Returns on Resilience:

Investing in Adaptation to Drive Prosperity, Growth and Competitiveness

A collaborative report by

In partnership with

Endorsements

Resilience is about protecting people and their livelihoods in the face of storms, heatwaves, and floods. However, it is also an urgent economic imperative: building resilience is critical to ensure that hard-won development gains and economic growth are not washed away. This report demonstrates with compelling evidence that investing in climate adaptation delivers real returns - strengthening communities, stabilising economies, and creating opportunities for societies and businesses. It is a call to action for world leaders to make resilience and adaptation the investment agenda of our time.

Ban Ki-moon
Eighth Secretary-General of the United Nations and Co-chair of the Ban Ki-moon Centre for Global Citizens

This report reframes resilience not as a sunk cost, but as a strategic investment in long-term prosperity. It shows how adaptation protects the most vulnerable, strengthens supply chains, and prevents the erosion of value before it happens. That's a critical insight for any company striving to be Net Positive and support the systems it depends on to thrive. Resilience is the connective tissue: it protects people and planet, stabilises economies, and unlocks opportunity. Leaders who embed it into core strategy will be the ones who thrive.

Paul Polman
Business leader, investor, philanthropist

Everyone should have the opportunity to live a healthy, productive life, yet for too many, droughts, floods, and extreme heat are putting that goal further out of reach. This report reaffirms that investing in climate resilience - especially with proven interventions that protect progress in health, agriculture and economic opportunity - is one of the smartest ways to future-proof development investments and help more people thrive.

Mark Suzman
CEO, Gates Foundation

For emerging markets and developing economies, closing the financing gap for adaptation and resilience is not optional—it's survival. These countries have already proved their toughness in the face of climate impacts, but growth without resilience is nothing more than a house of cards, collapsing under the weight of debt and repeated shocks. As this report makes clear, resilience is not charity, it is insurance—an investment that strengthens self-sufficiency and protects hard-won development gains. Framing it as a moral duty is fine, but let's be blunt: it's also the smartest economic bet anyone can make.

Professor Carlos Lopes
Chair of the African Climate Foundation Board and COP30 Special Envoy for Africa

Investing in resilience is not only about managing risks. It is an opportunity to transform our economies. As this report shows, resilience drives sustainable growth, creates jobs, and improves long-term debt prospects. It provides vital evidence and a clear action agenda for financial and economic decision makers, showing that resilience is one of the most strategic investments we can make to secure prosperity today and for generations to come.

Dr Vera Songwe
Chair and Founder, Liquidity and Sustainability Facility, and Non Resident Senior Fellow, Global Economy and Development, Brookings Institution

Nature sustains life - it underpins our economies, our communities, and our common future. The report demonstrates with clarity that ecosystem health, community well-being and economic prosperity are inseparable from building resilience, and that protecting natural capital, is essential for long term sustainability. Its message and recommendations are urgent for decision makers, not only of vulnerable communities but for every region where climate risk threatens both nature and livelihoods

Virgilio Viana
General Director, Foundation for Amazon Sustainability (FAS)

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About This Report

This report assesses the returns on resilience investments for communities, companies and countries, analysing a large volume of data and case studies from different regions of the world.

It finds that resilience investment has become a core pillar of growth and stability, especially as climate impacts intensify.

The report documents the evidence base around the returns on resilience investment, as well as outlines how decision-makers can take action to reap these benefits. It draws on insights and contributions from individuals associated with over 120 organisations, 70 publications, and ten consultations at international forums to produce three main deliverables:

A shared narrative

Communicating the centrality of climate and nature resilience to human development, economic growth and business strategy, in terms and metrics that meet demand from economic and financial decision-makers.

A strong evidence base

Synthesising data, insights and case studies on the costs of inaction, returns on resilience interventions, and financing needs, to provide decision-makers with the information and tools to assess and prioritise finance and policy. Based on this research, the report finds evidence that investing in resilience can deliver strong returns for human health, livelihoods, gross domestic product (GDP) growth and jobs, and that markets for resilient solutions are likely to see rapid and robust growth. There is also a strong evidence base for private investments in adaptation, although the potential differs between sectors and countries.

Clarity on breakthrough actions

Identifying high-impact actions that address systemic barriers to resilience investment, where there is momentum for scaling at COP30 and beyond. New analysis identifies specific investment areas with the potential to maximise these gains in low- and middle-income countries (LMICs), drawing on analysis of countries' National Adaptation Plans and Technology Needs Assessments, and consultations with over 50 climate and development experts from governments, funders, NGOs and the private sector.

The report is an invitation to action. COP30 is a critical opportunity to reframe resilience as a central part of the investment agenda of the 21st century. 'Temperature overshoot' beyond the goals of the Paris Agreement is now locked in at least temporarily, and achievement of the Sustainable Development Goals by 2030 is widely considered a stretch, with both parameters prompting reflection on levers to course correct. This report seeks to provide clarity on the economic and financial dimensions of resilience, as well as options that decision-makers are using and can use to embed resilience into growth and development strategies.

It is hoped that this report can be an input for climate and development finance providers as they prioritise policies and allocations, and for the broader public as they shape the narrative around climate and nature.

To translate this ambition into impact will require concerted action and collaboration. We hope to work with many of you going forward to deliver this agenda in the coming years.

Foreword

It is clearer now than ever that we need to act decisively in the face of climate urgency. I have seen the cost of inaction rising. In the past year alone, Brazil has faced unprecedented floods in the south, droughts in the Amazon, and heatwaves in our cities.

These are not isolated events. They are part of a deeper shift, where climate and nature shocks are colliding with economic fragility and social inequality. Events in Porto Alegre in 2024 showed with painful clarity how adaptation policies, if embedded earlier in infrastructure planning, could have made a real difference.

When we first began talking about adaptation and resilience, many believed that focusing on it meant surrendering on mitigation. That belief is fading. Extreme events are getting closer, harder to ignore, and more deeply felt. Adaptation is no longer an afterthought. It is a condition for stability.

That is why I have made adaptation and resilience central to COP30 in Belém. Our ambition is clear: to shift from negotiation to implementation, and to elevate climate solutions, especially those that protect lives, preserve capital, and promote equity.

We must also be honest: adaptation is different. It is deeply local, tied to specific geographies, communities, and governance systems. That makes it harder to finance through traditional mechanisms.

Yet this very local nature is also its strength. Around the world, communities are rethinking how investing in infrastructure, finance, and nature can work together to build more resilient futures. Their experience must shape - not follow - the global agenda.

Adaptation is also a global challenge and responsibility: natural disasters have social and economic impacts on large parts of the world; with ripple effects extending across value-chains and communities in an interdependent global economy.

In Belém, we are building a **mutirão**, a collective effort that brings together finance ministries, city governments, investors, scientists, Indigenous peoples, and community leaders. This report is a first step on that path. By clarifying the case for action, it helps move us from concepts to commitments, from diagnosis to delivery.

At COP30, we will bring together the evidence, crowd in local and global voices and help turn these insights into breakthrough actions. There is no time to waste. Investing in resilience is not only wise, it is essential. Let Belém be the moment we move from awareness to alignment, and from ambition to action.

Ambassador André Aranha Corrêa do Lago
COP30 President-Designate

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Executive Summary

The Case for Investments in Resilience

In the face of mounting climate and nature impacts, building resilience is imperative. For decades, the world has pursued economic development and growth with the assumption of a relatively stable environment.

That assumption no longer holds. The impacts of climate change and nature loss are now part of the 'standard operating environment' for ever-larger numbers of households, businesses and economies. They are experiencing both immediate and long-term costs, especially in lower-income countries. The ability to respond to and manage shifting risks is now essential to unlocking opportunity, in addition to safeguarding business and development gains.

A remarkable body of evidence from the efforts of countries, companies and communities has emerged in recent years, showing that resilience investments are the surest way to drive growth, stability and competitiveness. The results from these investments undermine the historical narrative that spending on resilience is 'charity' and 'economically unproductive.' In fact, the analysis of this report - which has been compiled with support from a consortium of partners - finds that resilience investments are a boon for both economies and human development. They offer concrete returns that include job creation, macroeconomic stability, growth and commerciality in addition to the most obviously significant benefit: lives saved. They also reinforce and supplement the longstanding frame of equity, justice and solidarity. The economic benefits furthermore stand in sharp contrast to the alternative: ruinously expensive inaction.

Among the report's key findings on resilience investments are their contributions to building stronger communities, companies and countries.

- **For communities[1]:** Resilience investments could generate 280 million jobs in emerging markets and developing economies (EMDEs) over the next decade.[2] They could also limit the 1 to 2 million additional deaths expected annually by 2050 without action.[3] Achieving resilient water, sanitation and hygiene (WASH) services alone could prevent 173,000 deaths annually until 2030.[4]
- **For companies:** The global adaptation and resilience market could reach $500 billion to $1.3 trillion by 2030.[5] Firms report high benefit-cost ratios: 7:1 in healthcare, biotech and pharmaceutical sectors[6], and 4-5 :1 across sectors for climate-proofing transport, energy and water infrastructure.[7]
- **For countries:** Adaptation interventions could generate a wide range of GDP gains versus current policies, but could be as high as 15 percentage point GDP by 2050 in certain countries highly vulnerable to climate and nature impacts, versus current policies.[8] Improved resilience also lowers borrowing costs: a 10-point improvement in a country's Notre Dame Global Adaptation Initiative (ND-GAIN) score (the difference between Haiti and the Dominican Republic; or between Zambia and Morocco), is associated with a 37.5 basis point drop in sovereign bond spreads.[9]

Across sectors, a synthesis of available benefit cost ratios (BCRs) by the Grantham Research Institute (GRI) suggests that **investments in adaptation deliver a median of 4 times more benefits than costs.** Available evidence also confirms a **median economic internal rate of return (EIRR) of 25%.**[10] This reinforces findings from the World Resources Institute (WRI) that every $1 invested in climate adaptation yields over $10 in benefits, with average economic annual returns of 20% to 27% - reaching 79% in health services and 27% in agriculture.[11] Investments in nature deliver particularly strong returns for communities, companies and countries, with 40% average economic annual returns for forestry and nature investments.[12]

1 For the purposes of this report, we use communities to refer to subnational groups of individuals and households - for example rural villages, towns and cities.
2 Systemiq analysis. See Technical Annex for further detail. Analysis is ongoing to inform the forthcoming flagship report Steer et al. (forthcoming), Jobs and Skills for the New Economy: An Action Agenda for a People-Centered Climate Transition, to be launched ahead of COP30. There may be minor adjustments to analysis. This initiative is funded by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), the Ares Foundation and NDC Partnership, and prepared by the World Resources Institute and Systemiq, with the contribution of several other partners including EDC, ADB, World Business Council for Sustainable Development (WBCSD) and LinkedIn.
3 Ibid.
4 WHO, *COP29 Special Report on Climate Change and Health: Health is the Argument for Climate Action* (2024).
5 BCG and *Temasek, The Private Equity Opportunity in Climate Adaptation and Resilience* (2025).
6 *CDP, Unlocking the Disclosure Dividend* (2025).
7 *CDP, Unlocking the Disclosure Dividend* (2025).
8 World Bank, People in a Changing Climate: From Vulnerability to Action-Insights from World Bank Group Country Climate and Development Reports Covering 72 Economies (Washington, DC: World Bank, 2024).
9 Cevik, Serhan and João Tovar Jalles, *Why Climate Change Vulnerability Is Bad for Sovereign Credit Ratings* (IMF Blog, 2021). Based on Cevik, Serhan and João Tovar Jalles, *Feeling the Heat: Climate Shocks and Credit Ratings, IMF Working Paper No. 2020/286* (Washington DC:International Monetary Fund, 2020).
10 Grantham Research Institute preliminary analysis of 75 studies – *The Macroeconomic Case for Adaptation Investment* (2025, forthcoming)
11 WRI, *Strengthening the Investment Case for Climate Adaptation: A Triple Dividend Approach* (2025).
12 Ibid.

What is Resilience?

At the core, resilience[13] is the capacity of households, communities, businesses and economies to adapt and thrive in a changing world, to absorb and to quickly recover from shocks and to reduce the suffering and loss of life and belongings that result from climate change and nature loss. Resilience is the intended outcome of adaptation. It requires continuous efforts to build strength in a changing world that is more prone to shocks.

Climate and nature hazards are no longer future risks - they are today's reality. Resilience is today's imperative.

Impacts are hitting at much greater frequency and intensity than anticipated when the Paris Agreement was signed in 2015. Acute shocks, like floods and wildfires, and slow-onset changes,[14] such as temperature rise, water stress and soil degradation, are disrupting people's lives, threatening business continuity and eroding the foundations of strong economies. Between 2000 and 2020, drought events increased by one-third, extreme temperature events more than tripled,[15] and billion-dollar weather disasters now strike every three weeks - compared to every four months forty years ago.[16]

Communities, companies and countries are experiencing material impacts. At least 20 million people are displaced annually by climate shocks.[17] Companies face mounting losses from damaged assets, disrupted supply chains and rising input costs. Emerging markets and developing economies have already lost more than $525 billion over the past two decades due to climate change[18]. The least developed countries are already an estimated 10% poorer today than they would have been without climate change, according to recent GRI analysis.[19]

These impacts are not inevitable. They underline the critical need for greater efforts to reduce emissions and nature loss. But unless investment in resilience scales alongside mitigation, the cost of inaction will grow, and the choices available will narrow, as outlined in Chapter 1.

Risks and losses fall disproportionately on lower-income countries. EMDEs suffer more than 10 times more economic damage than higher-income countries in the face of extreme weather disasters, recover four times more slowly and endure deeper human development losses due to higher exposure and weaker fiscal capacity.[20, 21]

Investments in resilience and emission reductions are synergistic and must be pursued together. This underscores the urgent need to double down on decarbonising the global economy.[22] Not all the costs can be adapted to easily.[23] There is no excuse for delay. And mitigation measures themselves must be resilient to remain effective over the long-term.[24] Fortunately, there are many opportunities for investments which help us to adapt, reduce emissions and support development at the same time. This has to be the core strategy which will ultimately boost overall economic resilience.

13 Rockstrom et al, 'Shaping a resilient future in response to COVID-19'. *Nature Sustainability* **6**, (2023):897–907. Definition of resilience: 'resilience as the capacity to live and develop with change and uncertainty, which is well beyond just the ability to 'bounce back' to the status quo. It involves the capacity to absorb shocks, avoid tipping points, navigate surprise and keep options alive, and the ability to innovate and transform in the face of crises and traps'. The IPCC defines resilience as: 'a system's ability to anticipate, reduce, accommodate, and recover from disruptions in a timely, efficient, and fair manner'.

14 The gradual changes that may be imperceptible day-to-day but drive large changes over several years; Park, J. Slow Burn: The Hidden Costs of a Warming World (Princeton University Press, 2024).

15 UNDRR, *Human Cost of Disaster: An Overview of the Last 20 Years 2000-2019* (2020).

16 Economist Impact, *Climate Change's Disruptive Impact on Global Supply Chains and the Urgent Call for Resilience* (2025).

17 Viviane Clement, et al. *Groundswell Part 2* (Washington DC: World Bank;13 September 2021).

18 *V20, Climate Vulnerable Economies Loss Report*, (2022).

19 Grantham Research Institute analyses 85 econometric models from 15 macroeconomic studies, which describe the reductions in GDP explained by temperature shocks and sea level rise. According to a synthesis of these models, least developed countries are estimated to already be 10% poorer today in terms of GDP per capita than they would have been without climate change. 'The Macroeconomic Case for Adaptation Investment' (2025, forthcoming)

20 Emerging markets and developing economies (EMDEs) are disproportionately affected by climate-related disasters. Over the past two decades, EMDEs have incurred over $525 billion in direct losses from extreme weather events alone - representing about 20% of their collective GDP, compared to less than 1% for high-income countries (World Bank, 2022; IMF, 2023).

21 Recovery from these shocks is also slower: according to IMF research, countries with lower adaptive capacity can take up to four times longer to return to pre-shock economic trajectories than high-income peers. Gigineishvili, Nikoloz, et al. 'Climate Change and Long-Term Growth'. IMF, Departmental Papers 2023, 004 (2023): A003.; Hallegatte et al., *SHOCK WAVES - Managing the Impacts of Climate Change on Poverty* (World Bank, 2016).

22 IPCC *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report* (Cambridge: Cambridge University Press, 2022).

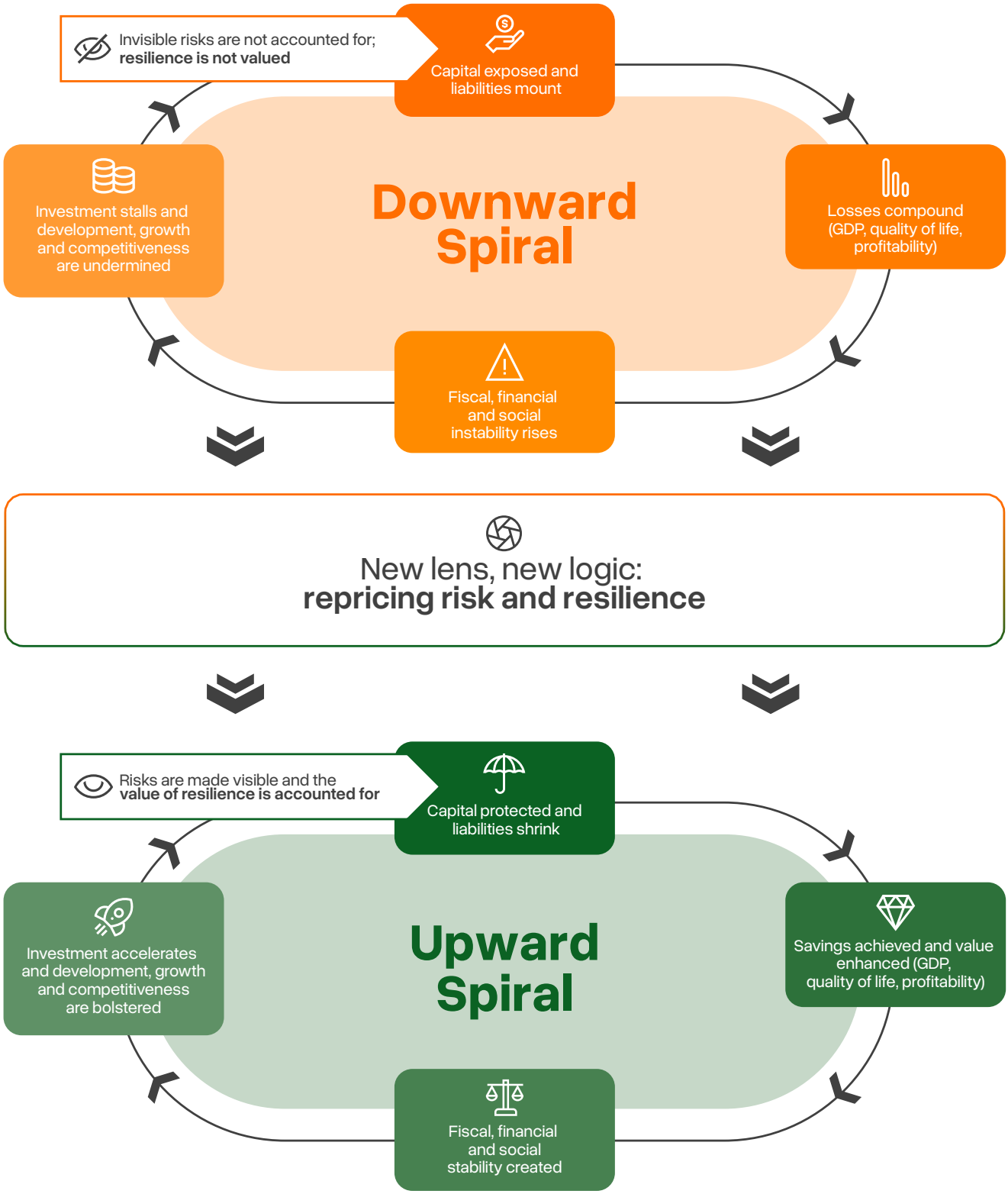
23 IIGCC, *Physical Climate Risk Appraisal Methodology (PCRAM) 2.0* (June 2025).

