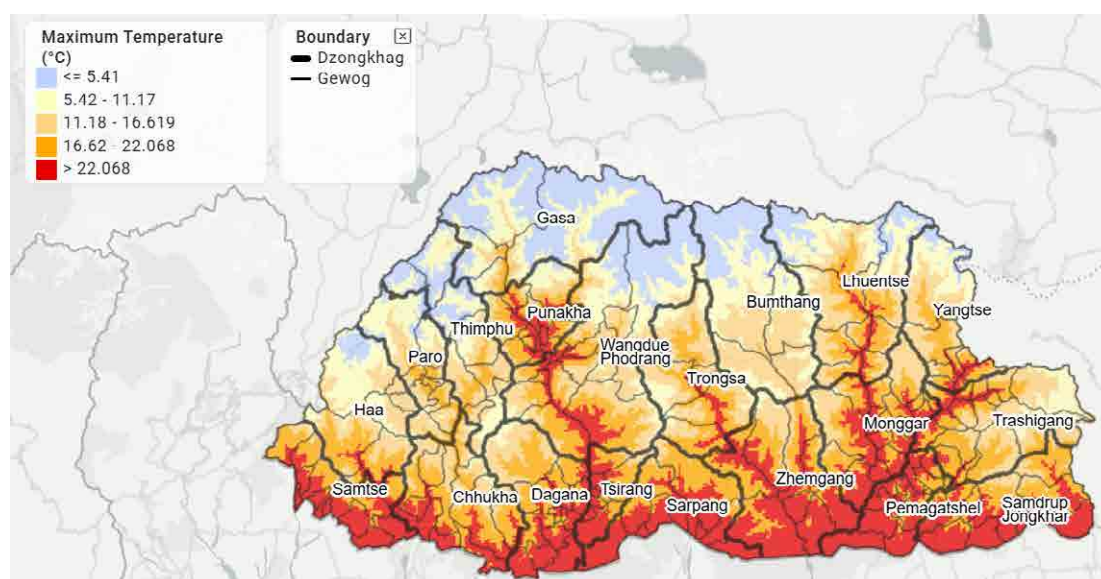
An Analysis of temperature and heat risk shows that current heat risk in Bhutan is concentrated in the southern lowlands where outdoor work and settlements already face high temperatures (WBG and ADB 2021; GFDRR 2020). Figure 1 maps historical annual maximum temperature and the number of hot days by dzongkhag. The World Bank Climate Change Knowledge Portal shows the historical trend for heat, where Pemagatshel has about 16 such days above 30 degree per year, followed by Sarpang at around nine days, Samtse and Samdrup Jongkhar at around eight days, and Zhemgang around seven days (World Bank n.d.a). as shown in Figure 1

This report uses several heat measures. Taken together, they give a comprehensive view of the heat landscape in Bhutan. Annual maximum temperature from the ESCAP Risk and Resilience Portal shows how hot the climatology is; the historical map is 1971–2000 (ESCAP n.d.a). Hot days from the World Bank Climate Change Knowledge Portal when daily maximum temperature is at or above 30 degree (historical 1995–2014; mid-century 2040–2059) (World Bank n.d.a). That 30 degree cut-off is a mapping threshold used here. It is not a universal heat-health threshold, and health risk still depends on humidity, acclimatisation and who is exposed. Heatwave days and heat-related deaths later in

the report come from the 2024 Lancet Countdown as reported by WHO, which uses its own heatwave definition (WHO 2025). Cooling degree days measure extra cooling demand as temperatures rise (ESCAP 2026). The Climate and Health Risk Index is a

separate, multi-hazard climate-health score (World Bank n.d.b). ata from the Risk and Resilience Portal as well as the Climate Change Knowledge Portal maps are modelled ensembles, not station observations.

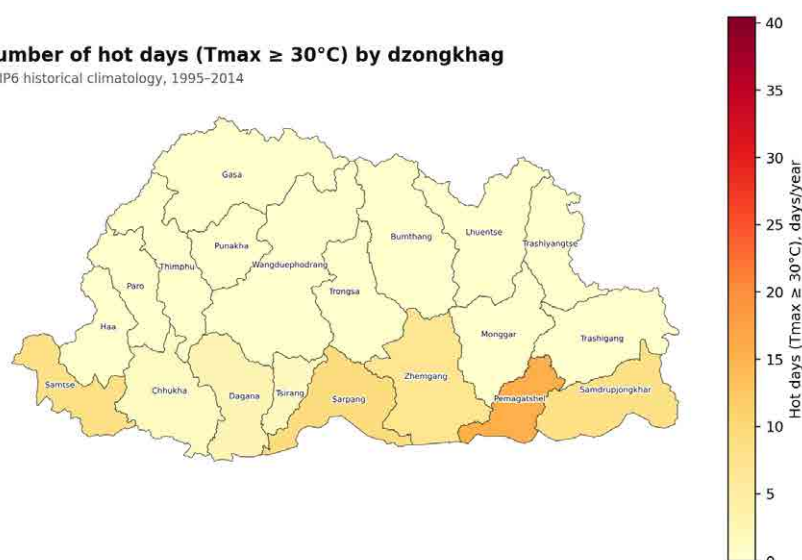
Figure 1. Historical annual maximum temperature (ESCAP Risk and Resilience Portal) and number of hot days ( $T_{max} \geq 30^{\circ}\text{C}$ ) by dzongkhag, 1995–2014 (World Bank CCKP).



Source: ESCAP Risk and Resilience Portal. Annual maximum temperature, historical climatology 1971–2000. Boundaries: Dzongkhag and Gewog.

#### Number of hot days ( $T_{max} \geq 30^{\circ}\text{C}$ ) by dzongkhag

CMIP6 historical climatology, 1995–2014



Source: World Bank. n.d.a. “Climate Change Knowledge Portal — Bhutan ADM1 Heat Indicators.” CMIP6 ensemble median; hot days ( $hd_{30}$ ) historical 1995–2014 and SSP2-4.5 / SSP5-8.5 2040–2059; change and population-density bivariate maps prepared for this brief.

Note: CMIP6 0.25° multi-model ensemble median, annual climatology. Boundaries: World Bank Official Boundaries (WB GAD ADM1).

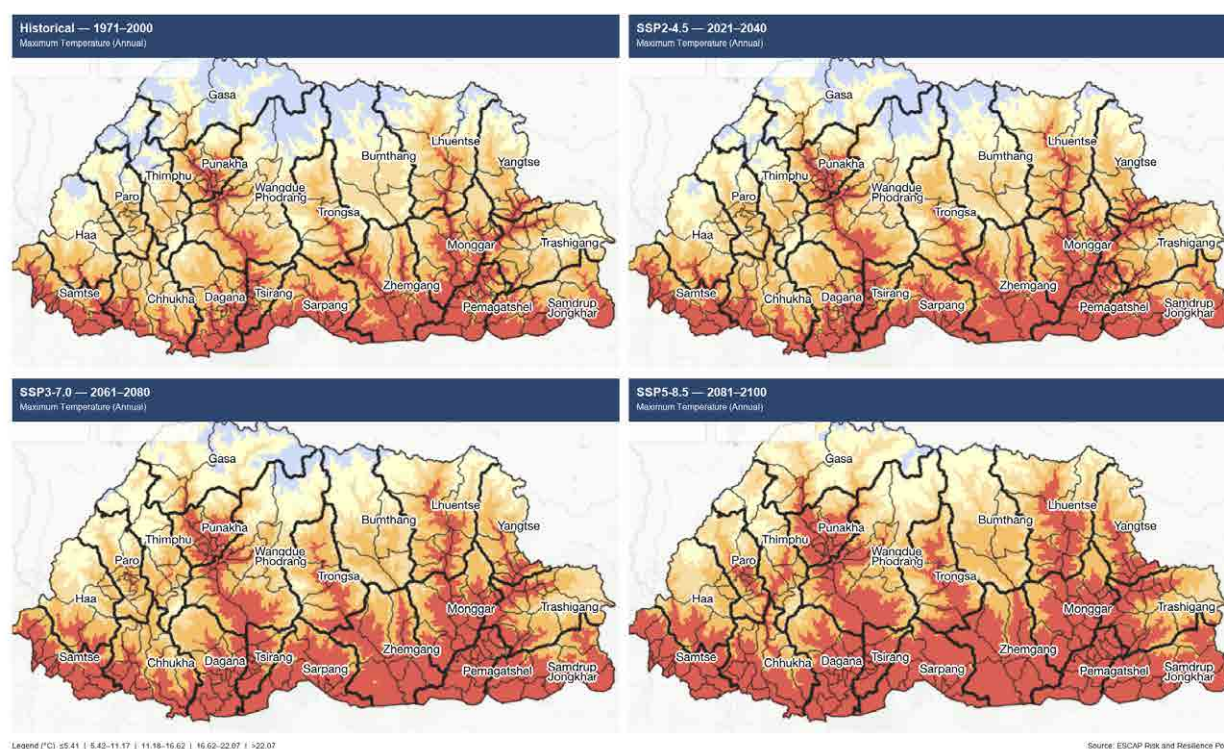
## 2.3. Future projections and assessment

