

H HEURISTICS

Navigating a Changing World

Human Survivability in the Twenty-First Century

*Assessing Long-Term Exposure to Climate, Pollution, Water, Food,
and Systemic Risks Across Global Regions*

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Abstract

Public debate about the climate century often asks whether parts of the planet will become uninhabitable. This report asks a more useful question: how much of humanity will live for decades with a shrinking margin for error, and where? It assesses long-term exposure to heat, air pollution, water stress, food insecurity and systemic risk across seven world regions, and sets that exposure against each region's adaptive capacity. The starting point is a set of present-day deficits that predate the next two degrees of warming: about 3.3 to 3.6 billion people in contexts highly vulnerable to climate change, 2.1 billion without safely managed drinking water, 645 million facing hunger, and 7.9 million deaths linked to air pollution in 2023. The three-year average of global temperature has passed 1.5 °C, and current pledges point to 2.3 to 2.8 °C by 2100.

Using World Bank indicators and CMIP6 climate projections, the report builds a transparent Survivability Exposure Index (SEI) from five exposure dimensions and a capacity deficit. Sub-Saharan Africa scores highest (70), driven by thin buffers: 22% undernourished, 55% with electricity and 23% with clean cooking. The Middle East and North Africa (50) is the most hazard-exposed, with about 100 days a year above 35 °C already and water withdrawals at 148% of renewable resources. South Asia (43) combines the world's worst air pollution (55 µg/m³, eleven times the WHO guideline) with rising heat. These three regions hold 3.8 billion people, 47% of humanity, and remain the top three in 85% of 20,000 random weightings. Latin America and the Caribbean scores lower today but sees the fastest proportional rise in heat, a ninefold increase in days above 35 °C under very high emissions.

The report argues that survivability erodes in stages: pollution and chronic heat erode health and working capacity now, infrastructure fragility peaks in a 2040-2060 Danger Window when heat, water stress, cooling demand, demographic loading and fiscal strain converge, and geographic thinning depends on the emissions path. Systemic coupling, not any single hazard, moves regions from strain to crisis. Because capacity is the variable that can be changed fastest and cheaply relative to the damage it prevents, the report concludes that priorities lie in electricity, clean cooking, water and sanitation, cooling standards, early warning and pre-arranged finance, in the capacity-limited regions, before the Danger Window opens.

Keywords: survivability; climate exposure; extreme heat; air pollution; water stress; food security; systemic risk; polycrisis; adaptive capacity; regional risk assessment

Data and method: Regional indicators are World Bank aggregates (latest year, 2015 to 2025) retrieved in October 2026. Heat projections are population-weighted country averages of CMIP6 ensemble medians from the World Bank Climate Change Knowledge Portal for SSP1-2.6, SSP2-4.5 and SSP5-8.5. Global findings are drawn from the institutional and peer-reviewed sources linked in the text. The SEI is a structured summary of public data, not a forecast; regional aggregates mask internal variation, only heat is forward-looking in the index, and the coupling matrix in Section 8 is an expert judgement. Section 13 sets out the limits.

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1. Introduction: Survivability Is a Process, Not a Date

The popular question about the climate century is whether parts of the Earth will become uninhabitable. The better question is how much of humanity will spend how many decades living with a shrinking margin for error, and where. This report maps that margin across the world's regions, asking how heat, pollution, water, food and systemic risks stack up against the capacity of people and institutions to absorb them.

Public debate about long-term risk tends to collapse into a binary. Either a place is livable, or it is lost; either civilisation muddles through, or it collapses. The evidence points to something slower, more uneven and more political. People rarely leave a place the year it crosses a physical threshold. They stay, and the cost of staying rises: outdoor working hours shrink, clean water has to be bought, air is breathed at several times the recommended limit, and a failed harvest or a blackout arrives more often than the household or the state can absorb. Survivability, in the sense used here, is the capacity of a population to sustain health, livelihoods and functioning institutions in place. It erodes in stages, and it erodes first and fastest where capacity is thinnest.

The stakes are not hypothetical. The Intergovernmental Panel on Climate Change estimates that about 3.3 to 3.6 billion people already live in contexts that are highly vulnerable to climate change ([IPCC AR6 Synthesis Report](#)). The WHO/UNICEF Joint Monitoring Programme counts 2.1 billion people without safely managed drinking water and 3.4 billion without safely managed sanitation ([WHO, 2025](#)). The 2026 edition of the UN's food security report estimates that 645 million people faced hunger in 2025 and that healthy diets were unaffordable for about 2.7 billion ([FAO, SOFI 2026](#)). Air pollution was linked to 7.9 million deaths in 2023 ([State of Global Air 2025](#)). These are present-day deficits, recorded before the next two degrees of warming arrive.

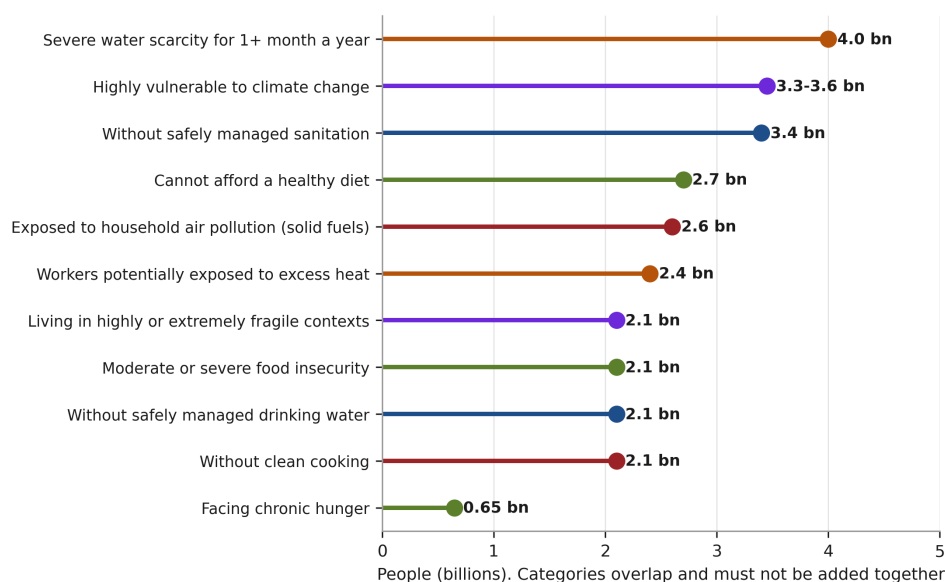


Figure 1. Billions of people exposed to selected survivability stressors. The categories overlap and must not be added together.

Sources: IPCC AR6 (3.3-3.6 bn highly vulnerable); WRI/Mekonnen and Hoekstra (4 bn severe scarcity); WHO/UNICEF JMP 2025; FAO SOFI 2026; ILO 2024; State of Global Air 2025; IEA Tracking SDG7 2025; OECD States of Fragility 2025. Compiled by the author.

1.1 The argument in brief

First, the unit of analysis should be exposure to a stress multiplied by the capacity to cope with it. The same wet-bulb temperature that interrupts a construction schedule in Doha can kill a rice farmer in the Indus Valley, because one has air conditioning, health insurance and a labour regulator, and the other has none of them. A ranking of regions by hazard alone would mislead; a ranking by poverty alone would also mislead. Section 2 sets out a composite that uses both.

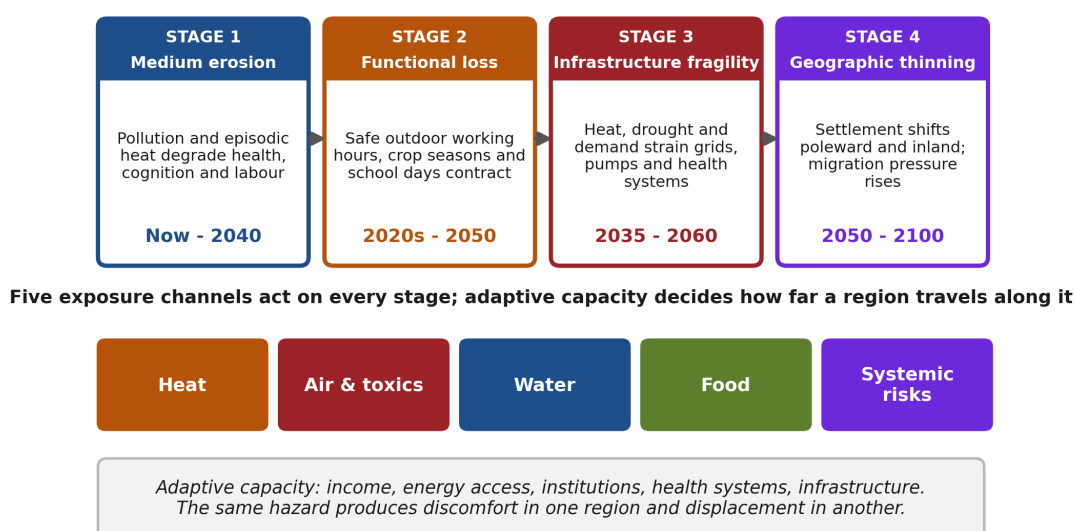


Figure 2. Survivability as a four-stage process. Five exposure channels act on every stage, and adaptive capacity decides how far a region travels along it. The framework is the author's synthesis and builds on H Heuristics' earlier work on tiered survivability risk.

Source: H Heuristics framework. Time bands are indicative, not forecasts.

Second, the five channels examined here, heat, pollution, water, food and systemic risk, are not independent. Heat raises electricity demand at the moment grids are least able to meet it; drought cuts hydropower and irrigation together; food price shocks feed political instability; instability drains the public finances needed for resilience. The coupling among them, rather than any one hazard, is what moves a region from strain to crisis (Section 8).

Third, the century has a shape. The 2020s and 2030s are a period in which stress accumulates but slack still exists. Between roughly 2040 and 2060, several slow curves peak together: hot days in the tropics, water stress, cooling demand, the population of the regions with the least capacity, and fiscal strain. We call this the Danger Window. It is a fork rather than a cliff: what is built before it determines whether the same hazards arrive into a wide buffer or a deep envelope of exposure (Section 11).

Fourth, the regional picture is stark but not fatalistic. On the composite introduced here, Sub-Saharan Africa, the Middle East and North Africa and South Asia form a high-exposure group that holds 3.8 billion people, 47% of today's population. Membership of this group is robust to different weightings (Section 10). Within that group the dominant risk differs: heat and water in the Middle East and North Africa, air pollution and heat in South Asia, and the combination of hunger, energy poverty and weak buffers in Sub-

Saharan Africa, where the population is also projected to rise from about 1.3 billion to about 3.3 billion by 2100.

Fifth, much of the exposure is addressable in the near term. Household air pollution, unsafe water, unreliable electricity and weak early warning are not unsolved scientific problems. They are delivery problems, and the cheapest time to solve them is before the Danger Window opens (Section 12).

1.2 Scope and structure

The report covers the world in seven regions that follow World Bank definitions: Sub-Saharan Africa, South Asia, the Middle East and North Africa, East Asia and Pacific, Latin America and the Caribbean, Europe and Central Asia, and North America. These regions are large and internally varied; a regional aggregate for South Asia averages the Indo-Gangetic Plain with the Himalayan foothills, and the aggregate for Sub-Saharan Africa averages Lagos with the Sahel. The regional frame is chosen because it allows consistent, publicly reproducible data. Section 13 discusses what it hides.

Section 2 defines the framework and describes the data. Section 3 sets the planetary baseline. Sections 4 to 7 take heat, pollution, water and food in turn, using the same pattern: what is known about the hazard globally, how it distributes across regions, and what is likely to change. Section 8 examines how the channels couple and what systemic and tail risks sit behind them. Section 9 turns to adaptive capacity and demography. Section 10 combines everything into a regional assessment. Section 11 looks across time, and Section 12 draws out priorities. Sections 13 and 14 set out limitations and conclusions, and the appendices give the underlying data.

2. Framework, Data and Method

The report treats long-term survivability risk as the product of five exposure channels and a capacity deficit. This section defines each, lists the data used, and explains how the composite index is built so that a reader can reproduce, challenge or change it.

2.1 Exposure, sensitivity and capacity

Disaster-risk practice has long separated a hazard from the exposure of people to it and from their vulnerability, a distinction the IPCC formalised in its [Sixth Assessment Report](#). This report follows that logic and adds a time dimension. A region is highly exposed when many people experience a severe hazard repeatedly, and its survivability is at risk when exposure is not matched by the means to absorb it. The five channels are:

- **Heat.** Days per year with maximum temperatures above 35 °C, from CMIP6 climate model projections, as a proxy for the expansion of functional heat stress. Dry-bulb temperature understates the burden in humid regions, so the measure is conservative.
- **Air pollution and toxics.** Population-weighted exposure to fine particulate matter (PM2.5) relative to the World Health Organization's annual guideline of 5 µg/m³, with mortality and household energy data as supporting evidence.
- **Water.** Freshwater withdrawals relative to renewable resources, combined with the gap in safely managed drinking water, to capture both physical scarcity and service failure.
- **Food.** The prevalence of undernourishment combined with the share of employment in agriculture, to capture both present hunger and the exposure of livelihoods to climate-sensitive production.
- **Coastal and systemic exposure.** The share of population living below 5 metres of elevation, as a measure of sea-level and storm-surge exposure. Wider systemic risks (conflict, fiscal stress, cascading failure) are treated qualitatively in Section 8 because they do not reduce cleanly to a regional number.

Adaptive capacity is measured as a deficit built from four indicators: income per head (purchasing-power adjusted, log-scaled), electricity access, clean-cooking access and extreme poverty. These are blunt, but they are available for every region, they change slowly, and they correlate with the institutional capacity that decides outcomes when shocks arrive. Where possible the report distinguishes the present baseline from the projected trajectory.