24 World Bank, *Rising to the Challenge: Success Stories and Strategies for Achieving Climate Adaptation and Resilience* (Washington, DC: World Bank, 2024).

Despite the profound threats and opportunities for building resilience, our economic and financial systems do not fully account for the impacts of climate change and nature loss.

The costs remain invisible in investment decisions, balance sheets and planning frameworks; the value of resilience interventions is not recognised. As outlined in Chapter 2, this risks setting a downward spiral of compounding costs in motion. See Exhibit 1 taken from Chapter 2.

Exhibit 1 From Risk to Resilience: Downward Spiral versus Upward Spiral



First, capital is exposed and liabilities mount. For every $1 spent on climate-resilient infrastructure right now, $87 is spent on infrastructure lacking resilience considerations.[25]

Only 30% of the world's largest 5,800 companies have quantified their exposure to climate and nature risks.[26] The result is a build-up of hidden liabilities: future costs that will eventually surface as reconstruction bills, uninsurable assets, defaults, and write-downs.

Second, losses compound, including:

- **For communities,** an additional 1 to 2 million deaths per year in EMDEs,[27] and 40 million more people experiencing extreme poverty by 2050.[28] These impacts will increase inequality: climate-related income losses are 70% greater for the poorest 40% of populations.[29]
- **For companies,** $885 billion losses by the 2030s, rising to $1.2 trillion by the 2050s for the world's largest companies.[30] Labour productivity losses equivalent to 80 million jobs are likely by 2030 globally.[31] Supply-chain disruptions could also cause $25 trillion in net-losses by the middle of the century, as droughts, floods, storms and heatwaves cause widespread supply-chain failures and production halts.[32]
- **For countries,** an 18 to 23% decline in GDP by 2050 globally due to slow-onset and acute climate impacts under a current policy scenario.[33, 34] This may not properly capture a further 7 to 10% GDP decline from nature impacts by 2030 (estimates for 2050 are not available).[35]

  Losses are especially severe in lower-income countries, many of which depend heavily on climate- and nature-sensitive sectors like agriculture for jobs and incomes.

Third, financial and fiscal instability rises as asset values and productivity fall. Properties exposed to flooding, wildfires or coastal erosion lose value as insurers withdraw and mortgages default. In the US, home insurers declined 37% of claims in 2023, up from 25% 20 years earlier[36]. As traditional risk-pooling breaks down, households, businesses and lenders are left unprotected.

Fiscal stability erodes as disruptions drive output volatility, inflation and debt stress. Rising emergency spending costs and lower earnings (due to productivity losses) reduce fiscal space and constrain monetary flexibility, limiting the tools available for macroeconomic management.

Finally, investment stalls not just in resilience interventions, but also in wider productivity-enhancing areas - as mounting damage makes these too risky. Weakened economies have less capacity to invest in resilience to protect and expand capital, becoming trapped in a cycle of escalating risk.

Recognising the reality of climate and nature impacts and revaluing resilience can reverse the cycle. By protecting and expanding productive capital, communities, companies and countries can withstand disruptions, expand opportunities, take 'productive risks' rather than suffer from imposed risks, unlock value and build long-term prosperity.[37] **This unlocks an upward spiral of escalating benefits of action, in which stability and investment reinforce one another, economies grow more robust, and resilience is strengthened.**

25 Climate Policy Initiative, *Tracking Investments in Climate Resilience Infrastructure* (2022)
26 Clarity AI, STUDY: *Only 30% of Global Companies Adequately Assess Physical Climate Risks* (September 25 2025).
27 Systemiq analysis 2025. See Technical Annex for further detail. This is likely an estimate as it does not account for other important climate-linked diseases such as salmonella and rabies, nor the wider nutrition impacts beyond stunting.
28 Moyer, J.D., Pirzadeh, A., Irfan, M. et al. 'How Many People Will Live in Poverty Because of Climate Change? A Macro-Level Projection Analysis to 2070'. *Climatic Change* **176**, 137 (2023).; Gilli et al. 'Climate Change Impacts on the Within-Country Income Distributions'. *Journal of Environmental Economics and Management,* **Volume 127,** (2024): 103012.
29 World Bank, *Rising to the Challenge: Success Stories and Strategies for Achieving Climate Adaptation and Resilience* (Washington, DC: World Bank, 2024).
30 BCG and Temasek, *The Private Equity Opportunity in Climate Adaptation and Resilience* (2025).
31 International Labour Organization (ILO), *Working on a Warmer Planet: The Impact of Heat Stress on Labour Productivity and Decent Work* (Geneva: International Labour Office, 2019).
32 Willner, S. N., Otto, C., Levermann, A., & Schewe, J. 'Global Supply Chains Increasingly at Risk from Climate Shocks'. *Nature*, **622,** 7982 (2023): 97–103.
33 NGFS, *NGFS Climate Scenarios for central banks and supervisors - Phase V* (NGFS, 2025).
34 An 18 - 23% GDP loss range by 2050 aligns with recent analysis by Grantham Research Institute, 'The Macroeconomic Case for Adaptation Investment' (2025, forthcoming), which finds GDP losses in the range of 15-20% on average for different groups of EMDEs by 2075 and potentially much higher, based on analysis of 85 econometric models from 15 macroeconomic studies, which describe the reductions in GDP explained by temperature shocks and sea level rise alone. Estimates do not account for non-market welfare losses, such as impacts on health and the biosphere, which are expected to be large, nor do they cover impacts that are not strongly driven by temperature shocks, such as slow-onset effects, water supply and demand impacts, and other extreme events, such as surface and river floods, droughts, and wildfires. Regional-scale tipping points such as AMOC and sea-level rise tipping points are not considered.
35 NGFS, *The Green Scorpion: the MacroCriticality of Nature for Finance* (2023).; World Bank Group, *The Economic Case for Nature - A global Earth-Economy Model to Assess Development Policy Pathways* (2021).
36 Insurance Information Institute, *Home Insurance Claim Trends in the U.S.* (2024).
37 As per the World Bank's World Development Report 2014: Risk and Opportunity, when people feel protected against imposed risks (such as storms, disasters, or disease), they are more likely to take 'productive risks' - investing in education, improving housing, or starting a business - which drive long-term growth and development.

The Resilience Investment Agenda

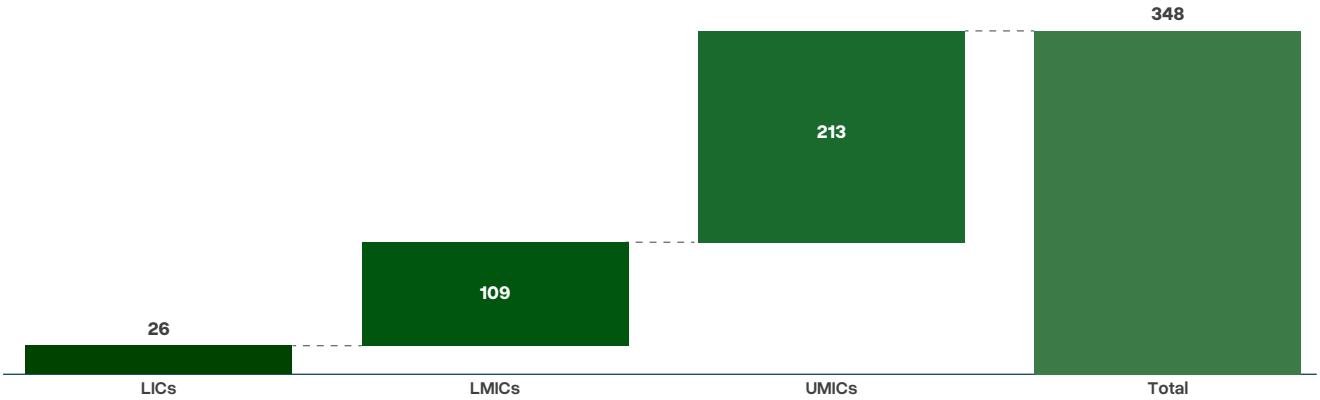
It is no surprise that the cost of inaction is far greater than the cost of action. Only an estimated $350 billion – equivalent to 0.5% of EMDEs' GDP in 2035[38] – is needed per year to build resilience in EMDEs by 2035.[39]

See Exhibit 2 taken from Chapter 3. **Investing a portion of the $350 billion in four key sectors alone could help to avoid up to $690 – $850 billion in socioeconomic losses per year by 2050** in health, agriculture, infrastructure, and water sanitation and hygiene (WASH).[40] Yet resilience investments do not flow at the scale needed. The inability in most cases to monetise avoided losses has long been at the crux of this paradox. However, this report highlights not just the avoided losses, but the value creation opportunities that resilience investments offer. Investing $350 billion per year can benefit: **i) communities** – by enhancing incomes and strengthening social institutions; **ii) companies** – by boosting agricultural yields and opening up new market opportunities; and **iii) countries** – by generating strong economic multipliers for growth, jobs and sectoral development, among other benefits.[41]

Building resilience requires that all investments become resilient and invest in new approaches to tackle new risks. This begins with redirecting and scaling existing investments to ensure they are resilient. For example, when building a new road, that investment should factor in financing to ensure the road is resilient to slow-onset and acute climate impacts. Second, there is a need for new investments that tackle specific climate and nature risks, such as a new sea wall, or new cooling facilities. Where possible, investments that boost resilience and reduce emissions at the same time can maximise returns. Chapter 6 identifies 15 impactful 'A&R Best Buys' comprising adaptation and resilience opportunities across sectors, including crop resilience, resilient health systems, and terrestrial protection and rehabilitation.

Exhibit 2 The Additional Resilience Investment Need by 2035 in Emerging Markets and Developing Economies(1)

Developing countries investment needed[1] ($ billion by 2035, US$2023 prices)
Estimates draw largely from 2025 UNEP Adaptation Gap Report (Forthcoming) (2)



(1) The values shown are for the non-annex 1 countries as defined by the UNFCCC, focusing only on LICs, LMICs and UMICs. (2) UNEP AGR (Forthcoming), covering adaptation estimates for agri-food, disaster risk reduction, health, fisheries and marine, energy and transport infrastructure, coastal protection and river flood protection. These sector results are only presented as aggregate numbers for country income groups. Systemiq conducted analysis to expand UNEP AGR (forthcoming) estimates for certain sectors, drawing on sources including Carapella et al. (2023), Aggarwal et al. (2024) and World Bank/UNESCO data on capital expenditure for education, Waldron et al. (2022)[42]. See Technical Annex for further detail. Note the figure captures public focused interventions, as well as interventions that have both public and private costs and benefits, for example climate-smart agriculture. It does not include interventions by private companies that are confined to their own assets or operations. The numbers are expressed in constant 2023 USD.

38 $350 billion is 0.05% projected GDP of EMDEs in 2035. Based on IMF (2024) GDP projections until 2030 in current prices for each country income group, deflated to USD2023 prices

39 The investment needs figure draws on the updated UNEP Adaptation Gap Report (forthcoming) Adaptation Gap Report 2025, complemented with Systemiq analysis (education, water and sanitation, nature) and UNEP AGR 2025 (other sectors). This is a recurring investment need. It captures public focused interventions -such as major flood protection investment or adaptive social protection -as well as interventions that typically have both public and private costs and benefits, for example climate-smart agriculture. This estimate does not include interventions confined to private company or household assets or operations, which UNEP AGR (forthcoming) estimates will be several hundred billion dollars per year by 2035. Nor does this figure include funding for losses and damages. See Technical Annex for further detail.

40 Indicative estimate only. Estimate applies damage reduction rates per sector from preliminary analysis by Grantham Research Institute – Grantham Research Institute, 'The Macroeconomic Case for Adaptation Investment' (2025, forthcoming) – to economic costs of inaction for the four listed sectors, calculated by Systemiq. The scope of sectors and hazards examined in each analysis do not align fully. See Technical Annex for further detail.

41 Systemiq analysis. See Technical Annex for further detail.

42 Waldron et al., *Global Landscape of Climate Finance 2024* (Climate Policy Initiative, 2024).

Policy is critical to mobilise private investment and redirect investment flows towards resilience. Governments can set a clear vision and integrate resilience into policymaking to ensure that economic growth and development are built to last. By setting the right frameworks and incentives, policymakers can shape markets to align capital with long-term stability and shared prosperity. And by establishing effective regulation, standards and innovation support, they can guide investment towards robust assets. Importantly, policy fosters inclusion and equity by establishing social protections and public safety nets that ensure vulnerable households are not left unable to afford the costs of climate and nature impacts, preventing inequality from deepening.

Today, resilience investment flows fall far short of needs. Only about $54 billion flows annually into climate resilience in EMDEs - roughly one-seventh of the $350 billion needed.[43] Chapter 4 outlines the main sources of finance that can close the resilience finance gap.

Private finance

Roughly 25% of the resilience investment needed in EMDEs - or $90 billion - lies in sectors that could generate predictable savings (including avoided losses or efficiency measures) or revenues that can be captured by the private sector.[44] Commercial agriculture, water management and real estate are prime examples. Private sector opportunities are stronger in mature and stable markets; in fragile states, achieving 25% private investment is estimated not to be possible currently, as a range of barriers mean revenue models do not work. Just $4 billion flows from private sources into publicly oriented resilience in EMDEs today, leaving a $85 billion financing gap.[45]

BOX A

Estimating the Private Finance Potential

The United Nations Environment Programme Adaptation Report (UNEP AGR) estimates the realistic private sector potential for publicly-oriented national adaptation funding at 15% to 20% by 2035.[46] This varies by country grouping - with higher numbers in upper middle-income countries and lower in low-income countries. The Returns on Resilience report takes a maximalist approach, using a 25/75 public versus private sector split for national adaptation funding. This assumes that all theoretical private sector potential is realised, in all countries and sectors, reflecting an aspirational view of what could be achieved under improved policy and market conditions, and increased use of public finance to catalyse private investment, even if not yet present in EMDEs.

BOX B

Households

Households play a critical role in financing resilience.[47] Individuals are already spending significant amounts of their own resources on adaptation.[48] These flows are not included in our analysis, due to methodological challenges, as highlighted by Climate Policy Initiative (CPI) and others, since much of this spending is diffuse and not systematically reported. Increased investment by households is needed by 2035, with support needed to ensure those from low-income households have access to solutions like increased air conditioning coverage.[49]

43 Systemiq synthesis, drawing on previously referenced Climate Policy Initiative (2024) and Waldron et al (2024). See Technical Annex for further detail.
44 Systemiq analysis. Investment needs in USD are estimated based on a range of sources, drawing primarily on the UNEP Adaptation Gap Report 2025 (forthcoming). Priority interventions are identified, and their capacity to attract private investment is assessed, based on a range of sources, including: BCG, *The Private Equity Opportunity in Climate Adaptation and Resilience* (2025).; CPI, *Adaptation Tracking Taxonomy* (2024); TNA (2024) Taxonomy of Climate Change Adaptation Technology; UNEP AGR, *Adaptation Gap Report 2023* (2023).; *IFPRI, Global Food Policy Report* (2021).; European Commissions, EU Taxonomy (2020).; Tailwind Futures, Tailwind Taxonomy for Adaptation and Resilience Investments, May 2024, among others. See Technical Annex for further detail.
45 Systemiq analysis. See Technical Annex for further detail.
46 UNEP AGR, *Adaptation Gap Report 2025* (forthcoming).
47 Key categories include air conditioning (both a response to rising temperatures and a determinant of future resilience), rainwater harvesting and retrofitting roofs and walls against storms.
48 Climate Policy Initiative, *Global Landscape of Climate Finance 2024* (2024).
49 Climate Resilience Alliance, *Adaptation Finance and the Private Sector: Opportunities and Challenges for Developing Countries* (2025).

Public finance

Approximately 75% of resilience investments - $260 billion - are best suited to public funding. These are investments that generate significant public goods or where the returns are hard to monetise. Yet just $50 billion flows from public sources (domestic and international) into resilience interventions in EMDEs today, leaving a $210 billion financing gap.[50] Public finance sources include:

- **International public finance:** an estimated $30 billion of international public finance flows into resilience investment in EMDEs, far below what is needed – and what has been committed through international negotiations.[51] Deployment of scarce concessional finance – in the form of grants, first-loss capital and ultra-cheap loans – is widely viewed as a priority for countries that are both physically and financially vulnerable.
- **Domestic public finance:** An estimated $20 billion flows into resilience investments from public EMDE sources each year.[52] The amount flowing into proactive investment pales in comparison to reactive expenditure, with many African countries diverting up to 10% of their budgets in order to respond to climate extremes.[53] Examples of proactive investments include health systems prepared for heatwaves or malaria outbreaks, and ecosystem protection. In countries facing high debt burdens and limited fiscal space, major public domestic investments are unlikely without external support.

If the returns on resilience are so strong, why is investment not flowing at the scale it is needed?

A set of barriers make it difficult for economic and financial decision-makers to fully understand or act on the investment opportunity, often owing to policy gaps. Challenges include:

- **Mispriced risks and returns:** The economic value of investments in resilience is still poorly measured and rarely reported. Associated spending is perceived as a cost, not an investment that generates returns.
- **Fragmented and underdeveloped markets:** Resilience investments are diffuse, spanning many sectors or business units. Clear 'resilience offerings' are only starting to be defined and there remains a lack of clarity about investable project opportunities. Innovation in resilience solutions remains under-funded.
- **Externalities and misaligned incentives:** Many resilience investments have strong public good characteristics, meaning that without supporting policies they are underprovided by the private sector. Yet rather than aligning private sector incentives with the need to invest in resilience, existing subsidies, price signals and regulations often encourage behaviour that undermines resilience.
- **Tragedy of the horizon:** Governments, businesses and financial institutions tend to prioritise short-term returns and electoral or market cycles, rather than long-term risks. Because the most severe consequences of climate change and nature loss will materialise beyond these decision-makers' immediate timeframes, there is little incentive to allocate capital today towards resilience measures.
- **High cost of capital:** Many countries and communities that are most affected by climate change and nature loss are poor and face high cost of capital. Public budgets are stretched, and private investors demand returns that these countries cannot meet without support.
- **Weak capacity and information gaps:** Ministries, local and national municipalities, and firms often lack the tools, skills and institutions needed to plan and deliver resilience investment. Reliable risk data is patchy; technical expertise is limited; institutions are overstretched.