Shared Socioeconomic Pathways describe different futures for greenhouse-gas emissions and development. This report uses SSP2–4.5 as a middle pathway, SSP3–7.0 as a higher-emission pathway, and SSP5–8.5 as a high-emission pathway. Analysis from the ESCAP Risk and Resilience Portal shows that annual maximum temperature remains highest along the southern border and intensifies there under later, higher-emission pathways, with heat also expanding inland as shown in Figure 2 (ESCAP n.d.a). Temperatures rise under all pathways, and they rise more under higher emissions and later in the century (ESCAP 2026). Figure 2 changes both the emissions pathway and the time period across panels (historical 1971–2000; SSP2–4.5 for 2021–2040; SSP3–7.0 for 2061–2080; SSP5–8.5 for 2081–2100) to showcase potential best and case scenarios across time and

different future scenarios. The maps therefore show combined later-century, higher-emission futures. They do not isolate the effect of higher emissions from the effect of moving later in the century (ESCAP n.d.a). These and CCKP results are multi-model ensemble projections. They showcase scenario and model uncertainty and should be read as direction and relative geography, not as precise counts of future hot days or degrees.

Northern high-altitude districts may warm by about 2–3 degree by mid-century under high-emission pathways, and by more than 4–5 degree in some areas by 2100 under SSP5, while southern districts that are already hot face more severe summers (ESCAP 2026).

Figure 2. Annual maximum temperatures remain highest along the southern border and intensify under later pathways



Source: ESCAP Risk and Resilience Portal. Annual maximum temperature. Historical climatology 1971–2000; SSP2–4.5 2021–2040; SSP3–7.0 2061–2080; SSP5–8.5 2081–2100. Panels change both the emissions pathway and the time period. Boundaries: Dzongkhag and Gewog.

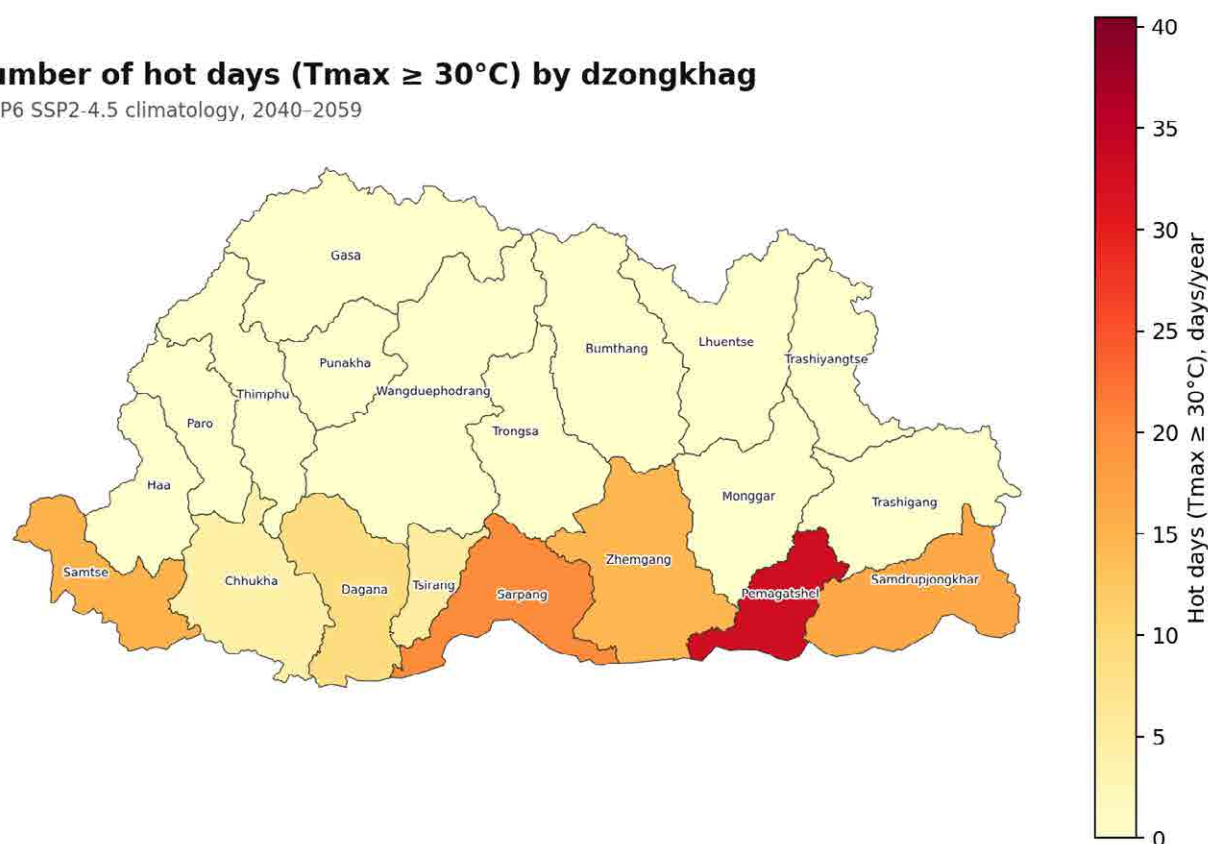
The same southern dzongkhags, already hottest in the historical period, also gain the most additional hot days. Figures 3 to 5 show the increase concentrated in Pemagatshel, Sarpang, Samdrup Jongkhar, Zhemgang and Samtse, with further gains in Dagana, Tsirang and Chhukha. Under SSP2–4.5 for 2040–2059, Pemagatshel rises to about 33 hot days a year and Sarpang to about 20. Under SSP5–8.5, Pemagatshel reaches about 40, Sarpang about

25 and Samdrup Jongkhar about 20. The change from historical to mid-century SSP5–8.5 is largest in Pemagatshel, about 25 additional hot days a year, with double-digit increases also in Sarpang and Samdrup Jongkhar as shown in Figures 3 and 5 (World Bank n.d.a). SSP5–8.5 adds more hot days than SSP2–4.5 in that same southern belt as depicted in Figure 5. (World Bank n.d.a). the World Bank’s Climate Change Knowledge Portal.