2.2 Data sources

Present-day indicators come from the [World Bank's World Development Indicators](#), which in turn draw on the WHO/UNICEF Joint Monitoring Programme, the FAO, the IEA and the Health Effects Institute, among others. Regional values are the aggregates published by the World Bank, using the latest year available (2022 to 2025 for most indicators; 2015 for the share of population below 5 metres). Climate projections are taken from the [World Bank Climate Change Knowledge Portal](#), which publishes CMIP6 ensemble medians for each country on a 0.25-degree grid. For each country the author retrieved annual mean temperature and the annual number of days above 35 °C for the historical period (to 2014) and for three

Shared Socioeconomic Pathways: SSP1-2.6 (low emissions), SSP2-4.5 (intermediate) and SSP5-8.5 (very high). Country values were then averaged within each region using 2025 population weights.

Headline global figures and findings come from the institutional and peer-reviewed sources linked throughout the text. Where a figure is a model output or a scenario rather than an observation, the text says so.

Table 1. Indicators and benchmark scales used in the Survivability Exposure Index (SEI).

Dimension	Indicator (source)	0 = low risk	100 = high risk
Heat	Days per year above 35 °C, 2050-2069, SSP2-4.5, population-weighted (CMIP6 via CCKP)	0 days	150 days
Air	PM2.5 mean annual exposure, 2023 (EN.ATM.PM25.MC.M3)	5 µg/m ³ (WHO guideline)	60 µg/m ³
Water	Freshwater withdrawals as % of internal resources (ER.H2O.FWTL.ZS); and gap in safely managed drinking water (SH.H2O.SMDW.ZS)	0% withdrawn; full coverage	100% withdrawn; 70% gap
Food	Prevalence of undernourishment (SN.ITK.DEFC.ZS); and employment in agriculture (SL.AGR.EMPL.ZS)	0% undernourished; 0% in farming	25% undernourished; 50% in farming
Coast	Population below 5 m elevation, % of total (EN.POP.EL5M.ZS)	0%	8%
Capacity deficit	GDP per capita PPP (NY.GDP.PCAP.PP.CD), log scale; electricity access (EG.ELC.ACCS.ZS); clean cooking (EG.CFT.ACCS.ZS); extreme poverty (SL.POV.DDAY)	\$60,000; universal access; 0% poor	\$3,000; 50% and 80% gaps; 45% poor

Each indicator is converted to a 0-100 score using a fixed benchmark scale, so scores are comparable across regions and over time rather than relative to the group. Water, food and capacity are averages of the sub-indicators shown. Data links: World Bank WDI indicator codes in brackets.

2.3 Building the composite

The Survivability Exposure Index (SEI) is a weighted combination: 60% from the equally weighted average of the five exposure dimensions, and 40% from the capacity deficit. The weighting reflects a judgement that hazard and capacity both matter, with a modest tilt towards hazard because the climate channels are the ones that change over the century while capacity can, in principle, be built. Three checks guard against over-reading the index. First, scales are fixed rather than relative, so a score of 50 means the same thing in every region. Second, a sensitivity run replaces the 60/40 weighting with 50/50, and another replaces 2050s SSP2-4.5 heat with 2080s SSP5-8.5 heat. Third, a Monte Carlo test draws 20,000 random sets of weights across the six components and records how often each region takes each rank (Section 10).

The index is a structured summary of public data, not a forecast, and it carries two deliberate simplifications. Only the heat dimension changes with the climate scenario; the other dimensions are held at their latest observed values, which means the forward-looking runs understate how far water, food and coastal exposure may move. And the regional aggregates average across very different sub-regions. These limitations are returned to in Section 13.

3. The Planetary Baseline: Where the Climate Stands

Every regional outcome in this report sits inside a global envelope set by emissions. That envelope has already tightened: the three-year average of global temperature has passed 1.5 °C, the pledged path leads to 2.3-2.8 °C, and the Earth system shows the first signs of crossing thresholds that cannot be undone on human timescales.

3.1 Warming to date

The Copernicus Climate Change Service reports that [2025 was the third-warmest year on record](#), at 1.47 °C above the 1850-1900 average, 0.13 °C cooler than 2024 and 0.01 °C cooler than 2023. For the first time the three-year average, covering 2023 to 2025, exceeded 1.5 °C. The World Meteorological Organization's [consolidated assessment](#) reached a similar conclusion, noting that the eleven years from 2015 to 2025 are individually the eleven warmest in the 176-year observational record. The IPCC's [Sixth Assessment Synthesis Report](#) puts warming over land at about 1.59 °C for 2011-2020, against 0.88 °C over the ocean, a difference that matters because people live on land.

3.2 Where current commitments lead

The [UNEP Emissions Gap Report 2025](#) finds that full implementation of nationally determined contributions would lead to 2.3-2.5 °C of warming by 2100, and current policies to about 2.8 °C, compared with 2.6-2.8 °C and 3.1 °C a year earlier. Adding all net-zero pledges would bring the figure to 1.9 °C. The report also concludes that the multi-decadal average temperature will exceed 1.5 °C, at least temporarily. The improvement relative to the previous edition is small and partly methodological, and the gap between pledges and implementation remains wide.

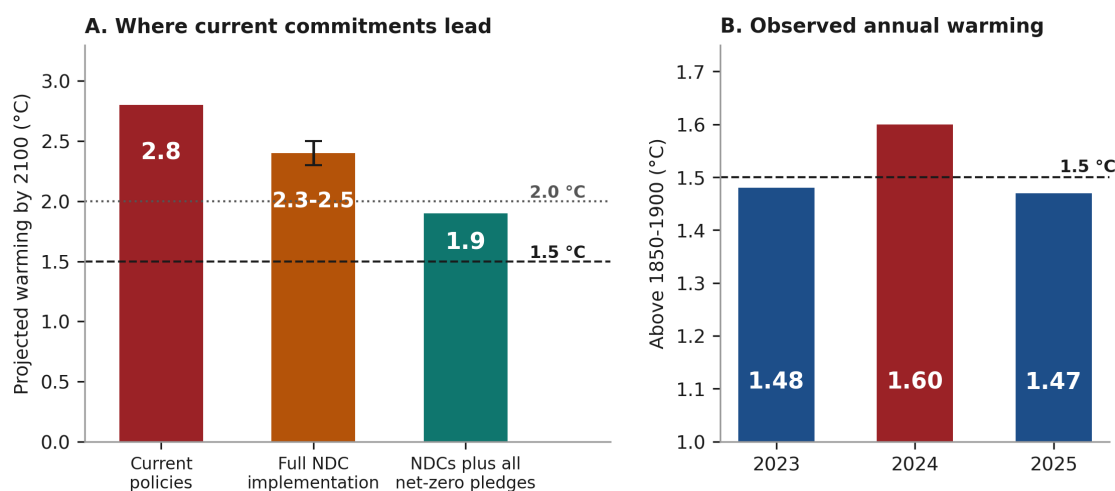


Figure 3. Panel A shows projected warming by 2100 under three policy assumptions. Panel B shows observed annual warming, 2023-2025, relative to 1850-1900.

Sources: UNEP Emissions Gap Report 2025; Copernicus Climate Change Service, Global Climate Highlights 2025. 2023 and 2024 values derived from Copernicus' comparison with 2025.

For regional exposure, the practical meaning is the range, not the point estimate. Using the World Bank's CMIP6 ensemble, population-weighted regional warming relative to 1995-2014 reaches between +1.3 °C

(SSP1-2.6) and +4.6 °C (SSP5-8.5) by the 2080s for the world as a whole, and the spread is wider for individual regions (Table 2). Mid-latitude and continental interiors warm fastest; the tropics warm somewhat less in absolute terms but start closer to the physiological limit, so a given increment has larger consequences there.

Table 2. Projected change in mean annual temperature relative to 1995-2014 (°C), by region.

Region	Baseline °C	2050s SSP2-4.5	2050s SSP5-8.5	2080s SSP1-2.6	2080s SSP2-4.5	2080s SSP5-8.5
Sub-Saharan Africa	25.0	+1.6	+2.3	+1.1	+2.2	+4.2
South Asia	24.4	+1.4	+2.2	+1.2	+2.0	+4.1
Middle East & N. Africa	21.0	+2.0	+2.9	+1.4	+2.7	+5.3
Latin America & Caribbean	22.8	+1.6	+2.4	+1.1	+2.2	+4.4
East Asia & Pacific	13.3	+1.8	+2.7	+1.4	+2.4	+4.7
Europe & Central Asia	8.2	+1.9	+2.9	+1.5	+2.6	+5.1
North America	8.8	+2.2	+3.2	+1.7	+3.0	+5.7
World (pop.-weighted)	18.2	+1.7	+2.6	+1.3	+2.4	+4.6

Population-weighted average of country values from the CMIP6 ensemble median (World Bank CCKP). The first data column is the 1995-2014 baseline temperature in °C; remaining columns are changes from that baseline.

3.3 Earth-system limits

Beyond temperature, the planet’s regulating systems are showing strain. The 2025 [Planetary Health Check](#) found that seven of the nine planetary boundaries have now been breached, with ocean acidification added as the seventh; only ozone depletion and aerosol loading remain inside the safe zone. The [Global Tipping Points Report 2025](#), led by the University of Exeter, concluded that warm-water coral reefs, on which nearly a billion people and a quarter of marine life depend, have passed their tipping point at an estimated threshold of about 1.2 °C. Its authors note that overshooting 1.5 °C is probable around 2030 on current projections.

Two slower changes bear directly on the regions studied here. Glaciers are the stored water of the mountain regions: Rounce and colleagues, writing in [Science](#), project that the world’s glaciers (excluding the ice sheets) will lose between 26% and 41% of their mass by 2100 relative to 2015, depending on warming of 1.5 °C to 4 °C, with up to 83% of glaciers disappearing in the high-warming case. And the sea is rising faster each decade; the IPCC records a rate of 3.7 mm per year over 2006-2018 and cannot exclude approaching 2 metres by 2100 under very high emissions, though with low confidence. Meanwhile biodiversity, the living infrastructure of food and water systems, continues to decline. The WWF/ZSL [Living Planet Report 2024](#) records an average 73% fall in monitored wildlife populations between 1970 and 2020, a headline that comes with methodological debate but is directionally consistent with other assessments.

3.4 What this means for people

Translating planetary change into human terms is difficult, but one approach is instructive. Lenton and colleagues, in [Nature Sustainability](#), define a human climate niche from the observed distribution of population against mean annual temperature. Their analysis finds that about 9% of people, more than 600

million, are already outside that niche, and that at about 2.7 °C of warming, roughly where current policies lead, about a third of people (22-39%) could be outside it by 2080-2100. Holding warming to 1.5 °C would cut the population exposed to unprecedented heat (mean annual temperature of 29 °C or more) by about a factor of five. The authors' own framing is that the result is a measure of human cost, not a prediction of mass migration. It nevertheless shows why the tropics and subtropics dominate the exposure maps that follow.

4. Heat: The Expanding Functional Envelope

Heat is the channel that changes most with the climate and the one in which the regional contrast is sharpest. The first damage is functional, not fatal: lost working hours, interrupted school years, strained grids. Fatal heat arrives behind it and arrives first for the old, the poor and the outdoor worker.

4.1 Thresholds and physiology

A long-standing idea holds that a wet-bulb temperature of 35 °C marks the limit of human survivability for healthy people at rest. Recent laboratory work suggests the practical limit is lower. Vecellio and colleagues at Penn State, in the [Journal of Applied Physiology](#), tested young, healthy adults in an environmental chamber and found that critical limits for core temperature fell well below 35 °C wet-bulb: around 31 °C at very high humidity, and a dry-bulb temperature near 38 °C at 60% humidity. Older adults, children, people on medication and people working or walking in the sun have lower limits still. Meanwhile [Raymond, Matthews and Horton](#) reported that brief episodes of wet-bulb temperature approaching or reaching 35 °C have already occurred at a small number of locations, notably around the Persian Gulf and in South Asia, with their frequency increasing over recent decades.

The implication for planning is that the dangerous zone begins well before the theoretical limit. For outdoor labour, the relevant benchmark is the wet-bulb globe temperature (WBGT) that occupational standards use, and for the elderly and chronically ill the relevant benchmark is lower still. A region does not need to approach 35 °C wet-bulb to lose a large share of its working year to heat.

4.2 The present burden

The most recent [Lancet Countdown report](#) estimates that heat-related deaths averaged about 546,000 a year in 2012-2021, 63% more than in the 1990s. In 2024, the hottest year on record at the time, the average person was exposed to about 16 additional health-threatening hot days attributable to climate change, a 389% increase over the 1986-2005 average, and the report puts the potential income lost to heat-related reductions in labour at US\$1.09 trillion. The [International Labour Organization](#) estimates that more than 2.4 billion of the world's 3.4 billion workers are likely to be exposed to excessive heat during their work, and attributes about 18,970 deaths and 22.9 million occupational injuries each year to it. Exposure and burden are not the same thing, and the deaths are modelled estimates, but the direction is not in doubt: heat is already a leading climate-health stressor, and its cost lands disproportionately on those who work outdoors.

4.3 How heat distributes across regions

To compare regions on a consistent basis, Figure 4 and Table 3 show the population-weighted number of days per year above 35 °C. The baseline already differs by a factor of about twenty between the hottest and the mildest regions. In the Middle East and North Africa the average person experiences about 100 such days a year in the 1995-2014 baseline, and in South Asia and Sub-Saharan Africa about 70 and 58. In North America and East Asia, the figures are about 10 and 6.