Economic and financial decision-makers can pull a series of levers to address these barriers and mobilise investment.

50 Naran et al, *Global Landscape of Climate Finance 2024: Insights for COP29* (CPI, 2024).; Waldron et al., *Global Landscape of Climate Finance 2024* (Climate Policy Initiative, 2024).
51 OECD, *Scaling Finance and Investment for Climate Adaptation: Input paper for the G20 Sustainable Finance Working Group* (OECD, 2025)
52 CPI, *Global Landscape of Climate Finance 2024: Insights for COP29* (October 2024).;Waldron et al., *Global Landscape of Climate Finance 2024* (Climate Policy Initiative, 2024).; *CPI, IDFC Green Finance Mapping Report 2024* (2024).
53 WMO, *State of the Climate in Africa 2023* (2024).

Call to action

The case for strengthening resilience is clear. We largely know what we need to do - and how to do it.

By embedding resilience into investment decisions, economic and financial decision-makers can scale investment in resilience to drive better outcomes for communities, companies and countries.

Chapters 5 and 6 outline key areas for action. Chapter 5 identifies the areas where momentum is building for finance ministers, central banks, private finance, businesses, development finance institutions, donors and philanthropies to drive action through COP30. Chapter 6 drills down into 15 impactful 'A&R Best Buys' in low- and middle-income countries that can be implemented now.[54]

COP30 offers a critical opportunity to pivot from raising awareness to implementation - the moment when the world aligns around resilience as the shared investment agenda. The Brazilian Presidency has placed unprecedented political focus on adaptation and resilience, providing much-needed space for a reimagining of priorities and next steps, alongside mitigation efforts. Building on existing coordination mechanisms like the Race to Resilience and Sharm El Sheikh Adaptation Agenda, hundreds of stakeholders are working with the Brazilian Presidency and High-Level Champions to spotlight a number of global initiatives that can serve as vehicles to address risks and opportunities identified in this report. They are importantly taking a multi-year frame, looking to 2028 when the United Nations' next 'Global Stocktake' takes place to assess progress on the Paris Agreement and set corresponding ambition. Among categories of action that stakeholders have identified to enhance the returns on resilience are:

Delivering on country priorities:

- **Turn National Adaptation Plans (NAPs) into investable resilience strategies.** This means credible, costed investment pathways and aligned project pipelines at the heart of national planning and budgeting processes that identify priority resilience investments, clarify investment needs and financing sources, and plot the policies and financing mechanisms needed to get finance flowing.
- **Scaling Country Platforms can play a valuable role in** supporting the development of resilience investment strategies and facilitating collaboration across actors and sectors. Multiple countries are exploring options to launch country platforms for this purpose. In addition, A&R Best Buys (Chapter 6) represent high-impact solution areas that can generate socioeconomic returns and help countries achieve NAP priorities. They also offer opportunities for financing across diverse funder types.

Embedding resilience into all economic and financial decision-making:

- A growing number of economic and financial decision-makers - in government, business and finance - are starting to embed resilience into policies, strategies and markets. COP30 offers a platform to showcase progress, share lessons and accelerate high-impact actions. Table 1 outlines key opportunities for action, where momentum is emerging.
  - **As part of these efforts, increasing provision of insurance and pre-arranged financing have a particularly important role to play.** They provide liquidity when shocks occur, reduce fiscal disruption, and lower the long-term costs of disasters. And with insurers collectively managing about one-third of global assets, the sector has the potential to mobilise long-term capital for resilient infrastructure. Yet in many climate-vulnerable countries, most households, small businesses, and even governments are uninsured; in low-income settings, more than 90% of disaster losses go uncovered, compared to around 50% on average in higher-income economies.[55] Expected losses from natural disasters have also risen steadily, increasing by roughly 6% per year in real terms since 1994.[56] By 2024, this amounted to an estimated $35 billion in uninsured losses across EMDEs. Addressing the protection gap is therefore a critical priority for decision-makers seeking to embed resilience into decision-making.

54 The Adaptation & Resilience Best Buys have been developed by BCG based on i) analysis of countries' NAPs and Technology Needs Assessments; ii) consultations with over 50 climate and development experts across governments, funders, NGOs, and the private sector, and iii) an extensive literature review. They represent critical, high-impact, cost-effective solutions that offer investment-ready opportunities to achieve resilience and development goals, particularly in low- and middle-income countries.

55 Insurance Development Forum and Bridgetown Initiative *From Risk to Resilience: How Insurance Can Mobilise Disaster Risk Finance and Climate Investment in Vulnerable Economies*, (2025).

56 Banerjee et al, *Natural Catastrophes in 2023: Gearing Up for Today's and Tomorrow's Weather Risks* (Swiss Re sigma, 2024).

Getting key enablers in place:

- Turning the resilience opportunity into reality requires a set of enabling actions that no single actor can deliver alone. These are the shared foundations - the data, tools, and frameworks - that allow decision-makers to measure what matters, align on goals and track progress. Based on discussions to inform this report, momentum and collaboration are growing in the following areas, with the potential to enable resilience investment at scale.
    - **Pricing resilience risks and returns:** Developing frameworks and tools for finance ministries and Central Banks to better understand the fiscal impact not just of climate and nature shocks, but also the quantified positive impacts of and co-benefits unlocked by resilience investments; for CEOs and CFOs to quantify resilience-adjusted profitability under different scenarios; and for investors to improve risk models and benchmarks to assess opportunities.
    - **Developing a shared risk typology across systems:** Coalescing around a common framework for how climate and nature risks accumulate across physical, natural, human and social capital, to create a shared language across sectors, reducing fragmentation and enabling alignment on systemic exposure.
    - **Improving access to physical risk data:** Leaders from the insurance, technology and data sectors coming together with potential users of physical risk data to create a shared baseline of exposure, enabling better fiscal planning, investment choices and insurance pricing.
    - **Tracking progress and positive outcomes of resilience investments:** As the delivery of resilience investments scales up, there is a need to converge around a coherent set of metrics to track progress and positive impacts for communities, companies and countries. This can help to inform approaches with best practice examples, avoid maladaptation, and strengthen the investment case. The Global Goal on Adaptation represents an important step towards developing the metrics to understand, monitor and assess resilience-building efforts and their impact.

The combination of these enablers ultimately drives transformation. Decision-makers can form partnerships to align strategies, pool resources, and drive systemic change at scale.

Table 1 Embedding Resilience into Investment Decisions – Priority Actions and Emerging Momentum

Decision-Maker	Key Opportunities for Action:
Finance Ministries	• Embed the benefits of resilience into macroeconomic forecasts and fiscal policy; • Prioritise investments that protect and grow productive capital; • Engage across ministries to reform subsidies, rules and regulations to incentivise investment in resilience.
Planning and coordination ministries	• Use spatial risk maps and climate-nature risk data to guide land use, infrastructure and sectoral investment decisions.
Central Banks and Regulators	• Integrate resilience into monetary policy, prudential supervision and financial stability frameworks.
Credit rating agencies	• Integrate resilience into sovereign ratings to better capture fiscal capacity, vulnerability and creditworthiness.
Business CEOs and CFOs	• Acknowledge that physical climate and nature risks impact your business, and develop resilience strategies and investments across core functions to reduce physical risk exposure;[57]
Insurance and reinsurance companies	• Develop tools and markets that reward resilience and reduce systemic exposure.
Private finance institutions; Asset owners and managers	• Embed climate risk and resilience assessments in disclosure, risk-return assessments, and portfolio decisions.
IMF	• Embed resilience in growth and debt models to support fiscal stability and poverty reduction.
Multilateral Development Banks and Development Finance Institutions	• Tie concessional finance and guarantees to resilience metrics so that countries can both attract more investment and count on predictable fiscal space when shocks hit.
National Development Banks	• Embed resilience into core investment criteria, including pricing climate and nature risks in lending; • Provide support to grow resilience market, including pipeline development and project preparation.
Donor governments	• Increase the provision of adaptation finance; • Scale the use of mechanisms that direct concessional finance to fill critical gaps in countries that are highly financially and physically vulnerable to climate and nature impacts, and for urgent repair and recovery costs.
Philanthropies	• Meet countries where they are at; supporting the implementation of resilience investment strategies that are aligned with national priorities; • Provide catalytic funding and technical support to build market solutions, including early-stage innovation and solutions that generate maximum socioeconomic returns.

57 WBCSD, *Physical Risk and Resilience in Value Chains: CEO Handbook on Executive Engagement* (2025).

Adaptation and Resilience (A&R) Best Buys

The risks and opportunities around adaptation and resilience are especially pronounced in low- and middle-income countries (LMICs), given their high exposure to climate hazards alongside typically limited adaptive capacity and financing. Declining aid flows and increasingly scarce grant finance are compounding existing challenges around investment opportunities that meet financiers' data and risk thresholds.

Yet there are already significant entry points for every funder – public, private and philanthropic – to finance adaptation and resilience in LMICs in ways aligned with their mandates and risk-return profiles.

To this end, the A&R Best Buys (see Chapter 6) identify 15 high-impact solution areas that can already generate strong socioeconomic returns (see Exhibit 3). These are drawn from analysis by BCG of countries' NAPs and Technology Needs Assessments, consultations with over 50 climate and development experts across governments, funders, NGOs and the private sector, and an extensive literature review. Chapter 6 outlines the rationale for each best buy and showcases exemplar solutions that are innovative, scalable and ready for investment. The Best Buys are critical options for LMICs facing diverse climate hazards, and simultaneously enhance climate resilience and deliver development outcomes aligned with the SDGs.

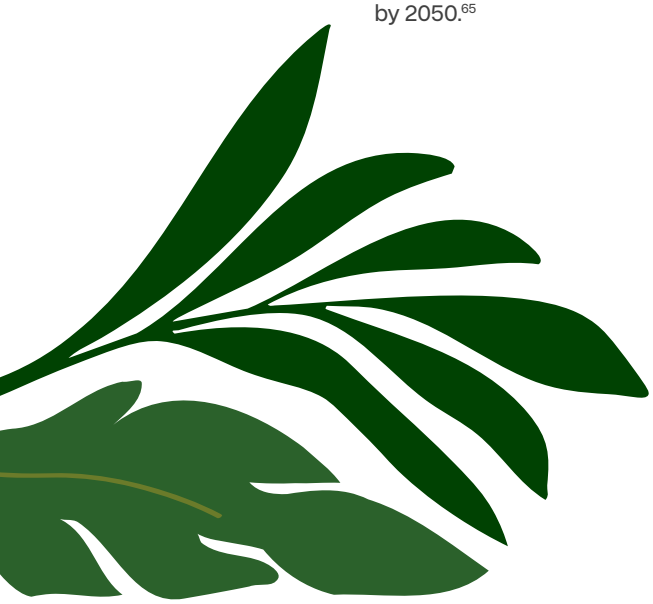
They unlock the 'triple dividend' of avoided losses, induced economic returns, and wider social and environmental benefits – such as reducing mortality and morbidity from climate-sensitive diseases, strengthening food security, and bolstering GDP growth, jobs and incomes.

The A&R Best Buys span six impact sectors broadly aligned with sectors prioritised by the Global Goal on Adaptation. These are broadly aligned with sectors prioritised by the Global Goal on Adaptation and include i) food; ii) water; iii) health; iv) infrastructure; v) community and business; and vi) nature, ecosystems and biodiversity. The A&R Best Buys also include cross-cutting enablers such as information, technology and planning that support and amplify impact across sectors. Among these, food and health are especially emphasised, as they are critical sectors that underpin human wellbeing and economic stability, jobs and growth. Food systems are central to food security and livelihoods in LMICs, where agriculture represents a large share of GDP and employment and is particularly climate-sensitive, while health systems are the frontline for protecting lives under rising climate risks. Both sectors are foundational to resilient economies and societies more broadly in LMICs.

Example A&R Best Buys include

- **Crop resilience:** Climate change is projected to have a staggering impact on global crops, cutting yields by up to 12% by 2050[58]; impacts in Africa could be especially severe, with crop yields projected to drop 18% by 2050.[59] This is on top of the more than 30% decline in agricultural productivity growth due to climate change since 1961 - the steepest decline of any region worldwide.[60] The agriculture sector is already absorbing 26% of the economic impact of climate disasters – increasing to 83% for drought in developing countries.[61] Crop resilience is vital for boosting productivity, strengthening food security, raising farmer incomes, and supporting economic stability, jobs and GDP growth - especially in LMICs.[62] Investments are needed in solutions such as climate-resilient crop varieties and agricultural practices, and innovations such as AI-enabled guidance and improved weather and seasonal forecasts.[63]
- **Resilient health systems:** Climate change is amplifying health threats at a scale that could overwhelm already strained health systems. For example, climate change is projected to cause more than 550,000 additional malaria deaths between 2030 and 2049. Of these, 92% are predicted to arise due to extreme weather events driven by the disruptions they cause to malaria protection and treatment.[64] Without action, climate-related health risks could drive at least $21 trillion in economic costs in LMICs by 2050.[65] Resilient health systems reduce morbidity and mortality, increase access to essential services during climate disruptions, and safeguard lives and jobs. Key investments include reducing dependence on facilities that may be inaccessible or non-functional during extreme weather events and strengthening health product supply chains through cold chain resilience and local pre-positioning of health commodities closer to communities.
- **Terrestrial protection and rehabilitation:** Climate change is disrupting more than 80% of ecological processes, degrading ecosystems, and driving biodiversity loss. The economic cost of nature decline could cut global GDP by $10 trillion by 2050 if the climate and nature emergency is not addressed, undermining livelihoods and economies that depend on nature.[66, 67] Conservation, restoration and sustainable management of forests, rangelands, and other terrestrial ecosystems can reduce climate vulnerability by preventing erosion, restoring soil fertility, retaining water and lowering risk from floods and landslides. Investments are needed in reforestation, assisted natural regeneration and wildfire prevention.

The A&R Best Buys are not a prescriptive list but a starting point to guide discussion and inform country- and locally-led adaptation planning, pointing to critical investments that can shift outcomes at scale. There are multiple considerations that advocates, funders and policymakers should keep in mind when assessing A&R Best Buys and broader A&R funding opportunities, which are explored in Chapter 6.



58 Sue, W; De Cian, E; N. Ministry, M. 'Global vulnerability of crop yields to climate change.' *Journal of Environmental Economics and Management* **109** (2021).
59 Philip Kofi Adom, *The Socioeconomic Impact of Climate Change in Developing Countries in the Next Decades* (Center for Global Development, 2024).
60 World Meteorological Organization (WMO), *State of the Climate in Africa* (2022).
61 FAO, *FAO's Work on Climate Change* (2019).
62 Food and Land Use Coalition, *Aligning Regenerative Agricultural Practices with Outcomes to Deliver for People, Nature and Climate* (2023).
63 World Bank Group, *Climate Smart Agriculture: From Knowledge to Implementation Results Briefs* (2024).
64 BCG & Malaria Atlas Project, *Climate Impacts on Malaria in Africa* (2024).
65 World Bank, *The Cost of Inaction: Quantifying the Impact of Climate Change on Health in Low- and Middle-Income Countries* (2024).
66 IUCN, *Climate Change Impacts on Nature* (2025).
67 Johnson et al. *Global Futures: Modelling the Global Economic Impacts of Environmental Change to Support Policy-Making* (WWF, 2020).

Exhibit 3 The Adaptation and Resilience (A&R) Best Buys

Resilience sector		Best Buy	Description	Exemplar solutions	Primary impacts
Food	1	**Crop resilience**	Inputs, tools and practices that help farms withstand climate shifts (e.g. drought) that affect crop yields and increase productivity	Climate-resilient/hybrid varieties, irrigation systems, biofertilisers	Increased productivity, which enhances farmer incomes and livelihoods, improves food security and diet quality and drives environmental co-benefits, economic stability and growth including GDP and job creation
	2	**Livestock, fisheries and aquaculture resilience**	Improved breeds, feeds, animal health, and pasture/pond management practices that increase productivity	Alternative feed innovations, animal disease management, fish and livestock breeds better suited to the environment	
Water	3	**Water collection and storage**	Nature-based or grey solutions to capture and manage water resources	Rainwater harvesting systems, watershed restoration	Increased water security including quantity and quality, which improves health outcomes and economic stability and growth
Health	4	**Prevention and control of climate-sensitive diseases**	Approaches that reduce burden and accelerate eradication of climate-sensitive diseases (e.g. malaria driven by increased flooding)	Disease surveillance systems, vaccines for climate-sensitive diseases, vector control measures	Reduced disease burden, morbidity and mortality; increased access to essential healthcare services including maternal, newborn and child health services due to fewer closures or interruptions in fixed health facilities, which protect lives and livelihoods and drive economic stability and growth
	5	**Improving nutrition**	Measures to protect nutrition and child growth amid rising climate risks	Food fortification, multiple micronutrient supplementation	
	6	**Health systems resilience**	Strengthened health facilities or mobile care for increased access, supply chains, and workforce capacity	Reduced facility dependence, strengthening health product supply chains	
	7	**Heat mitigation**	Strategies to reduce extreme heat-related deaths, illness, and system strain including for maternal, newborn, and child health	Heat action plans, passive cooling infrastructure, early warning systems for heatwaves	
Infra-structure	8	**Energy infrastructure resilience**	Resilient power systems that sustain communities and critical services amid climate disasters	Solar microgrids, battery storage	Minimised service disruptions and damages, keeping essential services and economies running amid climate events
	9	**Coastal and riverine infrastructure resilience**	Engineered or nature-based defenses to minimise impacts from coast and river floods	Mangrove protection and restoration, urban drainage and stormwater management	
Community and business	10	**Early warning systems**	Monitoring and communication tools to alert communities to prepare before disasters strike	Disaster risk early warning system, agriculture early warning system	Faster recovery and financial protection for households and SMEs, reducing poverty
	11	**Financial inclusion, insurance and social protection**	Financial tools and safety nets for preparedness and disaster recovery	Adaptive social protection, index-based insurance, financial innovation	
Nature, ecosystems and biodiversity	12	**Terrestrial protection and rehabilitation**	Healthy land ecosystems to ensure continued resilient resources, ecosystem services	Reforestation, assisted natural regeneration, wildfire prevention	Preserved biodiversity and natural buffers against climate risks; continued access to ecosystem services
Cross-sector enablers	13	**Climate information systems**	Access and availability of integrated weather- and climate-data systems for decision-making	Spatial data collection tools, improved weather data availability and seasonal forecasts	Adaptation solutions and emergency response measures reach and are co-created with vulnerable populations – quickly, reliably and securely to enable communities to build back in a more resilient way
	14	**Planning, preparation and response**	Informed planning, readiness, and response to reduce losses and speed recovery	Anticipatory action plans, national and sectoral adaptation plans	
	15	**Digital public infrastructure**	Digital systems and services to help climate solutions scale	Digital identity systems, inclusive digital payment platforms	

At COP30, governments, civil society, businesses, investors and financiers will gather to push resilience higher up the economic and political agenda. The challenge is not new plans, but delivery.