Figure 3. Mid-century hot days increase most where heat is already highest under SSP2–4.5

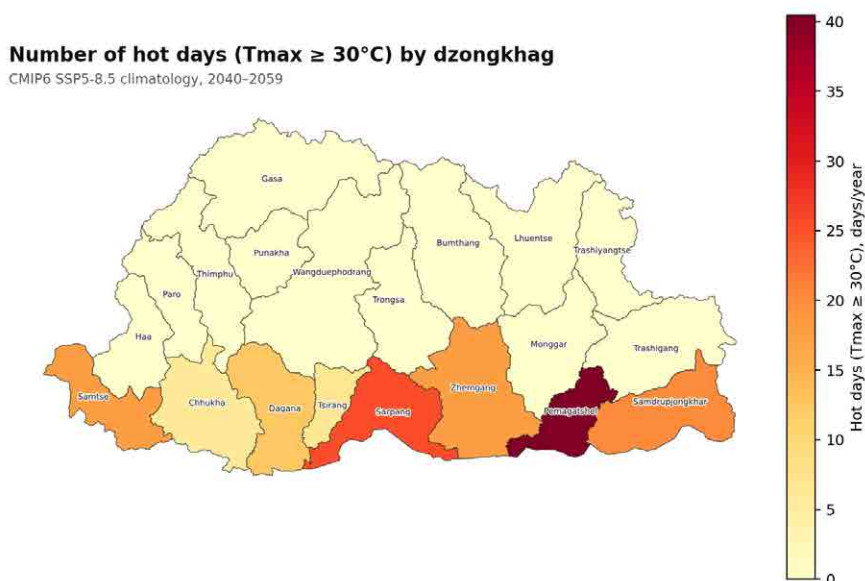
### Number of hot days ( $T_{max} \geq 30^{\circ}\text{C}$ ) by dzongkhag

CMIP6 SSP2-4.5 climatology, 2040–2059



Source: ESCAP Risk and Resilience Portal. Annual maximum temperature, historical climatology 1971–2000. Boundaries: Dzongkhag and Gewog.

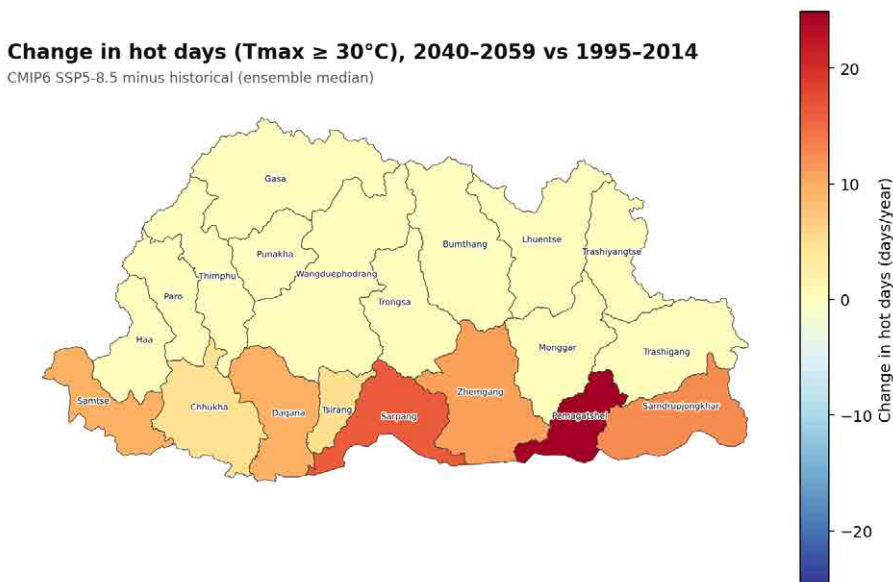
Figure 4. Under SSP5–8.5, mid-century hot-day increases are larger and remain concentrated in the south



Source: World Bank. n.d.a. “Climate Change Knowledge Portal — Bhutan ADM1 Heat Indicators.” CMIP6 ensemble median; hot days ( $hd30$ ) historical 1995–2014 and SSP2-4.5 / SSP5-8.5 2040–2059; change and population-density bivariate maps prepared for this brief.

Note: CMIP6 0.25° multi-model ensemble median, annual climatology. Boundaries: World Bank Official Boundaries (WB GAD ADM1).

Figure 5. The largest mid-century gains in hot days under SSP5–8.5 occur where historical heat is already high



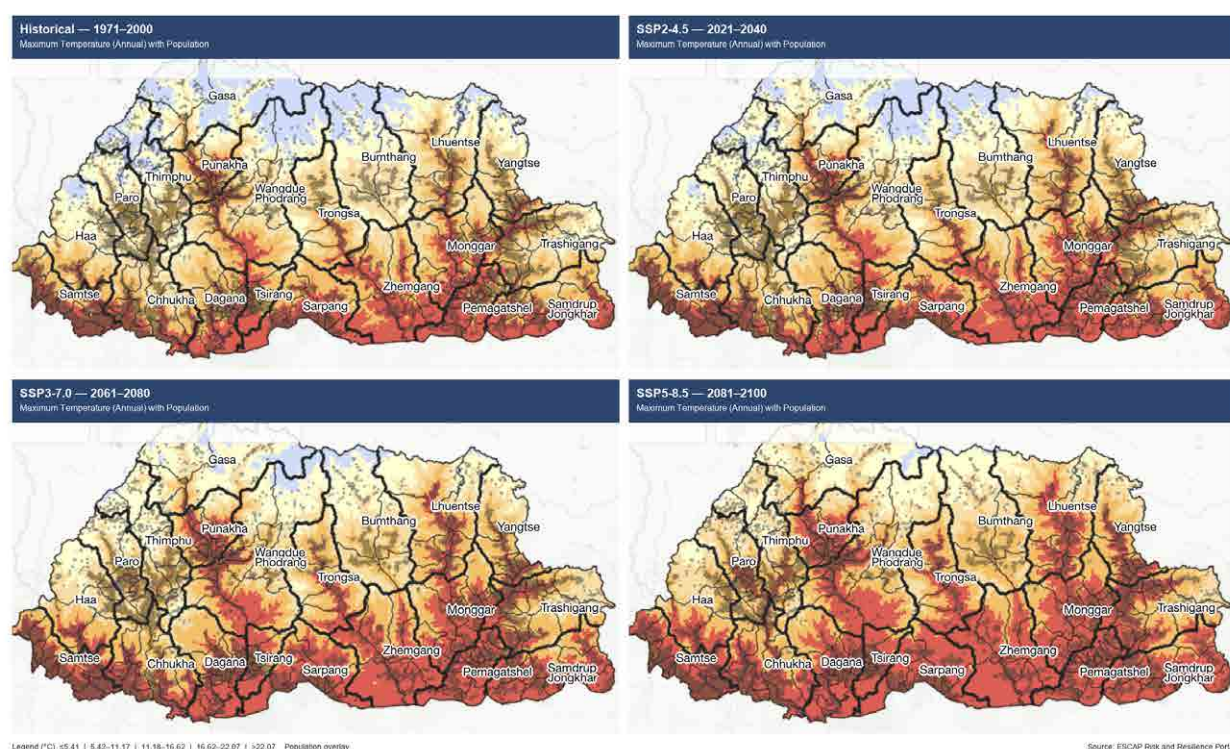
Source: World Bank. n.d.a. “Climate Change Knowledge Portal — Bhutan ADM1 Heat Indicators.” CMIP6 ensemble median; hot days ( $hd30$ ) historical 1995–2014 and SSP2-4.5 / SSP5-8.5 2040–2059; change and population-density bivariate maps prepared for this brief.

Note: CMIP6 0.25° multi-model ensemble median, annual climatology. Boundaries: World Bank Official Boundaries (WB GAD ADM1).

