



Reducing Human Exposure to Cascading Risks in an Age of Polycrisis

A Strategic Framework for Building Long-Term Resilience

How shrinking the number of people in harm's way, loosening the links between failing systems, and enlarging financial and institutional buffers can reduce the human cost of coupled global crises

H Heuristics · Hunter Hughes

Research Report · October 2026

About this report

Reducing Human Exposure to Cascading Risks in an Age of Polycrisis: A Strategic Framework for Building Long-Term Resilience. H Heuristics Research Report, October 2026. Author: Hunter Hughes.

Suggested citation. Hughes, H. (2026). *Reducing Human Exposure to Cascading Risks in an Age of Polycrisis: A Strategic Framework for Building Long-Term Resilience.* H Heuristics.

Reading guide. Sections 1 to 4 set out the problem: what cascading risk is, how large human exposure is, and why it compounds. Section 5 introduces the six-lever framework, and Sections 6 to 11 treat each lever in turn. Sections 12 to 14 cover the economics, the financing architecture and governance. Sections 15 to 18 turn to prioritisation, practice, measurement and conclusions. Readers short of time can read the Executive Summary, Section 5 and Section 18.

Hyperlinks. Sources are linked in the text. Where a statistic is quoted, the link points to the institution or publication that produced it. Links were checked at the time of publication; web addresses change, and readers who find a broken link can search for the title of the cited source.

Data and visuals. Figures are of three kinds: charts of published data (Figures 2, 7, 8, 9 and 10), conceptual schematics (Figures 1, 3, 5, 6, 11 and 13), and analytical products created for this report (Figure 4, a stylised simulation, and Figure 12, a qualitative prioritisation). Each is labelled with its source or basis.

Disclaimer. This report is analytical and is not predictive. It is published for information and discussion and does not constitute financial, investment, legal or policy advice. Views expressed are those of the author. © 2026 H Heuristics. All rights reserved.

Abstract

The defining danger of the present period is not the size of any single hazard but the way hazards are coupled. Since 2020 a pandemic, an energy and food price shock, the sharpest global rise in borrowing costs in a generation, and an accelerating run of climate extremes have arrived on top of one another and transmitted stress into one another. This report treats that condition, commonly called polycrisis, as a problem of *human exposure*: the number of people who sit in the path of a shock, the strength of the channels through which one shock becomes several, and the size of the buffers that remain once a shock lands. Of the elements that determine human risk, hazard, exposure, vulnerability and coping capacity, the last three are products of policy and investment that can be changed within a political cycle.

The report documents the scale of exposure. Between 3.3 and 3.6 billion people live in settings highly vulnerable to climate change; 1.81 billion are exposed to a once-in-a-century flood; about two billion lack adequate social protection; more than a billion urban residents live in slums or informal settlements; and a record 83.4 million people were internally displaced at the end of 2024. These categories overlap and are concentrated in countries with the least fiscal room to respond: developing-country external debt reached US\$11.4 trillion in 2024. A stylised threshold model constructed for the report shows why exposure compounds: below a critical level of coupling a shock stays local, above it the same shock sweeps through the system, and buffers push that critical level a long way out.

The report proposes a six-lever framework. *Place* keeps people and assets out of harm's way; *lifelines* hardens power, water, health, food and data systems; *anticipation* turns warning into action before the shock; *buffers* strengthens household and public financial shock absorbers; *livelihoods and health* reduces biological and economic vulnerability; and *circuit-breakers* decouples systems so that failure does not spread. Together they address every term in the risk equation and every stage of a cascade. The returns are high, with benefit-cost ratios of roughly four to one for resilient infrastructure and nine to one for early warning, yet international public adaptation finance of about US\$26 billion a year is a small fraction of the US\$310 to 365 billion estimated to be needed by 2035.

The strategy is designed to work in an age of competition: most of its value can be captured domestically and regionally, it relies on subsidiarity and durable institutions, and it treats international support as a bonus and not a precondition. The report sets out a three-horizon roadmap to 2050, a dashboard of indicators for measuring progress, six cases from practice (Bangladesh, Ahmedabad, Jamaica, Kenya, Rwanda and Barbados), and ten priority actions for 2026 to 2030. Its central finding is that countries which absorb shocks well are distinguished less by wealth or hazard than by whether they built and protected the enabling capacity before the shocks arrived.

Keywords: polycrisis; cascading risk; systemic risk; human exposure; vulnerability; resilience; disaster risk reduction; early warning; anticipatory action; adaptive social protection; critical infrastructure; heat-health action plans; disaster risk finance; climate adaptation; sovereign debt

Data and method: This report synthesises institutional and peer-reviewed research, including the *WEF Global Risks Report 2026*, the *IPCC Sixth Assessment Report*, the *UNDRR Global Assessment Report 2025*, the *2025 Lancet Countdown*, IDMC, UNHCR, World Bank, UNEP and UNCTAD publications. Every quantitative claim is attributed in the text to its source. Figure 4 is a stylised simulation and Figure 12 a qualitative judgement. The report is analytical rather than predictive.

Contents

Executive Summary.....	6
1. Introduction: From Hazards to Exposure	7
1.1 Why exposure, and why now	7
1.2 What this report argues	8
2. The Anatomy of Cascading Risk.....	9
2.1 Triggers, channels and outcomes	9
2.2 The four properties that make cascades dangerous.....	10
2.3 Evidence of cascades in practice.....	10
2.4 The geopolitical overlay.....	10
3. How Large Is Human Exposure?.....	12
3.1 Exposure to physical hazard	12
3.2 Exposure through lack of protection.....	13
3.3 Exposure through displacement and conflict.....	13
3.4 Who is most exposed	13
4. Why Exposure Compounds: Stacking, Thresholds and Ratchets	14
4.1 Stacking: shocks that arrive before recovery	14
4.2 Thresholds: when coupling tips a system	15
4.3 Ratchets: how exposure becomes locked in.....	16
5. A Strategic Framework: Six Levers to Reduce Exposure	17
5.1 The logic of the framework.....	17
5.2 The six levers at a glance	18
5.3 Design principles	18
6. Lever 1 — Place: Keeping People and Assets Out of Harm's Way	19
6.1 The problem: urbanisation without risk information	19
6.2 What works	19
6.3 The hardest case: managed relocation	20
6.4 Interactions with other levers	20
7. Lever 2 — Lifelines: Hardening the Systems People Depend On.....	21
7.1 Why lifelines justify priority.....	21
7.2 A lifeline hierarchy	21
7.3 What works	22
7.4 Constraints	23
8. Lever 3 — Anticipation: Early Warning and Acting Before the Shock.....	24
8.1 The evidence on returns	24
8.2 The coverage gap	24
8.3 From warning to action	24
8.4 Bangladesh: the benchmark case	24
8.5 Design priorities	25
9. Lever 4 — Buffers: Household and Public Financial Shock Absorbers	26
9.1 Household buffers: savings, insurance and social protection	26
9.2 Public buffers: fiscal space and contingent finance	26
9.3 Connecting the levels	27
9.4 Risks to buffers	27
10. Lever 5 — Livelihoods and Health: Reducing Biological and Economic Vulnerability.....	28
10.1 Heat: the clearest case	28
10.2 What works: heat as a governable risk.....	29
10.3 Livelihoods: diversification and protection	29

10.4 Health systems as shock absorbers	29
11. Lever 6 — Circuit-Breakers: Decoupling Systems So Failure Does Not Spread	30
11.1 Why a separate lever.....	30
11.2 Four design patterns	30
11.3 Where to apply them first.....	30
11.4 The institutional dimension.....	31
11.5 The trade-off with efficiency	31
12. The Return on Resilience.....	32
12.1 The benefit-cost evidence	32
12.2 The triple dividend	32
12.3 Why the investment gap persists.....	33
12.4 Caveats on the evidence.....	33
13. Financing the Framework	34
13.1 Layer 1: prevention capital	34
13.2 Layer 2: reserves and shock-responsive budgets	35
13.3 Layer 3: contingent credit and debt design	35
13.4 Layer 4: risk transfer.....	35
13.5 Principles for deploying the architecture	35
14. Governing in an Age of Competition	36
14.1 Subsidiarity: act where the benefit lands	36
14.2 Institutions that outlast governments	36
14.3 Regional and plurilateral cooperation	36
14.4 Risks to the strategy itself	36
15. Prioritisation and Sequencing	38
15.1 A prioritisation matrix.....	38
15.2 Three horizons.....	39
15.3 The sequencing rule	40
15.4 Adapting the sequence to context	40
16. Lessons from Practice	41
16.1 Bangladesh: building capacity over decades	41
16.2 Jamaica: the value and limits of pre-arranged finance.....	41
16.3 Kenya: social protection that scales	42
16.4 Rwanda: health coverage as a financial buffer	42
16.5 Cross-case lessons.....	42
17. Measuring Whether Exposure Is Falling	43
17.1 A dashboard of indicators	43
17.2 Making measurement work.....	44
18. Conclusion: A Resilience Agenda for the Next Decade.....	45
18.1 The argument in brief.....	45
18.2 Ten priorities for the next five years	45
18.3 The choice	46
References and Further Reading	47

Executive Summary

Reduce who is exposed, loosen what is coupled, and enlarge what can absorb the loss. These three moves, applied across six levers, are the most reliable way to cut the human cost of cascading crises in the decade ahead.

Key findings

- **Exposure is the controllable term in the risk equation.** Hazards can be shaped only over decades. Exposure, vulnerability and coping capacity are shaped by siting, infrastructure, finance, health and governance decisions that can change within a political cycle.
- **Human exposure is very large and overlaps.** Between 3.3 and 3.6 billion people live in highly climate-vulnerable settings, 1.81 billion are exposed to a 1-in-100-year flood, about two billion lack adequate social protection, and 83.4 million were internally displaced at the end of 2024 (Section 3).
- **Exposure compounds.** Shocks stack faster than recovery, systems tip once coupling passes a threshold, and settlement and institutional patterns lock in. A stylised model shows that buffers raise the level of coupling a system can tolerate before a local failure becomes systemic (Section 4).
- **Six levers cover the problem.** Place, lifelines, anticipation, buffers, livelihoods and health, and circuit-breakers act on every term in the risk equation and every stage of a cascade (Sections 5 to 11).
- **The returns are high but the financing is not in place.** Early warning returns about nine dollars per dollar and resilient infrastructure about four, while international public adaptation finance (about US\$26 billion in 2023) is a fraction of estimated need (US\$310 to 365 billion a year by 2035) (Sections 12 and 13).
- **Layered finance is the practical route.** Prevention capital, reserves, contingent credit and risk transfer each fit a different risk layer, and the layers work best when linked and pre-arranged. Jamaica's catastrophe-bond payout after Hurricane Melissa shows both the value and the limits of risk transfer (Sections 9 and 13).
- **Governance has to work without perfect cooperation.** Subsidiarity, statutory long-term plans, ring-fenced maintenance finance and regional pooling let a country capture most of the benefit of the strategy whatever others do (Section 14).
- **Start cheap, start slow things early, and measure.** Early warning, registries and triggers come first; land use and infrastructure must begin at once because of long lead times; a public dashboard and annual stress tests keep the programme honest (Sections 15 to 17).

Ten priorities for 2026 to 2030

Section 18 sets out ten priority actions, led by the following: close early-warning gaps for the most exposed communities; build household registries and payment systems that can scale within days; pre-arrange contingent finance and anticipatory-action triggers; publish parcel-level hazard maps and tie them to permitting and public investment; and put backup power and cooling into hospitals, water plants and clinics. Each has been done somewhere, and each pays back more than it costs.

1. Introduction: From Hazards to Exposure

Hazards are mostly beyond human control. Exposure is not. The difference between a storm that kills thirty people and one that kills three hundred thousand has rarely been the storm; it has been where people lived, what they could rely on, and how much warning and money they had when it arrived.

The most common way of talking about global risk is to list hazards: heatwaves, floods, pandemics, wars, cyberattacks, financial crashes. The lists are useful, and the most authoritative of them, the World Economic Forum's [Global Risks Report 2026](#), now ranks geoeconomic confrontation first for the near term, with extreme weather, societal polarisation and misinformation close behind, and environmental risks dominating the ten-year horizon ([WEF, Global Risks Report 2026: Geopolitical and Economic Risks Rise in New Age of Competition](#)). But a list of hazards describes the weather, not the damage. Damage is what happens when a hazard meets people, and the number of people it meets, and how badly it hurts them, are the product of decisions made long before the hazard arrives.

This report takes that observation seriously and builds a strategy on it. Its central proposition is that, in an age of polycrisis, the most reliable way to reduce harm is to reduce *human exposure to cascading risk*: to shrink the number of people who are in the path of a shock, to weaken the channels through which one shock becomes several, and to enlarge the buffers that allow households and states to absorb what remains. This is a different emphasis from the one that dominates public debate. Mitigation, the effort to limit emissions and slow the growth of hazards, remains indispensable and is not the subject of this report. Adaptation, usually understood as technical protection against specific climate impacts, is part of the story but only part. The focus here is on the intersection where hazards become human outcomes, and on the far larger set of interventions, in housing, infrastructure, finance, health, information and governance, that determine how severe those outcomes are.

1.1 Why exposure, and why now

Three developments make an exposure-centred strategy more urgent than it was a decade ago. The first is the accumulation of physical hazard. The [IPCC's Sixth Assessment Report](#) finds that between 3.3 and 3.6 billion people live in settings that are highly vulnerable to climate change, and the [World Meteorological Organization](#) confirmed 2024 as the warmest year in the instrumental record, at about 1.55°C above the pre-industrial level. Hazards that were once rare enough to ignore are becoming routine enough to plan for.