Resilience is no longer a side-agenda - it is the foundation of growth and stability.

If governments, businesses, investors and civil society act together, they can reverse the spiral from escalating costs to rising returns. The choice is clear: delay and face mounting losses, or act now to secure stronger, safer, more competitive economies that deliver for all.

Chapter One

Resilience is the Imperative for Communities, Companies and Countries

1.1 Investing in Resilience delivers Returns

Around the world, people aspire to better lives, safety and security. Businesses strive to expand and grow profits. Governments seek to secure prosperity, growth and security for their citizens.

Yet these aspirations are under threat in the face of mounting climate and nature impacts. For decades, the world has pursued economic development and growth with the assumption of a relatively stable environment. That assumption no longer holds. The impacts of climate change and nature loss are now part of the 'standard operating environment' for ever-larger shares of households, businesses and economies, with both immediate and long-term costs, especially in lower-income countries. At the same time, the ability to respond to and manage shifting risks is now essential to unlocking opportunity, in addition to safeguarding business and development gains.

A remarkable body of evidence from the efforts of countries, companies and communities has emerged in recent years, showing that resilience investments are the surest way to drive growth, stability and competitiveness.

The results from these investments undermine the historical narrative that spending on resilience is 'charity' and 'economically unproductive.' In fact, the analysis of this report – with support from 22 partners – finds that resilience investments are a boon for both economies and human development, offering concrete returns from job creation to macroeconomic stability, growth, and commerciality, among others, on top of lives saved. They also reinforce and supplement the longstanding frame of equity, justice and solidarity. The benefits furthermore stand in sharp contrast to the alternative: ruinously expensive inaction. Key benefits include:

Resilient communities

This means absorbing shocks and adapting while protecting livelihoods. Investing in resilient medical infrastructure - such as flood-proof hospitals, clinics with reliable renewable energy and climate-resilient cold chains for vaccines - helps to reduce disease burdens and maintain continuity of care, improving health outcomes. Early warning and advice systems for extreme heat, flooding and rainfall give people time to get themselves and their belongings to safety. Access to savings, insurance and social protection can make the difference between survival and destitution in the face of cyclones and earthquakes - or prevent a farming family from slipping into poverty during a period of prolonged drought. Strong communities and trusted institutions support recovery. Populations that feel secure are more inclined to invest in education, housing and entrepreneurship.

Resilient companies

A resilient company maintains continuity, protects value and develops competitive advantage. They understand - and secure themselves against - climate and nature risks across operations and supply chains, limiting disruptions and protecting productivity. Resilient businesses retrofit physical assets - from heat-resilient warehouses to flood-proof facilities - and invest in solutions like water efficiency processes and sustainable sourcing to ensure continuity in the face of supply shocks. They support employee wellbeing with shaded workspaces and heat-adaptive shift scheduling, reducing health risks and absenteeism. They are agile, adapting product lines and business models to respond to rising demand for resilient goods and services. Resilient SMEs with limited capital buffers can invest in low-cost, incremental measures like better ventilation and flood barriers. Access to affordable finance and technical support is essential to enable these investments. So too are financial tools that equip SMEs to manage disruptions when they hit, including affordable insurance, contingent credit lines and guarantees.

Resilient countries

A resilient country can continue to create jobs, deliver public services, and provide long-term security, even in the face of shocks. They embed adaptation and resilience (A&R) into national development plans and public investment strategies - protecting critical infrastructure, diversifying economies, and safeguarding the capital stocks that underpin growth. Investments such as flood-resilient transport networks, climate-smart agriculture, and restored ecosystems enable economies to absorb disruptions and prevent cascading failures across sectors. Fiscal tools like social protection systems and pre-arranged finance buffers help governments respond without derailing long-term development. Resilient economies properly price and manage risk - aligning finance and planning to enable stable, future-fit growth.

What is Resilience?

There are several definitions of resilience. The concept of 'resilience' has evolved in recent years, from a primary association with environmental sustainability and conservation, to encompassing critical social, economic and financial dimensions.[68] Rockstrom et al. (2023)[69] define resilience as: 'the capacity to live and develop with change and uncertainty, which is well beyond just the ability to 'bounce back' to the status quo. It involves the capacity to absorb shocks, avoid tipping points, navigate surprise and keep options alive, and the ability to innovate and transform in the face of crises and traps', while the IPCC defines resilience as: 'a system's ability to anticipate, reduce, accommodate, and recover from disruptions in a timely, efficient, and fair manner'.

For the purpose of this report, resilience is defined as the capacity of households, communities, businesses and economies to adapt and thrive in a changing world, to absorb and to quickly recover from climate and nature shocks. This is based on protecting and expanding productive capital - physical, natural, human and social - in the face of mounting threats. Building resilience to climate and nature impacts helps to build wider resilience, due to the ways in which climate change and nature loss destabilise societies and economies worldwide. Resilience is a dynamic state. As risks evolve, so too must investment and policy. It is not a one-off achievement but a constant process of reinforcement.

Resilience is built through - and enables - both adaptation and mitigation. **Investments in resilience and emission reductions are synergistic and must be pursued together.** This underscores the urgent need to double down on decarbonising the global economy.[70] Not all the costs can be easily adapted to.[71] There is no excuse for delay. And mitigation measures themselves must be resilient to remain effective over the long-term.[72] Fortunately, there are many opportunities for investments which help us to adapt, reduce emissions, and support development at the same time. This has to be the core strategy which will ultimately boost overall economic resilience.

68 Scordato, L. & Gulbrandson, M.. 'Resilience Perspectives in Sustainability Transitions Research: A Systematic Literature Review'. *Environmental Innovation and Societal Transitions,* Vol. **52,** (2024).
69 Rockstrom et al., 'Shaping a Resilient Future in Response to COVID-19', *Nature Sustainability Perspective* (2023).
70 IPCC, *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report.* (Cambridge: Cambridge University Press, 2022).
71 IIGCC, *Physical Climate Risk Appraisal Methodology* (PCRAM) 2.0 (June 2025).
72 World Bank, *Rising to the Challenge: Success Stories and Strategies for Achieving Climate Adaptation and Resilience* (Washington, DC: World Bank, 2024).

Across sectors, a synthesis of available benefit cost ratios (BCRs) by the Grantham Research Institute (GRI) suggests that investments in adaptation deliver a median of 4 times more benefits than costs. Available evidence additionally confirms a median economic internal rate of return (EIRR) of 25%.[73]

This reinforces findings from the World Resources Institute (WRI) that every $1 invested in climate adaptation yields over $10 in benefits, with **average economic annual returns of 20% to 27%** – reaching 79% in health services and 27% in agriculture.[74] Investments in nature deliver particularly strong returns for communities, companies and countries, with 40% average economic annual returns for forestry and nature investments.[75]

Investing in resilience delivers real returns. Resilience investments protect existing value and unlock new opportunity – from regenerative agriculture delivering higher yields to strong, equitable health systems raising labour productivity, as well as saving more lives. These investments save money when disasters hit, but they also generate dividends in growth and prosperity during 'normal' times. These outcomes are captured in the WRI 'Triple Dividend of Resilience' framework (see Box 1.1):

1. **Avoided losses:** Reduced deaths, damages and fiscal costs when hazards strike.
2. **Stimulated economic activity:** More reliable infrastructure, services and supply chains that increase productivity and attract investment.
3. **Social and development co-benefits:** healthier populations, new jobs, innovation and environmental gains.

There are many solutions that achieve both resilience and development goals. The Adaptation & Resilience Best Buys, identified by Boston Consulting Group (BCG), are high-impact, cost-effective solutions that can be financed and scaled now, particularly in low- and middle-income countries (see Chapter 6).

73 Grantham Research Institute preliminary analysis of 75 studies – 'The Macroeconomic Case for Adaptation Investment' (2025, forthcoming)
74 WRI, *Strengthening the Investment Case for Climate Adaptation: A Triple Dividend Approach* (2025).
75 ibid

BOX 1.1

Strengthening the Investment Case for Adaptation using the Triple Dividend of Resilience (TDR) Methodology

WORLD RESOURCES INSTITUTE

Addressing climate risk and building resilience is commonly seen as a cost - a necessary expenditure required to avoid losses resulting from the impact of extreme weather events. However, this is a narrow view of the benefits generated by investing in climate adaptation. In fact, careful analysis shows that adaptation investments generate high economic returns, well above their opportunity cost.

These high returns come in the form of avoided losses, induced economic benefits, and reduced environmental and social externalities. As per the triple dividends approach, the first dividend, avoided losses, is the investment's ability to reduce future losses (compared to an established baseline) from climate hazards. The second dividend (induced economic benefits) relates to development gains from enhanced efficiency, higher farm yields, or the creation of new jobs. The third dividend (social and environmental benefits) is non-market benefits such as healthier ecosystems, reduced greenhouse gas emissions, or improved female labour force participation. Importantly, the realisation of the second and third dividends is not dependent on whether the anticipated extreme event actually occurs or not.

World Resources Institute's *Strengthening the Investment Case for Adaptation* study[76] applies the Triple Dividend Methodology to better capture the diverse benefits of investing in adaptation in developing countries. The study analyses 320 public sector adaptation investments in 12 low- and middle-income countries between 2014 and 2024 and across four sectors: agriculture, health, infrastructure and water. It extracts information from the cost-benefit analysis section of the government- and donor-prepared project appraisal documents. The findings were compiled into the publicly available database called AdapTDR, which is a first-of-its-kind effort at collecting, organising, and analysing actual climate adaptation investments being implemented today. The study found that:

Adaptation is a high-impact and high-return investment:

- Investments analysed in AdapTDR show impressively high average returns, with an average of 27% across all sectors. This translates, on average, to $10 in economic benefits for every $1 invested. The highest average returns are in the health, disaster risk reduction and forestry sub-sectors.

Good adaptation is good development:

- On average, 50% of the monetised benefits of adaptation come from development, social and environmental gains (dividends two and three). In other words, the benefits of investing in adaptation pay off even when a disaster does not strike. Climate adaptation is not only about preventing future losses but is also about driving sustainable development.

Adaptation also generates mitigation benefits:

- Nearly half of the adaptation investments analysed in AdapTDR are also expected to generate greenhouse gas mitigation benefits either through emissions reduction or carbon sequestration. Greenhouse gas reduction benefits are the highest in the energy, forestry and nature, and transport sub-sectors.

Adaptation returns are underestimated:

- Project documents described many benefits qualitatively but not quantitatively. As a result, many benefits were not included in the calculation of projected economic internal rates of return (EIRRs). In fact, only 8% of all investments studied provided a dollar value for benefits in all three of the dividends. Adaptation investments, therefore, are likely to have even higher returns than presented in currently available quantitative data.

Since the true value of adaptation is routinely underestimated, it is likely that it is under-funded - and that the adaptation financing gap is larger than is economically warranted. By integrating the TDR method into their project design and economic analysis, governments and donors will be able to better capture adaptation's diverse benefits. This will help change the narrative of adaptation from being only 'the cost of avoiding losses' to 'high-return investments supporting smart development'. Highlighting the synergies between adaptation and mitigation can further unlock finance and create space for comprehensive climate-smart development action.

76 WRI, *Strengthening the Investment Case for Climate Adaptation: A Triple Dividend Approach* (2025).

1.2 Navigating a Rapidly Changing and Volatile World

Climate and nature hazards are no longer future risks - they are today's reality. Climate change and nature loss are driving material impacts for people, businesses, sectors and economies.

Acute shocks, like floods and wildfires, and slow-onset, gradual changes (that may be imperceptible day-to-day but amount to large changes year-on-year like temperature rise, water stress and soil degradation) are all disrupting people's lives, threatening business continuity, destabilising sectors and eroding economies (see Box 1.2). These impacts exacerbate inequalities. Within countries, poorer populations and vulnerable groups are disproportionately affected; they are less able to recover from climate and nature impacts and often work in sectors that are highly exposed. Across countries, the lowest-income and fragile states are least equipped to absorb and recover from slow-onset and acute impacts.

Communities

Communities are losing their health, property, income and livelihoods. Flash floods and storms displace families, destroy homes and wash away basic infrastructure. At least 20 million people are displaced by climate shocks per year.[77] At least 50% of the world's population - around 4 billion people - live under highly water-stressed conditions for at least one month of the year.[78]

The loss of essential infrastructure like roads, bridges and electricity cuts households off from markets and emergency services. Hurricane Ida left residents of Louisiana without power for three weeks in hot conditions in 2021.[79] Extreme heat puts pressure on human health and the health systems that support this; schooling is interrupted as classrooms are damaged. In 2024, extreme climate events such as heatwaves, storms and droughts disrupted the education of at least 242 million students worldwide.[80] East Africa's prolonged drought from 2018 to 2022 left over 22 million people acutely food insecure across Ethiopia, Kenya and Somalia.[81] As a global collective, women and girls spend up to 200 million hours daily collecting water as it grows more scarce, reducing the time available for education, employment, childcare and other daily responsibilities.[82]

Those working in highly exposed sectors are seeing their livelihoods in the balance. Evidence shows that extreme heat already costs women up to $120 billion in income losses across India, Nigeria and the US combined each year, with impacts tripling when unpaid care work is accounted for.[83]

Poorer and vulnerable groups are suffering the most. For example, Californian workers in the bottom 20% of income ZIP codes experience five times more injuries on hot days compared to those in the top 20%.[84] In Cape Town, urban heat and a lack of access to cool spaces in high density areas of the city are expected to exacerbate existing inequalities.[85]

77 Viviane Clement, *Groundswell Part 2* (Washington DC, World Bank, 2021).
78 WRI, *25 Countries, Housing One-Quarter of the Population, Face Extremely High Water Stress* (2023).
79 UNDRR, *When Extreme Events are no Longer Rare: Lessons from Hurricane Ida* (2021).
80 UNICEF, *Learning interrupted* (2024).
81 World Food Programme *(WFP), Horn of Africa Drought Response – Situation Report #16* (May 2023).
82 Carr et al. 'Climate Change to Exacerbate the Burden of Water Collection on Women's Welfare Globally'. *Nature Climate Change*, Volume **14,** (2023).
83 Arsht-Rock, *The Scorching Divide: How Extreme Heat Inflames Gender Inequalities in Health and Income (Atlantic Council and Climate Resilience Center*, Accessed 18 August 2025.
84 Mast, N. & Cohn, E. Extreme Heat is Deadly for Workers and Costly for the Economy', (Economic Policy Institute, Working Economics Blog, 2025).
85 C40 Cities, *Urban Heat & Equity: Experiences from C40's Cool Cities Network* (2021).

Companies

Companies are suffering damage to physical assets, destabilised supply chains and reduced business activity. Slow-onset impacts are causing natural resources to deplete, in turn driving input costs up. Ghana's cocoa output in 2024 was 55% below the average in the previous 4 to 5 years. The reduction has been linked to intensive farming practice and a focus on export growth. More broadly, the production of cocoa in West Africa is on a negative downward trend, with a 10% reduction year on year projected for the 2025 to 2026 season.[86] Heat stress can increase the risk of workplace injuries by 5%.[87] Preliminary analysis of existing evidence - specifically, eight econometric studies accompanied by additional studies employing complementary methods - was conducted by the Grantham Research Institute. Findings suggest that total labour productivity is expected to decline over 5% in parts of Asia and Africa due to temperature shocks.[88] Deeper productivity losses are expected in high-exposure sectors, such as agriculture, where reductions in productivity are estimated between 26% and 33% by 2050.[89]

Small and medium enterprises (SMEs), which form the backbone of employment in most emerging markets and developing economies (EMDEs), are particularly vulnerable to climate shocks. Limited savings and the high cost of capital reduces access to finance to invest in resilience measures.[90] Larger firms are also increasingly exposed. For example, Hurricane Otis in 2023 damaged around 80% of hotels in Acapulco, Mexico, causing an estimated $12 to $16 billion in damage to hotels and infrastructure, and severely impacting the travel industry.[91]

Countries

Countries are experiencing slowing growth and weakening job creation as climate and nature shocks damage infrastructure, disrupt sector functioning and reduce productivity. Cascading impacts compound disruption across sectors. Droughts deplete natural capital such as water systems, paralysing both agriculture and energy generation. Climate change has already erased at least $525 billion from emerging markets and developing economies over the last two decades.[92] Governments are regularly pushed into reactive emergency spending while revenue falls, leaving less fiscal space for long-term investment and adequate social safety nets. Over time, the cycle of shocks and underinvestment is eroding competitiveness and economic resilience - with the greatest impacts being felt in countries least equipped to respond.

86 Bjornlund, V., Bjornlund, H., & Van Rooyen, A. F. 'Why Agricultural Production in sub-Saharan Africa Remains Low Compared to the Rest of the World – a Historical Perspective'. *International Journal of Water Resources Development,* **36 (sup1)** (2020):S20–S53.; Reuters, *West Africa Facing 10% Drop in Cocoa Output in 2025/26, Industry Sources Say,* (2025).; Reuters, Ghana cocoa output is half of average with harvest almost complete, (2024).
87 Negrusa et al. 'Impact of Excessive Heat on the Frequency of Work-Related Injuries' (2024).
88 Grantham Research Institute, 'The Macroeconomic Case for Adaptation Investment - Preliminary Analysis' (2025, forthcoming).
89 Dasgupta et al. 'Heat Stress and the Labour Force'. (2024).
90 OECD, *Scaling Finance and Investment for Climate Adaptation: Input paper for the G20 Sustainable Finance Working Group* (2025).
91 National Hurricane Center, *Tropical Cyclone Report 'Hurricane Otis'* (2023).
92 V20, *Climate Vulnerable Economies Loss Report* (2022).

BOX 1.2

Resilience Must Be Built Around People, Climate and Nature Risks

Resilience strategy must consider huge risks from nature capital loss in addition to climate change. When ecosystems are degraded, water security declines, soils lose fertility, fisheries collapse and natural buffers against floods and storms disappear. Livelihoods and economic stability are eroded as a result. Climate and nature hazards are deeply interlinked and mutually reinforcing, with many of the most dangerous disruptions coming from the interaction between the two. Higher temperatures and deforestation combine to drive wildfires; mangrove loss magnifies storm surges; droughts are more devastating when wetlands and forests that store and regulate water have already been destroyed. These impacts are not linear: they can accelerate and cascade through feedback loops, meaning small changes can trigger disproportionate and sometimes abrupt shifts in ecosystems and climate systems.