Population exposure to higher temperatures is also increasing. By 2040, over 95 per cent of Thimphu residents are projected to experience summer warming of 1 to 1.5 degree, with larger increases later under more severe pathways (Royal Government of Bhutan and UNDP Bhutan 2025). That is exposure to projected warming is not, on its own, exposure to hazardous heat, because the health meaning depends on the starting temperature, humidity, acclimatisation and a locally relevant threshold. ESCAP, overlaying Bhutan's population on projected maximum temperature, shows that annual maximum temperature in Bhutan is already highest along the southern border, and the middle and worst-case climate scenarios show that pattern intensifying in the southern regions as shown in Figure 6. Temperatures above 22 degree have historically been concentrated in Samtse, Chhukha, Dagana, Tsirang, Sarpang,

Zhemgang, Pemagatshel and Samdrup Jongkhar; under the worst-case climate change scenario, more of those districts' populations are exposed. Under SSP3–7.0 and SSP5–8.5, heat expands inland. Valleys that were cooler in the historical period, notably Punakha, Wangdue Phodrang, Monggar and Trashigang, and lower parts of Thimphu and Paro, move into higher maximum temperatures, and populations that were not exposed to heat previously could now be increasingly exposed. In the north, including Gasa, temperatures increase under SSP3–7.0 and SSP5–8.5 even though those highlands remain cooler than the south. Figure 6 uses the same mixed pathway-and-period panels as Figure 2, so it also shows combined later-century, higher-emission futures rather than a controlled SSP-only or period-only comparison (ESCAP n.d.a).

Figure 6. Population centres increasingly coincide with areas of higher annual maximum temperature



Source: ESCAP Risk and Resilience Portal. Annual maximum temperature with population overlay. Historical climatology 1971–2000; SSP2-4.5 2021–2040; SSP3-7.0 2061–2080; SSP5-8.5 2081–2100. Panels change both the emissions pathway and the time period. Boundaries: Dzongkhag and Gewog.

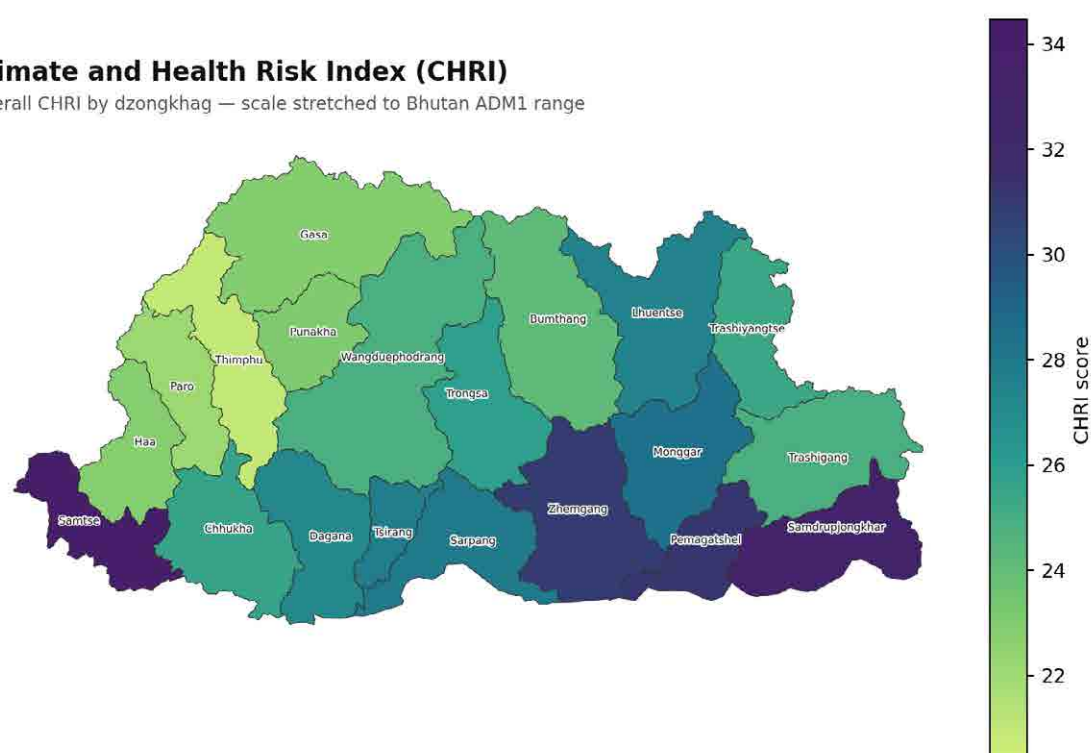
The World Bank Climate and Health Risk Index (CHRI) scores districts on climatehealth risk: how much climate hazards hit people (exposure), how sensitive those populations are (age, health and living conditions), and how well systems can cope (adaptive capacity). Scores are index points on a 0–100 scale; higher means climatehealth risk. CHRI combines several climate and environmental hazards with sensitivity and adaptive capacity. District rankings are therefore climate-health risk, not heat risk alone

(World Bank n.d.b). Bhutan district scores fall roughly in the 20s to mid-30s. CHRI is highest in Samtse (33.96), followed by Samdrup Jongkhar (33.17) and Pemagatshel (31.19), and lowest in Thimphu (20.88). Adaptive capacity is relatively high across Bhutan; higher exposure and sensitivity drive the ranking as shown in Figure 7 (World Bank n.d.b). The hottest districts and the highest climatehealth risk districts are not identical, but they overlap where it matters for people.

Figure 7. Composite climate–health risk is highest where exposure meets higher sensitivity and lower adaptive capacity

### Climate and Health Risk Index (CHRI)

Overall CHRI by dzongkhag — scale stretched to Bhutan ADM1 range



Source: World Bank Climate and Health Risk Index (CHRI) via Climate Change Knowledge Portal.

Longer hot seasons also raise cooling demand and put pressure on water systems that farms and hydropower already depend on. Cooling degree days are already higher in the south and keep rising under SSP2 and SSP5 in Dagana, Chhukha, Samtse, Tsirang, Sarpang, Zhemgang, Monggar and Samdrup Jongkhar, with further inland expansion by 2100 (ESCAP 2026). The same warming changes snowmelt and river flow (WBG and ADB 2021; ESCAP 2026). Of 7,399 water sources identified nationally, 69 had dried and 1,856

(25.1 per cent) were drying (UNDP Bhutan 2025). That is the setting for the health and labour burdens that follow.

A study done in Punakha links strong land-surface warming to water stress and falling farm productivity (Tempa 2026). Thimphu and Paro also face urbanisation and air-quality pressures that can make hot conditions harder on health (WBG and ADB 2021).

## 2.4. Socioeconomic Drivers of Heat Vulnerability in Bhutan

The health and labour impacts of heat fall unevenly. Infants, adults over 65 and people with chronic cardiovascular disease or diabetes face higher risk from heat (WHO 2025). Poorer groups absorb more of the change: heavy manual labour is among the lowest paid and the most heat-exposed; lowland businesses are least able to afford cooling; poorer farmers are least able to afford water storage and irrigation (WBG and ADB 2021). Because agriculture accounts for most heat-related income loss, outdoor rural workers remain most at risk (WHO 2025).

The exposure is strongest in the southern lowlands and lower valleys shown, while northern highlands face different risks from frost loss, snow and glacier melt, and glacial lake outburst floods (UNDP Bhutan 2025; WBG and ADB 2021).

Heat and water stress hit farms and outdoor labour hardest, and those livelihoods are already under pressure. People leave rural areas for western towns. Population loss is reported in 138 of 205 regions, with movement generally from the rural east toward western urban areas, mainly for economic and aspirational reasons. Climate change acts as a background stressor through precarious rural livelihoods (Morrison 2026). That movement is a broader climate and livelihood pressure, not a heat-only migration finding. Heat-specific costs are reflected in the labour-hour and older-adult death estimates above (WHO 2025). Punakha's documented pathway is temperature-related water and farm stress (Tempa 2026). Women who remain in rural areas carry more of the farm and unpaid care work. Household coping strategies also differ by sex. Men more often seek alternative employment or migrate to cities. Women more often respond to climate-related water and livelihood stress by adjusting household consumption patterns and purchasing water when usual sources are insufficient (NCWC and UNDP Bhutan 2020).