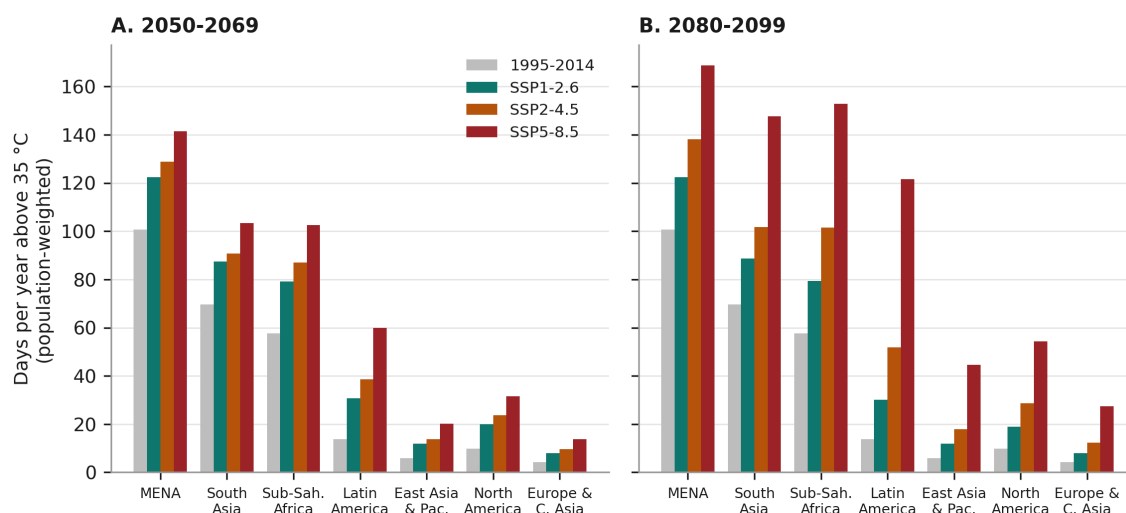


Figure 4. Days per year above 35 °C by region: 1995-2014 baseline and projections under three emissions pathways for 2050-2069 (A) and 2080-2099 (B). Values are population-weighted country averages from the CMIP6 ensemble median.

Source: World Bank Climate Change Knowledge Portal (CMIP6, 0.25°); World Bank WDI population; author's calculation. Country-mean values understate exposure in hot, populated districts.

Three features stand out. First, **the high-exposure group is already committed to further increases even under low emissions.** Under SSP1-2.6 the Middle East and North Africa reaches about 122 days by mid-century, South Asia about 88 and Sub-Saharan Africa about 79, up from 101, 70 and 58, and these figures barely move afterwards. Low emissions stabilise heat at a higher plateau; they do not return it to the past. Second, **the choice of pathway matters most for regions that are currently moderate.** Latin America and the Caribbean goes from 14 days today to 31, 39 or 60 in the 2050s, and in the 2080s to 122 under SSP5-8.5, a ninefold increase. East Asia and Pacific, North America and Europe and Central Asia remain below 60 days in every scenario to mid-century but rise several-fold in relative terms. Third, **the gap between the best and worst scenarios widens after 2050.** By the 2080s the very-high-emissions pathway puts South Asia at about 148 days and Sub-Saharan Africa at about 153, roughly 45-50% more than under the intermediate pathway.

Table 3. Days per year above 35 °C, population-weighted, by region and scenario.

Region	1995-2014	2050s SSP1-2.6	2050s SSP2-4.5	2050s SSP5-8.5	2080s SSP2-4.5	2080s SSP5-8.5
Middle East & N. Africa	101	122	129	141	138	169
South Asia	70	88	91	103	102	148
Sub-Saharan Africa	58	79	87	102	101	153
Latin America & Caribbean	14	31	39	60	52	122
North America	10	20	24	32	29	54
East Asia & Pacific	6	12	14	20	18	45
Europe & Central Asia	4	8	10	14	12	27
World (pop.-weighted)	38	51	55	66	64	101

Source: World Bank CCKP, CMIP6 ensemble median; author's population weighting. Figures are rounded. Baseline is 1995-2014.

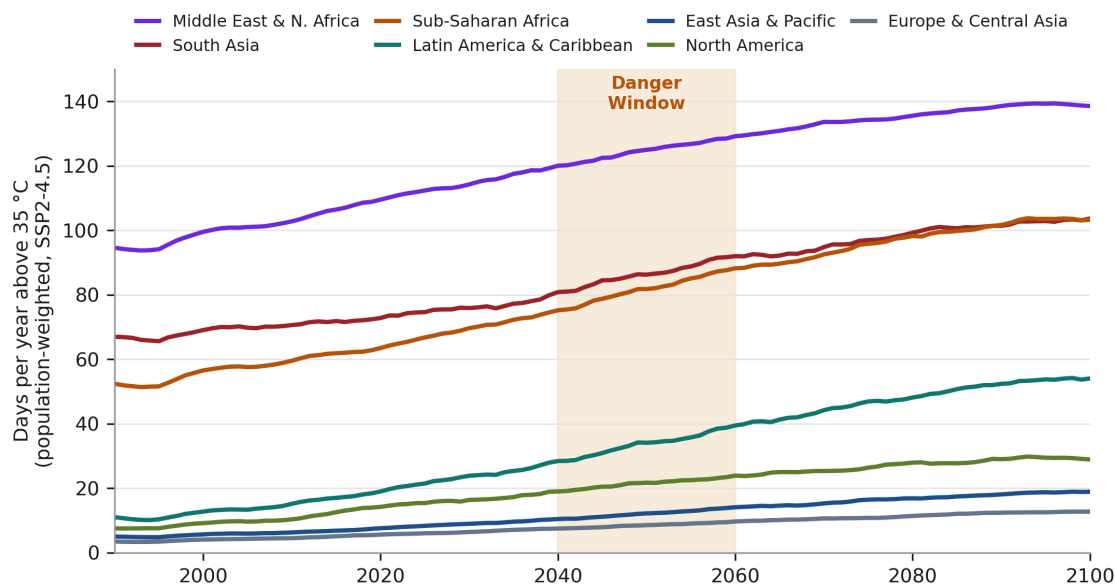


Figure 5. Trajectory of days above 35 °C under the intermediate pathway (SSP2-4.5), 1990-2100, population-weighted by region. Shaded band marks the 2040-2060 Danger Window.

Source: World Bank CCKP (CMIP6 ensemble median); author's population weighting; 7-year moving average.

The time series in Figure 5 shows the shape rather than the endpoint. Under the intermediate pathway, Sub-Saharan Africa goes from about 56 days in 2000 to 66 today, 80 in 2050 and 104 by 2100; South Asia from 68 to 73, 85 and 104; the Middle East and North Africa from 100 to 113, 126 and 138. These are steady, near-linear climbs. There is no step in the curve to mark the moment a region ‘fails’. What changes is the number of months in which outdoor work, school attendance and unconditioned housing become hazardous, and with them the cost of keeping a normal economy running.

4.4 Heat and the cooling gap

The decisive adaptation to heat is cooling, and cooling is unevenly available. SEforALL's [Chilling Prospects 2025](#) counts just over one billion people at high risk of lacking access to cooling and a further 2.83 billion at medium risk. The IEA's [Future of Cooling](#) projects the global stock of air conditioners growing from 1.6 billion to 5.6 billion by 2050, and UNEP's [Global Cooling Watch 2025](#) finds that a sustainable cooling pathway could cut 2050 cooling emissions by 64%. Cooling therefore sits at a double bind: it is the main protection against heat and, bought as cheap, inefficient equipment, a rising load on the grid and a contributor to further warming. Where the grid is weak, and in Sub-Saharan Africa 45% of people still lack electricity access, cooling is simply unavailable. H Heuristics' earlier work on cooling access and convergence develops this argument. The point here is that heat exposure in Figure 4 overstates the effective burden for the wealthy and understates it for those without cooling.

4.5 Reading the heat channel

Heat is the channel in which the regional ranking is clearest and most stable. The Middle East and North Africa is the most heat-exposed region today and remains so under every scenario. South Asia and Sub-Saharan Africa are next and converge towards the same level, with their populations vastly larger than that of the Gulf. The more nuanced finding is that heat is the dimension in which the future departs most from

the present. For most other dimensions, the regional ranking in 2050 will look much as it does today; for heat, the intermediate regions, Latin America above all, move materially closer to the high-exposure group. A strategy built on today's heat map will underinvest in the regions where the change is fastest.

5. Pollution and Toxics: Erosion of the Medium

Air pollution is the survivability risk that is already fully operational. It does not wait for a threshold. It thins health, cognition and productive capacity year after year, in places where growth statistics look healthy, and it is the channel in which the evidence for rapid improvement is strongest.

5.1 Air quality: exposure and mortality

The [State of Global Air 2025](#) report, produced by the Health Effects Institute with the Institute for Health Metrics and Evaluation, links air pollution to 7.9 million deaths in 2023, making it the leading environmental risk factor for death worldwide. Most of those deaths, 6.8 million, were from non-communicable diseases such as heart disease, stroke, chronic lung disease and diabetes, and the 2025 edition added dementia for the first time, with about 626,000 deaths. About 36% of the world's people live in places where annual PM2.5 exceeds the least stringent WHO interim target of 35 $\mu\text{g}/\text{m}^3$. India and China each recorded more than two million attributable deaths. The numbers are not comparable with earlier editions because of methodological updates: the estimate for 2021 was revised from 8.1 million to 7.6 million without any change in air quality.

Measured air quality confirms the picture. IQAir's [2025 World Air Quality Report](#) found that 130 of 143 countries and territories exceeded the WHO annual guideline of 5 $\mu\text{g}/\text{m}^3$, and only 14% of cities met it. Pakistan (67.3 $\mu\text{g}/\text{m}^3$), Bangladesh (66.1), Tajikistan (57.3), Chad (53.6) and the Democratic Republic of the Congo (50.2) had the highest national averages, with India sixth at 48.9. These are monitoring-station averages, so ranking reflects coverage as well as exposure, and wildfire smoke linked to climate change pushed some otherwise clean regions above the guideline in 2025.

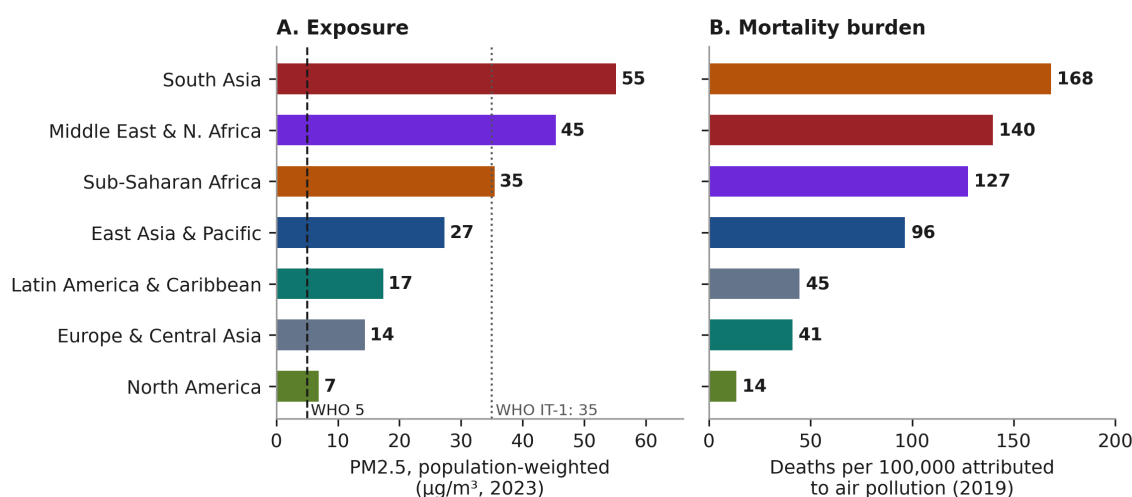


Figure 6. Air pollution by region: population-weighted PM2.5 exposure in 2023 (A), and age-standardised deaths per 100,000 attributed to air pollution in 2019 (B). The dashed line is the WHO annual guideline (5 $\mu\text{g}/\text{m}^3$); the dotted line is WHO interim target 1 (35 $\mu\text{g}/\text{m}^3$).

Source: World Bank WDI (EN.ATM.PM25.MC.M3; SH.STA.AIRP.P5), drawing on the Health Effects Institute and WHO. Regional aggregates are World Bank values.

Regionally, South Asia's population-weighted exposure of 55 $\mu\text{g}/\text{m}^3$ is eleven times the WHO guideline, followed by the Middle East and North Africa at 45 (where desert dust is a major contributor) and Sub-

Saharan Africa at 35 (dust, biomass burning and household fuels together). East Asia and Pacific is at 27, Latin America at 17, Europe and Central Asia at 14 and North America at 7. The mortality picture differs from the exposure picture because it reflects health-system capacity and household exposure as well as outdoor concentrations. Sub-Saharan Africa has the highest age-standardised death rate attributed to air pollution, 168 per 100,000, ahead of South Asia at 140 and the Middle East and North Africa at 127, against 14 in North America. The same particulate concentration is far more lethal where children are underweight, where respiratory infections go untreated and where cooking is done on open fires.

5.2 The household channel

Outdoor air is only part of the exposure. About 2.6 billion people breathe household air pollution from solid cooking fuels, according to the State of Global Air, and the multi-agency [Tracking SDG7 2025](#) report puts the number without clean cooking at about 2.1 billion, nearly unchanged from 2022, split almost equally between Asia and Africa. The same report finds that more than 666 million people still lack electricity, 85% of them in Sub-Saharan Africa. The World Bank's regional data show how concentrated the deficit is: clean cooking reaches 23% of people in Sub-Saharan Africa, 74% in South Asia and 78% in the Middle East and North Africa, and about 1.0 billion of the world's 2.0 billion without clean cooking live in Sub-Saharan Africa alone.

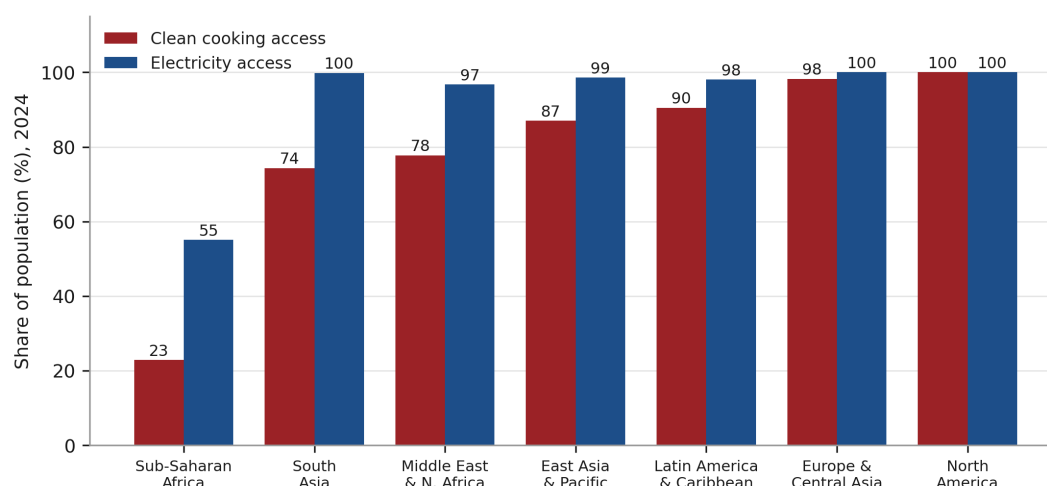


Figure 7. Access to clean cooking and electricity by region, 2024.