	Hazard		Climate[1]	Nature[2]
Chronic	Land	· Soil erosion and soil health decline	✓	✓
		· Land pollution	✓	✓
		· Decline of provisioning services (terrestrial ecosystems)		✓
		· Loss of pollination services		✓
		· Land use change	✓	✓
		· Residual loss of terrestrial biodiversity, habitat and species	✓	✓
	Ocean	· Sea use change	✓	✓
		· Coastal erosion	✓	✓
		· Sea level rise	✓	
		· Decline of provisioning services (marine ecosystems)	✓	✓
		· Ocean acidification	✓	
		· Residual loss of marine biodiversity, habitat and species	✓	✓
	Freshwater	· Reduced flood mitigation	✓	✓
		· Water stress	✓	✓
		· Water pollution and saline intrusion	✓	✓
		· Reduced regulation of water quantity and quality	✓	✓
	Atmosphere	· Temperature increase and variability	✓	
		· Changing wind patterns	✓	
		· Heat stress	✓	✓
		· Changing precipitation (patterns and types)	✓	✓
		· Air pollution	✓	✓
		· Disrupted regulation of climate, weather and air quality	✓	✓
		· Reduced storm mitigation	✓	✓
Acute	Land	· Residual acute terrestrial nature degradation[3]		✓
		· Mass movement (incl. landslide, avalanche)	✓	✓
		· Snow, glacier and icesheet thawing	✓	
		· Wildfires	✓	✓
		· Droughts	✓	✓
	Ocean	· Residual acute marine nature degradation[3]		✓
	Freshwater	· Floods	✓	✓
	Atmosphere	· Heatwave	✓	✓
		· Cold wave (frost)	✓	✓
		· Storms (incl. tornados, cyclone, hurricanes, typhoons)	✓	✓
		· Heavy precipitation (rain, hail, snow, ice)	✓	✓

1 Driven by climate change
2 Driven by nature loss
3 Man-made or natural acute and sudden ecosystem degradation causing ecosystem services decline

As the scale and frequency of impacts grow, people, businesses and economies approach a stage where shocks or changes previously considered rare could become the new normal. Cascading and unequal impacts will only intensify as the world passes critical climate thresholds such as 1.5°C warming. As extreme weather shocks and longer-run impacts increase in probability, distribution and frequency, the need for a profound shift in economic and financial decision-making grows. Between 2000 and 2020, drought events increased by one-third, extreme temperature events more than tripled,[93] and billion-dollar weather disasters now strike every three weeks – compared to every four months forty years ago.[94] These impacts are not inevitable. They underline the critical need for greater efforts to reduce emissions and nature loss. But unless investment in resilience scales alongside mitigation, the cost of inaction will grow, and the choices available will narrow.

Emerging markets and developing economies (EMDEs) face profound risks - particularly low-income countries in this group (see Box 1.3). But no country is immune: impacts ripple through supply chains, trade and finance. Droughts in Russia in 2010 slashed wheat exports, driving price spikes that helped spark the Arab Spring.[95] Floods in Thailand in 2011 disrupted 30% of global hard drive production.[96] In 2023 and 2024, severe drought conditions in the Panama Canal - exacerbated by El Niño and likely intensified by climate change - reduced daily ship transits by one-third, driving up freight costs and delaying shipments worldwide.[97] For Panama, the drought threatened a cornerstone of its economy. Canal toll revenue accounts for nearly 6% of Panama's GDP, and transit reductions were projected to cut national income by hundreds of millions of dollars in 2024. Infrastructure and logistics companies with operations in the region also saw downgraded growth forecasts.[98]

93 UNDRR, *Human Cost of Disaster: An Overview of the Last 20 years 2000-2019* (2020).
94 Economist Impact, *Climate Change's Disruptive Impact on Global Supply Chains and the Urgent Call for Resilience* (2025).
95 Hendrix, Cullen S., and Henk-Jan Brinkman. 'Food Insecurity and Conflict: Empirical Evidence from Africa.' *World Development* **54** (2013): 188–199.
96 OECD, *Thailand Floods and Hard Disk Drive Supply Chain Disruptions* (OECD Global Forum on Productivity, 2014).
97 New York Times, *Panama Canal Drought Impacts* (2023); *Carbon Brief, Drought behind Panama Canal's 2023 shipping disruption 'unlikely' without El Nino* (2024).
98 Baker Institute, *Supply Chain Alternatives for Ocean Shipping if Climate Change-driven Water Shortages Persist at the Panama Canal* (2023); Poladashvili, T. & Makharadze, I., *The Impact of the Panama Canal disruptions on International Trade'. International Scientific Journal Innovative Economics and Management,* Vol. **11**, No. 3 (2024).

BOX 1.3

Emerging Markets and Developing Economies (EMDEs)s in Focus - Shared Risks, Different Realities

While absolute losses may be greater in higher-income countries due to higher-value assets and infrastructure, development losses are disproportionately greater in low-income countries. In the context of extreme weather disasters, EMDEs face the greatest pressures. Compared with high-income countries, EMDEs suffer more than ten times the economic damage, recover four times more slowly, and endure deeper human development losses due to higher exposure and weaker fiscal capacity.[99] EMDEs also face more significant impacts from slow-onset changes, including temperature rise, sea level rise and desertification. For example, the number of deaths after a 34°C day can be ten times higher in India than in the US.[100] The burden often falls more heavily on households due to limited insurance coverage and weaker social safety nets.[101]

Least developed countries and small island developing states are the worst affected. Storms that cost 0.2% of GDP in North America can wipe out 46% in a Pacific Island nation.[102] Sub-Saharan Africa and South Asia are home to the largest number of people at high climate risk - nearly 42% of sub-Saharan Africa's population is highly vulnerable, and 87% of South Asia's population is exposed to climate-related hazards with significant vulnerability.[103] Physical vulnerabilities are compounded by extreme fiscal constraints. Between 2025 and 2031, debt service payments for V20 countries are expected to be four times higher than their climate investment needs.[104] Public debt levels in low-income countries have risen to record highs, while domestic capital markets remain shallow.

These countries need targeted support to invest in adaptation and resilience to cut the cycle of tightening fiscal space and increasing vulnerability. See Chapter 4 for financing recommendations and the role concessional capital must play in supporting the most exposed and fragile states.

In a volatile and rapidly changing world, countries need stabilising investments that can protect communities, strengthen businesses and sustain long-term development.

99 Emerging markets and developing economies (EMDEs) are disproportionately affected by climate-related disasters. Over the past two decades, EMDEs have incurred over $525 billion in direct losses from extreme weather events alone - representing about 20% of their collective GDP, compared to less than 1% for high-income countries (World Bank, 2022; IMF, 2023). Recovery from these shocks is also slower: according to IMF research, countries with lower adaptive capacity can take up to four times longer to return to pre-shock economic trajectories than high-income peers (IMF, Climate Change and Long-Term Growth, 2023; Hallegatte et al., World Bank, 2016)

100 Park, R. Jisung. *Slow Burn: The Hidden Costs of a Warming World* (Philadelphia: University of Pennsylvania, 2024).

101 Carleton et al., *Adaptation to Climate Change* (Massachusetts: National Bureau of Economic Research, 2024).

102 UNDRR, *Global Assessment Report on Disaster Risk Reduction, Resilience Pays: Financing and Investing for our Future* (2025).

103 World Bank Group, *Counting People Exposed to, Vulnerable to, or at High Risk From Climate Shocks* (2023).

104 Vulnerable Twenty (V20) Group of Finance Ministers & Boston University Global Development Policy Center, *V20 Debt Review: Third Edition – An Account of Debt in the Vulnerable Group of Twenty* (2025).

1.3 Resilience is Development

Development is resilience. Households and communities are only able to withstand disruptions and bounce back from shocks when they have full access to essential services - water, energy, healthcare, financial systems and education.

A 10% increase in GDP per capita reduces well-being losses from climate impacts by 2.4% and cuts the number falling into extreme poverty by 5%.[105] In India, access to banking reduces heatwave mortality by up to 75%.[106] Development is not optional; it is the bedrock of resilience.

Yet in a world of unavoidable climate change and nature risks, development without resilience is fragile and vulnerable to deepening inequalities. For decades, the world has pursued sustainable development with the assumption of a relatively stable climatic environment. That assumption no longer holds. Climate and nature shocks are now systemic - wiping out infrastructure, displacing millions, destabilising economies and deepening inequality.

Hurricane Maria in 2017 caused damages equivalent to 226% of Dominica's GDP - demonstrating how a single disaster can obliterate economic gains when resilience is low.[107] The path to development now depends on navigating volatility as the new normal rather than assuming stability will return. Economic and financial strategies need to respond to this reality with a long-term focus on resilience.

There is huge opportunity to build resilience from the outset. Today, 60% of the infrastructure needed by 2050 is yet to be built.[108] Where infrastructure exists, retrofitting is needed to ensure this is climate-proof. A resilient port designed with sea-level rise in mind keeps trade routes open and revenues flowing long-term.[109] A school built above flood levels becomes a safe haven during storms, protecting children's education while doubling as a community shelter. Drought-resilient irrigation systems safeguard harvests against rising temperatures and shifting rainfall, protecting farmer incomes while sustaining food security. Urban cooling measures such as green roofs and shaded streets enhance liveability and worker productivity year-round, not only during heatwaves. Smart investment, sound policy, and effective business strategy can work in tandem to drive a shift from at-risk people, businesses and economies, to unlock development, create jobs, boost growth and enhance macroeconomic stability.

105 World Bank, *Rising to the Challenge: Success Stories and Strategies for Achieving Climate Adaptation and Resilience* (Washington, DC: World Bank, 2024).
106 Park, R. Jisung. 'Slow Burn: The Hidden Costs of a Warming World' (Philadelphia: University of Pennsylvania, 2024).
107 Government of the Commonwealth of Dominica, *Post-Disaster Needs Assessment: Hurricane Maria, September 18, 2017* (Global Facility for Disaster Reduction and Recovery (GFDRR), 2017).
108 CDRI, *Global Infrastructure Resilience: Capturing the Resilience Dividend – A Biennial Report from the Coalition for Disaster Resilient Infrastructure* (New Delhi: CDR, 2023).
109 Global Commission on Adaptation (GCA), *Adapt Now: A Global Call for Leadership on Climate Resilience* (2019).

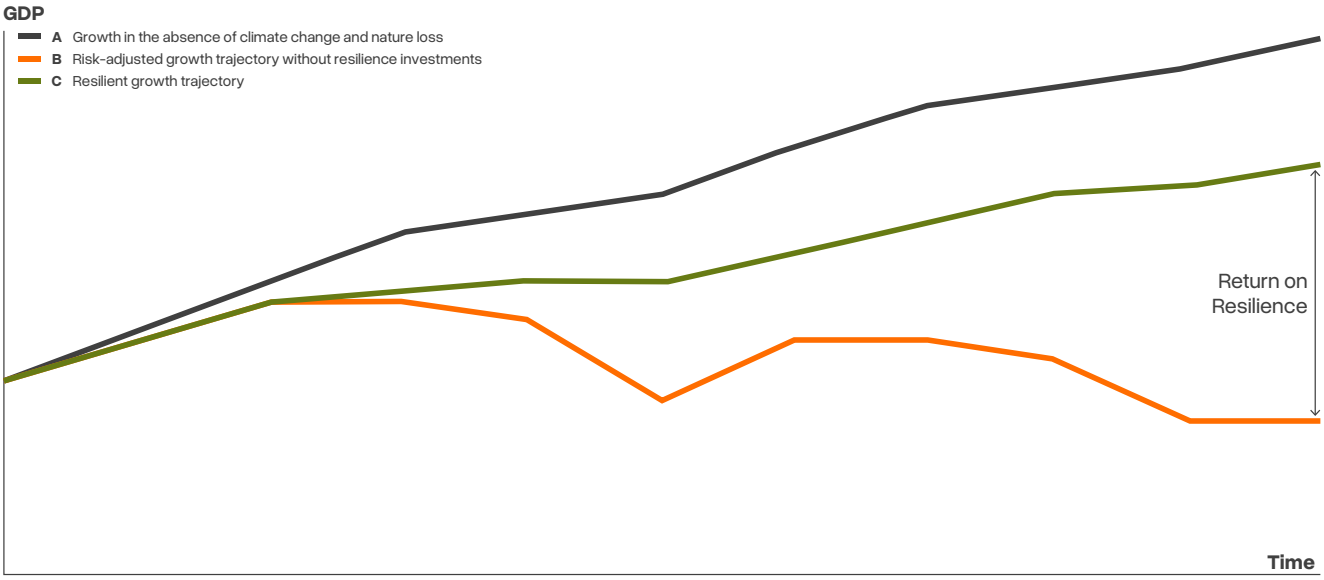
By anticipating and managing acute shocks and slow-onset changes, economic and financial decision-makers can reduce disruptions, avoid structural deterioration and unlock returns. Leaders who act early - with foresight and solidarity - can turn vulnerability into advantage. Resilience is not a separate track from climate action or development - it is the connective tissue. The investment agenda of the 21st century is one and the same: building economies that can both cut emissions and withstand shocks while driving inclusive growth.

Mitigation lowers future risks, but resilience determines whether societies and businesses can withstand impacts already locked in.[110] Just as renewable power systems must be storm-resilient and green buildings should be designed for extreme heat, so every development investment must integrate resilience by default.[111]

Exhibit 1.1 sets out three trajectories for development and growth. It is illustrative but is based on real world lessons.

- **Development and growth without climate change and nature loss:** A development and growth trajectory in a world without climate and nature risks - which until recently was the world we assumed we were building for.
- **Development and growth without resilience:** A risk-adjusted trajectory, where escalating shocks drive volatility and erode development gains. Without recognising reality, we risk locking ourselves into this path.
- **Resilient development and growth:** A resilient development and growth trajectory. Alongside investing in resilience, this trajectory depends on concurrent investment in low-carbon development.

Exhibit 1.1 Three Development and Growth Trajectories



110 IPCC, *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report* (Cambridge: Cambridge University Press, 2022).

111 World Bank, *Rising to the Challenge: Success Stories and Strategies for Achieving Climate Adaptation and Resilience* (Washington, DC: World Bank, 2024).

BOX 1.4

The Green Transition calls for Adaptation - Instituto Talanoa

Adaptation and transition are interdependent, and only when addressed together do they deliver durable results. Adaptation strengthens the resilience of energy and land-use transitions, while transition investments expand the space for effective adaptation. The outcome is resilience as a collective dividend.

Adapting the energy transition

Global electricity demand surged by 4.3% in 2024, with half of the increase driven by cooling needs, showing how adaptation gaps in energy systems amplify fossil use.[112] Meanwhile, clean energy infrastructure is also vulnerable to climate extremes. Droughts in Brazil, Zambia, and California have cut hydropower output by up to 40% since 2023, forcing emergency fossil fallback.[113] Heatwaves can reduce solar efficiency by 25% and have shut down nuclear plants in France as rivers overheated.[114] Making renewables resilient through weather-hardened and prepared energy grid infrastructure, decentralised storage, and integration of water and energy systems, is essential to keep the transition on track.

Protecting land-use transitions

Brazil's recent decline in deforestation is a significant mitigation achievement. Yet rising temperatures and drought have intensified fires, putting these gains at risk.[115] In 2024, degradation reached a two-decade high, with record wildfires and widespread drought driving severe ecosystem damage and emissions. Without adaptation measures like integrated fire management, resilient landscapes and indigenous stewardship, mitigation progress will remain highly vulnerable to cascading losses.

The reinforcing loop

Adaptation makes mitigation investments stick, while mitigation limits the scale of impacts that adaptation must manage. At COP30, this synergy is critical: one without the other leads to fragile progress. By embedding adaptation into just transition pathways, resilience emerges not as a side effect, but as a collective dividend.

Communities, companies and countries face a clear choice between reaction and resilient response.

They can continue reacting to crises and allowing slow-onset degradation to erode capital and wellbeing, or invest in resilience to protect lives, secure livelihoods, and deliver long-term prosperity. With the right strategies, they can turn rising risks into real returns - for people, economies and businesses. From ministries of finance and central banks to insurers, investors, regulators and philanthropies, the opportunity is now to embed resilience into the heart of economic planning, capital markets, and business strategy. This is the opportunity to seize the full potential of this resilience agenda.

112 IEA, *Global Energy Review 2025* (2025).
113 Gavin Maguire, *Forget AI. Keeping Cool is the Bigger Power Sector Problem* (Reuters, June 2025). Accessed: 9 October 2025.
114 CarbonBrief, *Factcheck: 16 misleading myths about solar power* (2025).
115 United Nations Environment Programme, *Spreading like Wildfire – the Rising Threat of Extraordinary Landscape Fires* (2022).

Chapter Two

The Returns on Investing in Resilience

Despite the threats and opportunities posed by a new context, our economic and financial systems do not yet fully account for the impacts of climate change and nature loss. The risks to communities, companies and countries, and the future costs of protection or revaluation, remain largely invisible in current valuations. Hidden liabilities distort asset values, creditworthiness and growth strategies.

What is needed is a shift in economic logic: resilience must be seen as the foundation of stability, growth and competitiveness rather than an add-on.

2.1 The Foundations of Development: Protecting Productive Capital from Climate and Nature Hazards

Building resilience means protecting and expanding productive capital in the face of mounting threats.

Climate and nature risks manifest as capital erosion, degrading the stocks that underpin prosperity. Resilience, by contrast, is about capital protection and expansion, ensuring that these foundations are preserved and strengthened for long-term growth, stability, and inclusion.

Productive capital takes four forms:

- **Physical capital:** Infrastructure and systems that enable production and services.
- **Natural capital:** Ecosystems and resources that provide food, water, protection and climate regulation.
- **Human capital:** The health, skills and knowledge of people that drive productivity and innovation.
- **Social capital:** The trust, norms, traditions and institutions that enable cooperation and collective action.

These capitals are not just abstract categories. They are used, maintained and invested-in every day by three core groups:

Communities: Relying on capital for health, education, livelihoods and safety.

Companies: Drawing on capital to produce goods, secure supply chains and generate returns.

Countries: Depending on capital to deliver public services, fiscal stability and growth.

The relationship cuts both ways: when climate and nature shocks degrade one form of capital, they undermine households, businesses and economies; when capital is protected and strengthened, it multiplies benefits across society. Financial institutions mediate these flows of risk and return by determining which assets are investable, insurable or stranded (explored further in Chapter 4).

BOX 2.1

Climate and Nature Hazards Threaten Productive Capital

Physical capital

Over the past five years, infrastructure-related losses due to natural disasters alone totalled $275 billion, with a rising proportion in middle-income countries where exposure is outpacing resilience investment.[116] Only 45% of these losses were insured, leaving households, firms, and governments to absorb the costs.[117] Climate hazards are projected to cause between $560 billion and $610 billion in fixed asset losses annually by 2035.[118] This causes loss of value from lost use which in some cases is higher than repair costs.[119] Slow-onset changes such as rising temperatures that warp road surfaces, droughts that weaken hydropower capacity or sea-level rise that floods coastal assets, steadily degrade infrastructure and raise maintenance costs. Mounting climate and nature impacts have knock-on effects for asset valuation: projections based on current climate and policy scenarios indicate that by 2050, infrastructure assets could see a net value decline of 4.4% on average, and up to 26.7% in the most severe scenarios.[120]

Natural capital

Land-use change, habitat loss, overexploitation and pollution are already eroding natural capital. Climate change accelerates degradation with intensifying droughts, altering ecosystems, and driving species collapse. This undermines the function of ecosystem services and resources that underpin all sectors of the economy. Over half of global GDP is directly dependent on nature,[121] yet the stock of global natural capital has declined by 40% per capita between 1992 and 2014.[122] Agriculture, manufacturing and water-intensive industries are particularly exposed: in the agriculture sector soil degradation reduces crop yields by up to 50%.[123] Loss of mangroves, wetlands and forests removes natural buffers, increasing disaster losses and tightening fiscal space as governments are compelled into emergency spending.