National surveys retain strong documentation on unequal climate impacts, even while heat-specific clinical studies remain thin. Respondents report warmer and more unpredictable weather, falling production, and rising pests and human-wildlife conflict (NCWC and UNDP Bhutan 2020). About half of surveyed respondents agreed strongly that climate change increases women's workload more than men's and impacts women more than men. In

2017, almost 60 per cent of employed women were active in agriculture, compared with more than 34 per cent of employed men. Land ownership in the survey stood at about 63 per cent male and 32 per cent female. Women perform about 71 per cent of unpaid household and care work. Access to climate-smart agriculture decision-making was about 25.5 per cent for males and 11.7 per cent for females. Participation in climate initiatives was 10 per cent for males and 3.5 per cent for females (NCWC and UNDP Bhutan 2020). Girls and women also face climate impacts through care roles, water and menstrual health constraints, and limited voice in climate policymaking (Choden 2023).

Similar gendered burdens are observed in highland communities, where women carry care and livelihood responsibilities under more erratic mountain weather, altitude-related illness and declining harvests, including of cordyceps, a high-value medicinal fungus harvested in alpine areas (Wangmo et al. 2024). While the underlying hazards differ from lowland heat exposure, women again absorb a disproportionate share of the resulting care and livelihood pressures.

Additionally, urban heat is a separate pathway from lowland farm heat, and it is growing as people move toward western and southern towns (Morrison 2026). Built-up areas raise heat risk (GFDRR 2020). The National Adaptation Plan names urban heat island effects among human-settlement adaptation needs (Royal Government of Bhutan 2023). A study in Thimphu municipality mapped land-surface temperature, the heat of the ground and roofs rather than air temperature at breathing height, using Landsat imagery and then simulated urban heat islands to 2031 (Pasang et al. 2025). Between 2001 and 2021, built-up area rose from 50.58 per cent to 67.57 per cent of the municipality, and vegetation fell from 44.76 per cent to 25.4 per cent. The gap between the highest and lowest land-surface temperature ranged from 18.33 degree to 25.74 degree. In 2021, hot urban-heat-island zones covered 11.83 per cent of the municipality and very hot zones 4.22 per cent. Extreme heat-island locations included the Jigme Dorji Wangchuck National Referral Hospital area, the Clock Tower, Motithang and Tashi Commercial (Pasang et al. 2025). By 2031, built-up area is projected at 72.82 per cent, with hot zones about 14.26 per cent and very hot zones about 6.08 per cent, including new heat islands on the urban fringe (Pasang et al. 2025).

This desk review found no published city Heat Action Plan for Thimphu or Paro. The 2012 Ministry of Health assessment called for minimum health, hygiene and sanitation standards in migrant labour settlements and low-income informal urban areas (Sithey et al. 2018).

Phuntsholing is developed below as the southern border case, where modelled informality is about 31 per cent and cooling access is minimal (“Heat Cost–Benefit Analysis tool”; Hera Now n.d.).

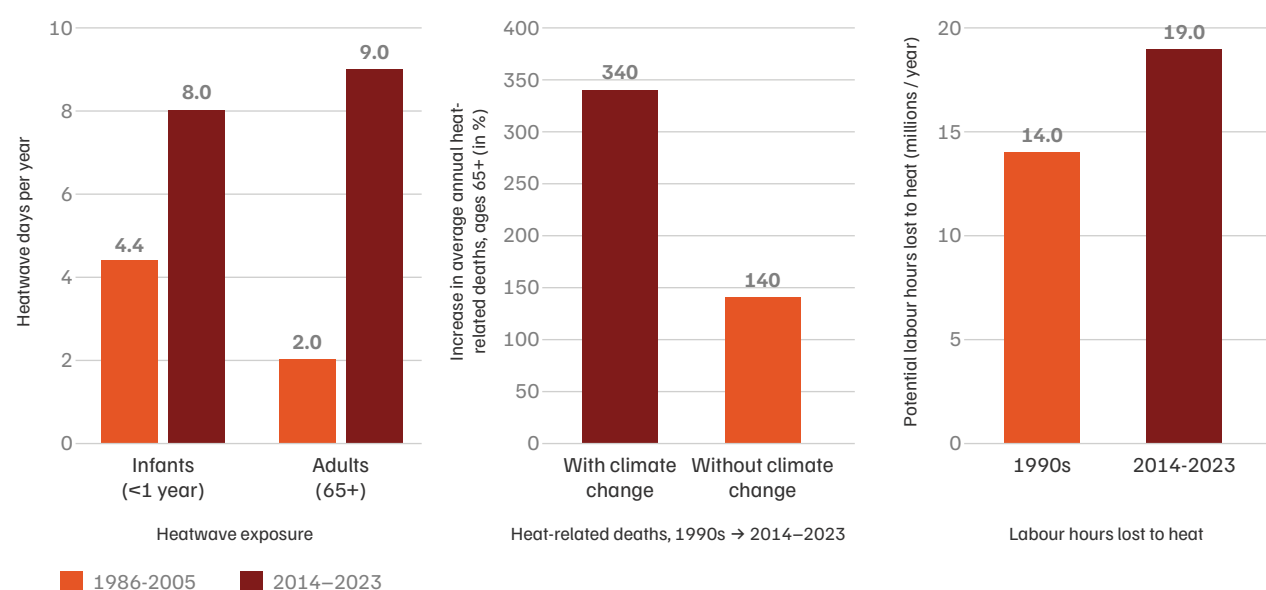
## 2.5. Recorded heat-health impacts

The observed heat-health evidence base for Bhutan is sparse. A 2024 study in the Bhutan Health Journal notes that there are few studies on climate change and physical health in Bhutan (Chhetri, Zangpo and Gyeltshen 2024). This section therefore uses modelled national estimates and a small number of local studies. It does not rest on routine hospital diagnosis of heat illness (UNDP Bhutan 2025; WHO 2025). The strongest national figures come from the 2024 Lancet Countdown, as reported by WHO. Those are modelled estimates of heatwave exposure, older-adult deaths and lost labour hours (WHO 2025). From 2014–2023, they show infants under one and adults over 65 exposed to an average of 8 and 9 heatwave days per year, about an 80 per cent and 350 per cent increase on 1986–2005. Rising temperatures and an ageing population drove a 340 per cent rise in average annual heat-related deaths among adults over 65

from 1990–1999 to 2014–2023. Without climate change, that increase would have been about 140 per cent, mainly from growth in the over-65 population (WHO 2025).

In the same decade, heat exposure cost local workers more than 19 million potential labour hours per year on average (a 36 per cent increase from the 1990s), equivalent to about US\$23.9 million in lost income annually. Agriculture bore about 86.7 per cent (about US\$20.5 million). Because a large share of employed women work in agriculture, those labour losses potentially fall heavily on women even where clinical heat illness is poorly recorded (NCWC and UNDP Bhutan 2020; WHO 2025). Figure 8 summarises those heatwave, mortality and labour estimates. They are modelled national estimates, not counts from hospital records (WHO 2025).

Figure 8. Modelled national estimates show rising heatwave exposure, older-adult mortality and labour-hour losses



Source: World Health Organization (WHO). 2025. Bhutan: Information Sheet on Climate Change, Air Pollution, and Health. Version 1.0. Geneva: WHO. Heat metrics from the 2024 report of the Lancet Countdown on Health and Climate Change.

Rising temperatures also work through broader climate-sensitive disease pathways that the health system already tracks. Temperature is one driver, alongside rainfall, humidity, vector ecology, water quality and health-system capacity. Bhutan's National Adaptation Plan reports rising risk from climate-related vector- and water-borne disease alongside direct disaster impacts. Heatwaves, flash floods and landslides threaten life, health, wellbeing and health infrastructure. Malaria cases may roughly double over 30 years, and dengue, first reported in 2004, could reach about 3,000 incidences per year by 2050, expanding beyond southern border districts (Royal Government of Bhutan 2023).