The second is the growth of exposure itself. Populations and assets are concentrating in coastal cities, flood plains and heat-prone urban cores faster than protective infrastructure is being built. A 2022 global analysis published in *Nature Communications* found that [1.81 billion people, nearly one in four, live in areas exposed to a once-in-a-century flood](#), and that 89 per cent of them are in low- and middle-income countries. UN-Habitat reports that [about a quarter of the world's urban population, more than a billion people, lived in slums or informal settlements in 2024](#), and that the absolute number has risen since 2020 after years of decline.

The third is the coupling of risks. A pandemic became an education crisis, a debt crisis and a supply-chain crisis; a war became a food and energy crisis; a monetary tightening cycle became a fiscal squeeze that now crowds out the very spending that would make the next shock survivable. The term that has attached itself to this condition is *polycrisis*, defined by [Lawrence, Homer-Dixon and colleagues](#) as the causal

entanglement of crises across multiple global systems, such that the whole is more dangerous than the sum of its parts. Where crises are entangled, a household's exposure is no longer the exposure to any single hazard; it is the exposure to whatever the combined system can deliver.

1.2 What this report argues

The argument proceeds in five steps, and the report is organised around them.

- **Exposure is the controllable term.** Of the elements that make up human risk, hazard, exposure, vulnerability and coping capacity, the last three are products of policy and investment. They can be changed within a political cycle, whereas hazard can only be shaped over decades (Sections 2 to 5).
- **Exposure compounds.** Overlapping hazards, shared infrastructure and thin financial buffers mean that exposure to cascading risk grows non-linearly: the same shock does disproportionate damage once coupling passes a threshold (Sections 3 and 4).
- **Six levers reduce it.** Safe siting, hardened lifelines, anticipation, financial buffers, livelihood and health protection, and deliberate circuit-breakers between systems together address every term in the risk equation and every stage of a cascade (Sections 5 to 11).
- **The economics are favourable, but the finance is not in place.** The returns on resilience investment are large and well documented; the money that flows to it is a small fraction of what is needed (Sections 12 and 13).
- **Delivery is a governance problem.** The strategy has to be sequenced, financed and held together in an international environment that is fragmenting, which requires choosing priorities and building institutions that survive political turnover (Sections 14 to 18).

A note on method. The report is analytical rather than predictive. It synthesises institutional and peer-reviewed research, links every quantitative claim to its source in the text, and distinguishes clearly between documented data, illustrative schematics and the author's own judgement. Where a figure is a stylised model or a qualitative scoring, it says so.

2. The Anatomy of Cascading Risk

A cascade is not a large shock. It is a small or medium shock that finds a path into other systems and arrives at people as something much larger. Understanding the paths is the first step towards closing them.

Risk analysts distinguish between a *compound* event, in which two or more hazards coincide in time or space, and a *cascading* event, in which an initial hazard triggers a chain of secondary failures. Both matter for human exposure, and in practice they merge: a heatwave that coincides with a drought and strains a grid already short of hydropower is both. The common feature is that the consequence for people is determined less by the magnitude of the trigger than by the structure of the system it strikes.

2.1 Triggers, channels and outcomes

It helps to think of a cascade as having three layers (Figure 1). *Triggers* are the physical, biological, political or technological events that start it. *Transmission channels* are the shared systems through which stress propagates: electric power, water and sanitation, food markets, health services, public finance, and information and trust. *Human outcomes* are what the cascade finally does to people: injury and death, ill health and malnutrition, loss of income and assets, loss of housing and tenure, and interrupted education.

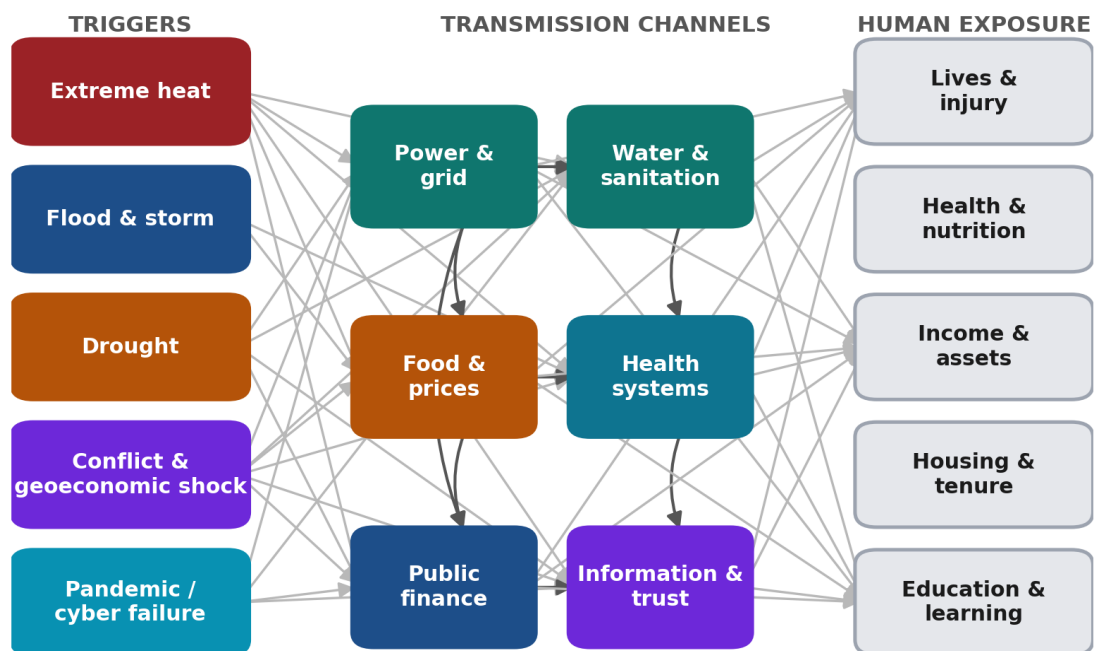


Figure 1. From trigger to human outcome: cascade pathways through shared systems.

Source: H Heuristics conceptual schematic, adapted from the causal-pathway framework in Lawrence, Homer-Dixon et al. (2024).

The figure makes a point that is easy to miss in sectoral policy: many triggers converge on a small number of channels, and many outcomes depend on the same channels. Electric power is the most important of these. Water pumping, hospital cooling and refrigeration, telecommunications and digital payments all depend on it, so a single grid failure arrives at households as a water outage, a health emergency, a food-spoilage problem and a cash-access problem at once. This is why the later sections of this report give such weight to lifelines.

2.2 The four properties that make cascades dangerous

Four structural properties explain why some systems cascade and others do not. Each corresponds to a design choice that a resilience strategy can change.

Table 1. Four structural properties of cascading systems and their human consequences

Property	What it means	Illustration	Design response
Tight coupling	Components depend on each other with little slack or delay	Just-in-time supply chains; grids tied to gas pipelines	Buffers, redundancy, manual fallbacks
Concentration	A few nodes carry a large share of function	One industrial region supplying a global component; one hospital serving a province	Diversify suppliers, sites and routes
Common causes	One hazard hits many components at once	Flood taking out roads, power and clinics together	Geographic spread; independent failure modes
Slow recovery	Repair capacity is thin, so damage persists and compounds	Months to restore housing, schools and clinics after a major storm	Pre-positioned repair capacity, pre-arranged finance

2.3 Evidence of cascades in practice

These properties are not theoretical. The 2011 floods in Thailand, which inundated seven industrial estates north of Bangkok, are the textbook case: a regional monsoon hazard hit a concentrated node of global manufacturing and propagated into worldwide supply shortages for hard drives and automotive parts ([World Bank and GFDRR, *Thai Flood 2011: Rapid Assessment for Resilient Recovery and Reconstruction Planning*](#)). In 2022 floods in Pakistan [submerged roughly a third of the country and caused more than US\\$30 billion in damage and losses](#), arriving in a country already under acute fiscal and food-price stress. And the learning losses of the pandemic show how a health shock reaches deep into human capital: the World Bank estimated that [learning poverty in low- and middle-income countries rose from 57 to 70 per cent](#) after school closures.

The pattern across these cases is consistent. The loss to people was not a function of the hazard's raw magnitude. It was a function of what the hazard touched, how tightly those things were tied together, and how little slack surrounded them.

2.4 The geopolitical overlay

A further feature of the current period is that the political environment for managing cascades is deteriorating at the moment the physical environment demands more cooperation. The WEF's 2026 survey finds that half of respondents expect a turbulent or stormy world over the next two years, and the report characterises the era as an age of competition ([WEF, *Global Risks Report 2026*](#)). Export restrictions,

sanctions and supply-chain securitisation add new channels through which a local shock becomes a global one, and they weaken the multilateral machinery that once smoothed them. A resilience strategy therefore cannot assume a cooperative world; it has to be built so that most of its benefit accrues to those who invest in it, whatever others do. That constraint returns in Section 14.

3. How Large Is Human Exposure?

The numbers are very large, they overlap, and they are concentrated among people with the least capacity to cope. Taken together they describe a global population that is far more exposed than the headline hazard statistics suggest.

No single statistic measures human exposure to cascading risk. Exposure has several dimensions (people in harm's way, people without protection, people already displaced) and each is measured by a different institution using different methods. Figure 2 places the principal indicators on a common logarithmic scale. The measures are not additive, since the same person can appear in several, but the overlap is itself the point.

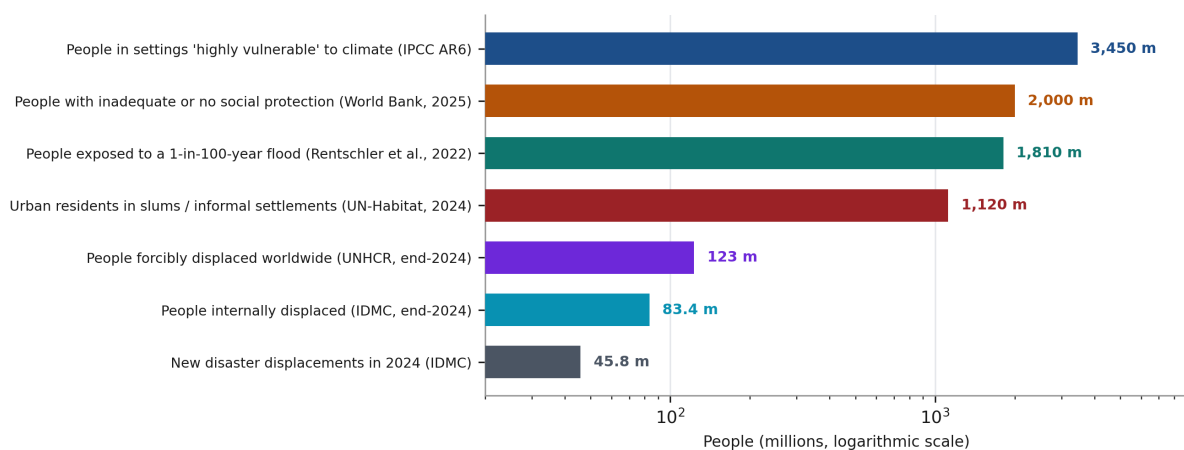


Figure 2. *The scale of human exposure: selected global indicators (millions of people).*

Sources: [IPCC AR6](#); [World Bank, State of Social Protection 2025](#); [Rentschler et al. 2022](#); [UN-Habitat/UN Stats](#); [UNHCR](#); [IDMC GRID 2025](#).
Indicators overlap and are not additive.

3.1 Exposure to physical hazard

The physical dimension is the best documented. Beyond the 1.81 billion people exposed to severe flooding, of whom about 780 million also live on less than US\$5.50 a day, the [World Meteorological Organization's atlas of weather, climate and water extremes](#) records nearly 12,000 reported disasters between 1970 and 2021, with about two million deaths and US\$4.3 trillion in economic losses, and shows that more than nine in ten of the deaths occurred in developing countries. Heat is increasingly the dominant killer. The [2025 Lancet Countdown](#) attributes roughly half a million deaths a year to heat, with heat-related mortality up by about 63 per cent since the 1990s, and records 639 billion potential labour hours lost to heat in 2024, equivalent to US\$1.09 trillion in income.

The cost does not fall evenly across the income distribution. The World Bank's *Unbreakable* study found that natural disasters cause [well-being losses equivalent to US\\$520 billion a year and push some 26 million people into poverty annually](#), with losses exceeding asset damage in every one of the 117 countries studied because poor households have so little capacity to cope.

3.2 Exposure through lack of protection

A second dimension is the absence of the protective systems that turn a shock into a recoverable event. The World Bank's [State of Social Protection Report 2025](#) finds that about two billion people in low- and middle-income countries are either uncovered or inadequately covered by social protection, 1.6 billion of them with no coverage at all. The [UNEP Adaptation Gap Report 2025](#) puts developing-country adaptation needs at US\$310 to 365 billion a year by 2035, against international public flows of about US\$26 billion in 2023, a gap of twelve to fourteen times. Early warning, discussed in Section 8, covers just [60 per cent of countries with a multi-hazard system, and only 43 per cent of small island developing states](#).

3.3 Exposure through displacement and conflict

The third dimension is the exposure of people already uprooted. The Internal Displacement Monitoring Centre's [Global Report 2025](#) put the number of people internally displaced at a record 83.4 million at the end of 2024, 73.5 million of them by conflict and violence, and recorded 45.8 million new disaster displacements during the year, the highest annual figure since tracking began in 2008. Many of the latter were pre-emptive evacuations, which is a success of a kind: early warning moved people out of harm's way. Forward-looking projections add to the concern: the World Bank's *Groundswell* analysis estimated that [climate change could force up to 216 million people to move within their own countries by 2050](#) under a pessimistic scenario, a figure that could fall by as much as 80 per cent with strong action.