Human capital

Both acute shocks and slow-onset changes reduce people's ability to learn and work, decreasing labour productivity. Physical strain and heat stress influences cognitive decline and workers need more rest and time out due to disease exposure. Extreme weather also increases occupational health risks that injure workers and interrupt work, particularly in highly exposed sectors such as agriculture, construction and manufacturing. 1.3°C of warming will cause 2.2% of working hours to be lost globally to rising heat stress alone - equivalent to 80 million full-time jobs.[124] In schools, heat reduces academic performance, especially in under-resourced schools without cooling systems. Climate shocks are disrupting education: in 2024, at least 242 million students in 85 countries faced disruption due to extreme weather events.[125]

Social capital

Repeated climate and nature shocks undermine trust, strain institutions and erode community cohesion and cultural traditions, in turn disrupting livelihoods and intensifying competition over scarce resources. The total number of armed conflicts associated with water resources has been increasing rapidly in recent years.[126] A one standard-deviation increase in global grain prices has been linked to an almost 10% spike in militia violence across Africa.[127] As climate and nature impacts erode cohesion and confidence, they can trigger migration and rising security costs.

All forms of capital are interconnected. Damage in one sets off decline in another. A major heatwave reduces labour productivity (human capital) and accelerates evapotranspiration, which strains water systems (natural capital), lowers crop yields and disrupts manufacturing operations (physical capital). Increased hunger and hardship in turn lower labour productivity and increase human suffering (human capital), undermining output and social cohesion (social capital), weakening public finances, deterring investments and limiting development trajectories.

116 SwissRe Institute, *Natural Catastrophes and Inflation: A Perfect Storm* (2022).
117 Swiss Re Institute, *In Five Charts: Continued High Losses from Natural Catastrophes in 2022* (2023).
118 World Economic Forum, *Business on the Edge: Building Industry Resilience to Climate Hazards* (2024).
119 Bo-Wen Wang, Yi He, Wen-Hao Wu, Fei Teng. 'Quantifying Indirect Economic Losses From Extreme Events to Inform Global and Local Adaptation Strategies'. *Advances in Climate Change Research,* **16,** Issue 4 (2025): 674-687.
120 World Bank, *Global Infrastructure Hub, Infrastructure Monitor 2024* (2024)
121 World Economic Foundation (WEF), *Nature Risk Rising: Why the Crisis Engulfing Nature Matters for Business and the Economy* (WEF, 2020).
122 Dasgupta, P., *The Economics of Biodiversity: The Dasgupta Review - Headline Messages* (London: HM Treasury, London (2021).
123 FAO, *Soil Erosion: The Greatest Challenge for Sustainable Soil Management* (Food and Agriculture Organization of the United Nations, 2019).
124 International Labour Organization (ILO), *Working on a Warmer Planet: The Impact of Heat Stress on Labour Productivity and Decent Work* (Geneva: International Labour Office, 2019).
125 UNICEF, *Learning Interrupted: Global Snapshot of Climate Hazards and School Disruption* (New York: United Nations Children's Fund, 2024).
126 Pacific Institute, *Water Conflict Chronology: Fact Sheet 2024* (August 2024).
127 David Ubilava et al. 'Agricultural Windfalls and the Seasonality of Political Violence in Africa', *American Journal of Agricultural Economics* **105,** no. 5 (2023): 1309-32.

CASE STUDY 2.1

Cyclone in Mozambique: When Natural Disasters Cascade Across Capitals

In 2019, Mozambique was hit by two back-to-back cyclones, the impacts of which were intensified by climate change.[128] Over 240,000 homes were partially or completely destroyed.[129] More than 90 health centres were damaged, as were key sections of the Beira transport corridor – a vital trade and logistics artery.[130] The storm crippled electricity and water services, delaying humanitarian response and halting commercial activity for weeks. Port closures and damaged roads cut off access to markets, reducing exports and pushing up food prices. The total economic cost was estimated at $3 billion, equal to nearly 20% of Mozambique's GDP, with public budgets reallocated to reconstruction and undermining planned health and education spending.[131]

2.2 One Thing Leads to Another: Resilience is an Upward Spiral

Resilience is an upward spiral. Invest now, and the benefits add up – protecting capital, unlocking value and opening the door for more investment.

Fail to act, and a downward spiral could take hold, with people, businesses and economies trapped in compounding losses, volatility, and stalled development.[132]

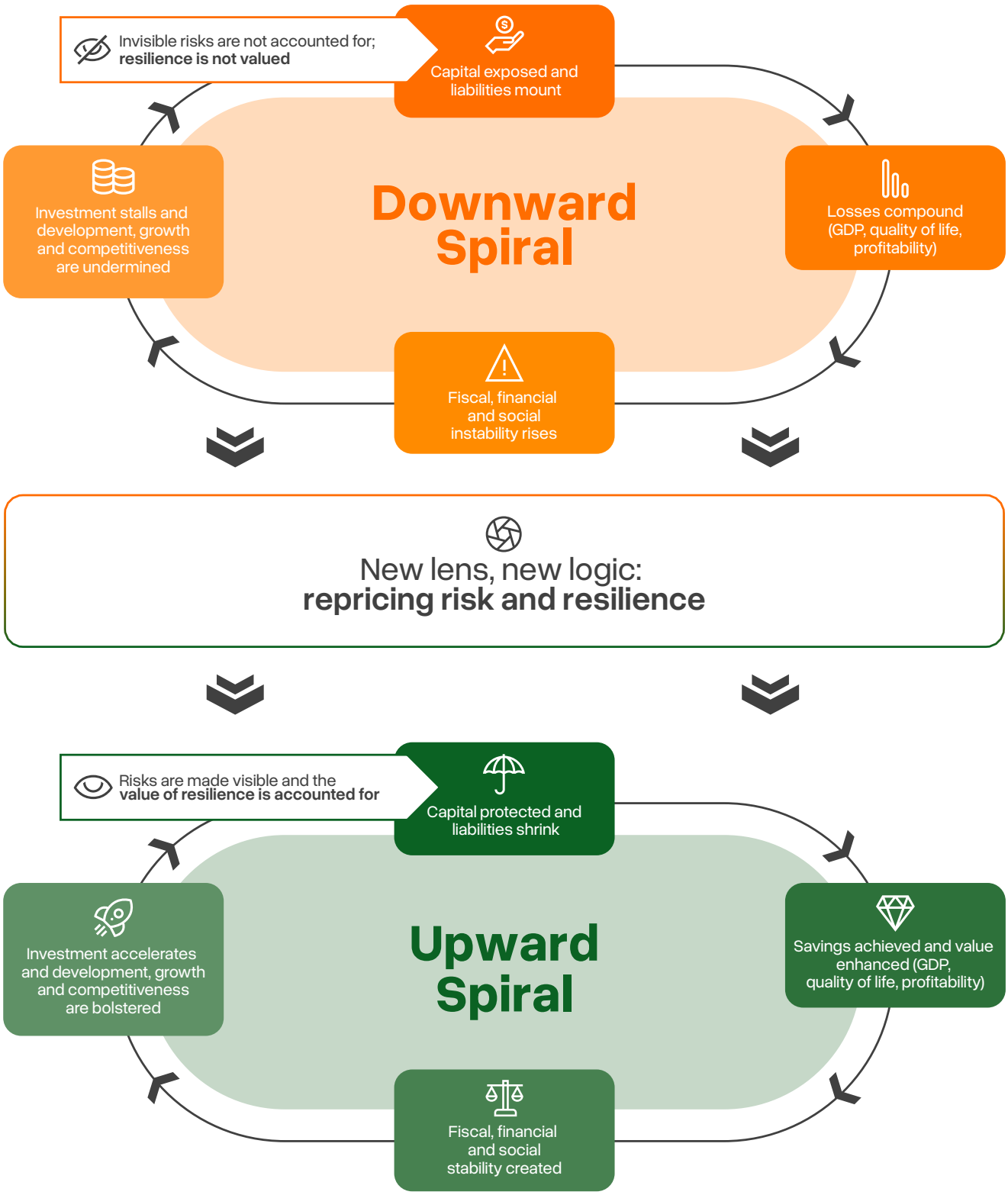
At the core of the spiral is the treatment of climate and nature risk. Our current economic and financial systems fail to account for the degradation of productive capital. As a result, the rising costs of climate change and nature loss remain invisible in investment decisions, balance sheets, and planning frameworks.

This mispricing triggers the downward spiral: capital is left exposed, liabilities mount, and systems grow more fragile. Communities, companies and countries are each affected – not just by individual shocks, but by the compounding effects of systemic risk.

By recognising the true impact of climate and nature risks – today and into the future – it is possible to reprice risk. Investments to protect and expand productive capital are properly valued, liabilities shrink, value is unlocked, and further investment becomes possible. Exhibit 2.1 illustrates how the downward and upward spirals unfold and reinforce themselves, step by step.

128 Oxfam International, *After the Storm: One Year On from Cyclone Idai* (Oxfam International, March 2020).
129 International Recovery Platform, *Recovery Collection: Cyclones Idai and Kenneth* (2019).
130 World Health Organisation (WHO), *Tropical Cyclones Idai and Kenneth Mozambique Situation Report 5* (2019).
131 World Bank, *Stakeholder Engagement Plan (SEP) Mozambique Cyclone Idai and Kenneth Emergency Recovery and Resilience Project (P171040)* (2019).
132 See also: UNDRR Global Assessment Report on Disaster Risk Reduction, *Resilience Pays: Financing and Investing for our Future* (2025).

Exhibit 2.1 The Downward Spiral Versus the Upward Spiral



2.3 The Downward Spiral: Capital Erosion Undermines Investment, Development, Growth and Competitiveness

Too often, the rising costs of climate change and nature loss remain invisible in investment decisions, balance sheets, and planning frameworks. Economic and financial decision-makers continue to invest in productive capital – physical, natural, human, and social – but the threats from climate and nature are still only partially recognised. As a result, a downward spiral can emerge: capital is left exposed, liabilities mount, and systems grow steadily more fragile. The impacts hit people, governments, and businesses alike – not just through individual shocks, but through the compounding effects of systemic risk.

The Downward Spiral is a worst-case trajectory of capital erosion. It is not theoretical: elements of this loop are already visible in economies and markets today.

This section describes how the downward spiral is at risk of playing out in emerging markets and developing economies (EMDEs) in the near future, in particular those with relatively low adaptive capacity. It outlines the cost of inaction for communities, companies and countries, based on a synthesis of available evidence conducted for this research. It then describes how these losses drive increased instability, with corrosive effects for development, growth and competitiveness.

2.3.1 Capital is Exposed and Liabilities Mount

Governments, businesses and households continue to invest in hazard-prone areas and systems without resilience safeguards. Health, water and agriculture infrastructure lacks adequate buffers, while finance still flows into assets whose long-term viability is already compromised. The result is a build-up of hidden liabilities: future costs that are not provisioned for, but which will eventually surface as reconstruction bills, insurance claims, defaults, and write-downs.

- **Communities:** Urban expansion continues into floodplains and coastal zones, putting lives directly at risk.[133] Between 1985 and 2015, there was more urban expansion into high flood hazard zones than into non-flood hazard zones, and the number of people living in settlements on floodplains doubled.[134] Critical services such as health, water and sanitation remain under-prepared, leaving households exposed to shocks. Uninsured losses and mounting health risks accumulate outside formal accounting systems, eroding household resilience.
- **Companies:** Only 30% of the world's largest 5,800 companies have quantified their exposure to climate and nature risks.[135] This figure is likely to be far lower in smaller companies, and those operating in areas with less adaptive capacity. Many continue to place assets and supply chains in exposed zones, even as insurers raise premiums or withdraw coverage. Financial institutions hold overvalued assets with growing risks of default. In April 2025, the Bank of England's Prudential Regulation Authority found no British lender could fully quantify climate risk across their portfolios, with most treating it only as a reputational issue.[136]
- **Countries:** Capital is misallocated and fragility reinforced. For every $1 spent on climate-resilient infrastructure, $87 is spent on infrastructure lacking resilience considerations.[137] Governments face reconstruction bills that escalate year on year, insurers confront unsustainable claims, and banks hold collateral at risk of rapid devaluation. Almost 60% of global economic losses from natural disasters are uninsured, rising to over 90% in many low-income countries.[138] Yet these liabilities remain invisible in growth models and fiscal strategies, masking systemic risk.

2.3.2 Losses Compound

As shocks and slow-onset degradation materialise, people, businesses and economies face losses, which are amplified as they cascade through interconnected systems.

The most severe impacts fall on communities and economies that are highly vulnerable to climate and nature impacts, and least equipped to respond, though knock-on effects spread across borders and sectors.

133 Rentschler et al. *Global Evidence of Rapid Urban Growth in Flood Zones Since 1985* (2023).
134 World Bank, *Resilient Infrastructure for Thriving Cities in a Changing Climate* (Washington, DC: World Bank, 2019).
135 Clarity AI, *Study: Only 30% of Global Companies Adequately Assess Physical Climate Risks* (2024).
136 Martin Arnold & Lee Harris, *Bank of England finds UK banks unprepared for climate risks* (Financial Times, April 2025) Accessed on 1 October 2025.
137 Climate Policy Initiative, *Tracking Investments in Climate Resilience Infrastructure* (2022).
138 Financial Stability Institute (FSI), *Too Hot to Insure: Avoiding the Insurability Tipping Point* (2024).

Without action, research for this paper finds that climate and nature impacts could result in:

For communities:

- **An additional 1 - 2 million deaths** per year in EMDEs by 2050. This will include approximately 600,000 deaths annually due to rising temperatures and shifting precipitation patterns; roughly 340,000 deaths annually due to direct exposure to hazards such as floods, storms and sea-level rise; about 700,000 deaths annually due to unmitigated air pollution - largely due to cardiovascular and respiratory diseases.[139]
- **Around 78 million more people could be chronically hungry by 2050 as a result of climate change.** This will be driven by reduced yields, higher food prices and slower income growth relative to a world without the current crisis. The majority of this burden will fall on EMDEs.[140]
- **An additional 25 million people experiencing extreme poverty** by 2030, rising to 40 million by 2050. If climate tipping points are passed, these figures could grow to 57 million people by 2030 and 78 million by 2050.[141]
- **Vulnerable populations will suffer the most,** as climate and nature impacts hit them hardest. Climate-related income losses are already 70% greater for the poorest 40% of populations.[142] By 2100, climate change could raise inequality by an average of 1.4 Gini points - nearly three times the 0.5-point rise seen during the Covid-19 pandemic, the largest increase since the Second World War.[143]

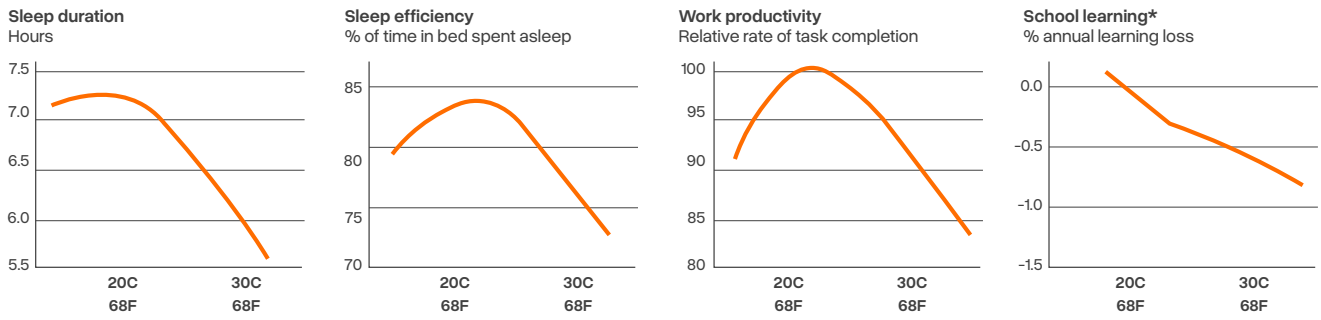
For companies:

- **$885 billion losses by the 2030s, rising to $1.2 trillion losses by the 2050s** for the world's largest companies (S&P 1200), assuming no adaptation measures are taken.[144] Businesses are projected to lose profitability and competitiveness as climate and nature shocks damage company assets, reduce output, and destabilise operations.
- **$560 to$610 billion asset losses** across all listed companies by 2035, with estimated knock-on effects of 6.6 to 7.3% declines in companies' earnings, and up to 24% in highly exposed sectors like telecommunications and utilities.[145]
- **Labour productivity losses equivalent to 80 million jobs by 2030,** as slow-impact changes such as heat stress diminish labour output and acute shocks disrupt access to work.[146] Exhibit 2.2 shows that when indoor temperatures exceed 23°C work productivity, sleep duration, sleep efficiency and school learning all decline. These higher temperatures can result either from slow-onset temperature change or extreme heat days. Indoor cooling measures are of critical importance.[147]
- **$25 trillion in net losses due to supply-chain disruptions** by mid-century,[148] compared to around $2.7 trillion in reduced trade during the Covid-19 pandemic, November 2020 to September 2021.[149] Acute shocks, including droughts, floods, storms and heatwaves, cause widespread supply chain failures and production halts. Impacts are transferred across global supply chains. Slow-impact changes, ecosystem degradation and natural resource depletion is tightening access to critical inputs and driving price volatility in commodity markets. In 2024, reductions in West African cocoa yields due to heavy rainfall and severe droughts caused cocoa prices to surge 300% compared to 2023.[150]

139 Systemiq analysis 2025. See Technical Annex for further detail. This is likely an estimate as it does not account for other important climate-linked diseases such as salmonella and rabies, nor the wider nutrition impacts beyond stunting.
140 IFPRI, *Climate Change and Hunger: Estimating Costs of Adaptation in the Agrifood System* (2021).
141 Moyer et al. (2023). 'How Many People Will Live in Poverty Because of Climate Change? A Macro-Level Projection Analysis to 2070'. *Springer Nature* volume, no. **176,** article no. 173 (2023); Gilli et al. 'Climate Change Impacts on the Within-Country Income Distributions'. *SSRN* (2023)
142 World Bank, *Rising to the Challenge: Advancing Adaptation and Resilience in a Changing Climate* (World Bank, 2024).
143 Johannes Emmerling et al. 'A Multi-Model Assessment of Inequality and Climate Change'. *Nature Climate Change* **14**, no. 12 (2024): 1254-60.; *World Bank, Poverty and Shared Prosperity 2022: Correcting Course* (2022).
144 S&P Global, For the World's Largest Companies, Climate Physical Risks Have a $1.2 Trillion Annual Price Tag by the 2050s (S&P Global, 10 March 2025).
145 World Economic Forum (WEF), *Business on the Edge: Building Industry Resilience to Climate Hazards* (2024).
146 International Labour Organization, *Increase in Heat Stress Predicted to Bring Productivity Loss Equivalent to 80 Million Jobs* (2019).
147 Burn-Murdoch, J. *Britain and Europe need to get serious about air conditioning* (Financial Times, 11 July 2025).
148 Willner, S. N., Otto, C., Levermann, A., & Schewe, J.. 'Global Supply Chains Increasingly at Risk from Climate Shocks'. *Nature,* **622,** 7982 (2023): 97-103.
149 European Central Bank, *Supply Chain Disruptions and Effects on the Global Economy* (ECB Economic Bulletin, Issue 8, 2021).
150 Christian Aid, *Cocoa Crisis: How Chocolate is Feeling the Bite of Climate Change* (2025).