Source: World Bank WDI (EG.CFT.ACCS.ZS; EG.ELC.ACCS.ZS), based on the Tracking SDG7 process. Regional aggregates are World Bank values.

The household channel matters for survivability for three reasons. It is the largest source of exposure for women and young children in the poorest regions; it is a driver of deforestation and black carbon; and it is the clearest case of a deficit that blocks adaptation to other hazards, because a household without clean energy cannot run a fan, a refrigerator or a water pump either. The same infrastructure gap that leaves Sub-Saharan Africa at 23% clean-cooking access leaves it with 55% electricity access, and it is a large part of why the region's capacity deficit scores 91 on the index.

5.3 Toxics: the hidden channel

Pollution is wider than air. UNICEF and Pure Earth's [Toxic Truth report](#) estimated that up to 800 million children, about one in three worldwide, have blood lead levels at or above 5 micrograms per decilitre, the level at which clinical action is recommended, and nearly half of them live in South Asia ([UN News](#)). The report identifies informal and substandard recycling of lead-acid batteries as a leading source in low- and middle-income countries and estimates that childhood lead exposure costs those countries almost US\$1 trillion in lost economic potential over the lifetimes of the children affected. Lead, like fine particles, damages cognition. In combination, the two erode the human capital on which every adaptation strategy depends. Other toxics, from pesticides to persistent chemicals and microplastics, are less well quantified; the Planetary Health Check lists novel entities among the boundaries already breached.

5.4 Evidence that the medium can recover

What distinguishes pollution from the other channels is how quickly it has been reduced when governments choose to. The University of Chicago's Air Quality Life Index estimates that particulate pollution in China [fell by 40.8% between 2014 and 2023](#), adding about 1.8 years to average life expectancy if sustained, with Beijing's decline reaching 55%. Even after this fall China's average is still 5.5 times the WHO guideline, and the same analysis notes that the global fall in particulate pollution since 2014 is attributable entirely to China. The lesson is double-edged. It shows that a decade of determined policy can produce large and measurable gains. It also shows that, outside China, the global trend is not improving, and that wildfires, dust and growing energy demand are working in the other direction.

In the survivability framework, pollution is a Stage 1 process. The damage it does is chronic and cumulative, and it is mostly invisible in headline economic data. It deserves attention for a further reason: it compounds the other channels. Heat waves and particulate pollution together raise cardiorespiratory mortality, wildfire smoke is a product of heat and drought, and the combustion that drives pollution is the same combustion that drives warming. Policies that cut fossil combustion pay twice.

6. Water: Stress, Service Gaps and Vanishing Buffers

Water risk has three layers that are often conflated: physical scarcity, service failure and the slow loss of the buffers (aquifers, glaciers, wetlands) that smooth variability. Regions differ sharply in which layer binds, and a region can be water-rich and water-insecure at the same time.

6.1 Scarcity and stress

The World Resources Institute's Aqueduct analysis finds that [25 countries, home to a quarter of the world's people, face extremely high water stress each year](#), using more than 80% of their renewable supply. The Middle East and North Africa is the most exposed region, with 83% of its people living with extremely high stress, followed by South Asia at 74%. Across the world, at least half of the population, about four billion people, lives under highly water-stressed conditions for at least one month a year. Looking ahead, WRI expects global water demand to rise by 20-25% by 2050 and an additional billion people to face extremely high stress even in an optimistic warming scenario; in the Middle East and North Africa, it projects that the entire population will live with extremely high stress by 2050, and that water demand in Sub-Saharan Africa will rise by 163%. About 31% of global GDP, roughly US\$70 trillion, is exposed to high water stress, up from 24% in 2010.

The World Bank's measure of freshwater withdrawals relative to internal renewable resources gives a complementary view. It exceeds 100% in the Middle East and North Africa (148%), because the region relies on desalination, fossil groundwater and rivers originating elsewhere. It is 38% in South Asia and 12% in East Asia and Pacific, about four billion people, lives under highly water-stressed conditions for at least one month a year. Looking ahead, WRI expects global water demand to rise by 20-25% by 2050 and an additional billion people to face extremely high stress even in an optimistic warming scenario; in the Middle East and North Africa, it projects that the entire population will live with extremely high stress by 2050, and that water demand in Sub-Saharan Africa will rise by 163%. About 31% of global GDP, roughly US\$70 trillion, is exposed to high water stress, up from 24% in 2010.

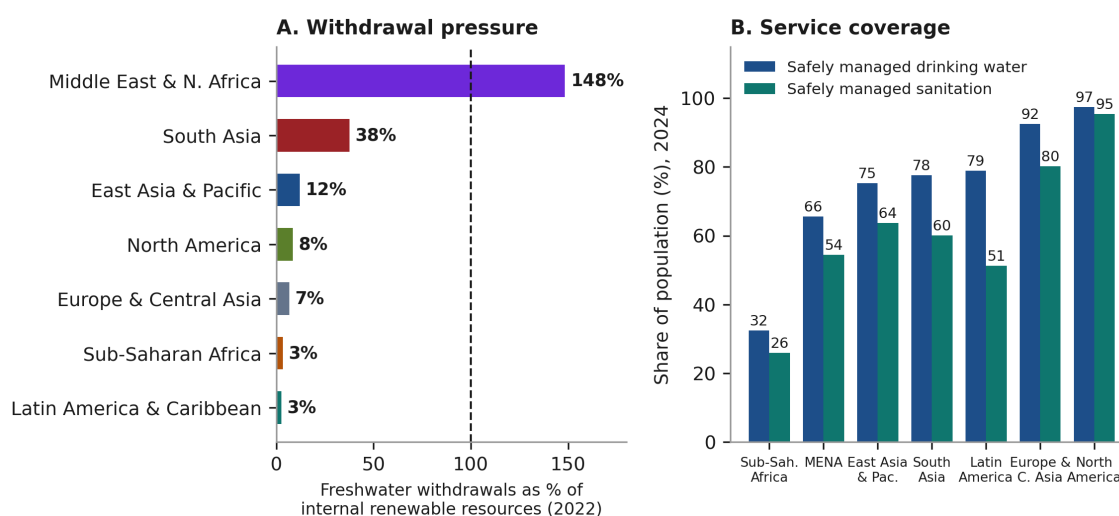


Figure 8. Water by region: freshwater withdrawals as a share of internal renewable resources, 2022 (A), and coverage of safely managed drinking water and sanitation, 2024 (B).

Source: World Bank WDI (ER.H2O.FWTL.ZS; SH.H2O.SMDW.ZS; SH.STA.SMSS.ZS), based on FAO AQUASTAT and the WHO/UNICEF Joint Monitoring Programme.

6.2 Service gaps

Physical scarcity is not the whole story. In Sub-Saharan Africa, withdrawals are only 3% of internal resources, yet only 32% of people have safely managed drinking water and 26% safely managed sanitation. The constraint is money, infrastructure and institutions, not rainfall. The WHO/UNICEF [Joint Monitoring Programme](#) reports that 2.1 billion people still lack safely managed drinking water, including 106 million who drink directly from untreated surface sources, and 3.4 billion lack safely managed sanitation, 354 million of whom practise open defecation ([JMP data portal](#)). Calculating from the World Bank's regional shares, about 0.9 billion of those without safe drinking water live in Sub-Saharan Africa and about 0.6 billion in East Asia and Pacific, a reminder that service failure follows income and governance, not climate zone.

The two layers interact. A region with low coverage is less able to withstand a drought or flood, because it lacks the storage, treatment and distribution that turn a bad year into an inconvenience instead of an outbreak. And the regions with the highest physical stress, such as the Gulf, can afford desalination and long-distance conveyance, which makes them resilient but costly and energy-dependent, a coupling that Section 8 returns to.

6.3 The loss of buffers

The slow variables are the most worrying. In a [Nature study](#) of aquifers worldwide, Jasechko and colleagues found rapid groundwater decline in many regions, with a minority showing recovery where policy intervened. The UN University's January 2026 report on [global water bankruptcy](#) argues that in many places the problem has moved beyond temporary shortage into lasting damage. As relayed in press coverage of the report, about 70% of the world's major aquifers show long-term decline, glacier mass has fallen about 30% since 1970, about two billion people live on sinking ground, and four billion face severe scarcity for at least a month a year. Primary figures should be checked against the report itself, but the direction is consistent with the Rounce glacier projections in Section 3.

The economic implication was set out by the [Global Commission on the Economics of Water](#), which in 2024 warned that the water crisis could threaten more than half of global food production by 2050, and could reduce average GDP by about 8%, with lower-income countries facing losses of up to 15%. These are projections under a business-as-usual case, but they establish the scale of what is at stake: water is not a sector. It is an input to food, energy, health and industry, and its failure transmits through all of them.

7. Food: Hunger, Yields and the Transmission of Shocks

Food security is both an outcome of the other channels and a channel in its own right. Hunger is already concentrated in the regions with the thinnest buffers, and the climate science points to the same regions as those where production is hardest to protect.

7.1 Hunger and affordability today

The [2026 edition of the State of Food Security and Nutrition in the World](#) estimates that 645 million people faced hunger in 2025 (7.8% of the world, down from 8.1% in 2024 and 8.6% in 2022), and about 2.1 billion experienced moderate or severe food insecurity. This year's theme is affordability: healthy diets were out of reach for about 2.7 billion people, at a global average cost of US\$4.28 per person per day in purchasing-power terms. [FAO](#) cautions that its estimates may understate risk because they do not fully account for a strong El Niño or for recent cuts in development and humanitarian financing.

The regional split is sharp. World Bank data for 2024 show undernourishment affecting 22.3% of people in Sub-Saharan Africa, 12.3% in the Middle East and North Africa and 9.5% in South Asia, against 2.5-3.5% in North America, Europe and East Asia. Applied to 2025 population, that is roughly 295 million hungry in Sub-Saharan Africa and 160 million in South Asia, together about two-thirds of the world's hungry on these approximate numbers. The decline in global hunger is real, but it has been concentrated outside Africa; the regions where it is highest are those where population is growing fastest.

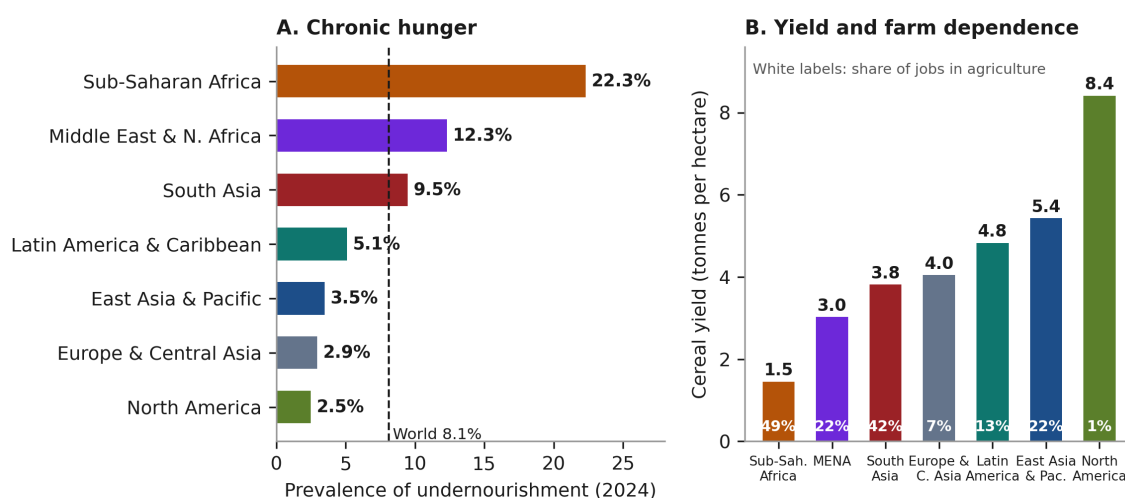


Figure 9. Food by region: prevalence of undernourishment, 2024 (A), and cereal yield with the share of employment in agriculture (B).

Source: World Bank WDI (SN.ITK.DEFC.ZS; AG.YLD.CREL.KG; SL.AGR.EMPL.ZS), based on FAO and ILO. Cereal yield for 2023 or 2024.

7.2 Climate and the yield outlook

Climate change affects food production through temperature, water, extreme events and pests, and the effects differ by crop and latitude. A study by Jägermeyr and colleagues in [Nature Food](#) using a new generation of climate and crop models found that climate impacts on global agriculture emerge earlier than previously estimated. At the end of the century under a very-high-emissions pathway, global maize yields fall by about 24% (against a +1% projection in the earlier model generation), and under a low-emissions

pathway by about 6%, while wheat, by contrast, gains about 18% as CO₂ fertilisation and expanded high-latitude cultivation outweigh warming. The headline is not that the world will starve, but that the gains and losses are unevenly distributed: they favour temperate and high-latitude producers and penalise tropical ones, who are also the ones with the least capacity to adapt.

Structural features amplify the exposure. Cereal yields in Sub-Saharan Africa average about 1.5 tonnes per hectare, against 5.4 in East Asia and Pacific and 8.4 in North America, and 49% of jobs in Sub-Saharan Africa and 42% in South Asia are in agriculture, against 1% in North America. When harvests are poor in a region where half the workforce farms and yields are low, hunger and loss of income arrive together. In a region with a small farming sector and high yields, the same shock is a price blip.