3.4 Who is most exposed

Table 2. A typology of exposure and the groups most affected

Dimension	Indicator	Groups most affected	Principal cascade link
Hazard in place	Flood, heat, storm and drought exposure	Residents of informal urban settlements, coastal and delta populations, outdoor workers	Power, water and transport failures
Income and assets	Poverty, informality, lack of savings	Informal workers, smallholder farmers, female-headed households	Food prices, remittances, public finance
Physiology	Age, pregnancy, chronic illness, disability	Over-65s, infants, people with cardiovascular or kidney disease	Health-system and cooling failures
Services and protection	Social protection, insurance, warning coverage	People outside registries, remote and island communities	Information, finance and trust
Tenure and mobility	Displacement, insecure land rights	Internally displaced people, migrants, tenants without title	Housing, conflict and fiscal stress

Two features stand out. First, exposure dimensions cluster: the people who live in the most flood-exposed settlements are disproportionately those outside social protection and with the least access to warning. Second, the cluster is concentrated in countries with the least fiscal room to respond. The UN Conference on Trade and Development reports that [developing-country external debt reached a record US\\$11.4 trillion in 2024, and that 3.4 billion people live in countries that spend more on interest than on health or education](#). Exposure and fiscal fragility are, in short, not independent problems.

4. Why Exposure Compounds: Stacking, Thresholds and Ratchets

If risks simply added up, the policy problem would be large but tractable. They do not add up. Three mechanisms make exposure grow faster than the hazards that cause it, and each points to a specific kind of intervention.

4.1 Stacking: shocks that arrive before recovery

The first mechanism is simple: shocks arrive faster than recovery. A household that loses assets to a flood and has not rebuilt them before a drought arrives faces the second shock with a smaller buffer than it had for the first. The same is true of states. Hurricane Melissa's [preliminary damage in Jamaica was estimated at US\\$8.8 billion, about 41 per cent of 2024 GDP](#), and Dominica's losses from Hurricane Maria were [226 per cent of the previous year's GDP](#). Economies hit on that scale do not recover in the interval between storms.

The consequence is a ratchet. Each shock lowers the baseline from which the next is absorbed, so that a country or household can be driven down a staircase of losses by a series of events that, individually, would have been survivable. The 2025 [UNDRR Global Assessment Report](#) describes the macro version of this: a cycle of rising debt, shrinking insurance access and growing dependence on humanitarian relief, which it estimates alongside total disaster costs of more than US\$2.3 trillion a year once indirect and ecosystem losses are counted.

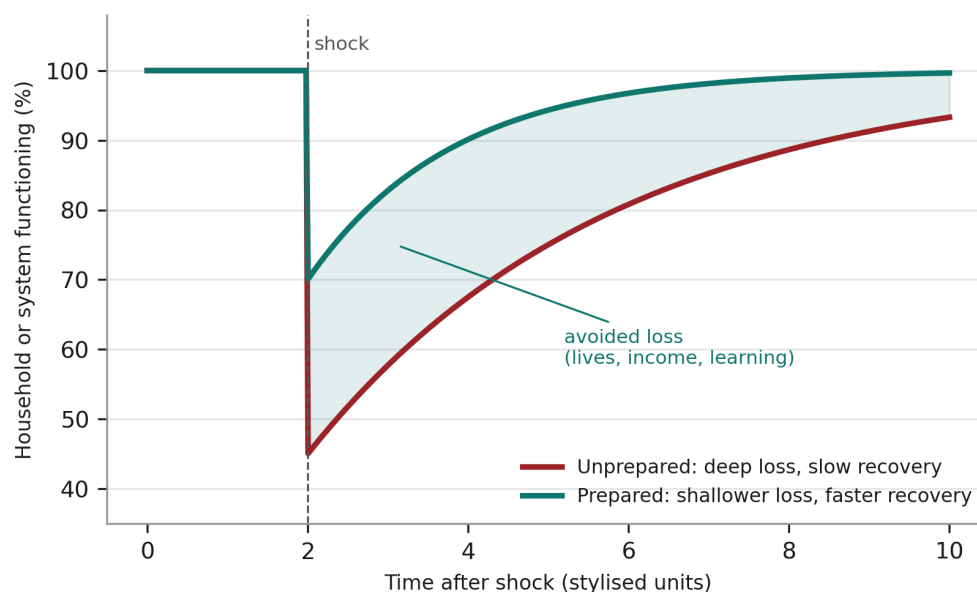


Figure 3. The resilience curve: preparation changes both the depth of the loss and the speed of recovery.

Source: H Heuristics stylised schematic; not empirical data. The shaded area represents loss avoided through preparation.

4.2 Thresholds: when coupling tips a system

The second mechanism is non-linear. In network models of cascading failure, whether a local shock stays local or spreads across the whole system depends sharply on two parameters: how strongly the components are coupled to each other, and how much slack each component has before it fails. Below a critical level of coupling, failures are contained within the originating sector. Above it, the same initial shock sweeps through the system.

Figure 4 illustrates this with a stylised threshold model constructed for this report. The system consists of five interlinked sectors of 200 nodes each. A shock disables 30 per cent of the nodes in one sector. A node then fails if the share of its neighbours that have failed reaches its failure threshold, which stands in for buffers: spare capacity, savings, redundant supply. The model is not a forecast and its parameters are arbitrary; its value is in the shape of the result.

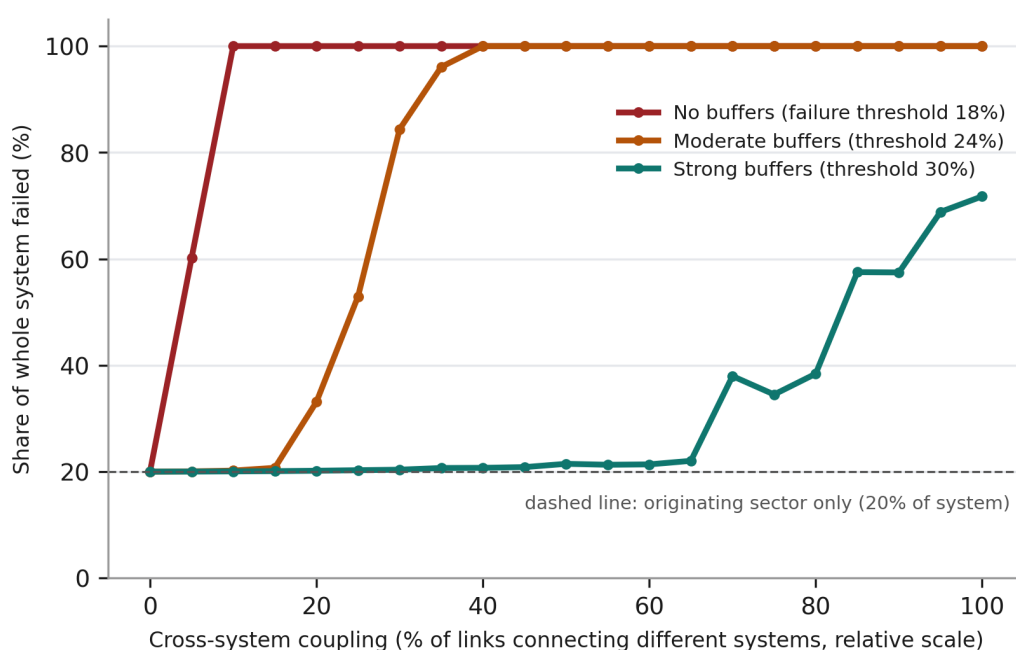


Figure 4. Stylised cascade model: buffers push the tipping point of system-wide failure to much higher levels of coupling.

Source: H Heuristics threshold-cascade simulation (five sectors, 1,000 nodes, mean of 20 runs per point). Illustrative only; thresholds and coupling scale are arbitrary.

Three conclusions follow, and they recur through the rest of the report. With no buffers, a system collapses at very low coupling: even a modest number of cross-sector links is enough to carry the initial failure everywhere. Moderate buffers shift the tipping point a long way to the right. Strong buffers keep the failure confined to the originating sector until coupling is very high, and even then only partial. The practical implication is that investing in slack, in the form of savings, spare capacity and redundant routes, is not an alternative to reducing coupling; it is a way of raising the coupling a system can tolerate. And because modern systems are becoming more coupled, not less, the buffers have to grow at least as fast.

4.3 Ratchets: how exposure becomes locked in

The third mechanism concerns the persistence of exposure. Physical settlement patterns, once established, are very hard to change, and the choices made in a fast-growing city in the next decade will fix exposure for the next century. A neighbourhood built on a flood plain with substandard housing becomes the place where the poorest households live because land is cheap, which in turn makes it politically costly to relocate or protect them. Infrastructure follows population, and once it is built it shapes the next round of settlement. The same lock-in applies to institutions: a country that has not built a household registry cannot deliver cash quickly in a crisis, and a country that cannot deliver cash quickly loses the political trust it would need to build one.

Lock-in cuts both ways. Safe siting, building codes and registries, once in place, are also hard to reverse, and they compound in the right direction. This is the reason the report places so much emphasis on the next decade: it is the period in which an enormous volume of new building, infrastructure and institutional capacity will be established, and in which the cost of getting it right is lowest.

5. A Strategic Framework: Six Levers to Reduce Exposure

A strategy has to say what to do and what to do first. The framework below organises the field into six levers that together address every term in the risk equation and every stage of a cascade, supported by an enabling layer of finance, governance, data and sequencing.

5.1 The logic of the framework

The conventional risk equation expresses human risk as the product of hazard, exposure and vulnerability, reduced by coping capacity. This is the logic underlying the [Sendai Framework for Disaster Risk Reduction 2015 to 2030](#), the main international agreement on the subject, and it is the right starting point. The difficulty with using it as a policy guide is that it hides two things that the preceding sections have shown to be central: the interaction between hazards, which makes the terms non-additive, and the coupling between the systems on which people depend.

The framework adds that dimension. It identifies six levers (Figure 5), each of which acts on a specific part of the equation or the cascade. *Place* and *anticipation* act on exposure: they change who is in the path of a hazard and when. *Lifelines* and *livelihoods and health* act on vulnerability: they change how much a given hit hurts. *Buffers* act on coping capacity. *Circuit-breakers* act on the cascade itself, by decoupling systems so that failure does not spread.

$$\text{Human risk} = \text{Hazard} \times \text{Exposure} \times \text{Vulnerability} \div \text{Coping capacity}$$

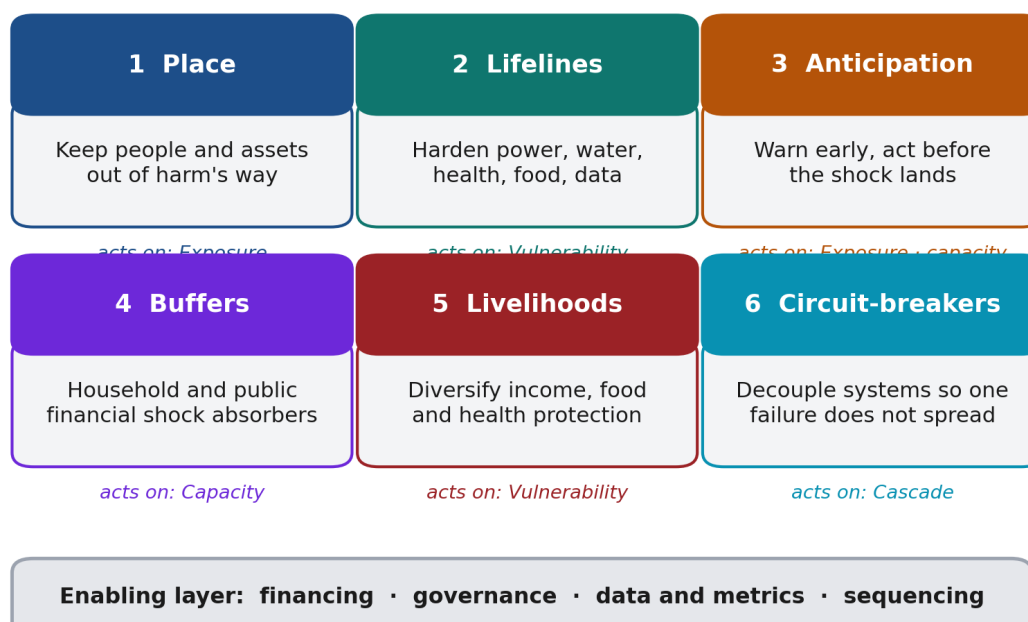


Figure 5. The six-lever framework for reducing human exposure to cascading risk.

Source: H Heuristics framework.

5.2 The six levers at a glance

Table 3. Summary of the six levers

Lever	Core question	Typical interventions	Evidence base
1. Place	Who is in harm's way?	Risk-informed land use, building codes, flood and heat zoning, managed relocation	Rentschler et al.; IPCC AR6 WGII Ch. 6
2. Lifelines	What do people depend on?	Resilient power, water, health, transport and digital infrastructure	World Bank <i>Lifelines</i>
3. Anticipation	How much warning, and what action?	Multi-hazard early warning, anticipatory cash, evacuation systems	WMO; WFP; Bangladesh record
4. Buffers	What can absorb the loss?	Adaptive social protection, savings, contingent finance, risk transfer	World Bank; CCRIF; Jamaica cat bond
5. Livelihoods & health	How fragile are bodies and incomes?	Heat-health plans, diversified livelihoods, climate-ready health systems	Lancet Countdown; ILO; Ahmedabad
6. Circuit-breakers	Where can spread be stopped?	Redundancy, modularity, manual fallbacks, supply diversification	Network-cascade literature; Thai floods

5.3 Design principles

Six principles guide how the levers are applied. They are stated here because they shape the trade-offs in the sections that follow.