These links have already been noted in national assessments. In 2012, the Ministry of Health completed a climate and health vulnerability and adaptation assessment. It examined diarrhoea, vector-borne disease and health-system exposure to extremes including glacial lake outburst floods, and flagged nutrition, mental health, respiratory disease and cardiovascular disease as climate-sensitive concerns. Diarrhoea, one of the top ten causes of morbidity, showed strong seasonality, with 53 per cent of cases between April and August, overlapping the warmest months, when temperature, rainfall and water quality move together. The assessment called for climate-informed disease surveillance and early

warning, and stronger preparedness for emergencies and extreme weather (Sithey et al. 2018).

Routine documentation of heat's clinical toll remains sparse. National loss and damage assessment still finds sparse records of climate-induced health losses. The best-recorded fatalities relate to heavy rainfall, landslides, floods and glacial lake outburst floods, even though temperature shifts are described as significant for heat and cold stress where communities are unprepared (Royal Government of Bhutan and UNDP Bhutan 2025). A study in Punakha found clear livelihood and water impacts from rising temperatures. In that survey, 92.7 per cent reported that the community had not experienced health issues related to the temperature increase (Tempa 2026). That finding does not rule out heat-related health risks and shows the need for heat-specific monitoring and locally grounded epidemiological evidence. Climate shocks also affect children's health, education and school operations, while adaptation education remains limited (Thapa, Gough and Cooper 2024). UNICEF's global children's climate risk indices assign Bhutan a relatively low heatwave score, while child poverty and water, sanitation and hygiene scores remain more elevated, so child vulnerability is shaped by services and poverty as well as by heat layers (UNICEF 2026).

### Box 1. Phuntsholing urban heat and adaptation profile

Phuntsholing is on Bhutan's southern border in Chhukha District, inside the Risk and Resilience Portal's highest annual maximum-temperature band (above about 22 degree ) (ESCAP n.d.a). Hot-day counts for Chhukha are lower than for Pemagatshel or Sarpang, yet the town remains in the southern heat and cooling-demand belt, with a mid-range Climate and Health Risk Index score (ESCAP 2026; World Bank n.d.a; World Bank n.d.b). The National Adaptation Plan already names urban heat island effects among human-settlements adaptation needs (Royal Government of Bhutan 2023). In a southern border town, that meets high informality, almost no modelled air-conditioning, and outdoor work ("Heat Cost–Benefit Analysis tool"; Hera Now n.d.). The 2012 Ministry of Health assessment had already called for minimum health, hygiene and sanitation standards in migrant labour settlements and low-income informal urban areas (Sithey et al. 2018; World Bank n.d.a)

The ESCAP's analysis from the Hera City Heat Solutions Calculator models city results from a heat cost–benefit analysis tool. In Phuntsholing, annual mean temperature rise from 23.9 degree in 2025 to 24.8 degree in 2050, and heatwave days from 10.7 to 11.8. Heat-attributable deaths rise from 1.8 to 4.5, mostly among people aged 65 and over; lost labour hours from 6.8 million to 7.8 million; and total heat-related cost from US\$8.6 million to US\$11.2 million (USD112 to 133 per person). A default adaptation package including heat action planning, cool roofs, greening, outdoor-worker measures and limited insurance yields a benefitcost ratio of about 3.8 and about 23 lives protected over the package horizon (tables –) ("Heat Cost–Benefit

Analysis tool”; Hera Now n.d.). These figures compare a modelled baseline with a modelled package; they are not observed municipal clinical statistics, and should be read with national WHO heathealth estimates (“Heat Cost–Benefit Analysis tool”; Hera Now n.d.; WHO 2025). The 2025 and 2050 death, labour-hour and cost figures come from a single modelled run. They are sensitive to the modelled population, informality and cooling assumptions in Table , and they should not be read as measured city outcomes (“Heat Cost–Benefit Analysis tool”; Hera Now n.d.).

This desk review found no published city Heat Action Plan or heat early warning system for Phuntsholing. National heat-risk and heat early-warning actions point to hydrometeorology, health, the Department of Local Governance and Disaster Management and human settlements (Royal Government of Bhutan 2023). High informality and near-zero cooling access show why southern towns need heat planning now (“Heat Cost–Benefit Analysis tool”; Hera Now n.d.; Sithey et al. 2018)

Phuntsholing’s modelled city profile shows a southern border town with high informality and almost no air-conditioning, so outdoor work and informal housing meet heat with little cooling. Table population of about 76,650 is the Hera City Heat Solutions Calculator 2025 modelled figure, not a count (“Heat Cost–Benefit Analysis tool”; Hera Now n.d.). The 2017 Population and Housing recorded 27,658 residents in Phuntsholing municipality (National Statistics Bureau 2018). The local Hera extract does not name an administrative boundary that reconciles the two, so deaths, labour hours and cost per person in to inherit that modelled denominator.

Source: Authors’ analysis

Table 1. City profile of Phuntsholing

| Indicator                             | Value                   |
|---------------------------------------|-------------------------|
| Population (Hera modelled, 2025)      | ~76,650                 |
| Climate class                         | Cwa (humid subtropical) |
| Informality rate                      | ~31%                    |
| Modelled air-conditioning penetration | ~0.5%                   |
| Outdoor workforce (modelled, 2025)    | ~2,230                  |

Source: Author’s analysis

Table 2. Modelled heat exposure in Phuntsholing rises between 2025 and 2050

| Indicator                               | 2025 | 2050 |
|-----------------------------------------|------|------|
| Annual mean temperature (°C)            | 23.9 | 24.8 |
| Outdoor wet-bulb globe temperature (°C) | 24.2 | 25.0 |
| Indoor wet-bulb globe temperature (°C)  | 22.3 | 23.1 |
| Predicted heatwave days                 | 10.7 | 11.8 |

Source: Author’s analysis

Table 3. Modelled health and economic burden, Phuntsholing

| Indicator                        | 2025        | 2050         |
|----------------------------------|-------------|--------------|
| Heat-attributable deaths (total) | 1.8         | 4.5          |
| — of which ages 65+              | 1.3         | 4.0          |
| Deaths per 100,000               | 2.4         | 5.3          |
| Lost labour hours                | 6.8 million | 7.8 million  |
| Total heat-related cost (US      | 8.6 million | 11.2 million |
| Cost per person (US              | 112         | 133          |

Source: Author's analysis

Table Default adaptation package, Phuntsholing (scenario for comparison, not adopted policy)

| Package element                                  | Setting          |
|--------------------------------------------------|------------------|
| Heat action planning                             | Included         |
| Cool roofs                                       | 15% coverage     |
| Greening                                         | Toward 13% share |
| Outdoor-worker measures                          | Included         |
| Insurance                                        | 10%              |
| Benefit-cost ratio                               | ~3.8             |
| Lives protected (present value, package horizon) | ~23              |

Source: Author's analysis

Note: A default adaptation package is included for comparison only; it is not adopted city policy. The modelled benefit-cost ratio is about 3.8.

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# 3. Policy and institutional mechanisms to mitigate heat risk

This section reviews the treatment of heat within Bhutan's climate adaptation, labour and disaster risk management frameworks, identifies relevant institutional mandates, and assesses opportunities to strengthen coordination for seasonal heat-health action.

Heat-related mandates span health, labour and disaster management in Bhutan but remain fragmented across institutions.