7.3 Trade, prices and the tail

Food security is partly about production and partly about trade. Regions that import a significant share of calories are exposed to shocks elsewhere, including export bans, port disruptions and fertiliser price spikes. The Middle East and North Africa, where food accounts for 13% of merchandise imports, the highest regional share in World Bank data, and where internal renewable water is very scarce, is the clearest case; the 2026 [World Economic Forum Global Risks Report](#) continues to rank geoeconomic confrontation among the leading near-term risks, a reminder that trade routes are themselves a form of infrastructure that can fail.

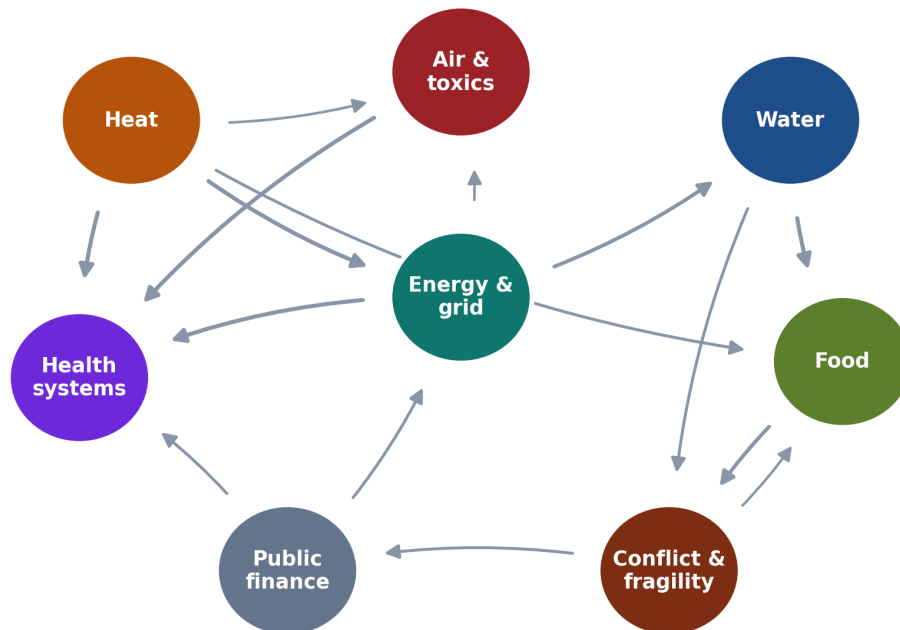
At the far end of the distribution, the worst food shock would come from a nuclear war. Xia and colleagues, in [Nature Food](#), modelled six soot-injection scenarios and estimated that a war between India and Pakistan could cut global average caloric production by 7% within five years and put more than two billion people at risk of famine, while a war between the United States and Russia could put more than five billion at risk. These are model results, and the authors flag that they omit important effects such as ozone loss. They are cited here not as a forecast but because they show how a food system optimised for efficiency in normal times has little slack against a large and abrupt shock. The Bulletin of the Atomic Scientists has set its [Doomsday Clock](#) at 85 seconds to midnight, the closest it has ever been.

8. Systemic Risk: How the Channels Couple

A region's survivability depends less on any single hazard than on how hazards interact. Heat strains the grid that pumps the water that irrigates the crops that feed the cities whose failure strains the state that is supposed to respond. This section examines that coupling and the global-scale risks that sit above it.

8.1 The polycrisis framework

The term polycrisis has often been used loosely. [Lawrence, Homer-Dixon and colleagues](#) offer a precise version in *Global Sustainability*: a global crisis arises when fast-moving trigger events meet slow-moving stresses, and systems are linked by three causal pathways, common stresses affecting many systems at once, domino effects, and inter-systemic feedbacks. The framework is useful here because the regions with the greatest exposure are those where slow stresses (poverty, water decline, demographic pressure) are already high, so that ordinary triggers (a drought, a price spike, a heatwave) are more likely to cascade.



Arrow thickness indicates the strength of the documented coupling (author's qualitative synthesis)

Figure 10. Principal couplings among eight survivability systems. Arrow thickness reflects the strength of the documented coupling; the diagram is the author's qualitative synthesis of the literature cited in Sections 4 to 8.

Source: Author's synthesis. The framework follows Lawrence et al. (2024) on common stresses, dominoes and feedbacks.

Figure 11 formalises the couplings as a matrix, scoring each source system's influence on each receiving system from 0 (negligible) to 3 (strong and well documented). The scoring is an expert judgement, not a measurement, and readers may weight the cells differently; its value lies in making the logic explicit. Three observations follow. Heat has the largest outbound influence (15 points), because it acts on food, energy, health and water simultaneously. Health systems have the largest inbound exposure (19 points), because they absorb the consequences of every other failure, from heat stroke to malnutrition to the injuries of

conflict. And conflict and fragility sit second on the outbound side (13 points), because once institutions fail, they disable the response to every other hazard.

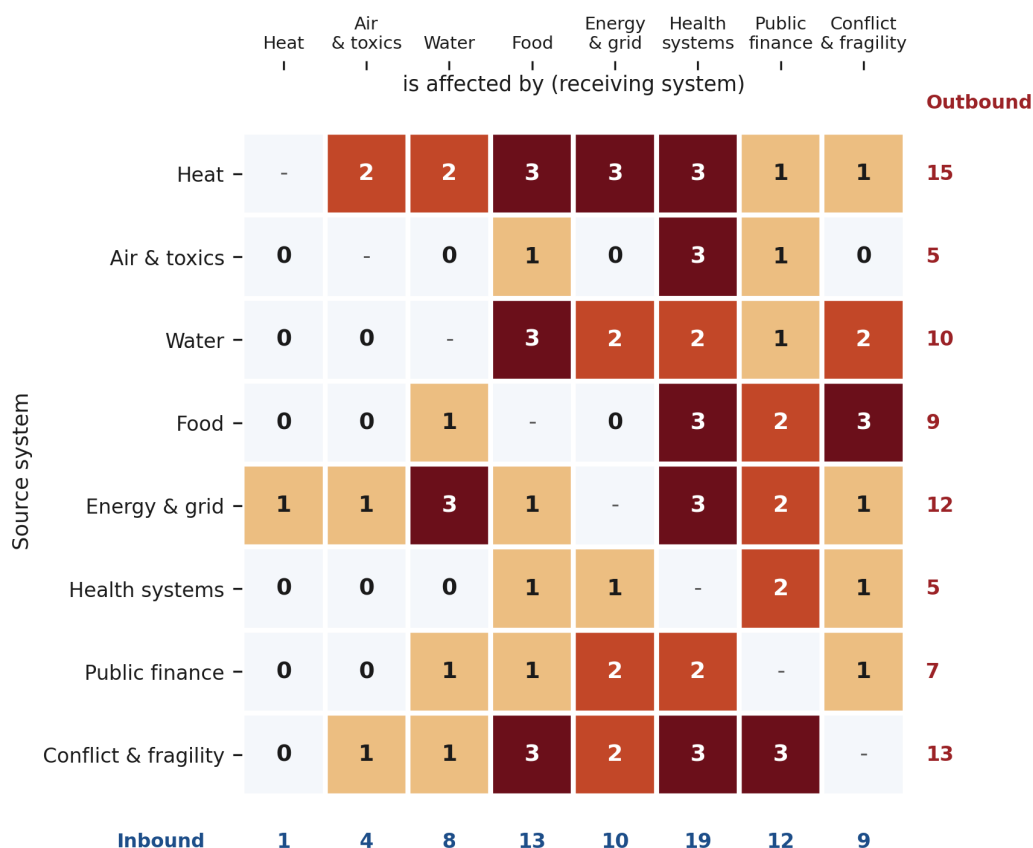


Figure 11. Coupling matrix. Cells score the influence of the row system on the column system (0 negligible, 3 strong). Row totals (outbound) and column totals (inbound) are shown.

Source: Author's expert judgement based on the literature cited in the text. Not a measured quantity.

8.2 Quantifying the cascade

Some of the cascade can be measured. The UN Office for Disaster Risk Reduction's [Global Assessment Report 2025](#) estimates direct disaster losses at about US\$202 billion a year, and total costs, once cascading and ecosystem effects are counted, above US\$2.3 trillion a year, with the burden falling disproportionately on developing countries and an increasing proportion uninsurable. The Internal Displacement Monitoring Centre's [2026 Global Report](#) counts more than 82 million people living in internal displacement at the end of 2025, and records, for the first time, more new displacements caused by conflict (32.3 million) than by disasters (29.9 million). The two are not independent: displacement driven by drought or floods increases pressure on land and services in the places where people arrive, and where governance is weak that pressure feeds conflict.

Fragility is the amplifier. The OECD's [States of Fragility 2025](#) identifies 61 contexts of high or extreme fragility, home to about 2.1 billion people, a quarter of humanity, and 72% of the world's extreme poor in 2024, a share that could rise to 92% by 2040. The mapping onto the high-exposure regions is close, and it

is not a coincidence. The same weak institutions that fail to provide safe water and clean cooking are those least able to run early-warning systems, cooling centres or social protection when heat and drought arrive.

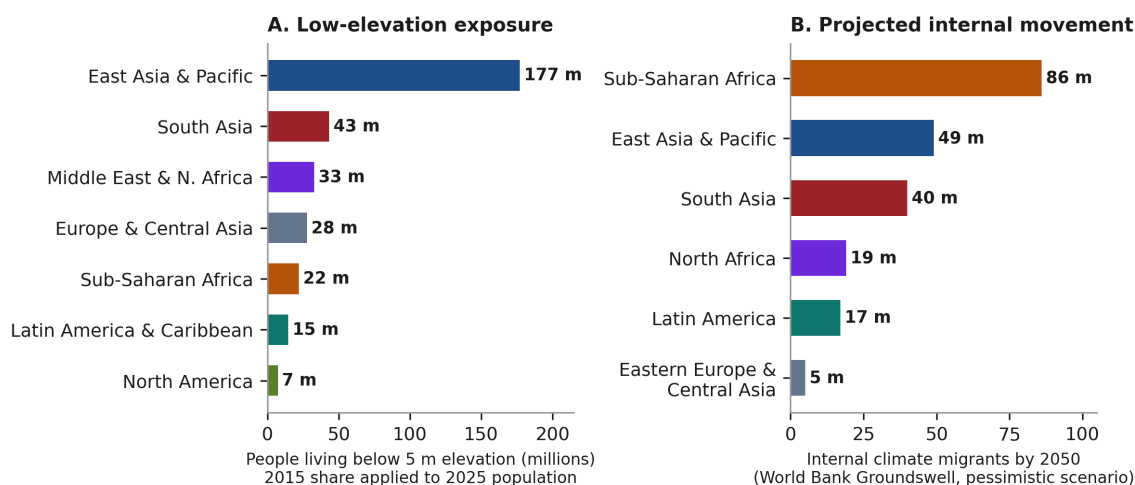


Figure 12. Coastal and mobility exposure: people living below 5 m elevation by region (A), and World Bank projections of internal climate migration by 2050 under the pessimistic scenario (B). Regional groupings differ between the two panels.

Sources: World Bank WDI (EN.POP.EL5M.ZS, 2015) and population (2025); World Bank Groundswell Part 2 (2021). Panel A is the author's calculation.

Coastal exposure and mobility add a spatial dimension. About 177 million people in East Asia and Pacific live below 5 metres, more than the rest of the world combined, though the region's high capacity and state ability to build defences make this a very different risk from the 22 million below 5 metres in Sub-Saharan Africa, where defences are scarce. [Kulp and Strauss](#) found that using a more accurate elevation model roughly triples earlier estimates of the population on land below projected high-tide lines: about 300 million people could face annual coastal flooding by 2050 regardless of how rapidly emissions fall, with China, Bangladesh, India, Vietnam, Indonesia and Thailand accounting for three-quarters. The World Bank's [Groundswell](#) analysis estimates that up to 216 million people could move within their own countries by 2050 under slow-onset climate impacts if action is weak, 86 million of them in Sub-Saharan Africa, with hotspots emerging as early as 2030. Early, concerted action could reduce these numbers significantly.

8.3 Global tail risks

Behind the regional picture sit risks that are global in scope and low in probability but very high in consequence. The [Global Risks Report 2026](#) of the World Economic Forum, based on a survey of more than 1,300 experts, puts geoeconomic confrontation first for the next two years, while extreme weather events lead the ten-year ranking, followed by biodiversity loss and critical changes to Earth systems. Antimicrobial resistance is a slower, less visible tail: the Global Research on Antimicrobial Resistance project, in [The Lancet](#), estimated 1.14 million deaths directly attributable to resistant bacterial infections in 2021, forecast about 39 million cumulative deaths from 2025 to 2050 without intervention, and found South Asia would be hardest hit. Table 4 summarises these and other systemic pressures by scale and by the regions where they bite hardest.

Table 4. Selected systemic pressures: scale, timing and regional concentration.

Pressure	Scale	Timing	Where it concentrates
Disaster losses (incl. cascading, ecosystem) (UNDRR)	US\$2.3 trillion a year; direct losses US\$202 billion	Present, rising	Low- and middle-income countries; uninsured households
Internal displacement (IDMC)	82+ million displaced; conflict now exceeds disasters as driver	Present	Sub-Saharan Africa, Middle East, South Asia
Fragility (OECD)	2.1 billion people; 72% of extreme poor, rising to 92% by 2040	Present to 2040	Sub-Saharan Africa, parts of MENA and Asia
Internal climate migration (World Bank)	Up to 216 million by 2050 (pessimistic)	Hotspots from 2030	Sub-Saharan Africa (86 m), East Asia & Pacific (49 m), South Asia (40 m)
Antimicrobial resistance (GRAM)	1.14 m attributable deaths in 2021; about 39 m cumulative 2025-2050	Rising to 2050	South Asia, Sub-Saharan Africa
Nuclear soot famine (Xia et al.)	2 to 5 billion at risk of famine in large-war scenarios	Tail event	Global, with import-dependent regions most exposed
Biodiversity loss (WWF/ZSL)	73% average fall in monitored wildlife, 1970-2020	Continuing	Latin America (95%), Africa (76%), Asia-Pacific (60%)

Sources linked in text. Figures are estimates or scenarios as described by their authors and are not additive.