- **Reduce exposure before relying on response.** A person who is not in the path of a hazard needs no rescue. Prevention costs less than cure, and the evidence reviewed in Section 12 shows by how much.
- **Favour measures that work across hazards.** Registries, warning systems and hardened lifelines serve flood, heat, storm and conflict alike. Single-hazard measures are justified only where a hazard dominates.
- **Build before the shock.** Registries, trigger agreements, contingent credit and shelters are cheap to build in peacetime and impossible to improvise in a crisis.
- **Protect the vulnerable first, because they are the cascade's endpoint.** Poor, old, sick and displaced people absorb the largest share of loss per dollar of damage. Equity is therefore not an add-on but a source of efficiency.
- **Create slack deliberately.** Efficiency pursued without margin makes systems brittle. Resilience spending is partly the purchase of spare capacity that is idle most of the time.
- **Design for a non-cooperative world.** Where possible, choose measures whose benefits accrue to those who invest in them, and treat multilateral support as a bonus rather than a prerequisite.

The six sections that follow take each lever in turn, setting out the evidence on what works, the constraints that bind, and the interactions with the other levers.

6. Lever 1 — Place: Keeping People and Assets Out of Harm's Way

The cheapest way to protect a person from a flood is not to build the house in the flood's path. Yet most of the world's urban growth over the next quarter-century will be built, under pressure and in haste, on whatever land is available.

Place is the lever with the longest lead time and the greatest permanence. Land-use decisions determine exposure for generations, and they are made by thousands of local authorities, developers and households rather than by any central planner. The task of strategy is therefore less to design cities than to change the incentives and information under which they are built.

6.1 The problem: urbanisation without risk information

The [IPCC's assessment of cities, settlements and key infrastructure](#) finds that urban areas concentrate both exposure and vulnerability, and that informal settlements, which often occupy the least safe land, are among the most affected. UN-Habitat's data show that the [slum population grew by 191 million between 2020 and 2024](#), reversing the earlier downward trend. The households concerned are not choosing risk; they are choosing proximity to work and affordable land, and the unsafe parcels are what remain.

Three failures recur. First, risk information is often unavailable or unused: hazard maps are missing, out of date or not incorporated into permitting. Second, building codes are weak or unenforced, so that even in safe locations structures fail under moderate loads. Third, land markets do not price risk, either because insurance is absent or because government bail-outs after disasters dull the signal. The result is that the exposed population grows faster than the protective capacity around it.

6.2 What works

Risk-informed land use and zoning

The most robust intervention is also the least glamorous: publish hazard maps at parcel level and make them binding on permitting, public investment and lending. Where flood, heat and landslide risk is mapped and the maps govern where schools, clinics and housing may be built, new exposure falls. The instrument is cheap relative to its effect, but it is politically demanding because it constrains land value. Countries that have succeeded, from the Netherlands to Bangladesh, have done so by embedding risk assessment in long-horizon planning documents with statutory force. Bangladesh's [Delta Plan 2100](#) frames delta management as a multi-decade programme requiring around 2.5 per cent of GDP annually, including an explicit allocation for operations and maintenance.

Building codes and retrofitting

Codes are the point at which land-use policy meets the individual household. A code that is enforced for new construction cuts losses at small marginal cost; the World Bank's *Lifelines* analysis finds that [resilience built into new infrastructure adds only about 3 per cent to cost while returning around four dollars per dollar invested](#). Retrofitting existing stock is more expensive but justified where occupancy is dense and hazards

are frequent, particularly for schools and hospitals, whose failure in a shock removes the services that recovery depends on.

Cooling and nature-based protection

Urban design can also lower the hazard itself. Cool roofs, shade trees and permeable surfaces reduce heat exposure; restored wetlands and mangroves attenuate floods and storm surge. These measures belong with Place because they change what the hazard does to a given neighbourhood, and because they are cheapest when designed into new districts rather than added later.

6.3 The hardest case: managed relocation

Where hazards will become unmanageable, the honest answer is to move people. Managed relocation is the most contested element of the Place lever, and the evidence is cautionary: relocation programmes that move people far from their livelihoods, or that are imposed without consent, often leave households worse off and end with residents drifting back to the original site. The principles that appear in successful cases are consistent: relocation should be voluntary where possible and compensated adequately, should keep communities and their livelihood networks intact, and should offer a destination that is safer *and* economically viable. It is slow, expensive and should be reserved for the highest-risk settlements. The roadmap in Section 15 accordingly places it in the third horizon.

6.4 Interactions with other levers

Place interacts most strongly with Lifelines, since the siting of infrastructure and the siting of people are the same decision, and with Buffers, because safe siting lowers the insurance premium and the contingent liability that governments carry. It is also the lever most sensitive to governance: where local authorities lack both the technical capacity and the fiscal resources to enforce rules, mapping alone does not change what is built. This is one reason why Section 14 treats subnational capacity as a priority.

7. Lever 2 — Lifelines: Hardening the Systems People Depend On

Power, water, health care, food distribution and digital connectivity are not sectors like any other. They are the channels through which every cascade travels, and protecting them is the highest-leverage use of public capital in a resilience strategy.

Section 2 argued that a small number of shared systems carry most of the weight in cascades. The Lifelines lever therefore focuses on protecting those systems, not on making every asset invulnerable, which would be impossible, but on ensuring that the functions people cannot do without continue to work, or fail gracefully, when the hazard strikes.

7.1 Why lifelines justify priority

The economic case rests on the *Lifelines* analysis from the [World Bank and GFDRR](#), which found that disruption of infrastructure services costs low- and middle-income economies hundreds of billions of dollars a year, and that making new infrastructure resilient yields about four dollars of benefit per dollar spent. Crucially, most of the benefit comes not from avoiding damage to the asset but from avoiding the downstream losses to the businesses and households that depend on the service.

The human side is equally clear. When the grid fails, hospitals lose cooling and refrigeration for vaccines; water treatment stops; mobile networks and payment systems go dark; and households lose the ability to buy food or call for help. The mechanism that converts an infrastructure outage into a health emergency is rarely the outage itself; it is the dependence of other lifelines on the failed one.



One regional hazard, one concentrated node, a global tail: the shape of a cascade

Figure 6. The 2011 Thai floods: one regional hazard, one concentrated node, a global tail.

Source: H Heuristics schematic based on [World Bank and GFDRR, Thai Flood 2011: Rapid Assessment](#).

7.2 A lifeline hierarchy

Not all lifelines are equal. A useful ordering puts those on which the others depend at the top and gives them the strongest protection.

Table 4. A hierarchy of lifelines and priority protection measures

Tier	System	Why it ranks here	Priority measures
1	Electric power	Powers every other lifeline; failure propagates fastest	Distributed generation and storage for critical loads; islanding capability; flood- and heat-proofed substations
2	Water and sanitation	Public health depends on continuous supply and treatment	Backup power at pumps and plants; protected intakes; emergency supply plans
3	Health facilities	Where cascades end in death or recovery	Solar-plus-storage for clinics; cooling; supply of essential medicines; hardened structures
4	Food distribution and storage	Price and access shocks reach the poorest first	Strategic reserves; cold chains; diversified import routes; market information
5	Transport and communications	Enable evacuation, aid delivery and coordination	Redundant routes; resilient mobile networks; offline-capable systems
6	Digital identity and payments	Enable cash delivery and access to services in a crisis	Offline resilience; interoperability; data protection

7.3 What works

Distributed power for critical loads

Centralised grids are efficient but fragile: a failure at one node can black out millions, as the April 2025 outage across Spain and Portugal demonstrated. The resilience-oriented alternative is to supplement the grid with local generation and storage at critical sites, so that clinics, water plants and communication hubs continue to run when the grid does not. Solar-plus-storage has fallen in cost to the point where this is increasingly the economic choice, not merely the resilient one. The same logic favours microgrids for communities at the end of fragile lines.

Design for failure, not just for strength

Resilient design accepts that failure will occur and arranges for it to be partial, local and recoverable. In practice that means redundancy for critical components, modular layouts that can be isolated, spare parts and repair crews pre-positioned, and manual fallbacks when digital systems fail. These measures are often cheaper than hardening against all conceivable loads, and they address the unknown unknowns that no hazard map covers.

Maintenance as resilience policy

A large share of infrastructure failure arises not from extreme hazard but from deferred maintenance. Budgets that fund construction but not upkeep leave assets weaker each year. A resilience strategy should therefore treat maintenance finance as a first-order commitment, with dedicated funding streams that are protected against the first round of fiscal cuts. Bangladesh's inclusion of operations and maintenance in its Delta Plan budget is a model.

7.4 Constraints

Two constraints bind. The first is finance: many of the countries where lifeline fragility is greatest are those with the least fiscal space, and the capital cost of infrastructure there is inflated by high risk premiums. Section 13 returns to the financing architecture. The second is institutional: resilient infrastructure requires coordination across utilities, ministries and levels of government that rarely have shared planning. A country that treats its power, water and health ministries as separate silos will build lifelines that fail together.

8. Lever 3 — Anticipation: Early Warning and Acting Before the Shock

Warning is the cheapest form of protection that exists. It converts a shock that would have caught people unprepared into an event they could move away from, and it is the single best-documented route to cutting deaths.

The anticipation lever covers the technologies, institutions and finance that allow people to act in the interval between the first signs of a hazard and its impact. It is notable for two reasons: its returns are unusually high, and its coverage is unusually incomplete.

8.1 The evidence on returns

The World Meteorological Organization puts the benefit-cost ratio of multi-hazard early warning at roughly nine to one, and finds that countries with limited warning coverage suffer around six times the disaster mortality of well-covered ones ([WMO, *The Triple Dividends of Early Warning Systems and Climate Services*](#)). The Global Commission on Adaptation found that twenty-four hours of warning ahead of a storm reduces resulting damage by around 30 per cent ([GCA, *Adapt Now*](#)). The WMO's long-run disaster record shows the effect in aggregate: [disasters have grown more frequent and costly over five decades, but deaths have fallen](#), a pattern the organisation attributes substantially to better warning and preparedness.

8.2 The coverage gap

The UN's [Early Warnings for All](#) initiative, launched in 2022, aims for universal coverage by 2027. The latest status report finds that [119 countries, about 60 per cent, now report a multi-hazard early warning system, a 113 per cent increase since 2015, but only 43 per cent of small island developing states do](#). The gaps are not only technical. Warnings fail at the last mile: they are not understood, not trusted, not translated into local languages, or not accompanied by a safe place to go and a reason to leave.

8.3 From warning to action

The most important recent development is the move from warning to *anticipatory action*: pre-agreed plans, with pre-agreed financing, that release resources when a forecast crosses a trigger threshold, before the hazard arrives. The [UN OCHA anticipatory action framework](#) and the World Food Programme's [anticipatory cash transfers in Bangladesh](#) have shown that giving households money days before a flood allows them to move assets, buy food and water and evacuate livestock, reducing the harm the flood inflicts. The Oxford Centre for the Study of African Economies has summarised the emerging evidence on [anticipatory cash transfers in climate disaster response](#). The logic is the same as for any form of buffer, applied to timing: a dollar spent before the shock does more than a dollar spent after it.

8.4 Bangladesh: the benchmark case

Bangladesh is the clearest demonstration of what a sustained commitment to anticipation can achieve. Cyclone Bhola in 1970 killed on the order of 300,000 people; Cyclone Amphan in 2020 struck a more populous coast and killed fewer than thirty after authorities moved [around 2.4 million people into more](#)

than 12,000 shelters. The change was assembled from unglamorous components: a volunteer-based [Cyclone Preparedness Programme](#) that reaches coastal villages, thousands of multipurpose shelters, improved forecasting and rehearsed evacuation protocols ([Our World in Data](#); [UCL analysis](#)).

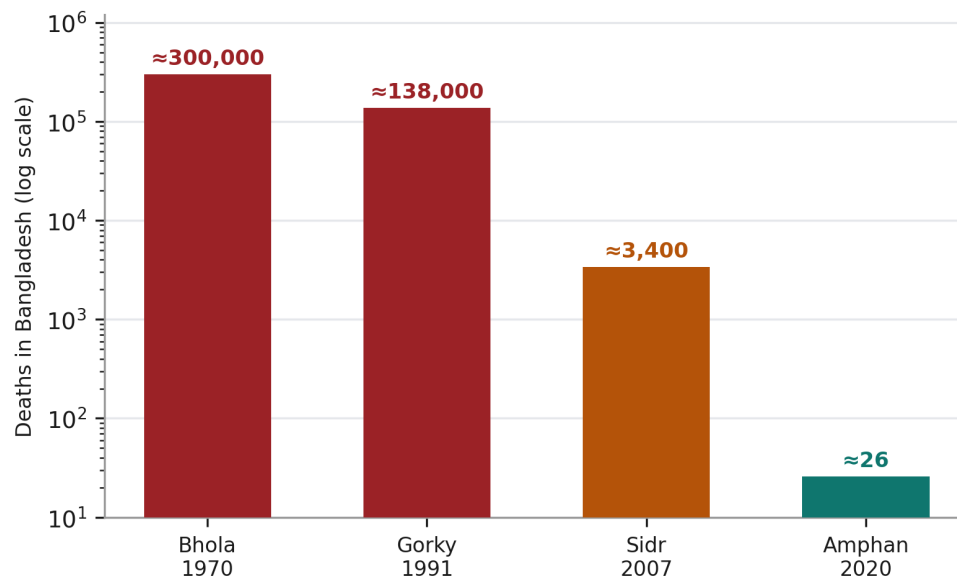


Figure 7. Deaths from major Bangladesh cyclones, 1970 to 2020 (approximate, logarithmic scale).