Exhibit 2.2 People Start To Struggle Once Indoor Temperatures Exceed Around 23°C (73°F)

Change in quality/performance at different temperatures



* Effect of five days of outdoor temperatures at a given level. Learning loss disappears almost entirely in schools with air conditioning.
Source: John Burn-Murdoch, *Britain and Europe Need to Get Serious About Air Conditioning* (Financial Times, July 2025). Accessed 1 September 2025.

CASE STUDY 2.2

Slovenia Flooding Disrupts Global Automotive Supply Chain

In 2023, severe flooding in Slovenia caused €9.9 billion (USD 10.7 billion) in direct damages and disrupted production across the European automotive supply chain.[151] Slovenia hosts important automotive suppliers, manufacturing engine components and parts for well-known car brands – every car produced in Europe includes at least one component from Slovenia.[152] The floods damaged suppliers' factories and production lines, causing significant shortages of key components, such as engine parts and batteries. This led to temporary shutdowns at major European car manufacturers.

Volkswagen had to halt production at its Autoeuropa plant in Portugal for two months, due to a shortage of parts from Slovenia. Production dropped 150,000 units, resulting in a 0.5% decline in quarterly margins (versus average 6 to 7% margins).[153]

151 Matjaž Mikoš, *Reflections on the Floods in Slovenia in August 2023* - ResiliEnhance Platform meeting, 26-27 November 2024 (University of Ljubljana, 2024).
152 Everstream Analytics, *Slovenia Floods Impact Global Automotive Supply Chain* (August 11, 2023).
153 Bloomberg Professional Services, *Physical Climate Risk Assessment in Practice: Lessons from the Financial Sector* (September 12, 2023).

For countries:

- **18 to 23% GDP decline by 2050 globally** due to slow-onset and acute climate impacts under current policy scenarios (10 to15% GDP losses due to slow-onset impacts; an additional 8% GDP losses due to acute impacts).[154, 155] This may not properly capture a further 7 to 10% GDP decline from nature impacts by 2030 (estimates for 2050 are not available).[156] Losses are particularly stark in Asia and Africa, with projected losses of 6% GDP in Asia and up to 12.5% in Africa in the next five years.[157]
- **Existing inequalities are reinforced.** At the country level, multi-year trends in poverty reduction are being stalled or reversed due to climate impacts, increasing the gap between the poorest countries and the rest of the world. According to recent preliminary analysis of econometric models and macroeconomic studies by the Grantham Research Institute, least developed countries are already an estimated 10% poorer today than they would have been without climate change, with estimates rising to 14% poorer by 2050, and 20% poorer by 2075.[158] Welfare losses are expected to be considerably higher.

Repeated losses for communities, companies and sectors coalesce, disrupting economic growth. Asset damage halts production and reduces efficiency, while workers exposed to extreme heat or sudden extreme weather are less productive. Service disruptions force firms to delay or cancel operations, and tax revenues fall as output declines. Disruptions to value chains are transferred across global supply chains.

CASE STUDY 2.3

Senegal

In Senegal, World Bank modelling shows that climate-related shocks could slash 3 to 4% of GDP each year by 2030, rising to nearly 9.4% by 2050 if no resilience measures are deployed. This would effectively erase years of progress in per capita income growth and undermine fiscal stability. Without adaptation, over two million people could be pushed into poverty, amplifying demands on public services and weakening revenue bases. In contrast, adaptation interventions could help restore economic gains - adding back about 2% of GDP by 2030 and up to 1% in the years that follow.[159]

154 NGFS, *NGFS Climate Scenarios for central banks and supervisors - Phase V* (NGFS, 2025).
155 An 18 – 23% GDP loss range by 2050 aligns with recent analysis by Grantham Research Institute, 'The Macroeconomic Case for Adaptation Investment' (2025, forthcoming), which finds GDP losses in the range of 15-20% on average for different groups of EMDEs by 2075 and potentially much higher, based on analysis of 85 econometric models from 15 macroeconomic studies, which describe the reductions in GDP explained by temperature shocks and sea level rise alone. Estimates do not account for non-market welfare losses, such as impacts on health and the biosphere, which are expected to be large nor do they cover impacts that are not strongly driven by temperature shocks, such as slow-onset effects, water supply and demand impacts, and other extreme events, such as surface and river floods, droughts, and wildfires. Regional-scale tipping points such as AMOC and sea-level rise tipping points are not considered.
156 NFGS, *The Green Scorpion: the MacroCriticality of Nature for Finance* (2023).; World Bank Group, *The Economic Case for Nature - A global Earth-Economy Model to Assess Development Policy Pathways* (2021).
157 Network for Greening the Financial System (NGFS), *NGFS Long-Term Scenarios for Central Banks and Supervisors, Phase V* (Paris: NGFS, 2024).
158 Grantham Research Institute preliminary analysis – 'The Macroeconomic Case for Adaptation Investment' (2025, forthcoming). This work involved the Grantham Research Institute analysing 85 econometric models from 15 macroeconomic studies, which describe the reductions in GDP explained by temperature shocks and sea level rise alone. These estimates do not account for non-market welfare losses, such as impacts on health and the biosphere, which are expected to be large nor do they cover impacts that are not strongly driven by temperature shocks, such as slow onset effects, water supply and demand impacts, and other extreme events, such as surface and river floods, droughts, and wildfires. Regional-scale tipping points such as AMOC and sea-level rise tipping points are not considered.
159 World Bank, *Democratic Republic of Congo (DRC) Country Climate and Development Report 2023* (2023), Accessed 18 August 2023.

By 2050, climate and nature impacts in the downward spiral could generate $4.4 – 5.4 trillion financial and economic costs per year in four sectors that are key to development: health, agriculture and food, water, sanitation and hygiene systems (WASH) and infrastructure (power, transport and telecoms).

Projected losses are almost certainly under-estimated (see Box 2.2). Yet, based on available analyses, economic and financial costs in EMDEs include:

- **$2.1 trillion annual economic costs due to human health impacts** between 2025 and 2050. This is based on the Value of Statistical Life (VSL) and the monetary value of attributable impacts. Annual economic losses could reach nearly $0.8 trillion in sub-Saharan Africa and $0.4 trillion in South Asia.[160] The world's biggest health companies are expected to face annual losses of $31 billion by 2050, due to a combination of impacts including increased operational expenditure (OPEX) costs, lost revenues due to business interruptions after physical damage is incurred, and the costs of repairing assets.[161] This does not include the costs to Small- and Medium-sized Enterprises (SMEs), which is hard to secure, nor the costs to the economies of publicly-run hospital closures. Across the health sector, over 5% of global hospitals are at high risk of total or partial shutdown from extreme weather events by 2050, with the risk of damage increasing by 40% between 2020 and 2050.[16]
- **$250 billion in the value of crop and livestock losses alone due to impacts on the agriculture and food sector by 2050,** including $200 billion in the value of staple crop losses due to temperature and rainfall changes, and $50 billion in the value of livestock losses due to heat stress.[162] These figures do not capture the total losses due to impacts on the agriculture sector, as sea-level rise, floods and wildfires are not included in the calculations. Land degradation has already reduced productivity across 23% of global terrestrial areas, while pollinator decline threatens $235-577 billion of annual global crop production.[163] This threatens food security and rural livelihoods, with the most vulnerable at greatest risk. For example, a 1°C rise in long-term average temperatures is associated with a 23.6% decline in female-headed farm household incomes relative to male-headed farm households.[164] At the other end of the spectrum, the world's largest agriculture, food and beverage companies could face over $45 billion in annual financial impacts from climate risks by 2050.[165]

160 Systemiq analysis 2025. See Technical Annex for further detail.
161 S&P Global, *For the World's Largest Companies, Climate Physical Risks Have a $1.2 Trillion Annual Price Tag by the 2050s* (2025).
162 Systemiq analysis 2025. See Technical Annex for further detail.
163 Nor does it capture all value-chain steps (e.g. the rising cost of inputs) or the knock-on effects of production losses, employment, malnutrition and long-term economic development. IPBES, *The Global Assessment Report on Biodiversity and Ecosystem Services* (2019)
164 FAO, *The Unjust Climate: Measuring the Impacts of Climate Change on Rural Poor, Women and Youth* (Food and Agriculture Organization of the United Nations, 2024).
165 Systemiq analysis 2025. See Technical Annex for further detail.

- **$460-720 billion annual losses due to impacts on power, transport and telecoms infrastructure** by 2050, including the economic impacts of service disruptions on productivity, jobs, competitiveness and human wellbeing.[166] This includes $75 billion in direct asset damage and immediate service disruptions[167] and $391 – 647 billion in the direct financial cost of disrupted infrastructure services on businesses and households in LMICs.[168] Indirect losses associated with service disruption, such as from reduced competitiveness and innovation, are likely to be far higher. People will suffer, as patients struggle to reach health facilities, food spoils without refrigeration, and households are compelled to spend on costly substitutes like generators, water storage and taxis when transport fails. In Pakistan, household spending to deal with outages is estimated at 6.7% of annual expenditure, with over half of this cost coming from self-generation. Poorer households, unable to afford these costs, suffer income and service losses.[4] For businesses, annual losses to global utilities and energy companies could exceed $400 billion by 2050.[169] Extreme heat accounts for over half of these losses, by reducing power generation efficiency, driving up electricity and cooling costs, and disrupting energy distribution and transport networks.[170]
- **$1.6 to $2.3 trillion annual losses due to inadequate WASH and water storage for human consumption** by 2050. This causes health impacts due to waterborne diseases, and compels women and girls to lose out on schooling and work. Poor sanitation and hygiene already contribute to around 3 billion lost school and work days each year, equivalent to $420 billion in lost productive value.[171] For businesses, poor access to water and sanitation reduces workforce productivity through illness and absenteeism.

The annex outlines the key risks, potential cost of inaction, as well as priority interventions for each of these sectors.

166 World Bank, *The Resilient Infrastructure Opportunity* (2019). This figure also includes losses from water and wastewater infrastructure. However, water and wastewater direct infrastructure losses only represent $2.6 billion (3%) of average annual loss in low- and middle-income countries.
167 CDRI, *Global Infrastructure Resilience Report* (2023). These losses are average annual losses (AAL) representing the expected annualised loss from climate-related hazards, calculated using probabilistic risk models. In this analysis, AAL reflects losses under projected 2100 climate conditions, likely annualised over a period such as 2025 to 2100. Direct losses from 'high-income countries' and 'water and wastewater infrastructure' were excluded to prevent overlap with the 'water and sanitation' sector deep dive, and only emphasise losses for developing countries.
168 Hallegatte, S., Rentschler, J., Rozenberg, J., *Lifelines: The Resilient Infrastructure Opportunity* (World Bank, 2019)
169 S&P Global, *For the World's Largest Companies, Climate Physical Risks Have a $1.2 Trillion Annual Price Tag by the 2050s* (2025).
170 Ibid.
171 WaterAid, *Economic Report: Unlock Trillions of Dollars with Clean Water, Decent Toilets and Hygiene* (2021).

BOX 2.2

Limitations in Sector-Specific Cost of Inaction Figures

1. **Global annual averages do not capture 'tail risks'** (the extreme, low-probability but high-impact events). Averages are calculated across time and geography, so do not capture tail risks associated with climate and nature impacts, nor the impacts these can have in a given country. For example, crop yields are projected to fall on average by 7% in EDMEs by 2050, but this number is not evenly distributed and can be as high as 11% in sub-Saharan Africa and the Middle East and North Africa. This has profound consequences for human development and economic growth, particularly in countries that are highly dependent on agriculture - for example, in Africa, where agriculture accounts for 49% employment on average.[172]
2. **Available estimates do not cover all potential hazards and emissions scenarios.** Most global and EMDE estimates focus on a subset of hazards (e.g. temperature and precipitation shifts), leaving out others (such as floods and wildfires) and activities or products within a sector (e.g. staple crops, rather than all crops). Different estimates are also based on varied emissions and policy scenarios, making it difficult to compare them. Where possible, we have cited figures based on more conservative - but still realistic - emissions and policy scenarios. This underlines the critical importance of mitigation, alongside adaptation and resilience measures.
3. **Risks compound across sectors.** Climate and nature impacts do not occur in isolation; they cascade through interconnected systems. For instance, a drought reduces agricultural output, which can raise food prices and contribute to malnutrition, increasing strain on health systems. Additionally, cross-cutting impacts undermine productivity and development across sectors - for example, by reducing labour productivity. As a result, it is to be expected that the sum of sector-specific estimates of losses is smaller than economy-wide estimates of these losses.
4. **Impacts increase after 2050.** This report presents the costs of inaction up to 2050. Yet the most severe damages are expected to occur after 2050, as physical risks (such as sea-level rise or biodiversity collapse) accelerate non-linearly. The scale of risks could also increase exponentially if physical tipping points are reached (e.g. Amazon rainforest die-back, ice sheet collapse, permafrost melt), after which huge, unmanageable impacts would follow. It is therefore critically important to invest in both mitigation and building resilience today, to reduce and manage future risks.

2.3.3 Financial, Fiscal and Social Risks and Instability Increase

Financial instability increases, as credit and liquidity risks rise due to declining asset values and productivity. Climate and nature impacts can lower the value of assets long-term. After Hurricane Sandy in 2012, property values in flooded neighbourhoods fell by 20%, and remained 10% lower six years later.[173] These devaluations have knock-on effects for lenders and investors: as asset values erode, loan-to-value ratios rise, weakening collateral coverage, making defaults more likely and elevating credit risk. This poses a profound risk for sectors such as mortgage lending or infrastructure finance, for which physical assets serve as the backbone of loan security. At the same time, weaker business productivity reduces firms' cash flows, raising risks of default.

In parallel, liquidity risks rise due to riskier or impaired assets becoming harder to sell, and increased risk of businesses with shrinking output drawing down bank credit lines or delaying payments to creditors.

Simultaneously, rising climate risk erodes insurability, driving up premiums or leading insurers to withdraw entirely - or both. This further undermines asset value and financial viability. By 2030, nearly four million households may become uninsurable against flood risk in the UK, and 1 in 25 homes in Australia.[174] In EMDEs, there is already a large insurance protection gap (see Box 2.3), leaving many already dangerously exposed. An inability to insure further undermines asset value and financial viability.

172 World Banks, *Employment in Agriculture (% of total employment) (modeled ILO estimate) - Sub-Saharan Africa* (World Bank Data, 2023).
173 Ortega, F., and Taşpınar, S. *Why Housing Values in New York's Flood Zones Have Stayed Down After Hurricane Sandy* (PBS, PBS NewsHour, 2018).
174 Financial Stability Institute, *Too Hot to Insure: Avoiding the Insurability Tipping Point* (Basel: Bank for International Settlements, 2024).

BOX 2.3

The Insurance Protection Gap and its Impact on Macro-Stability

The growing insurance protection gap for natural catastrophes, defined as the share of climate and disaster-related losses not covered by insurance, is compounding systemic risk. In many climate-vulnerable countries, most households, small businesses, and even governments are uninsured. In low-income settings, more than 90% of disaster losses go uncovered, compared to around 50% on average in advanced economies.[175] Expected losses from natural disasters have also risen steadily, increasing by roughly 6% per year in real terms since 1994.[176] By 2024, this amounted to an estimated $35 billion in uninsured losses across emerging markets and developing economies (EMDEs).[63]

As hazards intensify, coverage can become increasingly unaffordable or unavailable, further widening the protection gap. The result is that households, firms and governments are left to absorb shocks directly: debt burdens worsen and the country's fiscal deficits increase. This dynamic weakens sovereign balance sheets, increases reliance on post-disaster borrowing, and crowds out long-term investment, ultimately undermining both recovery and development.

Fiscal instability and risk increases as disruptions drive output volatility, inflationary pressures and debt stress. Rising inflation, emergency spending and reduced earnings due to productivity losses (whether all occurring at once or in isolation) erode fiscal space and constrain monetary flexibility, limiting the tools available for macroeconomic management.

For climate-vulnerable and low-income countries, fiscal fragility is already acute, and is worsened by the losses felt by climate and nature impacts. Reduced freshwater availability increases input costs for a range of sectors - from irrigation in agriculture to cooling processes in thermal power plants, desalination plants for mineral processing, and fabric dyeing in textiles - driving up the costs of goods and services.

Similarly, crop shortages drive food price spikes (see Box 2.4). Following drought in Eastern Africa, Kenya experienced food price spikes, contributing to national inflation of over 14% for 2011.[177] Inflation hits households, increasing the fiscal burden on governments, which may need to provide subsidies or import food to meet population needs. Degraded resources reduce export earnings, widen trade deficits and heighten currency volatility.

Monetary policy becomes constrained as central banks face hard trade-offs between curbing inflation and supporting growth. The compounded strain of inflation, volatility, and limited fiscal space forces many governments to borrow after each shock, raising debt-to-GDP ratios just as growth slows and revenues decline.

175 Insurance Development Forum and Bridgetown Initiative, *From Risk to Resilience: How Insurance Can Mobilise Disaster Risk Finance and Climate Investment in Vulnerable Economies* (2025).
176 Swiss Re sigma, *Natural Catastrophes in 2023: Gearing up for Today's and Tomorrow's Weather Risks* (2024).
177 Kenya Central Bank (2011).

BOX 2.4

Extreme Weather and Food Price Volatility in a Globalised Economy

Climate and nature shocks in one country can quickly trigger food price spikes across the globe - with knock-on effects for inflation and fiscal stability. In 2024, reductions in West African cocoa yields due to heavy rainfall and severe droughts caused cocoa prices to surge 300% compared to 2023, seeing a spike in chocolate prices in the UK. Record summer heat in South Korea in 2024 has seen cabbage prices rise 70%.[178] In India, severe heat and drought damaged rice crops so much that the government implemented export restrictions to control inflation, contributing to global prices surging to a 15-year high.[179]

Countries heavily reliant on food imports, such as the UK, are particularly vulnerable to these global disruptions, with food price spikes feeding directly into headline inflation. The burden is heaviest for low-income households, who are forced to cut back - not just on quantity, but also on nutritional quality.[180] Rising prices lead to declines in fruit and vegetable consumption and increased food insecurity, compounding long-term health and productivity risks.