8.4 What the coupling implies

The practical conclusion is that risk reduction should be judged by its effect on couplings, not only on individual hazards. A solar-plus-storage system that keeps a clinic's refrigerators and a water pump running through a heatwave addresses heat, health, water and energy at once. A fiscal rule that allows a government to borrow for resilience before a disaster, rather than after, weakens the link between disaster and debt. And a regional trade arrangement that keeps grain flowing through a drought reduces the transmission of food shocks into conflict. Conversely, interventions that treat each hazard in a separate silo can look efficient and still leave the system brittle. Section 12 draws on this logic.

9. Adaptive Capacity and Demography

The same hazard is a nuisance in one place and a catastrophe in another. Capacity, meaning the income, energy, infrastructure and institutions that stand between a hazard and its human consequences, is what explains the difference, and it is distributed even more unevenly than the hazards are.

9.1 The capacity gradient

The gradient is steep. GDP per capita at purchasing-power parity is about US\$5,800 in Sub-Saharan Africa, US\$11,600 in South Asia and US\$16,900 in the Middle East and North Africa, against US\$29,300 in East Asia and Pacific, US\$54,100 in Europe and Central Asia and US\$87,500 in North America. On the World Bank's international poverty measure, 45% of people in Sub-Saharan Africa live on less than US\$3 a day, against 10.1% worldwide and under 1% in Europe and North America. Life expectancy is 62.8 years in Sub-Saharan Africa and 79.2 in North America, and under-five mortality is 71 per 1,000 live births against 6. Each of these is a summary of the buffers a population has: nutrition, health care, savings, housing and the state's ability to respond.

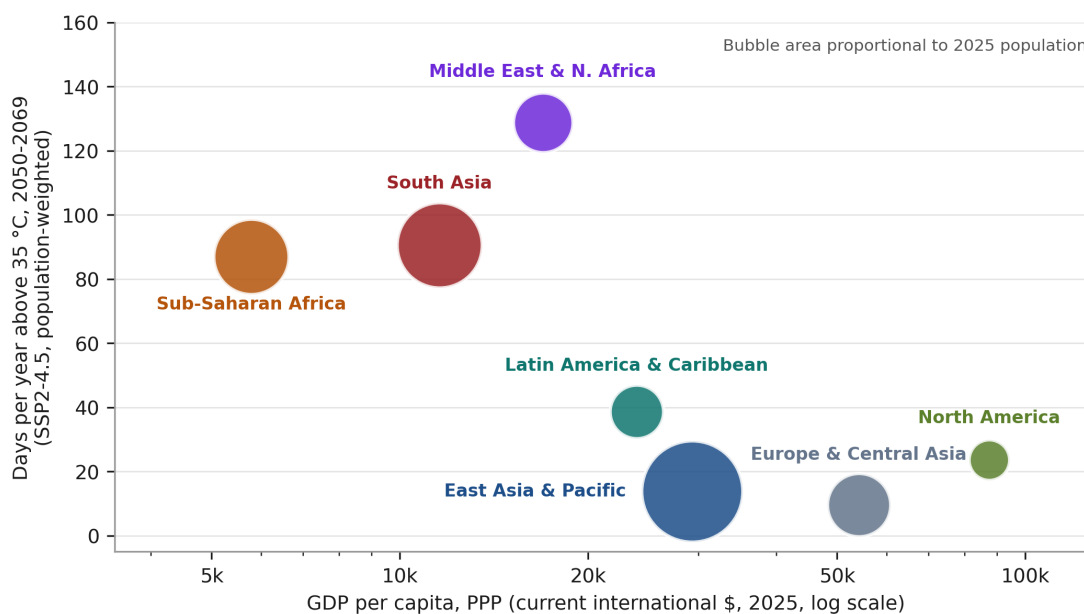


Figure 13. Capacity versus heat. Days above 35 °C in 2050-2069 (SSP2-4.5) against GDP per capita at purchasing-power parity, 2025, by region. Bubble area is proportional to 2025 population.

Sources: World Bank CCKP (CMIP6); World Bank WDI (NY.GDP.PCAP.PP.CD, SP.POP.TOTL); author's calculation.

Figure 13 places the regions on the two axes that matter most for heat. The upper-left quadrant, hot and lower-income, contains Sub-Saharan Africa, South Asia and, slightly higher on the income scale, the Middle East and North Africa. These regions hold 3.8 billion people. The lower-right quadrant, cooler and wealthier, holds North America, Europe and Central Asia and East Asia and Pacific, whose population is the largest. No region sits in the lower-left quadrant. The wealthiest regions are also those with the lowest heat exposure, a coincidence of geography and history which implies that the world's capacity to respond is least where it is most needed.

Energy is the most concrete expression of the gradient. Of the world's 666 million people without electricity, 85% live in Sub-Saharan Africa ([Tracking SDG7](#)). By World Bank figures, about 590 million people in the region lack access, while South Asia, with 1.7 billion people, is close to universal access. This explains why the capacity deficit for South Asia scores 23, near that of the Middle East, and for Sub-Saharan Africa scores 91. Electricity is not only a convenience; it runs pumps, refrigerators, cooling, clinics and communications, and so the margin by which a region survives a heatwave or a drought.

9.2 The demographic loading

Exposure is then multiplied by headcount. The UN's [World Population Prospects 2024](#) project that world population will peak at about 10.3 billion in the mid-2080s and ease to about 10.2 billion by 2100 ([summary](#)). Almost all of the net growth comes from one region. Sub-Saharan Africa, with about 1.3 billion people in 2025, is projected to reach about 3.3 billion by 2100, which, on these approximate numbers, would put its share of world population at about 32%, up from 16% today. The rest of the world's population, on the same figures, is about 6.9 billion both now and in 2100. Put differently, the entire net growth of humanity this century occurs in the region that today has the lowest capacity and the highest food insecurity.

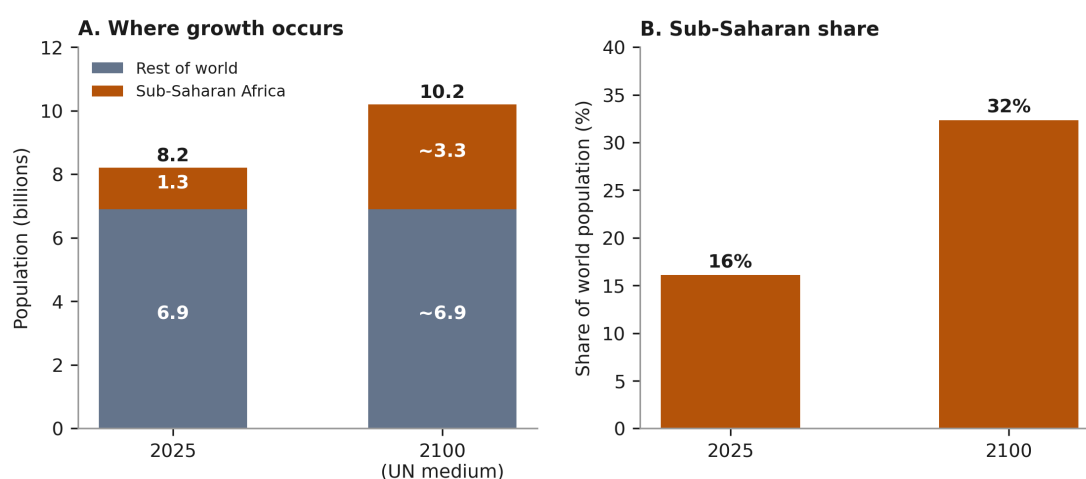


Figure 14. Demographic loading. World population split into Sub-Saharan Africa and the rest of the world, 2025 and 2100 (A), and Sub-Saharan Africa's share (B).

Sources: World Bank WDI population, 2025; UN World Population Prospects 2024, medium variant, as summarised in the text. 2100 values are approximate.

This is not an argument about numbers of people being a problem in themselves. A growing, young population is a potential source of labour and innovation if jobs, health and education are available. It is an argument about timing. The Danger Window of 2040 to 2060 coincides with the period in which the region's population is rising steeply, its urbanisation is accelerating, and its hot-day count is rising along the same trajectory (Figure 5). Capacity built before then will be spread over a larger base; capacity built after will be playing catch-up.

9.3 Capacity can be bought, and it is cheap relative to damage

The evidence that adaptation pays is substantial, though it has to be read with care. The Global Commission on Adaptation estimated in 2019 that investing US\$1.8 trillion globally between 2020 and 2030 in five areas, early warning systems, climate-resilient infrastructure, improved dryland agriculture, mangrove protection and water-resource resilience, could generate US\$7.1 trillion in net benefits, with benefit-cost ratios from 2:1 to 10:1 ([WRI summary](#)). The same work is cited by the WMO's [Early Warnings for All](#) initiative for two figures: that 24 hours' notice of a hazardous event can cut the ensuing damage by about 30%, and that US\$800 million invested in early warning in developing countries would avoid US\$3 to US\$16 billion in annual losses. These numbers are estimates made before the 2020s began, and their form (an upper bound in some citations, a point estimate in others) varies. But they establish a defensible rule of thumb: the cheapest lives and livelihoods to save are those protected by information and basic infrastructure, not by rebuilding afterwards.

10. Regional Assessment: Who Is Most Exposed

Combining the five exposure channels with the capacity deficit gives a clear ordering. Sub-Saharan Africa is the most exposed region, driven by hunger, energy poverty and thin buffers. The Middle East and North Africa and South Asia follow, for different reasons. The three together hold 47% of humanity.

10.1 The index results

Figure 15 shows the six dimension scores for each region, and Figure 16 the composite. Sub-Saharan Africa scores 70 on the Survivability Exposure Index, driven by a capacity-deficit score of 91 and a food score of 94, which reflect the highest hunger prevalence (22.3%), the largest share of employment in agriculture (49%), and the lowest access to electricity, clean cooking and safe water. The Middle East and North Africa scores 50, led by the highest heat (86) and water (75) scores and a high air-pollution score (73), tempered by a moderate capacity deficit (27). South Asia scores 43, led by the highest air-pollution score (91), heat (60) and food (60), with a low capacity deficit (23). East Asia and Pacific scores 28, almost entirely from coastal exposure (93). Latin America and the Caribbean scores 19, Europe and Central Asia 11 and North America 7.

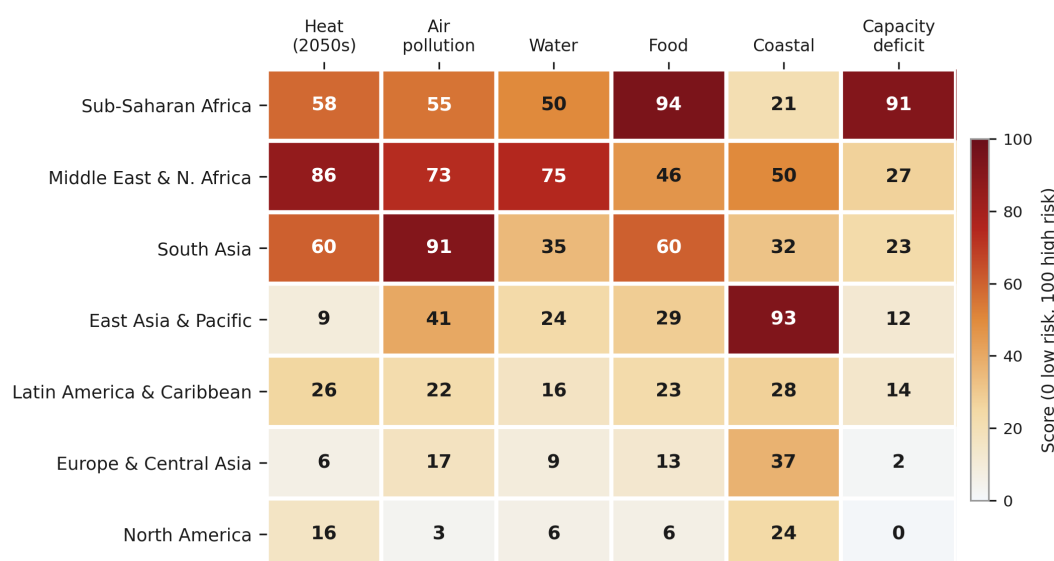


Figure 15. Dimension scores by region (0 = low risk, 100 = high risk), ordered by composite index. Scores use the fixed benchmark scales in Table 1.

Source: Author's calculation using World Bank WDI and World Bank CCKP data. Heat is for 2050-2069 under SSP2-4.5.

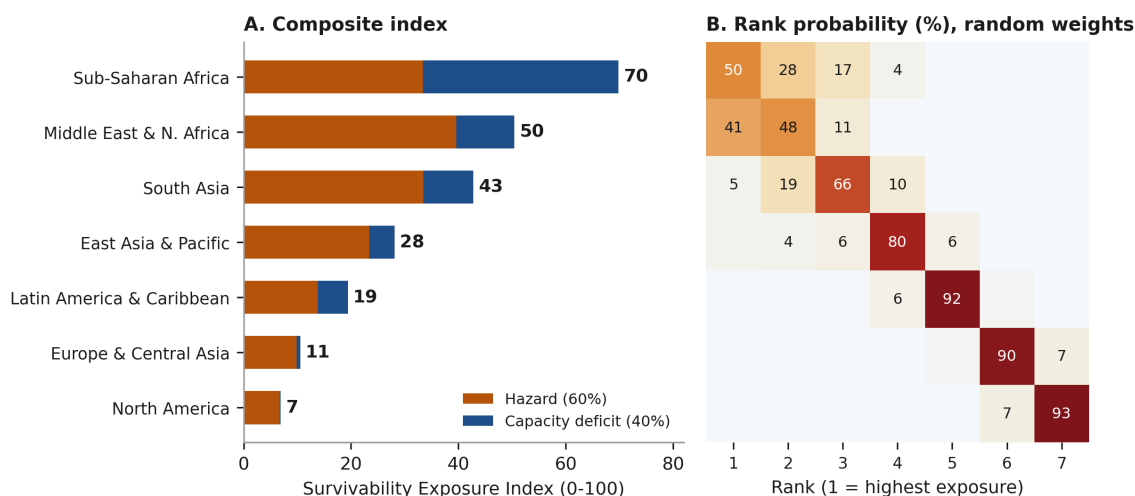


Figure 16. Survivability Exposure Index by region (A), and rank probabilities from 20,000 random weightings of the six components (B). Row order in panel B follows panel A.