Sources: [The Conversation](#) / [UCL](#); [Our World in Data](#). Reported tolls vary slightly by source; values rounded.

Three features of the Bangladeshi model generalise. It relied on the community, not just the state: volunteers carry warnings to households and help with evacuation. It was built over fifty years, which means the capacity survived changes of government. And it combined warning with a physical destination, shelters, so that the warning had somewhere to lead.

8.5 Design priorities

- **Finish the last mile.** Prioritise coverage of the most exposed communities, in local languages and through multiple channels, over further sophistication of forecasting.
- **Pair warning with an action.** Shelters, evacuation routes, pre-positioned supplies and anticipatory cash must exist before a warning can save lives.
- **Pre-agree triggers and finance.** Anticipatory action works only if funds and decision rules are in place before the forecast, which makes it a Buffers question as much as an Anticipation one.
- **Extend beyond weather.** The same architecture can warn of heat, disease outbreaks, food-price spikes and cascading infrastructure failure, and doing so would give the lever its cross-hazard character.

9. Lever 4 — Buffers: Household and Public Financial Shock Absorbers

The simulation in Section 4 showed that slack determines how much coupling a system can survive. For people, the most important form of slack is money, in the right hands, at the right time.

Buffers are the resources that let a household, business or government absorb a loss without a cascade of secondary harms: selling productive assets, pulling children from school, skipping meals, or borrowing at ruinous rates. They operate at three levels, and a coherent strategy builds all three.

9.1 Household buffers: savings, insurance and social protection

At the household level the dominant policy instrument is *adaptive social protection*: social protection systems designed to expand quickly when shocks hit. The World Bank defines the approach as combining routine support for the chronically poor with the ability to scale up to additional households in a crisis ([Adaptive Social Protection: Building Resilience to Shocks](#)). Its value was demonstrated at extraordinary scale during the pandemic, when emergency measures reached some 1.7 billion people in developing countries, but the same experience exposed the problem: where no routine system existed to expand, delivery was slow, partial and poorly targeted. Today about two billion people remain uncovered or inadequately covered ([World Bank, State of Social Protection Report 2025](#)).

The lesson is that a shock-responsive system has to be built before the shock. That means a registry of households that is wider than the routine caseload, a payment mechanism that works when networks are disrupted, a pre-agreed trigger, and a financing line. Kenya's Hunger Safety Net Programme, which maintains a registry well beyond its regular caseload and scaled up payments within weeks across the 2021 to 2023 Horn of Africa drought, is a leading example ([World Bank, How the World Bank Supports Shock-Responsive Social Protection Systems](#)).

9.2 Public buffers: fiscal space and contingent finance

States face the same logic at a larger scale, and many are far less protected than their citizens assume. A government that must raise taxes or cut spending after a disaster deepens the shock; one with a pre-arranged line of credit or insurance payout does not. The instruments span a spectrum from reserves to risk transfer:

- **Contingency funds and reserves** hold money for frequent, moderate events. They are cheap but small, and are usually the first thing to be raided in a budget squeeze.
- **Contingent credit** gives pre-approved access to borrowing when a trigger is met. The IMF's [Resilience and Sustainability Trust](#) and the multilateral development banks' contingent facilities are the main sources.
- **Climate-resilient debt clauses** pause debt service after a defined disaster. They convert a fixed obligation into a state-contingent one, as described in [Climate Policy Initiative's primer](#).
- **Risk transfer**, through parametric insurance and catastrophe bonds, shifts the tail of the distribution to capital markets. When Hurricane Melissa struck Jamaica in 2025 it [triggered a 100 per cent payout of the US\\$150 million World Bank catastrophe bond](#), providing immediate liquidity, although the payout covered a small share of a loss estimated at US\$8.8 billion.

The Jamaican case carries a double lesson. Pre-arranged finance worked as designed and delivered cash within days, which is exactly what cat bonds are for. But the gap between the payout and the loss shows that risk transfer is a complement to, not a replacement for, prevention and fiscal buffers. A country that relies on insurance for events it could have prevented pays premiums for losses it should not have to bear.

9.3 Connecting the levels

The most effective buffer systems link household and public layers. A government with contingent finance can fund an expansion of social protection; a social protection system with a registry can deliver cash within days; an early-warning trigger can release both. Each link is simple on its own and difficult to arrange in the middle of a crisis, which is why the design work has to be done in advance. The [Global Shield against Climate Risks](#) is the main international vehicle for building these linkages in vulnerable countries and is discussed in Section 13.

9.4 Risks to buffers

Three risks deserve attention. *Basis risk* arises when a parametric trigger pays out less than the loss, or pays out when no loss occurs; it can be managed but not eliminated. *Moral hazard* arises if buffers weaken incentives to reduce exposure, which is why they should be conditioned on risk-reduction measures. And *fiscal crowding* arises when buffer financing competes with other priorities: the UNCTAD data cited earlier show that [3.4 billion people live in countries that spend more on interest than on health or education](#), leaving little room for new commitments unless debt relief and concessional finance expand alongside.

10. Lever 5 — Livelihoods and Health: Reducing Biological and Economic Vulnerability

Two people in the same flood, or the same heatwave, do not suffer the same harm. The difference lies in their bodies, their incomes and the health systems they can reach. This lever reduces the harm that a given hazard does to a given person.

The first four levers act on the hazard's path and on the resources around it. The fifth acts on people themselves: on the physiology that determines how a heatwave is survived, on the income that determines whether a drought ruins a household, and on the health services that determine whether an illness becomes a death.

10.1 Heat: the clearest case

Heat illustrates the lever better than any other hazard because its toll is so heavily mediated by vulnerability and so responsive to cheap intervention. The [World Health Organization](#) and the [2025 Lancet Countdown](#) attribute roughly half a million deaths a year to heat. Reconstructions of European mortality in [Nature Medicine](#) estimated about 61,700 heat-related deaths across the continent in the summer of 2022 and about 47,700 in 2023, and the [corresponding analysis for 2024](#) put the toll at around 62,800. These are among the richest countries in the world, with air conditioning, universal health systems and advanced warning. The figures show that heat remains lethal even where resources are abundant, and that the mortality is concentrated among the elderly.

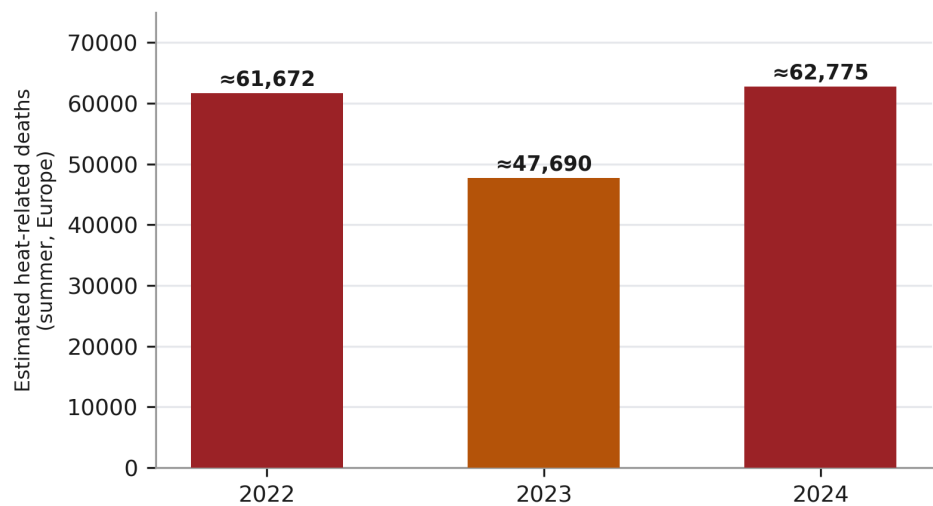


Figure 8. Estimated heat-related deaths in Europe, summers of 2022, 2023 and 2024.

Sources: [Ballester et al., Nature Medicine \(2023\)](#); [Nature Medicine \(2024\)](#); [Nature Medicine \(2025\)](#). Estimates are modelled and rounded.

In poorer settings the economic channel is as important as the clinical one. The [International Labour Organization](#) has documented how heat stress cuts productivity and endangers outdoor workers, and the Lancet Countdown's estimate of US\$1.09 trillion in lost income in 2024 falls most heavily on agriculture and construction in low- and middle-income countries. Heat also reaches the next generation: research on

[classroom heat and learning](#) finds measurable losses in student achievement, and studies have linked [extreme heat to preterm birth and stillbirth](#) in lower-middle-income countries.

10.2 What works: heat as a governable risk

The best-documented response is the heat-health action plan. Ahmedabad, in western India, recorded 46.8°C in May 2010 and roughly 1,344 excess deaths in that month alone. The city then developed [South Asia's first heat-health action plan](#), combining early warning, public awareness, training for health workers, cool-roof programmes and access to water. A [pilot evaluation of its impact on all-cause mortality](#) found that the plan was associated with about 1,190 fewer deaths a year, and the plan has since been [credited with avoiding on the order of 1,100 deaths annually](#). India's disaster-management authority has since pushed [more than twenty heat-prone states to adopt plans](#). The [Global Heat Health Information Network](#) maintains a library of other cases. The elements are inexpensive relative to their effect and are replicable.

10.3 Livelihoods: diversification and protection

Income vulnerability follows from dependence on a single, weather-exposed source of income. Smallholder farmers dependent on rain-fed agriculture, fisherfolk and outdoor day labourers carry the greatest risk because a single hazard removes both their income and their food. The evidence-based responses combine diversification, such as drought-tolerant varieties and off-farm income opportunities, with protection, such as index insurance and savings groups, and with information, such as seasonal forecasts and market prices delivered by mobile phone. The common thread is to reduce the correlation between a household's income and its hazard, so that one bad season does not mean ruin.

Livelihood programmes interact with Buffers: a farmer with an insured crop and a savings account can plant a riskier but more productive variety. They also interact with Anticipation, since seasonal forecasts allow earlier decisions on planting, destocking and migration. The programmes that have worked best have bundled these components rather than offering them separately.

10.4 Health systems as shock absorbers

Health systems stand at the end of most cascades, and their resilience determines how many of the people harmed survive. A climate-resilient health system has a handful of capabilities that can be planned and funded: facilities that keep functioning when power and water fail (Section 7), surveillance that detects outbreaks and heat-related admissions early, supply chains for essential medicines that are diversified and pre-positioned, and a workforce trained for climate-sensitive conditions. Rwanda's community-based health insurance, which covers [more than 90 per cent of the population](#) in a low-income setting, shows that universal coverage is achievable on modest budgets and provides the financial buffer that lets households seek care before an illness becomes catastrophic.

Heat and health also interact with the demographic transition. Because the proportion of older people is rising everywhere, exposure to heat and to disruption of care will grow even if hazards stayed constant. The Lancet Countdown reports that [heat-related mortality among people over 65 has risen by around 85 per cent](#) since the 1990s, much faster than ageing alone would imply, which suggests that the health system's capacity to protect the elderly is a priority.

11. Lever 6 — Circuit-Breakers: Decoupling Systems So Failure Does Not Spread

The first five levers make individual systems stronger. The sixth makes the connections between them safer. It is the lever most specific to polycrisis, and the one that conventional risk management is least equipped to supply.

A circuit-breaker in electrical engineering interrupts current before it can damage the equipment downstream. The analogy for a social and economic system is a design feature that stops a failure in one part from propagating into another. The idea is common in engineering and finance, where it takes forms such as grid islanding, trading halts and bank resolution regimes, and it is underused in the management of everyday life.

11.1 Why a separate lever

The stylised model in Section 4 showed that the tipping point of system-wide failure depends on coupling as well as buffers. The other levers raise buffers; only this lever reduces coupling. Because coupling is often created by efficiency drives (single suppliers, shared platforms, just-in-time inventories), it tends to grow unnoticed until a shock reveals it. Deliberately limiting it costs something in the good times, and that is why it needs to be a named strategic choice rather than a by-product.

11.2 Four design patterns

Table 5. Circuit-breaker design patterns for human-facing systems

Pattern	How it works	Example application	Cost
Redundancy	Duplicate critical functions so one failure does not stop service	Backup power at clinics; two independent suppliers for essential medicines	Moderate; idle capacity
Modularity	Divide systems into semi-independent units that can be isolated	Microgrids that island from the main grid; regional food hubs	Moderate; planning complexity
Slack and stockpiles	Hold reserves that decouple supply from demand shocks	Strategic grain and fuel reserves; medical stockpiles; inventory buffers	Storage and carrying costs
Manual fallbacks	Retain non-digital procedures for essential services	Paper records at hospitals; offline payment modes; radio warnings	Low; training and drills

11.3 Where to apply them first

Because circuit-breakers cost something, they should be applied where the potential cascade is largest, which means at the nodes with the greatest concentration and the most connections. Three candidates stand out. The first is electric power, where the cost of islanding and distributed supply is falling quickly. The second is food and fertiliser supply, where a small number of exporters and chokepoints supply most of the world's staples to countries with narrow fiscal margins. The third is digital infrastructure: payments, identity

and communications systems that nearly every other service now depends on, and whose failure, whether through a cyberattack or an outage, would cut people off from cash, information and help at once.