## 3.1. Evolution of Heat Risk Governance in Bhutan

Bhutan already has a multi-stakeholder architecture for climate and disaster risk. National adaptation and loss and damage processes bring together environment and climate institutions, hydrometeorology, disaster management, health, agriculture, forests, water, human settlement, finance, academia and civil society partners such as the Bhutan Ecological Society (Royal Government of Bhutan and UNDP Bhutan 2025; Royal Government of Bhutan 2023). A National Task Force on Loss and Damage has been established, with calls for a national framework and a centralised data repository (Royal Government of Bhutan and UNDP Bhutan 2025). Bhutan also participates in the Alliance for Transformative Action on Climate and Health (WHO 2025).

Gender institutions are part of that set-up, which matters because women absorb more of the remaining farm and care load under heat and water stress. The National Commission for Women and Children, Gender Focal Points and a Gender Expert Group support mainstreaming. Climate change is integrated into the *National Gender Equality Policy* and the *National Plan of Action for Gender Equality* (2019–2023). The *Climate Change Policy 2020* includes gender issues, unlike the 2015 Nationally Determined Contribution. Capacity and resources for genderclimate work remain limited (NCWC and UNDP Bhutan 2020).

Those ministries, gender bodies and civil society partners already work on climate and disaster risk, but heat action has not yet been incorporated into national planning, development and early warning systems (Royal Government of Bhutan and UNDP Bhutan 2025; Royal Government of Bhutan 2023).

### 3.1.1. Governance structure and identification of departments responsible for building heat resilience, including heat-health governance

The mandates that would carry heat resilience are already assigned across government. Bhutan's National Adaptation Plan names the Ministry of Health as lead for assessing heatwave and heat-stress risk across population groups and for developing early warning for heatwaves and heat stress, with Khesar Gyalpo University of Medical Sciences of Bhutan and the labour ministry as collaborating partners (Royal Government of Bhutan 2023). The *Regulation on Occupational Health, Safety and Welfare, 2022*, administered by the Department of Labour (then Ministry of Labour and Human Resources, now Ministry of Industry, Commerce and Employment), requires employers at hot workplaces to provide

acclimatisation time, work-rest schedules on hot days, drinking water, worker awareness of heat illness, and a Heat Stress Prevention Program with periodic heat-stress monitoring (Department of Labour 2022).

Hydrometeorology, disaster management, settlements, agriculture, and gender already have mandated institutions for adjacent functions. Heat-health duties are already assigned in the National Adaptation Plan and in occupational safety law, but they are not yet integrated into a Heat Action Plan.

Table 5. Institutional landscape for advancing heat resilience in Bhutan

| Function                                                                                             | Institution                                                                             |
|------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Climate monitoring, projections, and hydrometeorological services                                    | National Center for Hydrology and Meteorology                                           |
| Public health, heatwave and heat-stress risk assessment, and heat early warning (NAP health actions) | Ministry of Health                                                                      |
| Occupational heat stress at regulated workplaces                                                     | Department of Labour, Ministry of Industry, Commerce and Employment                     |
| Disaster risk management and local government interfaces                                             | Department of Local Governance and Disaster Management                                  |
| Climate policy, National Adaptation Plan, and loss and damage coordination                           | Department of Environment and Climate Change / Ministry of Energy and Natural Resources |
| Human settlements and urban planning                                                                 | Department of Human Settlement                                                          |
| Agriculture and outdoor rural livelihoods                                                            | Ministry of Agriculture and Livestock                                                   |
| Gender equality and women's empowerment mainstreaming                                                | National Commission for Women and Children                                              |

Source: Author's analysis

### 3.1.2. Identification of government schemes

The National Adaptation Plan lists assessment of heatwave and heat-stress risk and development of early warning for heatwaves and heat stress as health-sector actions, with the Ministry of Health as lead agency (Royal Government of Bhutan 2023). A dedicated Heat Action Plan is a different instrument. This desk review found no published national or city Heat Action Plan, and no operational heat plan for southern dzongkhags or Phuntsholing. No government schemes are labelled specifically for heat protection. Related entry points nevertheless exist across current policy and programme frameworks. These include National Adaptation Plan priorities for health, water, agriculture and settlements; occupational heat-stress duties under the 2022 regulation for workplaces

covered by the *Labour and Employment Act*; green school and environmental initiatives; climate-smart agriculture support that remains unevenly accessible by sex; and growing attention to cooling demand and energy resilience as temperatures rise (Department of Labour 2022; NCWC and UNDP Bhutan 2020; Royal Government of Bhutan 2023; ESCAP 2026; Thapa, Gough and Cooper 2024; WBG and ADB 2021).

Informal farm and care work, where much of the heat-labour burden sits, falls largely outside that occupational instrument. Household cooling demand is already visible: men more often reported increased use of electric fans as a personal climate impact (NCWC and UNDP Bhutan 2020).

## 3.2. Heat-related Health Risks and Preparedness

Health-system work on climate already exists, but it is not yet organised as seasonal heat-health preparedness. Bhutan participates in the Alliance for Transformative Action on Climate and Health (WHO 2025). The National Adaptation Plan includes climate-sensitive disease surveillance, health-system research, vulnerability assessment, policy integration, climate-resilient water and sanitation in health facilities, and capacity development for climate-induced emergency medical services, with the Ministry of Health as lead and the Department of Local Governance and Disaster Management as a partner (Royal Government of Bhutan 2023). The 2012 Ministry of Health assessment, with World Health Organization support, was designed to inform adaptation programming and climate-informed decision tools, including emergency and extreme-weather preparedness (Sithey et al. 2018). Ministry of Health emergency materials include clinical guidance on heat exhaustion and heat stroke (Royal Government of Bhutan 2018).

A 2015 WHO climate and health country profile reported that Bhutan had conducted a national climate-health assessment and was implementing health adaptation work, while remaining gaps included technical capacity, climate resilience of health infrastructure, and costing. That profile also referred to an approved national health adaptation strategy, which is not a published Heat Action Plan

(WHO 2016). Specialised mental health services remain concentrated at Jigme Dorji Wangchuck National Referral Hospital, with clinical counsellors in about half dzongkhags, so surge capacity for climate-linked distress is limited outside Thimphu (Chhetri, Zangpo and Gyeltshen 2024). This desk review did not find seasonal, facility-level heat-health protocols for hospitals and primary care, heat-linked surge or cooling arrangements, or confirmation from Bhutanese agencies that such protocols are in operational use. Occupational heat rules under the 2022 regulation cover regulated workplaces; they do not substitute for facility-level heat-health preparedness (DoL 2022).

Heat illness and heat-related mortality remain sparsely monitored nationally (Royal Government of Bhutan and UNDP Bhutan 2025). The strongest comparative estimates of heatwave exposure, older-adult deaths and labour losses come from the 2024 Lancet Countdown as reported by (WHO 2025). Proposed loss and damage indicators include hospital visits during or after events, mental distress, days of lost productivity, degradation of urban green space due to heat stress, and energy costs for cooling or heating, but these are not yet reported as a routine national heathealth system (Royal Government of Bhutan and UNDP Bhutan 2025). Gender-disaggregated clinical and labour data would strengthen that monitoring if applied to heat (NCWC and UNDP Bhutan 2020).

## 3.3. Extending Forecasting Capacities and Early Warning System

Bhutan's Flood and glacial lake outburst flood early warning systems are comparatively advanced, with control-room systems and hydrometeorological modernisation support (Royal Government of Bhutan and UNDP Bhutan 2025). Heat early warning linked to public health triggers remains undeveloped relative to that capacity, even though heatwave early warning is a National Adaptation Plan activity led by the Ministry of Health and monitoring and forecasting are

priorities for high extreme-heat hazard areas (GFDRR 2020; Royal Government of Bhutan 2023). The 2012 Ministry of Health assessment already recommended integrating climate information with disease surveillance for multisectoral early warning, including monsoon advisories when warmer temperatures and contaminated runoff raise diarrhoeal risk (Sithey et al. 2018).