Source: Author's calculation. Panel B draws weights from a flat Dirichlet distribution over the five exposure dimensions and the capacity deficit.

Table 5. Survivability Exposure Index results and sensitivity.

Region	Pop. (bn)	Share	Hazard	Capacity deficit	SEI	SEI, 2080s SSP5-8.5 heat	SEI, 50/50 weights
Sub-Saharan Africa	1.32	16%	56	91	70	75	73
Middle East & N. Africa	0.83	10%	66	27	50	52	47
South Asia	1.69	21%	56	23	43	47	40
East Asia & Pacific	2.39	29%	39	12	28	31	25
Latin America & Caribbean	0.67	8%	23	14	19	26	19
Europe & Central Asia	0.93	11%	16	2	11	12	9
North America	0.38	5%	11	0	7	9	6

Hazard is the average of the five exposure scores; capacity is the deficit score. $SEI = 0.6 \times \text{hazard} + 0.4 \times \text{capacity}$. Sensitivity columns replace only the stated component. Population is 2025 (World Bank).

10.2 How robust is the ranking?

The ranking is robust in its structure and less so in its details. Under 50/50 weights, and under 2080s very-high-emissions heat, the order of all seven regions is unchanged. In a Monte Carlo test with 20,000 random weightings, the three highest-ranked regions are Sub-Saharan Africa, the Middle East and North Africa and South Asia, in some order, in 85% of draws. Sub-Saharan Africa ranks first in 50% of draws and second in 28%; the Middle East and North Africa ranks first in 41% and second in 48%; South Asia ranks third in 66% and second in 19%. Below the top three, East Asia and Pacific is fourth in 80% of draws, Latin America and the Caribbean fifth in 92%, Europe and Central Asia sixth in 90% and North America seventh in 93%. If the capacity component is dropped and only hazards are considered, the Middle East and North Africa ranks first and South Asia and Sub-Saharan Africa are essentially tied. If the hazards are dropped and only capacity is considered, Sub-Saharan Africa is far ahead. The index is therefore telling a consistent story:

three regions share the largest exposure, and what distinguishes them is the balance between hazard and capacity.

Replacing 2050s intermediate heat with 2080s very-high-emissions heat raises Sub-Saharan Africa's index by five points, to 75, South Asia's by four, to 47, and Latin America and the Caribbean's by seven, to 26, the largest relative increase. These are lower bounds on the change, since only the heat dimension is allowed to move.

10.3 Sub-Saharan Africa (SEI 70): the capacity-limited region

Sub-Saharan Africa is not the most hazardous region on any single dimension. Its heat score (58) is below that of the Middle East and North Africa and its air-pollution score (55) below South Asia's. What sets it apart is the thinness of its buffers. About 22% of people are undernourished, roughly 295 million; half the workforce farms, on yields of about 1.5 tonnes per hectare; only 23% of people cook with clean fuels, 55% have electricity and 32% have safely managed drinking water; 45% live below US\$3 a day. These deficits mean that a regionally modest heat increase, from about 58 days above 35 °C to about 87 by mid-century under the intermediate pathway, lands on households with almost no margin. Air pollution kills at the highest age-standardised rate in the world (168 per 100,000), and the World Bank's projection of 86 million internal climate migrants by 2050 is the largest of any region.

The region's trajectory runs directly into the Danger Window. Its population is projected to rise from about 1.3 billion to about 3.3 billion by 2100. For a region in this position, the strategic task is to build capacity faster than hazard and demography grow: universal electricity and clean cooking, safe water and sanitation, agricultural productivity, and early warning and social protection. Stage 1 and Stage 2 damage, erosion of health and loss of working capacity, is already underway; Stage 3 infrastructure fragility is the risk to be pre-empted.

10.4 Middle East and North Africa (SEI 50): the hazard-limited region

The Middle East and North Africa is the most hazard-exposed region, with the highest heat and water scores and the second-highest air-pollution score. Its population experiences about 100 days a year above 35 °C today, a figure that rises to about 129 by mid-century under the intermediate pathway and about 169 in the 2080s under very high emissions. WRI finds that 83% of its people already live with extremely high baseline water stress and projects that all of them will by 2050; freshwater withdrawals are 148% of internal renewable resources, so the region lives on desalination, imports and fossil groundwater. Raymond and colleagues' observations of wet-bulb extremes around the Persian Gulf mark it as the region where the physiological tail (Stage 4 in the framework) is first approached.

The region's capacity is not uniform. Income per head (about US\$16,900 at purchasing-power parity) and electricity access (97%) are moderate on average, but they conceal a gap between wealthy hydrocarbon producers and fragile or conflict-affected economies, and the World Bank's measure of extreme poverty is 14.3%, above the world average. Wealthy states can buy resilience through cooling, desalination and imports, but this makes them dependent on the energy system and on trade routes, and it concentrates risk in a few pieces of critical infrastructure. For the region as a whole, the central question is whether the energy that cools and desalinates can be made reliable and low-carbon before the heat curve steepens.

10.5 South Asia (SEI 43): the pollution-and-heat region

South Asia combines the world's worst air pollution with high and rising heat. Its population-weighted PM_{2.5} exposure of 55 µg/m³ is eleven times the WHO guideline, and its age-standardised mortality attributed to air pollution is 140 per 100,000. All six of the most polluted countries in IQAir's 2025 ranking are in South and Central Asia or Africa, and Pakistan, Bangladesh and India are among them. Nearly half of the world's children with blood lead levels above the action threshold live here ([UNICEF](#)). Heat days rise from about 70 to about 91 by the 2050s, and the region's 74% share of people in extremely high water stress is second only to the Middle East and North Africa's. With 42% of jobs in agriculture and about 160 million people undernourished, working outdoors in heat and dependent on monsoon variability, it is also the region where the labour channel of heat is most exposed. Its capacity score is relatively low (23): electricity access is close to universal and growth has been fast, though about 430 million people still lack clean cooking.

South Asia is also where the most coastal and deltaic population lives within reach of rising seas: about 43 million below 5 metres of elevation on World Bank figures, and Bangladesh and India are among the six countries that account for three-quarters of the world's population at risk of annual coastal flooding by 2050 on the Kulp and Strauss estimates. The AQLI result for China shows what can be achieved on pollution; for South Asia, the strategic task is to apply that lesson at scale while building heat-resilient labour practices and water storage.

10.6 East Asia and Pacific (SEI 28): the coastal and demographic giant

East Asia and Pacific is the largest region, with 2.4 billion people, 29% of the world. It scores low on heat (about 6 days above 35 °C today, rising to about 14 by mid-century), moderate on air pollution (27 µg/m³, falling), and high on coastal exposure: about 177 million people live below 5 metres of elevation, more than in all other regions combined. Capacity is relatively high, with GDP per capita of about US\$29,300, 87% clean-cooking access and 99% electricity access, which makes the coastal exposure a problem of engineering, planning and finance more than of vulnerability. The region's principal risks are those that arrive through compound events, such as typhoon surge on subsiding deltas, and through the interdependence of its dense urban and industrial systems. Subregional variation is large: Pacific island states and Southeast Asian deltas face much higher exposure than the regional average suggests, and 49 million internal climate migrants are projected by 2050.

10.7 Latin America and the Caribbean (SEI 19): the region whose heat moves fastest

Latin America and the Caribbean scores low today because it has abundant water (about 21,000 cubic metres of renewable resources per person, almost four times the world average), moderate poverty and relatively high clean-cooking access (90%). Its distinctive feature is the speed with which heat is projected to rise. Days above 35 °C increase from about 14 to 39 by mid-century on the intermediate pathway, and to about 122 by the 2080s on the very-high pathway, a ninefold rise, so its index increases by seven points, the largest in the group, when 2080s heat replaces 2050s heat. The Global Tipping Points Report flags Amazon dieback among the risks that could affect the region's rainfall and carbon stocks, and the Living Planet Report records a 95% average fall in monitored wildlife populations in the region. Only about 51%

of people have safely managed sanitation. The region is best understood as one in which a good present position could deteriorate quickly if heat and ecosystem loss are not addressed.

10.8 Europe and Central Asia (SEI 11) and North America (SEI 7): low exposure, not no exposure

Europe and Central Asia and North America have the lowest exposure on the index, because they combine mild present climates, high income, universal energy access and strong institutions. Heat days rise from about 4 to 10 in Europe and Central Asia and from about 10 to 24 in North America by mid-century on the intermediate pathway. Both regions still face exposures that the aggregates hide: Cyprus is among the five most water-stressed countries in the WRI ranking, the World Bank counts about 28 million people below 5 metres in Europe and Central Asia, and IQAir links fewer countries meeting the WHO air-quality guideline in 2025 partly to wildfires across North America and Europe. And in North America, annual emissions per head are about 13.7 tonnes of CO₂, compared with a world average of 4.7 (World Bank data for 2024), a reminder that the exposure of the low-risk regions is partly the exposure of the others.

More importantly, low direct exposure does not mean insulation. These regions are linked to the high-exposure group through food and energy trade, finance, migration and security. A food price spike driven by drought in the tropics, a displacement crisis driven by conflict in a fragile state, or a financial shock from uninsurable disaster losses will arrive in these regions by the supply chain, the border or the balance sheet. Their stake in reducing exposure elsewhere is not only humanitarian.

11. Time Horizons: The Layering Phase and the Danger Window

The century does not collapse in a single year; it narrows. The 2020s and 2030s are a layering phase in which stress accumulates while slack remains. Between about 2040 and 2060, slow curves peak together and the margin for error shrinks. The choice of what is built before that window determines what happens within it.

11.1 Why 2040-2060

Several independent trajectories cross in the middle of the century. Hot days in the high-exposure regions are on a steady climb (Figure 5), reaching about 126 a year in the Middle East and North Africa, 85 in South Asia and 80 in Sub-Saharan Africa by 2050 under the intermediate pathway. Water stress deepens, with WRI projecting an additional billion people under extremely high stress and the whole Middle East and North Africa population by 2050. Cooling demand is on course to more than triple (the IEA projects air-conditioner stock rising from 1.6 to 5.6 billion by 2050), loading grids at the moment of peak need. Sub-Saharan Africa's population rises steeply, to an estimated 2.2 billion by 2054 on one UN-based summary, and the world's population approaches its peak. And fiscal strain from disaster losses and debt service accumulates, with the UNDRR documenting a loop in which disasters raise debt and debt reduces the ability to invest in resilience.

None of these curves is a cliff. Their danger lies in synchrony. In the layering phase a heat wave can be answered by borrowing capacity from another system: spare grid capacity, a good harvest, a fiscal reserve. In the Danger Window, with all systems under stress together, the borrowing runs out, and a shock in one system propagates into the others (Figure 10). This is the practical meaning of the coupling analysis in Section 8.

Table 6. Three horizons for survivability risk.

Horizon	Dominant dynamics	Highest-exposure regions	What can still be changed
2026-2040 Layering	Pollution and heat erode health, cognition and working capacity (Stage 1-2). Capacity deficits persist. Hot-day counts rise by roughly 5-10 days by 2040 in the hottest regions; hunger and displacement concentrate outside high-income regions.	Sub-Saharan Africa; South Asia; Middle East and North Africa	Nearly everything: electricity, clean cooking, water systems, cooling standards, early warning, health systems
2040-2060 Danger Window	Heat, water stress, cooling demand, demographic loading and fiscal strain peak together (Stage 3). Infrastructure fragility converts hazards into cascades.	Sub-Saharan Africa; South Asia; Middle East and North Africa; rising exposure in Latin America	Operating practice: grid and water redundancy, labour rules, social protection, trade corridors; limited scope to build new capacity
2060-2100 Reorganisation	Outcomes depend on the emissions path: 1.9-2.8 °C by 2100 on current pledges. Geographic thinning and migration in the hottest regions (Stage 4); population peaks at about 10.3 billion in the mid-2080s.	Hot, low-capacity regions; coastal deltas; water-bankrupt basins	Mostly adaptation at the margin and settlement choices; the emissions path is largely set by then

Qualitative synthesis. Quantities are drawn from the sources cited in earlier sections; time bands are indicative.

11.2 The fork

The best description of the Danger Window is a fork. On one branch, the 2030s are used to build energy access, cooling and water infrastructure, early warning and social protection, so that the window arrives into a wide buffer. On the other, the work is deferred, and the same hazards arrive into a narrow one, at higher prices and with fewer institutional options. The physical hazard is similar on both branches; what differs is the capacity to absorb it. Emissions policy determines which of the scenarios in Figure 4 materialises, but the evidence in this report suggests that capacity decides what that scenario means for people.

12. Implications: Where Action Buys the Most Survivability

The analysis points to a short list of priorities. They are ordered here by how directly they reduce exposure or raise capacity, and by how well their returns are documented. Most are not new. The case is for doing them first, and in the places where the capacity deficit is largest.

12.1 Six principles

- **Build capacity before the Danger Window.** Electricity access, clean cooking, water and sanitation, health systems and early warning reduce vulnerability to every hazard at once. Sub-Saharan Africa's capacity deficit (91) is the largest single contributor to the global exposure score, and it is the most tractable.
- **Treat pollution as the first priority for the near term.** Air pollution is the largest operating killer, its reduction is well-evidenced (China's fall of 40.8% in nine years), and the measures that cut it, clean cooking, cleaner power and transport and waste control, also cut emissions.
- **Make heat a labour and infrastructure issue, not only a health issue.** Heat action plans, working-hour rules, shaded and cooled public space, cool roofs, efficient cooling standards, and reliable grids reduce the largest present burden (the ILO's 2.4 billion exposed workers) and avoid locking in inefficient cooling.
- **Defend and rebuild water buffers.** Groundwater governance, storage, leakage reduction, reuse and sanitation coverage matter most where withdrawals are above renewable supply (the Middle East and North Africa) or service coverage is lowest (Sub-Saharan Africa).
- **Reduce transmission between systems.** Prefer interventions that decouple: distributed solar and storage for clinics and water pumps, grain reserves and open trade corridors, pre-arranged disaster finance, and social protection that scales up automatically.
- **Keep the emissions path honest.** Capacity cannot compensate for unlimited warming. The difference between 1.9 °C and 2.8 °C by 2100 is the difference between a manageable and an unmanageable Danger Window, and the number of people outside the human climate niche scales steeply with it (Section 3.4).