11.4 The institutional dimension

Circuit-breakers also exist in the institutional sense. Pre-agreed rules that suspend debt service after a disaster, trade rules that restrict export bans on food in a crisis, and emergency protocols that coordinate agencies are all ways of preventing a shock in one policy domain from spilling into another. They are harder to establish than physical redundancy because they require agreement among parties with different interests, but they are cheap to maintain once agreed. The climate-resilient debt clauses discussed in Section 9 are an example of an institutional circuit-breaker that has begun to spread.

11.5 The trade-off with efficiency

The principal objection to circuit-breakers is that they reduce efficiency, and it is a fair one. A system with redundancy, stockpiles and modularity costs more to run than a lean one in normal times. The answer is that efficiency is measured against the typical state of the world, and resilience against its tail. When the tail is becoming heavier, the optimal level of slack rises. The sensible approach is therefore not to eliminate efficiency but to price the tail: to compare the carrying cost of a buffer with the expected loss from the cascade it prevents. Section 12 sets out the evidence that this comparison, applied to the interventions in this report, generally favours resilience.

12. The Return on Resilience

A resilience strategy competes for scarce public money against health, education and infrastructure. It wins that competition only if the returns are as high as advocates claim. The evidence suggests they are, and by a wide margin.

The case for investing in resilience rests on a body of cost-benefit work that has accumulated over fifteen years. It is more consistent than most areas of development economics, although its quality varies and its estimates depend on assumptions that deserve scrutiny.

12.1 The benefit-cost evidence

Figure 9 summarises three widely cited estimates. The Global Commission on Adaptation's [Adapt Now](#) assessment found that US\$1.8 trillion invested across five categories between 2020 and 2030 could generate US\$7.1 trillion in net benefits, with benefit-cost ratios from roughly two to one to ten to one. The World Bank's [Lifelines](#) finds about four dollars of benefit per dollar invested in resilient infrastructure, and the WMO puts early warning at about nine to one ([WMO](#)). The 2026 [IFC study](#) of adaptation and resilience investment in infrastructure points in the same direction.

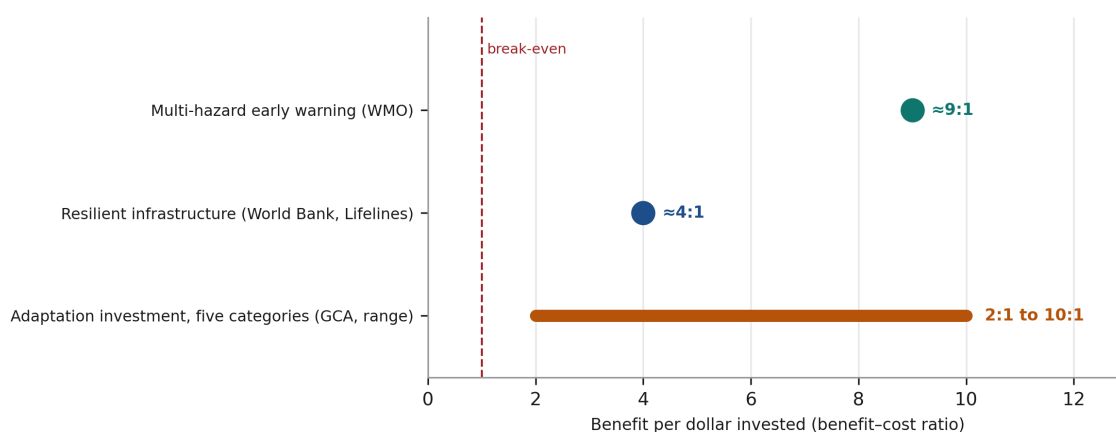


Figure 9. Benefit-cost ratios for selected resilience investments.

Sources: [WMO](#); [World Bank/GFDRR, Lifelines](#); [GCA, Adapt Now](#). Ratios are central estimates; actual returns vary by site and hazard.

12.2 The triple dividend

The framework that best explains these returns is the [triple dividend of resilience](#), developed at the Overseas Development Institute. The first dividend is avoided losses: the damage that does not occur. The second is stimulated economic activity: when people and firms are confident that assets will not be lost, they invest more. The third is development co-benefits: a flood-protection embankment that also serves as a road, an early-warning network that improves everyday forecasting, a clinic with reliable power that treats more patients. The three dividends together explain why resilience spending can pay for itself even in years with no disaster, which matters for the politics: a measure that delivers returns only in an unlikely catastrophe is hard to sustain, while one that pays continuously is easier.

12.3 Why the investment gap persists

If returns are so high, why is the investment not made? Three reasons recur. First, benefits are *counterfactual*: a disaster that did not occur does not appear in any budget, so prevention is politically invisible. Second, benefits are *diffuse* and accrue to different actors from those who bear the costs, which weakens the case for any single ministry. Third, the countries with the greatest needs face the highest capital costs and the tightest fiscal constraints. The result is a gap whose size Figure 10 shows.

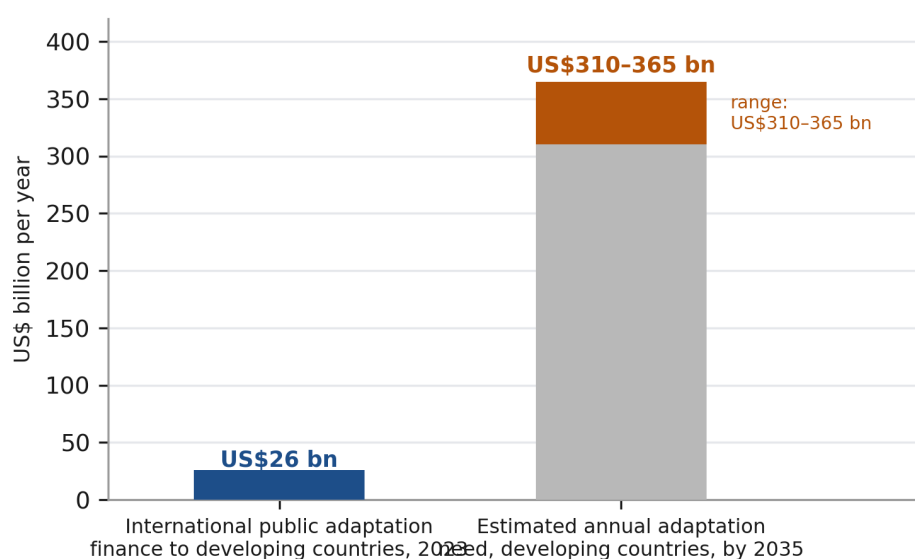


Figure 10. The adaptation finance gap: international public flows against estimated annual need.

Source: [UNEP, Adaptation Gap Report 2025](#). Need is the estimated range by 2035; flows are 2023 international public adaptation finance.

The gap in Figure 10 is large, although it understates the issue. It covers adaptation finance in the narrow sense and does not include the broader resilience investments in lifelines, social protection and health systems described in this report. And it is a gap in *finance*, not in *knowledge*: the interventions with the highest returns are known. The constraint is mobilising and directing the money, which is the subject of the next section.

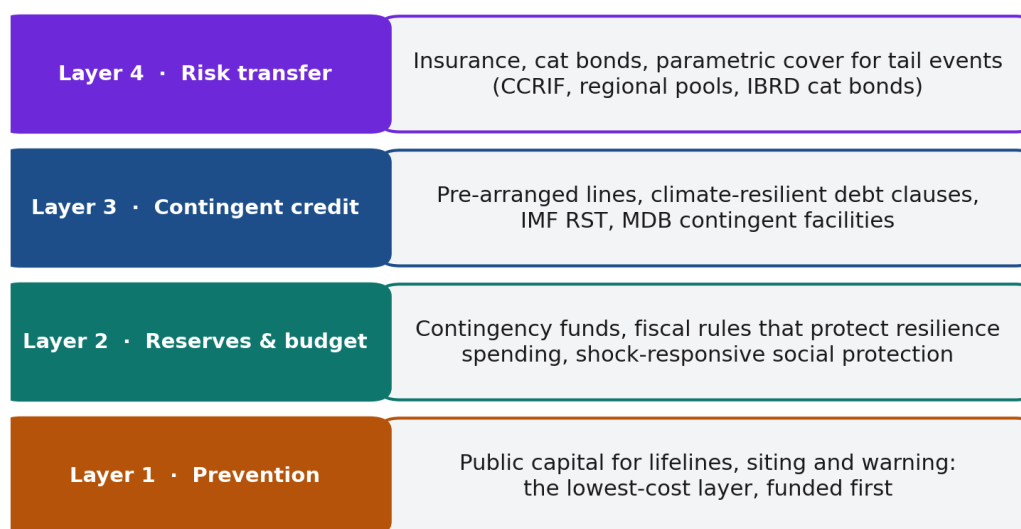
12.4 Caveats on the evidence

Three caveats are worth stating. Benefit-cost ratios are sensitive to discount rates and to the valuation of lives and well-being, and ratios reported by advocates should be read as indicative. Site specificity matters: the same intervention can return ten to one in one location and less than one in another, so averages should not substitute for local appraisal. And estimates of avoided losses depend on the counterfactual hazard path, which is itself uncertain. None of these caveats overturns the conclusion that the average return is high, but they argue for investing in measurement alongside implementation, a point developed in Section 17.

13. Financing the Framework

The finance needed to reduce exposure is large, but it is small relative to the losses it prevents and to what is already spent on response. The task is less to find new money than to layer existing instruments so that the right kind of money arrives at the right time.

Financing a resilience strategy involves matching instruments to risks. Frequent, low-severity events are best financed from budgets and reserves; rare, severe events from risk transfer; and the structural investments that reduce risk, from patient public capital. Figure 11 sets out a layered architecture.



Cheaper, more frequent risks sit lower; rarer, more severe risks sit higher

Figure 11. A layered financing architecture for resilience.

Source: H Heuristics framework, drawing on risk-layering practice in sovereign disaster risk finance.

13.1 Layer 1: prevention capital

The base of the pyramid is public and concessional capital for the structural measures that reduce exposure: lifelines, safe siting, warning systems and social-protection infrastructure. These are the lowest-cost layer per dollar of risk reduced, and the one most neglected. Funding comes from domestic budgets, development banks and concessional sources. The 2025 [Sevilla Commitment](#) on financing for development and the COP30 outcome in Belém, which includes a call to [triple adaptation finance and a roadmap toward US\\$1.3 trillion a year](#), set a more ambitious direction, but commitments have yet to translate into flows on that scale.

The binding constraint on this layer is the cost of capital. Resilient infrastructure is capital-intensive and long-lived, so its economics are acutely sensitive to interest rates. A project that returns four to one at a 5 per cent cost of capital can fail at 15 per cent, which is why concessional and blended instruments are essential in high-risk economies. The reforms to multilateral development bank balance sheets now under way can multiply lending capacity, but only if shareholders allow a higher tolerance of risk.

13.2 Layer 2: reserves and shock-responsive budgets

The second layer holds funds for frequent, moderate events and connects them to delivery systems. Its design questions are procedural: who may release the money, on what trigger, how quickly, and how it is replenished. A contingency fund that requires a month of parliamentary approval is useless in a flood. The strongest examples tie the fund to a social-protection system (Section 9) so that release produces payments to households, not merely a transfer between accounts.

13.3 Layer 3: contingent credit and debt design

The third layer provides liquidity when events exceed reserves. The IMF's [Resilience and Sustainability Trust](#) provides long-term, low-cost financing for resilience-building reforms, although [analysis from ODI](#) and the [Boston University GDP Center](#) suggest it is underused relative to need. Debt design is the other half of the layer. [Climate-resilient debt clauses](#) allow a country to pause debt service after a qualifying disaster, and Barbados, which pioneered them, has also used a 2024 [debt-for-climate swap to redirect savings into water and sewerage resilience](#). The broader point is that sovereign debt is a transmission channel for cascades, and redesigning it is therefore a circuit-breaker (Section 11).

13.4 Layer 4: risk transfer

The top layer moves the tail risk to those best able to hold it. Parametric insurance, catastrophe bonds and regional risk pools pay out on the basis of an objective trigger such as wind speed or rainfall, which makes them fast and cheap to administer. The Jamaican bond that paid in full after Hurricane Melissa (Section 9) showed the instrument working. The [Global Shield against Climate Risks](#) aims to extend such arrangements, together with social-protection linkages, to more vulnerable countries. The principal limits are premium affordability and basis risk, and the lever works best as a complement to prevention rather than a substitute.

13.5 Principles for deploying the architecture

- **Fund the base first.** Each dollar of prevention capital reduces the volume of risk that the upper layers must carry and thereby cuts premiums.
- **Pre-arrange everything.** Triggers, approvals and delivery channels should be agreed before the shock, and tested regularly through simulation.
- **Link the layers.** A reserve that releases into a social-protection system is worth more than the same reserve held in a treasury account.
- **Price the debt channel.** Debt that cannot flex in a disaster is a source of cascade risk; contingent features should be negotiated at issuance, when they are cheapest.
- **Count the full return.** Use the triple-dividend framing in appraisal so that avoided losses, stimulated activity and co-benefits are all included.

14. Governing in an Age of Competition

A strategy that depends on perfect international cooperation will fail in the world as it is. The framework in this report is designed so that most of its value can be captured domestically and regionally, while leaving room for the cooperation that is available.

The WEF's 2026 risk survey describes a world in which cooperation is harder to organise than at any time in a generation ([WEF, Global Risks Report 2026](#)). That matters for a strategy of exposure reduction in two ways. The funding and technology that the poorest countries need may not arrive on the scale required, and the shocks that propagate internationally are the ones least likely to be managed by coordinated action. Governance has to be designed with those constraints in mind.