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## 4. Non-Government and community-oriented solutions

This section considers the role of civil society, research institutions and communities in shaping responses to heat, water stress and related climate risks. It identifies existing initiatives and practices that can complement and support government-led heat-health action.

**Bhutan's existing adaptation efforts offer opportunities to strengthen locally led heat resilience.**

### 4.1. Tracing key NGOs and civil society working for heat resilience

Civil society and research partners already active in national climate processes include the Bhutan Ecological Society and the College of Natural Resources (Royal Government of Bhutan and UNDP Bhutan 2025). The International Centre for Integrated Mountain Development is a recurring technical partner on Himalayan climate and early warning (Royal Government of Bhutan and UNDP Bhutan 2025). Gender and climate work has drawn in civil society,

academia and development partners alongside the government, with calls for stronger participation in climate initiatives (NCWC and UNDP Bhutan 2020). Education-focused actors working on climate literacy through schools offer another entry point for heat and climate awareness (Choden 2023; Thapa Gough and Cooper 2024). These partners already work on climate, gender and schools, but they do not run programmes labelled as heat resilience.

### 4.2. Community coping strategies and nature-based solutions

Communities are already adapting under the stress mapped above, often through water and farm responses rather than heat-branded programmes. In Punakha, coping centres on water scarcity and farm impacts are linked to rising temperatures (Tempa 2026). Nationally, the most common reported strategies are receiving aid (60 per cent), changing farm practices (59 per cent) and changing consumption patterns (56 per cent). About 5 per cent reported taking children out of school. Women more often buy water and change consumption; men more often seek alternative employment or migrate

(NCWC and UNDP Bhutan 2020). Broader adaptation measures include watershed management, water-source protection and rehabilitation, rainwater harvesting and community forestry with women's engagement (NCWC and UNDP Bhutan 2020; Royal Government of Bhutan 2023). Schools use disaster management and green school activities as entry points, while wider climate education remains limited (Thapa, Gough and Cooper 2024). Communities are already adapting through water, farming and school-based measures, but that has not been matched by city-level heat planning in southern towns.

### 4.3. Identification of best practices (cool roofs, greening, infrastructure adaptation)

Green school initiatives, participatory environmental conservation in schools, and nature-based water-source protection already exist under wider adaptation programming (Royal Government of Bhutan 2023); (Thapa, Gough and Cooper 2024). Genderclimate recommendations also point to gender-responsive climate-smart agriculture, cleaner household energy that reduces indoor air pollution for women and children, and safer outdoor working

conditions under heat stress (NCWC and UNDP Bhutan 2020). Scaled national programmes for cool roofs or heat-specific building standards are not yet in place, while rising cooling degree days and urban electricity demand show growing need (ESCAP 2026; WBG and ADB 2021). Regional experience with cool roofs and heat action planning, including in India, can offer transferable options for design (NRDC 2026).



*Safer outdoor conditions are among the measures recommended for Bhutan as heat rises.*

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# 5. Conclusion

Extreme heat has rapidly emerged as a critical public health, environmental, and developmental challenge across South Asia, transitioning from a seasonal discomfort into a compounding systemic threat. Due to the convergence of high ambient temperatures, rapid and unplanned urbanisation, and deeply entrenched socioeconomic inequalities, the region is highly exposed but has severely constrained adaptive capacity. The macroeconomic and human consequences of this shifting climate regime are profound.

Bhutan's The findings above identify where heat exposure and burden are concentrated. The next step is to strengthen how existing mandates are translated into coordinated, seasonal action. Responsibilities for heat-related risks already fall across health, labour, hydrometeorological services and human settlements. The key gap is coordination across these areas, supported by routine monitoring and agreed triggers for action. The report identifies four priorities.

- **Establish heat-health surveillance and monitoring:** Observed clinical records of heat illness in Bhutan are sparse, so the national picture rests on modelled estimates rather than routine diagnosis. The Ministry of Health, working with the National Center for Hydrology and Meteorology, can begin recording heat-related presentations at health facilities in the southern dzongkhags, and take forward the loss and damage indicators already proposed, hospital visits during and after events, days of lost productivity and cooling energy costs, as a routine reporting system. Sex-disaggregated clinical and labour data would strengthen further.
- **Join existing mandates into a heat action plan:** Responsibilities for heat already exist across the Ministry of Health, the Department of Labour (under the 2022 occupational health regulation), hydrometeorology, disaster management, and human settlements, but no instrument connects

them. A national heat action plan, with city plans for southern border towns such as Phuntsholing where modelled informality is around 31 per cent and air-conditioning access close to zero, would convert assigned duties into coordinated seasonal action.

- **Extend early warning from floods to heat:** Bhutan's flood and glacial lake outburst flood early warning is comparatively advanced, with control-room systems and hydrometeorological modernisation already in place. Heat early warning, though a National Adaptation Plan activity, remains undeveloped. Building heat triggers and public health thresholds onto that existing infrastructure is faster and cheaper than building a parallel system.
- **Apply a differentiated vulnerability lens to heat-health action:** Heat exposure and its impacts vary across population groups, including by age, sex, occupation and income. Heat-health measures should therefore prioritize groups facing higher exposure or limited capacity to adapt, including older persons, outdoor and agricultural workers, and women engaged in unpaid care and agricultural work. This should include measures to identify and address heat-related illness that may not be captured through routine clinical surveillance. The 2022 occupational regulation applies to regulated workplaces; additional measures are needed to extend protection to informal agricultural and care work through health, labour and social protection systems.

The GHHIN South Asia Hub will help address these priorities in Bhutan by convening stakeholders, strengthening the regional evidence base, facilitating knowledge exchange, and building capacities for heat-health action. By connecting Nepal, Bhutan, Bangladesh, and India around shared priorities and solutions, the Hub will foster institutional collaboration and cross-country learning, supporting countries to advance sustained and anticipatory heat-health resilience across South Asia.

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# Acronyms

|        |                                                     |
|--------|-----------------------------------------------------|
| ADB    | Asian Development Bank                              |
| CCKP   | Climate Change Knowledge Portal                     |
| CHRI   | Climate and Health Risk Index                       |
| GFDRR  | Global Facility for Disaster Reduction and Recovery |
| GHHIN  | Global Heat Health Information Network              |
| IITM   | Indian Institute of Tropical Meteorology            |
| IMD    | India Meteorological Department                     |
| NAP    | National Adaptation Plan                            |
| NCWC   | National Commission for Women and Children          |
| NDC    | Nationally Determined Contribution                  |
| NGO    | non-governmental organisation                       |
| NOAA   | National Oceanic and Atmospheric Administration     |
| SSP    | Shared Socioeconomic Pathway                        |
| Tmax   | daily maximum temperature                           |
| UNDP   | United Nations Development Programme                |
| UNICEF | United Nations Children's Fund                      |
| WBG    | World Bank Group                                    |
| WHO    | World Health Organization                           |
| WMO    | World Meteorological Organization                   |

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# The authors

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## Dr Madhurima Sarkar-Swaigood

Economic Affairs Officer, ICT and Disaster Risk  
Reduction Division at ESCAP

[sarkar-swaigood@un.org](mailto:sarkar-swaigood@un.org)

[in](#) Dr Madhurima Sarkar-Swaigood

Dr Madhurima Sarkar-Swaigood is an Economic Affairs Officer in the ICT and Disaster Risk Reduction Division at ESCAP. Her work spans disaster risk analytics, multi-hazard risk assessment and resilience measurement, including ESCAP's Risk and Resilience Portal. She contributes to the Commission's regional analysis of climate and disaster risk and writes on disaster risk reduction policy across Asia and the Pacific.



COUNCIL ON ENERGY, ENVIRONMENT AND WATER (CEEW)

ISID Campus, 4 Vasant Kunj Institutional Area

New Delhi - 110070, India

T: +91 11 4073 3300

info@ceew.in | ceew.in |  @CEEWIndia |  ceewIndia



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