Table 7. Priority actions by region, ordered by the dominant exposure.

Region	Binding constraint	First-order priorities	Supporting evidence
Sub-Saharan Africa	Capacity and food	Electricity and clean cooking; safe water and sanitation; agricultural productivity and storage; early warning; social protection	SDG7 gap (666 m without electricity); JMP; SOFI 2026; GCA returns
Middle East & North Africa	Heat and water	Efficient cooling and grid reliability; water reuse and demand management; groundwater governance; worker heat protections; low-carbon desalination	WRI Aqueduct; ILO; Raymond et al.
South Asia	Air pollution and heat	Air-quality regulation and clean household energy; lead-acid battery recycling; heat action plans; water storage; coastal defence	SoGA 2025; AQLI China; Toxic Truth
East Asia & Pacific	Coastal exposure	Coastal and deltaic protection; compound-event planning; continued air-quality gains; support for small island states	Kulp and Strauss; Groundswell
Latin America & Caribbean	Rapidly rising heat; ecosystems	Heat planning and efficient cooling now; sanitation coverage; forest and ecosystem protection	CMIP6 heat; Living Planet Report
Europe & Central Asia; North America	Linkages and tails	Resilient trade and energy systems; wildfire and heat management; support for capacity abroad; deep emission cuts	WEF Global Risks 2026; UNDRR GAR 2025

Author's synthesis based on the index and the evidence cited in earlier sections. Priorities are illustrative and do not imply that other regions can neglect these areas.

12.2 The economics

The Global Commission on Adaptation's estimate of US\$7.1 trillion in net benefits from US\$1.8 trillion of investment is a global average. The index suggests where the highest returns lie: in the capacity-limited regions, where the first dollar of electricity, clean cooking, clean water or early warning removes a larger share of exposure than the thousandth dollar in a high-capacity region. It also suggests that the sequence matters. The costs of a strategy are lower when it is executed in the layering phase, when the choice is between building and not building, than in the Danger Window, when the choice is between rebuilding, subsidising and abandoning.

12.3 Governance and finance

Two constraints cut across the regions. The first is fiscal. Countries with the highest exposure also tend to have the least room to borrow, and the UNDRR shows that for vulnerable countries disasters can trigger fiscal crises at intervals of a decade or less. Instruments that provide finance before a shock, such as contingent credit, pre-arranged insurance and regional pools, break the link between hazard and debt. The second is institutional. Survivability depends on governments that can deliver services at scale; the OECD's finding that fragile contexts hold 72% of the world's extreme poor and are on track to hold more means that capacity-building in those contexts, harder as it is, cannot be skipped.

13. Limitations and Uncertainty

Every analysis of this kind simplifies, and the simplifications here should be stated plainly.

- **Regional aggregates hide variation.** Within South Asia, the Indo-Gangetic Plain and the Himalayan foothills face very different hazards; within Sub-Saharan Africa, the Sahel and the Congo basin are different worlds. The index describes regions as units and should not be used to rank countries, cities or districts. Subnational analysis would be the natural next step.
- **Climate data are country means from a model ensemble.** The days-above-35 °C figures average over each country's area before population weighting. They understate the heat experienced in hot, densely populated districts and overstate it in cool, sparsely populated ones. Model medians smooth extremes, and CMIP6 models have known regional biases. Dry-bulb temperature ignores humidity, so the figures understate the risk in humid regions.
- **Only heat is forward-looking in the index.** Water, food, pollution and coastal indicators are held at present values. In the high-emissions scenario they would almost certainly worsen, so the forward-looking index is a lower bound.
- **Benchmark scales and weights are judgements.** The scales in Table 1 and the 60/40 weighting are defensible but not unique. The sensitivity and Monte Carlo tests show that the three-region top group is robust, but the order within it is not.
- **Some indicators are old.** The share of population below 5 metres is from 2015, and the air-pollution mortality rates are from 2019. They are the latest regional series available on a consistent basis, but they predate recent changes in population and policy.
- **Coupling scores are expert judgements.** Figures 10 and 11 are a transparent synthesis of the literature, not measurements. Reasonable analysts could score them differently.
- **Some sourced figures come from secondary summaries.** Where primary documents were not directly accessible, notably for the UNU-INWEH water bankruptcy report and some elements of the Global Commission on Adaptation work, the text identifies the secondary source and the figures should be checked against the primary before formal use.
- **Scenarios are not forecasts.** SSP pathways, policy projections and demographic projections are conditional on assumptions about technology, policy and behaviour. The report uses them to bracket possibilities rather than to predict.

14. Conclusion: A Narrowing Margin, Unevenly Distributed

Human survivability in the twenty-first century will not be decided by a single threshold. It will be decided by whether the margin between hazard and capacity widens or narrows in the regions where the margin is thinnest, and whether it does so in time. The evidence in this report points to three conclusions.

First, exposure is concentrated. Sub-Saharan Africa, the Middle East and North Africa and South Asia, 47% of humanity today, carry the highest combined exposure to heat, pollution, water stress, hunger and weak adaptive capacity. This concentration is robust to the weighting scheme and to the climate scenario, though the balance between hazard and capacity differs in each. East Asia and Pacific faces a large coastal exposure but has the capacity to manage it; Latin America's present position is comfortable but its heat is rising fastest; Europe and North America are least exposed directly but linked to the others by trade, finance, migration and shared atmosphere.

Second, the damage is staged. Pollution and chronic heat erode health, cognition and working capacity now. Infrastructure fragility, in which heat, drought and demand overwhelm grids, water systems and health services together, is the principal risk of the 2040-2060 Danger Window. Geographic thinning belongs to the later decades and depends on the emissions path. The practical implication is that the near-term priorities are not the dramatic ones: they are clean household energy, reliable power, safe water, cooling standards and early warning.

Third, the window for cheap action is open now. The same hazards produce very different outcomes depending on the capacity they meet, and capacity is the one variable that can be changed quickly and at modest cost compared with the losses it prevents. A decade of determined policy has already cut particulate pollution in China by about 40%. The remaining question is whether the world will apply the same determination, and the same finance, to the regions where it matters most before the window closes.

The century will be hard in any scenario. Whether it is survivable in a way that people would recognise as a decent life, in the places where most of them will live, remains a matter of choice.

Sources and Data Notes

Links were compiled in October 2026. Headline figures cited in the text come from the institutional and peer-reviewed sources below. Where the author derived a figure, the text says so.

Climate and Earth system

- [Copernicus Climate Change Service: 2025 was the third-warmest year on record](#)
- [WMO: 2025 set to be second or third warmest year on record](#)
- [UNEP: Emissions Gap Report 2025](#)
- [IPCC AR6 Synthesis Report: Summary for Policymakers](#) and [WGII Impacts, Adaptation and Vulnerability](#)
- [Global Tipping Points Report 2025](#) and [Planetary Health Check 2025](#)
- [Lenton et al. \(2023\), Quantifying the human cost of global warming, Nature Sustainability](#)
- [Rounce et al. \(2023\), Global glacier change in the 21st century, Science](#)
- [World Bank Climate Change Knowledge Portal \(CMIP6 projections\)](#)

Heat, health and pollution

- [Lancet Countdown 2025 \(via WHO\)](#) and [Lancet Countdown](#)
- [ILO: Ensuring safety and health at work in a changing climate](#)
- [Vecellio et al. \(2022\), wet-bulb limits, Journal of Applied Physiology](#) and [Raymond, Matthews and Horton \(2020\), Science Advances](#)
- [State of Global Air 2025](#) and [IQAir World Air Quality Report](#)
- [Air Quality Life Index: China's air quality policies](#)
- [UNICEF and Pure Earth: The Toxic Truth](#) and [UN News coverage](#)
- [IEA: Tracking SDG7 2025](#); [IEA: The Future of Cooling](#); [UNEP: Global Cooling Watch 2025](#); [SEforALL: Chilling Prospects 2025](#)

Water and food

- [WRI: Aqueduct water stress ranking](#)
- [WHO/UNICEF JMP 2025](#) and [JMP report page](#)
- [UNU-INWEH: Global Water Bankruptcy \(press coverage\)](#)
- [Jasechko et al. \(2024\), groundwater decline, Nature](#)
- [Global Commission on the Economics of Water](#)
- [FAO: State of Food Security and Nutrition in the World 2026](#) and [FAO publication page](#)
- [Jägermeyr et al. \(2021\), Nature Food](#)
- [Xia et al. \(2022\), nuclear war and global famine, Nature Food](#)

Systemic risk, displacement and demography

- [Lawrence et al. \(2024\), Global polycrisis, Global Sustainability](#)
- [World Economic Forum: Global Risks Report 2026](#)
- [UNDRR: Global Assessment Report 2025](#)
- [IDMC: Global Report on Internal Displacement 2026](#)
- [OECD: States of Fragility 2025](#)
- [World Bank: Groundswell Part 2](#) and [Kulp and Strauss \(2019\), Nature Communications](#)
- [GRAM \(2024\), antimicrobial resistance, The Lancet](#)
- [WWF/ZSL: Living Planet Report 2024](#) and [Bulletin of the Atomic Scientists: Doomsday Clock](#)
- [UN World Population Prospects 2024](#)
- [Global Commission on Adaptation, Adapt Now \(via WRI\)](#) and [WMO Early Warnings for All](#)
- [World Bank World Development Indicators](#)

Appendix A. Underlying Data

The tables below give the regional indicator values that enter the Survivability Exposure Index. All values are World Bank regional aggregates for the latest available year, retrieved in October 2026 through the World Bank API, except the climate values, which are the author's population-weighted averages of country-level CMIP6 projections from the World Bank Climate Change Knowledge Portal.

Table A1. Exposure indicators by region (latest available year).

Region	PM2.5	Withdrawals	Safe water	Hunger %	Farm jobs %	Below 5 m
Sub-Saharan Africa	35.4	3	32	22.3	49	1.7
Middle East & N. Africa	45.4	148	66	12.3	22	4.0
South Asia	55.2	38	78	9.5	42	2.6
East Asia & Pacific	27.3	12	75	3.5	22	7.4
Latin America & Caribbean	17.4	3	79	5.1	13	2.2
Europe & Central Asia	14.4	7	92	2.9	7	3.0
North America	6.9	8	97	2.5	1	1.9

PM2.5 in $\mu\text{g}/\text{m}^3$ (2023); freshwater withdrawals as % of internal renewable resources (2022); safely managed drinking water (% of population, 2024); undernourishment (% of population, 2024); agriculture (% of employment, 2025); population below 5 m elevation (% , 2015). Source: World Bank WDI.

Table A2. Capacity indicators by region (latest available year).

Region	GDP per capita	Electricity	Clean cooking	Poverty \$3/day	Life exp.	U5 mortality
Sub-Saharan Africa	5,786	55	23	45.0	62.8	71
Middle East & N. Africa	16,921	97	78	14.3	72.3	36
South Asia	11,562	100	74	2.6	72.6	27
East Asia & Pacific	29,303	99	87	2.0	76.7	13
Latin America & Caribbean	23,901	98	90	4.3	75.8	15
Europe & Central Asia	54,129	100	98	0.6	78.6	8
North America	87,504	100	100	0.9	79.2	6

GDP per capita in current international dollars (PPP, 2025); electricity and clean cooking access (% of population, 2024); extreme poverty at US\$3 a day (% of population, 2024); life expectancy (years, 2024); under-five mortality (per 1,000, 2024). Source: World Bank WDI.

Table A3. Dimension scores (0-100) by region.

Region	Heat	Air	Water	Food	Coast	Capacity deficit
Sub-Saharan Africa	58	55	50	94	21	91
Middle East & N. Africa	86	73	75	46	50	27
South Asia	60	91	35	60	32	23
East Asia & Pacific	9	41	24	29	93	12
Latin America & Caribbean	26	22	16	23	28	14
Europe & Central Asia	6	17	9	13	37	2
North America	16	3	6	6	24	0

Scores apply the benchmark scales in Table 1. Heat uses 2050-2069 under SSP2-4.5.

Method notes

Climate series. For each of 215 countries and territories with population data, annual mean near-surface temperature and annual days above 35 °C were retrieved from the World Bank Climate Change Knowledge Portal (CMIP6, 0.25-degree grid, ensemble median) for the historical period (1950-2014) and for SSP1-2.6, SSP2-4.5 and SSP5-8.5 (2015-2100). Period averages are 1995-2014 (baseline), 2050-2069 and 2080-2099. Regional values are population-weighted means of country values, using 2025 population.

Index. Each indicator is clipped to a fixed benchmark range (Table 1) and scaled to 0-100. The water score averages the withdrawal score and the drinking-water gap score; the food score averages the undernourishment and agricultural-employment scores; the capacity deficit averages scores for income (log scale), electricity gap, clean-cooking gap and extreme poverty. The hazard score is the unweighted mean of the five exposure dimensions. $SEI = 0.6 \times \text{hazard} + 0.4 \times \text{capacity deficit}$.

Robustness. The Monte Carlo test draws 20,000 weight vectors from a flat Dirichlet distribution over six components (five exposure dimensions and the capacity deficit), computes a weighted score for each region and records the rank distribution.

Derived figures. People-count estimates by region (for example, hungry people and people below 5 metres) multiply a World Bank regional share by 2025 regional population and are approximations. The 2100 demographic comparison uses the UN's medium-variant totals as reported in the cited summaries (world about 10.2 billion; Sub-Saharan Africa about 3.3 billion).