14.1 Subsidiarity: act where the benefit lands

Most of the levers are local in their effects. Safe siting protects the households in the district; a hardened clinic serves its catchment; a heat-health plan protects the city that adopts it. The principle of subsidiarity implies that responsibility should rest with the lowest level of government that can capture the benefit and has the capacity to act. In practice this means that national strategies should be built around enabling local action: providing risk data, setting standards, and funding capacity, rather than substituting for local decision-making. The experience of Ahmedabad and Bangladesh's Cyclone Preparedness Programme suggests that local ownership is a stronger predictor of durability than central design.

14.2 Institutions that outlast governments

Resilience investments pay off over decades, while political horizons are shorter. Governance therefore needs structures that make commitments sticky. Four mechanisms have worked: statutory long-term plans, as in Bangladesh's Delta Plan 2100; independent agencies with dedicated funding, such as national disaster-management authorities with multi-year budgets; ring-fenced financing for operations and maintenance; and public reporting against metrics that make backsliding visible (Section 17). None of these removes politics, but they raise the cost of abandoning a long-term programme.

14.3 Regional and plurilateral cooperation

Where global cooperation falters, regional and plurilateral arrangements can do much of the work. Regional risk pools spread the financial exposure of small states that could not individually afford cover; the V20 group of climate-vulnerable economies has become an effective bloc for advancing common positions on debt and finance; and regional power grids, if designed to avoid creating new common-mode failures, can supply the redundancy that single national systems lack. The [Bridgetown Initiative](#) is an example of a coalition that moved the international agenda by combining a technical proposal with coordinated advocacy.

14.4 Risks to the strategy itself

A strategy of this kind is exposed to its own risks, and it is better to name them than to leave them to be found. The table sets out the principal implementation risks and the hedges available.

Table 6. Principal risks to implementation and corresponding hedges

Risk	How it manifests	Hedge
Political short-termism	Resilience budgets are cut when fiscal pressure rises or leadership changes	Statutory plans, ring-fenced financing, public metrics
Elite capture	Protection flows to well-connected districts and groups, not the most exposed	Transparent targeting, independent audit, community oversight
Moral hazard	Buffers and insurance weaken incentives to reduce exposure	Condition support on risk-reduction actions; price risk in land markets
Maladaptation	Measures that protect some people increase risk for others, or lock in vulnerability	Systems-level appraisal; monitoring of spillovers; reversible design
Data and trust failure	Warnings or triggers are not trusted, or data are inaccurate or misused	Transparent methods, local validation, strong data-protection rules
Capacity limits	Implementing bodies lack skills and staff to deliver at scale	Sequenced roll-out; peer learning; long-term capacity funding

The risks are manageable, but none of them can be solved by technology alone. Each is a question of institutions and incentives, which is why governance sits at the centre of the strategy and not at its edge.

15. Prioritisation and Sequencing

Everything in this report cannot be done at once, and not everything deserves equal priority. A sequencing rule helps decision-makers choose where to begin and what must precede what.

The six levers differ in cost, lead time and breadth of effect. Prioritisation should favour measures that reduce exposure across many hazards at modest cost and short lead time, while recognising that some of the most important measures, such as safe siting and relocation, have long lead times and must be started early even though their benefits arrive late.

15.1 A prioritisation matrix

Figure 12 scores eight categories of intervention on two dimensions: the breadth of exposure each reduces across hazards, and the combined cost and lead time. The scoring is a qualitative judgement by the author, informed by the evidence cited in the preceding sections, not an empirical calculation. Its purpose is to structure discussion, and readers with local knowledge should re-score it for their own context.

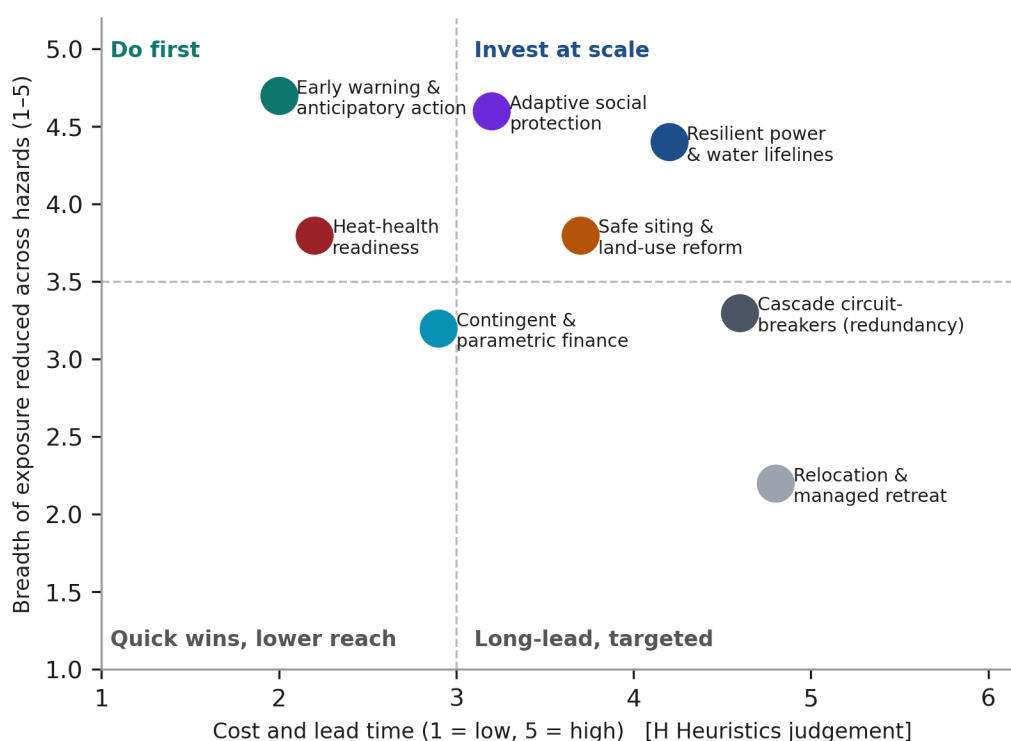


Figure 12. Prioritisation matrix for exposure-reduction interventions.

Source: H Heuristics qualitative assessment. Scores are judgemental and intended for discussion; they should be recalibrated to local conditions.

Three clusters emerge. *Early warning and anticipatory action* is in the upper left: high breadth, low cost, short lead time. It should come first. *Adaptive social protection and resilient lifelines* are in the upper right: very high breadth, with moderate to high cost, so they deserve sustained investment at scale. *Safe siting, heat-health readiness and contingent finance* occupy the middle ground, with moderate returns across

several hazards. *Cascade circuit-breakers and managed relocation* sit at the right, with long lead times and targeted rather than universal application.

15.2 Three horizons

A staged approach follows from the matrix and from the lock-in argument of Section 4. The roadmap in Figure 13 organises the work into three horizons.

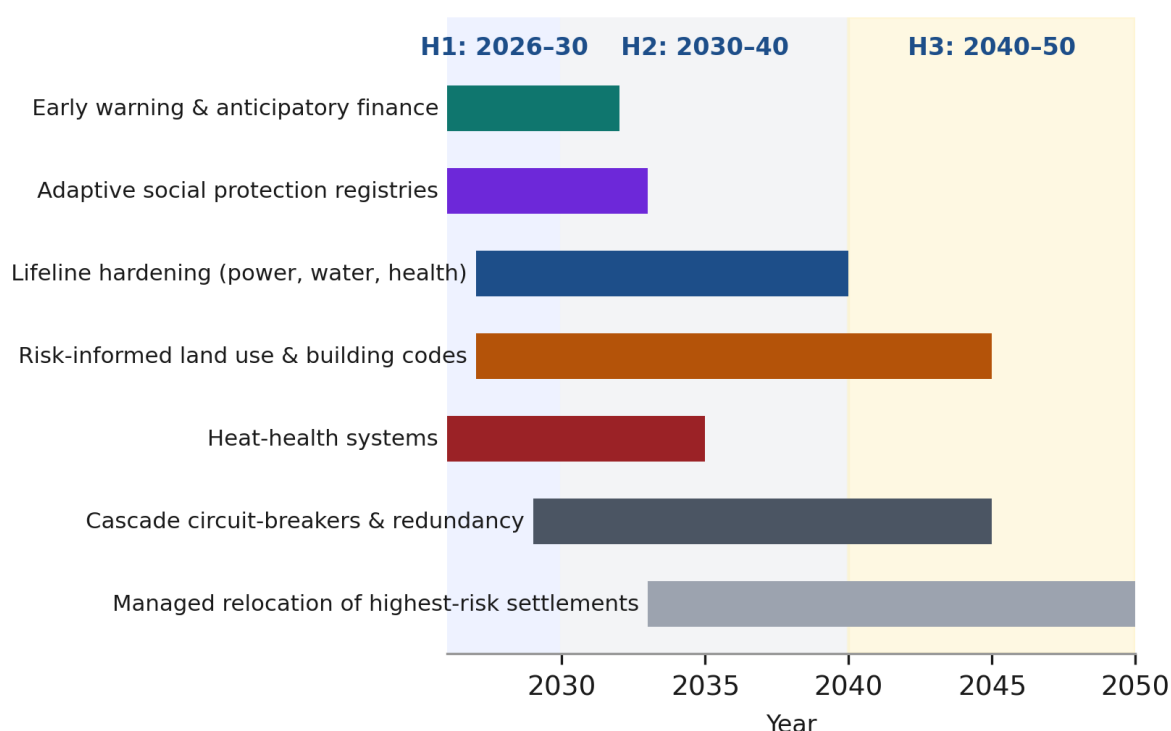


Figure 13. Indicative roadmap for the six levers, 2026 to 2050.

Source: H Heuristics indicative roadmap. Timings are illustrative and would vary by country.

- **Horizon 1 (2026 to 2030): build the base.** Extend early-warning coverage to the most exposed communities; build or widen household registries and payment systems; pre-arrange contingent finance and trigger agreements; map hazards at parcel level; begin heat-health plans in the most exposed cities; and start distributed power for critical facilities. These measures are cheap, have the shortest lead times, and make everything later work better.
- **Horizon 2 (2030 to 2040): scale and integrate.** Harden lifelines at scale, with priority to power, water and health; embed risk-informed land use and building codes in all new construction; link warnings, cash, finance and health response into integrated systems; and put circuit-breaker standards (redundancy, modularity, stockpiles) into utility and supply-chain regulation.
- **Horizon 3 (2040 to 2050): transform.** Complete the relocation of the highest-risk settlements; retrofit remaining critical infrastructure; and use the improved data and institutions to adjust the strategy as the hazard picture clarifies.

15.3 The sequencing rule

Three dependencies determine the order. First, *information before investment*: hazard maps and registries come first because every other lever relies on them. Second, *software before hardware where possible*: warning systems, triggers and registries are cheaper and quicker than embankments and cables and should be in place first. Third, *the quick and the slow in parallel*: because land use and infrastructure have the longest lead times, work on them has to begin in Horizon 1 even though completion lies in Horizon 2 or 3. A strategy that waited for the quick wins before starting the slow ones would arrive late on the measures that matter most.

15.4 Adapting the sequence to context

The sequence above is a default. Fragile and conflict-affected states, where institutions are weak, may need to focus Horizon 1 on community-based systems and humanitarian linkages. Middle-income countries with strong institutions can move faster on land use and infrastructure. Small island states face a particular set of risks and are best served by regional pooling and by external contingent finance, since their domestic buffers are inevitably small. The strategy should be treated as a menu organised by logic, not a recipe.

16. Lessons from Practice

The levers are not hypothetical. Each has been implemented somewhere, with documented results and documented failures. Six cases illustrate the framework and the conditions under which it works.

The cases below were chosen to cover each lever and a range of income levels. They are not a representative sample; they are among the better-documented successes, and one should be wary of generalising from them. Table 7 summarises them and the following sections draw out the lessons.

Table 7. Six cases mapped to the framework

Case	Primary lever(s)	What was done	Documented result
Bangladesh cyclones	Anticipation; Place	Volunteer warning network, multipurpose shelters, forecasting, evacuation drills	Deaths from about 300,000 (1970) to fewer than 30 (2020)
Ahmedabad heat plan	Livelihoods & health	Early warning, health-worker training, cool roofs, water access	About 1,100 to 1,200 fewer deaths a year
Jamaica after Melissa	Buffers	Pre-arranged catastrophe bond and contingent finance	Full US\$150m payout within days; loss about US\$8.8bn
Kenya HSNP	Buffers; Anticipation	Registry beyond routine caseload; drought-triggered scale-up	Payments scaled within weeks in the 2021–23 drought
Rwanda health coverage	Livelihoods & health; Buffers	Community-based insurance and local financing	Coverage above 90 per cent in a low-income setting
Barbados debt design	Buffers; Circuit-breakers	Disaster clauses in bonds; debt-for-resilience swap	Debt service pauses after qualifying events; savings redirected to water

16.1 Bangladesh: building capacity over decades

Bangladesh demonstrates the cumulative character of anticipation (Section 8). Its distinctive feature is not any single technology but the persistence of the effort across governments and decades. The programme blends community volunteers, physical shelters, state forecasting and a rehearsed system of evacuation. Its limitations should also be noted: the country's most exposed populations continue to face rising salinity, riverbank erosion and slow-onset losses that the cyclone system does not address, which is why the [Delta Plan 2100](#) extends to land and water management.

16.2 Jamaica: the value and limits of pre-arranged finance

Hurricane Melissa in October 2025 produced damage estimated at about 41 per cent of 2024 GDP. The [World Bank catastrophe bond paid out in full](#), providing immediate liquidity, and commentary in [PreventionWeb](#) has highlighted how pre-arranged instruments change the early response. But a US\$150 million payout against a loss of US\$8.8 billion makes the point that insurance is a bridge, not a foundation. The case supports the layering argument of Section 13: risk transfer works best when prevention and reserves have already lowered the size of the loss it must cover.

16.3 Kenya: social protection that scales

Kenya's Hunger Safety Net Programme shows how adaptive social protection works when the underlying infrastructure exists. By holding a registry larger than its normal caseload and agreeing drought triggers in advance, it was able to expand payments to additional households within weeks during the severe 2021 to 2023 Horn of Africa drought ([World Bank](#)). The lesson is that the speed of response depends on decisions taken years before the shock. The programme's limits are scale and adequacy: payments were modest relative to need, and a drought of this length strained any budget.

16.4 Rwanda: health coverage as a financial buffer

Rwanda's community-based health insurance, built in the aftermath of the 1994 genocide when the country was among the poorest in the world, [now covers more than 90 per cent of the population](#). Its relevance to this report is the way it combines two levers: it is a health system that absorbs shocks and a financial buffer that stops illness from becoming impoverishment. It also shows that a low-income country can build durable institutions when political commitment is sustained and the design is simple.

16.5 Cross-case lessons

- **Long horizons, short-term wins.** The successful cases combined multi-decade commitments with early visible results that sustained political support.
- **Local ownership.** Community volunteers in Bangladesh, municipal action in Ahmedabad and local financing in Rwanda each mattered more than central design.
- **Pre-arrangement.** Every case in which money or help arrived quickly relied on triggers, registries or contracts agreed in advance.
- **Complementarity.** None of the successes rested on a single lever. Bangladesh pairs warning with shelters; Jamaica pairs insurance with fiscal buffers; Kenya pairs payments with registries.
- **Honest limits.** Each case also shows what a single instrument cannot do, which is why the framework asks for six levers and not one.

17. Measuring Whether Exposure Is Falling

What gets measured gets managed, and exposure to cascading risk is currently measured poorly. A small set of indicators, tracked consistently, would make it possible to tell whether the strategy is working before the next crisis answers the question.

The Sendai Framework includes seven global targets, among them reductions in disaster mortality and in the number of people affected, and a target on access to multi-hazard early warning. Progress against them has been uneven, and the data that support them are weakest in the places where exposure is greatest. A strategy for reducing exposure to *cascading* risk needs indicators that capture not only outcomes but also the structure of the system: the buffers, the redundancy and the coupling.

17.1 A dashboard of indicators

Table 8. A proposed dashboard of indicators for exposure to cascading risk

Lever	Indicator	Data source (examples)	Direction
Place	Share of new buildings and public investments meeting risk-informed siting and code standards	Permitting data; satellite imagery	Up
Place	Population living in mapped high-hazard zones, by income group	Hazard maps; census	Down
Lifelines	Share of hospitals and water plants with tested backup power	Facility surveys; utility reports	Up
Lifelines	Customer-hours of service interruption per year for critical systems	Utility and regulator data	Down
Anticipation	Share of population covered by multi-hazard early warning and able to act on it	WMO and UNDRR monitoring; surveys	Up
Buffers	Share of households on a registry able to receive cash within seven days	Social-protection administrative data	Up
Buffers	Pre-arranged finance as share of expected annual disaster losses	Treasury and insurer data	Up
Livelihoods & health	Heat-related and flood-related deaths per million, age-adjusted	Health registries; vital statistics	Down
Circuit-breakers	Share of critical supply and digital functions with a tested fallback	Regulator audits; exercises	Up
Outcome	Share of people pushed into poverty or displacement by disasters each year	Household surveys; IDMC	Down

The dashboard has three types of indicator. *Outcome* measures (deaths, displacement, new poverty) show whether the strategy is working but arrive late and are noisy. *Capacity* measures (coverage, backup power, registry reach) show whether the system is being built and arrive sooner. *Stress-test* measures, which come from regular simulation exercises, show how the system behaves under shock and can be run annually without waiting for a disaster. A balanced scorecard needs all three.

17.2 Making measurement work

- **Disaggregate.** Report by income, age, gender and location, since averages hide the cascade's endpoint.
- **Test, do not just count.** An early-warning system that exists is not the same as one that works; drills, simulations and post-event reviews are essential.
- **Publish.** Public dashboards make backsliding visible and give civil society and the press a basis for holding governments to account.
- **Invest in data in fragile settings.** Exposure is greatest where data are scarcest, and some of the highest-return investments in the whole strategy are in basic information systems.
- **Update the strategy.** The framework should be revisited every five years as evidence accumulates and as the hazard picture sharpens.

18. Conclusion: A Resilience Agenda for the Next Decade

The world cannot choose how many shocks it will face. It can choose how many people are standing where the shocks land, how tightly the systems that serve them are tied together, and how much slack surrounds them when they fall.

This report began from a simple observation: damage is what happens when a hazard meets people, and the meeting is shaped by prior decisions. In an age of polycrisis, in which shocks are coupled and arrive in sequence, that observation becomes a strategic imperative. It points the effort of governments, financiers and communities towards the terms of the risk equation that can be changed within a political cycle.

18.1 The argument in brief

- Human exposure to cascading risk is very large, overlapping and concentrated among those least able to cope (Section 3).
- Exposure compounds through stacking, thresholds and ratchets, which means that buffers and decoupling matter as much as the size of the hazard (Section 4).
- Six levers, namely place, lifelines, anticipation, buffers, livelihoods and health, and circuit-breakers, address every term in the risk equation and every stage of a cascade (Sections 5 to 11).
- The returns are high, often four to one or better, and the finance gap is large but closable through a layered architecture (Sections 12 and 13).
- Governance in a fragmented world should rely on subsidiarity, durable institutions and regional cooperation, with international support treated as a bonus (Section 14).
- Start with the cheap, cross-hazard measures, begin the slow ones at once, and measure honestly (Sections 15 to 17).

18.2 Ten priorities for the next five years

Table 9. Ten priority actions for 2026 to 2030

#	Action	Lead actors	Lever
1	Close early-warning gaps for the most exposed communities, starting with small island states and informal settlements	National meteorological services; UNDRR; WMO	Anticipation
2	Build household registries and payment systems that can scale within days	Social-protection ministries; World Bank	Buffers
3	Pre-arrange contingent finance and anticipatory-action triggers for the highest-risk countries	Finance ministries; MDBs; Global Shield	Buffers
4	Publish parcel-level hazard maps and tie them to permitting and public investment	Local and national planning authorities	Place
5	Put backup power and cooling into hospitals, water plants and clinics	Health and utilities ministries; development banks	Lifelines
6	Adopt heat-health action plans in all major cities exposed to extreme heat	Municipal governments; health ministries	Livelihoods & health
7	Negotiate climate-resilient debt clauses and contingent credit into new sovereign borrowing	Debt managers; creditors; IMF	Buffers; Circuit-breakers

#	Action	Lead actors	Lever
8	Set circuit-breaker standards for power, food and digital systems in utility and supply regulation	Regulators; industry	Circuit-breakers
9	Ring-fence maintenance and operations finance for critical infrastructure	Finance ministries	Lifelines
10	Publish an exposure dashboard and run annual stress-test exercises	Statistical offices; disaster-management authorities	All

18.3 The choice

None of these ten actions is technologically exotic. Each has been done somewhere, and each pays back more than it costs. What they require is the unglamorous work of building systems before they are needed, in an environment in which political attention is drawn to the loudest crisis of the moment. The risk in an age of competition is that the quiet, cumulative work of reducing exposure is crowded out by the urgent. The opportunity is that the same work is among the few areas in which countries can protect their own people without waiting for anyone else to act.

A decade from now, the number of people in harm's way will be higher or lower than it is today because of choices made in the next few years. The framework in this report is an argument for making them deliberately.

References and Further Reading

Systemic risk, polycrisis and the global risk landscape

- World Economic Forum (2026), [Global Risks Report 2026](#); [press release](#).
- Lawrence, M., Homer-Dixon, T. et al. (2024), [Global polycrisis: the causal mechanisms of crisis entanglement](#), *Global Sustainability*.
- [Cascade Institute](#), research on systemic risk and polycrisis.
- IPCC (2023), [Sixth Assessment Report: Synthesis Report](#); [Working Group II: Impacts, Adaptation and Vulnerability](#); [Chapter 6: Cities, Settlements and Key Infrastructure](#).
- WMO, [WMO confirms 2024 as warmest year on record](#).

Exposure, vulnerability and displacement

- Rentschler, J., Salhab, M. and Jafino, B. A. (2022), *Flood exposure and poverty in 188 countries*, *Nature Communications*; [World Bank blog summary](#).
- UN-Habitat / UN Statistics Division, [SDG Report 2025, Goal 11](#).
- IDMC (2025), [Global Report on Internal Displacement 2025](#); UNHCR, [Global Trends](#).
- World Bank (2021), [Groundswell 2.0: Climate change could force 216 million people to migrate within their own countries by 2050](#).
- World Bank / GFDRR, [Unbreakable: Building the Resilience of the Poor in the Face of Natural Disasters](#).
- WMO, [Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes \(1970–2021\)](#).
- UNDRR (2025), [Global Assessment Report on Disaster Risk Reduction 2025: Resilience Pays](#).
- UNDRR, [Sendai Framework for Disaster Risk Reduction 2015–2030](#).

Infrastructure, early warning and anticipatory action

- World Bank / GFDRR, [Lifelines: The Resilient Infrastructure Opportunity](#).
- World Bank / GFDRR, [Thai Flood 2011: Rapid Assessment for Resilient Recovery and Reconstruction Planning](#).
- WMO, [The Triple Dividends of Early Warning Systems and Climate Services](#); [Early Warning Systems Reach New Heights, but Critical Gaps Jeopardize Global Progress](#); [Weather-related disasters increase over past 50 years](#).
- UN, [Early Warnings for All](#).
- UN OCHA, [Anticipatory Action](#); WFP, [Acting Before a Flood to Protect the Most Vulnerable](#); CSAE, [Anticipatory Cash Transfers in Climate Disaster Response](#).
- UNDRR, [UN praises Bangladesh Cyclone Preparedness Programme](#); Our World in Data, [Bangladesh has become much more resilient to cyclones](#); The Conversation, [Bangladesh has saved thousands of lives from a devastating cyclone](#).
- Government of Bangladesh, [Bangladesh Delta Plan 2100: Finance and Investment](#).

Health, heat and livelihoods

- [2025 Lancet Countdown on Health and Climate Change](#); WHO, [Climate change: Heat and health](#).
- ILO, [More workers than ever are losing the fight against heat stress](#).
- *Nature Medicine*, heat-related mortality in Europe: [2022](#); [2023](#); [2024](#).
- Ahmedabad Heat Action Plan: [Development and implementation of South Asia's first heat-health action plan](#); [Pilot evaluation of impact on all-cause mortality](#); NRDC; [PreventionWeb](#).
- Global Heat Health Information Network, [Heat action plans and case studies](#).
- Park, R. J. et al., [Heat and Learning](#), *American Economic Journal: Economic Policy*.
- Innovations in Healthcare, [Universal Health Coverage: How Rwanda Is Moving Forward](#).

Finance, social protection and debt

- World Bank, [State of Social Protection Report 2025: The 2-Billion-Person Challenge](#); [Adaptive Social Protection: Building Resilience to Shocks](#); [How the World Bank Supports Shock-Responsive Social Protection Systems](#).
- UNEP (2025), [Adaptation Gap Report 2025](#).
- UNCTAD (2025), [A World of Debt 2025](#).
- Global Commission on Adaptation, [Adapt Now](#); ODI, [The Triple Dividend of Resilience](#); IFC (2026), [Low Cost, High Yield](#).
- IMF, [Resilience and Sustainability Trust](#); ODI, [The IMF's Resilience and Sustainability Facility](#); Boston University GDP Center, [What Role for the RST?](#).
- Climate Policy Initiative, [Climate-Resilient Debt Clauses: A Primer](#); The Nature Conservancy, [Barbados Debt Conversion for Climate Resilience](#).
- World Bank, [Hurricane Melissa triggers 100% payout of \\$150 million catastrophe bond for Jamaica](#); [PreventionWeb](#), [Hurricane Melissa, debt and pre-arranged financing](#).
- [Global Shield against Climate Risks](#); [Bridgetown Initiative](#).
- UN DESA, [Sevilla Commitment](#); Carbon Brief, [COP30: Key Outcomes Agreed at the UN Climate Talks in Belém](#).
- World Bank / GFDRR, [Pakistan: flood damages and economic losses over US\\$30 billion](#); [Dominica Post-Disaster Needs Assessment following Hurricane Maria](#); World Bank, [70% of 10-year-olds now in learning poverty](#).

Data notes and limitations

Quantitative claims are attributed in the text to the primary or authoritative secondary source, and the version of each source consulted is the one linked. Global indicators in Figure 2 overlap and cannot be summed. Figures 1, 3, 5, 6, 11, 12 and 13 are conceptual schematics or qualitative judgements by the author; Figure 4 is a stylised simulation designed to show the qualitative effect of buffers on cascade thresholds and is not a forecast. Disaster-mortality figures for Bangladesh and Europe are rounded and vary slightly by source and method. Benefit-cost ratios are central estimates from the sources cited and vary by site, hazard and discount rate. The report is analytical rather than predictive and does not constitute financial, investment or legal advice.