Social instability and risk increases as falling incomes, increased competition for resources, and rising inequality can cause lower trust in institutions, reduced social cohesion and unrest. Conflict risks are already escalating: between 2007 and 2014 over 60 food riots in 30 countries were linked to food price volatility.[181] Since 2020, over 785 water-based conflicts have been reported worldwide, already exceeding the 630 water-based conflicts reported between 2010 and 2019.[182]

The hostile conditions created by climate and nature impacts will also lead to increased migration. By 2050, up to 216 million people are expected to be forced to move within their own countries due to water stress, declining crop yields and rising sea levels.[183]

178 Financial Times, *Extreme Weather Drives Food Price Surges Across the Globe* (2025).
179 Anuradha Raghu and Suttinee *Yuvejwattana, Rice Prices Scale Fresh 15-Year High as Supply Risks Linger* (Bloomberg UK, December 20 2023).
180 Financial Times, *Extreme Weather Drives Food Price Surges Across the Globe* (2025).
181 Hendrix, Cullen S., and Henk-Jan Brinkman. 'Food Insecurity and Confllict: Empirical Evidence from Africa'. *World Development* **54** (2013): 188-199.
182 Pacific Institute, *Water Conflict Chronology* (Oakland, CA.: Pacific Institute, 2024) Accessed: 31 August 2025.
183 World Bank, *Groundswell Part 2: Acting on Internal Climate Mitigation* (2021).

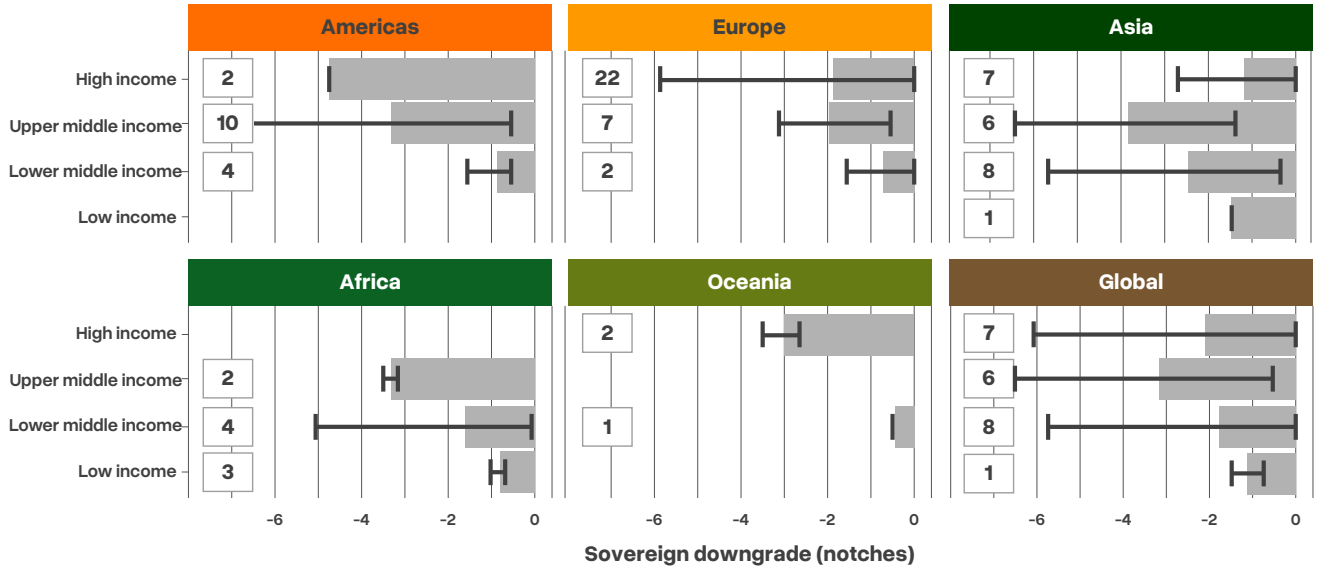
2.3.4 Investment Stalls and Development, Growth and Competitiveness are Undermined

Instability deters investment. Households that have suffered from - or anticipate suffering from - climate shocks are more likely to save defensively and less likely to make new investments or take financial risks.[184]

At the economy-wide level, with public spending diverted into emergency response or repair, and fiscal space eroded by revenue shortfalls and weaker tax collection, countries can become trapped and unable to invest in long-term development priorities, particularly if they are already financially vulnerable. As debt burdens rise and fiscal space is eroded, creditors and rating agencies may downgrade sovereign credit ratings. Countries with higher climate vulnerability face an average increase of 1.17% in sovereign borrowing costs.[185] This is compounded by an amplified perception of sovereign risk. With emissions as they stand today, just a one unit increase in climate vulnerability, as measured by the Notre Dame Global Adaptation Initiative (ND-GAIN) index[186] increases sovereign credit spreads for two-year debt by up to 23% for high-risk countries.[187]

A near-future world of higher emissions could see declines in sovereign risk ratings of 1-notch in low-income countries, nearly 2-notches in lower-middle-income countries, and 3-notch declines in upper-middle-income countries by 2050 (see Exhibit 2.3).[188] Already, budgetary resources are increasingly consumed by debt service, leaving less for investing in long-term growth, public services and human development. One in three developing countries now spends more on post-disaster response than on education or health. In the 50 most climate-vulnerable countries, external debt payments are projected to average at least 15.5% of government revenue in 2024. This is the highest level since records began in 1990.[189]

Exhibit 2.3 Sovereign Credit Downgrading Across Regions and Income Groups in 2050



Impact of climate change on sovereign credit ratings, from Klusak et al. (2023), evaluated under our standard SSP3-7.0 scenario for 2050

184 Li, J., Li, J., Ouyang, C. 'Physical Climate Risk and Household Saving Behaviour: Evidence from China'. *Economic Analysis and Policy* Vol. **87,** September 2025, (2025): 2508 - 2519.
185 Leykun, F. 'Climate Change and External Debt Vulnerability: the Case of Sub-Saharan Africa'. *Journal of Innovation and Entrepreneurship* **13,** 81, (2024).
186 Climate vulnerability as measured by the Notre Dame Global Adaptation Initiative (ND-GAIN) index: https://gain.nd.edu/our-work/country-index/
187 Jean-François Bonnefon, Jing Cai, Alia Gizelis, Thomas McDermott, and Swarthi Subramanian. 'Climate Change Adaptation Finance for the Most Vulnerable: Lessons from Social Protection'. *World Development* **176** (December 2024).
188 Klusak et al. 'Rising Temperatures, Falling Ratings: The Effect of Climate Change on Sovereign Creditworthiness', *Management Science,* Vol. **69,** Issue 12 (2023).
189 Debt Justice, *Debt Payments in Climate-Vulnerable Countries: 2024 Projections* (Debt Justice, May 2024).

At the same time, the capacity to secure private investment declines, due to higher perceived risks and rising cost of capital. Higher country-level climate vulnerability is associated with significantly lower foreign direct investment inflows.[190]

As instability and underinvestment persist, and economies become compromised, the ability to invest in resilience to protect and expand capital further weakens. This restarts the loop, trapping people, businesses and economies into a cycle of mounting risk and diminishing capacity to respond.

CASE STUDY 2.4

Floods in Pakistan - Public Budgets For Climate Disasters

The 2022 floods in Pakistan displaced over 12 million people, caused extensive infrastructure damage and pushed an estimated eight to nine million additional people into poverty.[191] The country endured $30 billion in flood damages and economic losses.[192] Despite pledges exceeding $10 billion for recovery, much of the aid materialized as loans, exacerbating Pakistan's debt challenges. Local development budgets intended for new schools and paved roads were used instead for flood reconstruction. As Sherry Rehman, Pakistan's former Federal Minister for Climate Change said, her country was left in a 'recovery trap', where increased debt redirected much-needed development spending to pay for climate disasters.[193] Debt servicing as a percentage of GDP rose from 8.4% in 2022 to 11.6% in 2023, consuming 57% of government revenues.[194]

2.4 The Upward Spiral: Capital Protection and Expansion

Accounting for the costs of climate and nature impacts flips the logic of the downward spiral, transforming risk into returns. Risky investments are exposed for what they are, and the value of resilience returns leads to increased investment to protect and strengthen productive capital. When governments, businesses and communities invest in resilience - including infrastructure, ecosystems, health systems and early warning tools - they reduce exposure to climate and nature impacts, shrink future liabilities, and unlock long-term value.

This sets in motion an upward spiral: capital is preserved and enhanced, confidence builds and investment flows towards growth and stability. The steps below show how that upward spiral of transformation happens - and how it delivers shared returns for people, firms and economies. While progress is being made towards accounting for risk and reward, this is not the current reality: the following should be understood as a hypothetical vision to aim for.

190 Syed Jawad Hussain Shear, Javeria Ashraf, and Ahmad Nawaz Butt, 'Sensing the Heat: Climate Change Vulnerability and Foreign Direct Investment Inflows'. *Research in International Business and Finance* **65** (2023): 101956.
191 Khan, Mehreen, *Pakistan's Floods Recovery 'Test Case' Leaves Millions Still in Tents* (Financial Times, 10 January 2023).; The Government of Pakistan, Asian Development Bank, European Union, United Nations Development Programme, World Bank, *Pakistan Floods 2022 Post-Disaster Needs Assessment* (2022).
192 World Bank, *Pakistan: Flood Damages and Economic Losses Over USD 30 Billion and Reconstruction Needs Over USD 16 Billion - New Assessment* (World Bank press release, October 28, 2022), accessed September 11, 2025.
193 Khan, Mehreen, *Pakistan's Floods Recovery 'Test Case' Leaves Millions Still in Tents* (Financial Times, 10 January 2023).
194 Kazmi, Zafar Bhutta *Debt Servicing Consumes 57% of Federal Revenue* (Dawn, 20 August 2023).

2.4.1 Capital is Protected and Liabilities Shrink

Investing in resilience enables people, businesses and economies to protect the foundational capital stocks that underpin productivity and long-term economic growth.

Communities:

- Resilience investments protect people's critical assets such as their homes, their health and their income-generating activities. Resilient water and sanitation systems prevent disease outbreaks during floods and maintain access during water stress. Early warning systems, social protection mechanisms such as climate-linked insurance programmes and emergency credit prevent households from losing livelihoods and falling into poverty traps when shocks occur.

Companies:

- Investment in resilience ensures businesses protect their productive inputs through asset protection, asset enhancement and value chain security. Elevated or waterproofed warehouses and factories reduce flood damage. Cooling systems in factories and retail outlets enable continued production in the face of rising temperatures.

Digital risk monitoring enables predictive maintenance and strategic investment. For example, Jupiter Intelligence's ClimateScore Global provides asset-level assessments of physical climate risk, to help organisations quantify financial impacts of climate risks and plan resilience strategies.[195] By combining both, companies can safeguard productivity and reduce exposure to escalating disruptions.

Countries:

- By safeguarding physical, natural, human and social capital, countries can reduce the costs of disasters, avoid productivity losses, and preserve long-term growth potential. Resilient infrastructure keeps trade routes open during extreme weather; restored ecosystems lower public spending on flood control; strong health systems maintain population health and productivity - even in the face of mounting stressors.

CASE STUDY 2.5

Forecast-Based Financing Through International Federation of Red Cross and Red Crescent Societies (IFRC)

The IFRC uses forecast-based financing mechanisms to provide pre-arranged financing, activated by early warning triggers. These funds provide rapid cash assistance or credit to affected communities, enabling timely anticipatory actions to reduce disaster impacts.[196] These mechanisms have been shown to save lives, be highly cost-effective and avoid damage thanks to faster response times. For example, in Nepal, the World Food Programme found that having finance-based mechanisms in place reduced response costs from $32 million to $10 million over 20 years, saving $22 million while benefiting 175,000 people.[197]

CASE STUDY 2.6

Green Climate Fund Supports Early Warning Systems in Climate-Vulnerable Countries

In 2025, the Green Climate Fund approved over $100 million in grant financing to strengthen early warning systems in highly climate-vulnerable countries including Antigua and Barbuda, Chad, Cambodia and Ethiopia. The program supports multi-hazard early warning systems that help populations prepare for disasters by improving risk assessment, forecasting and communication systems. The initiative is part of the global Early Warnings for All (EW4All) effort to cover everyone on the planet with early warning systems by 2027.[198]

195 Jupiter Intelligence, *ClimateScore Global* (Date accessed: June 2025).
196 USAID, *Anticipatory Action to Reduce the Impact of Extreme Weather Events on Health* (USAID Climate Adaptation Support Activity, 2024).
197 IFRC, WFP, GIZ, *Report: 6th Global Dialogue Platform on Forecast-based Financing* (2018).
198 United Nations Development Programme (UNDP), *Green Climate Fund Approves $103 Million to Strengthen Early Warning Systems in Vulnerable Countries* (UNDP, February 18, 2025).

2.4.2 Losses Are Avoided, Savings Achieved and Value is Created

Losses avoided and savings achieved

- **Human lives are saved:** Countries with comprehensive early warning systems have mortality rates six times lower than those without.[199] Flood-resilient healthcare and education systems ensure continuity of critical services during climate shocks.
- **Inequality increases are limited:** Investments and policies directed towards redistributing resources and protecting vulnerable groups can limit the negative impacts on equality caused by climate change and nature loss. A multi-model study finds that ambitious climate policies - such as the redistribution of carbon price revenues equally among citizens - could reduce inequality by almost two points of the Gini index.[200] Designing and implementing interventions locally and with the participation of the beneficiary communities is critical to ensure that these are effective and avoid maladaptation because local actors have better understanding of their local risks.

Value created

- **Livelihoods are enhanced:** Social protection measures, such as cash transfers, social insurance, feeding programmes or the integration of these into 'adaptive social protection' schemes, prevent households from falling into a poverty trap, and also generate economic multipliers by helping to stabilise demand, support local markets and accelerate recovery.[201] The Hunger Safety Net Programme in Kenya, which uses the drought early warning system to trigger anticipatory cash disbursements to households, enables people to buy food and water in advance of droughts and also maintain livestock and protect their long-term earning potential.[202]
- **Social capital multiplies:** Early warning systems prevent deaths and also nourish social capital through community building. For example, Bangladesh's investment in early warning systems, cyclone-resistant infrastructure and a network of 76,000 volunteers has dramatically reduced deaths during major storms. It has also turned cyclone shelters into year-round community hubs that support education, mobility and local development.[203]

CASE STUDY 2.7

Cisterns Deliver Development Returns in Brazil

The Cistern Program provides low-cost rainwater cisterns to low-income families in Brazil's semi-arid regions, boosting water security. The program emerged from a grassroots social movement, led by the Articulação Semiárido Brasileiro, and was scaled through partnerships with the government. More than 1.2 million units have been built, each storing enough water for a family of five for eight months.[204] Beyond improving public health thanks to safe drinking water, the program also stimulates the local economy by generating jobs, increasing school attendance and household autonomy, and weakening traditional systems of political clientelism.

199 United Nations Office for Disaster Risk Reduction (UNDRR), *Global Status of Multi-Hazard Early Warning Systems 2024* (UNDPR, 2024).
209 Emmerling, J. 'A Multi-Model Assessment of Inequality and Climate Change'. *Nature Climate Change,* Vol. **14,** (2024):1254 - 1260.
201 Tenzing, JD. 'Integrating Social Protection and Climate Change Adaptation: A Review'. *WIREs Climate Change* Vol **2,** issue 2 (2019):e626.
202 Ibid.
203 Kazi, Swarna et al, *Enhancing Coastal Resilience in a Changing Climate* (World Bank, 2022).
204 DryNet, *Building One Million Water Cisterns – Harvesting Drinking Water in North East Brazil* (2015).

CASE STUDY 2.8

Cold Chain Multistakeholder Partnership in Kenya Led by DanChurchAid

Smallholder farmers in Kenya are facing post-harvest losses of up to 40% as high temperatures accelerate food spoilage of crops like sugar snap and snow peas.

A multistakeholder partnership, led by DanChurchAid and funded through Denmark's Danida Green Business Partnerships, is helping farmers adapt by expanding access to cold storage. With support from the Global Food Cold Chain Council (GFCCC) the partnership enables farmer cooperatives to invest in cooling technologies developed by Danfoss.

FSD Kenya designs practical financial models to make these solutions affordable for smallholders and SMEs while Fresh Produce Exporters Association of Kenya (FPEAK) strengthens farmer capacity on export standards and certification.[205]

This partnership delivers benefits to all stakeholders: Danfoss serves new markets with cooling technology, local financial institutions provide loans, farmers gain income, resilience and market access, and FPEAK members generate profit through access to markets and value chains.[206]

Companies:

Losses avoided and savings achieved

- **Disruptions and maintenance costs decline:** Resilience-building measures help businesses maintain uptime and reduce risk. Measures like upstream water conservation and on-site water efficiency (e.g. rainwater harvesting and wastewater reuse) reduce demand for critical inputs and stabilise supply. Retrofitting buildings and equipment with flood defences or heat-resistant materials extends their lifespan, cuts maintenance costs, and reduces downtime. Businesses are investing in their supply chains through climate-smart sourcing, diversified and localised supply strategies, risk-sharing contracts and nature-based solutions to strengthen the security of their upstream production.

CASE STUDY 2.9

AstraZeneca Invests to Protect Business Continuity[207]

In 2017, Hurricane Maria disrupted business at the AstraZeneca plant in Puerto Rico for three weeks. In response, AstraZeneca invested $20 million in resilience interventions, including renovating manufacturing and warehouse buildings to future-proof the site and building cogeneration plants to reduce dependence on the local power grid and increase water storage capacity.[208]

One year later, in 2018, a heatwave in Sweden caused AstraZeneca's plant to breach environmental controls and good manufacturing practices. A $4 million investment followed, aimed at preventing manufacturing interruptions. Investments included building cooling towers and maintaining a three-month inventory to mitigate risks during extreme heat conditions.[209]

In both cases, AstraZeneca saw these measures as critical productive investments that delivered savings far greater than the initial outlay costs.

205 DanChurchAid, *From Loss to Value Creation* (2025).
206 More information about the project can be found at: https://www.danchurchaid.org/from-loss-to-value-creation
207 WBCSD, *The Business Leaders' Guide to Climate Adaptation and Resilience* (2024)
208 AstraZeneca, *Building Resilience in Our Operations: TCFD Case Study 3* (2020).
209 AstraZeneca, *Embedding Climate Resilience in Our Supply Chain: TCFD Case Study 1* (2020).

CASE STUDY 2.10

Exelon Corporation[210]

Exelon Corporation, a leading US energy provider, has implemented a comprehensive resilience strategy in the face of increasing extreme weather events and climate-induced disruptions. The strategy includes over $6.6 billion investments in grid modernisation in 2021, with an additional $29 billion planned through 2025 to strengthen infrastructure and integrate renewable energy sources. The company also conducts proactive vegetation management to minimise storm-related outages.

These resilience initiatives have yielded tangible benefits. Exelon's Commonwealth Edison unit in Illinois reported an 8% profit increase in the third quarter of 2024, attributed to higher distribution rate base and return on regulatory assets, resulting from more reliable service delivery. The company's proactive approach to infrastructure investment has enhanced its credit profile, with a dividend yield of 3.8% as of Q3 2025.

A capital expenditure plan of $38 billion to modernise grids and upgrade infrastructure between 2025 and 2028 is projected to support between 5% and 7% annualised earnings growth.

Value unlocked

- **Productivity grows:** Regenerative agricultural practices like agroforestry and cover cropping can increase primary crop yields by 11% on average.[211, 212] For example, SLC Agrícola, one of Brazil's largest farming companies, integrates regenerative practices such as no-tillage planting, crop rotation, cover crops and crop-livestock integration across 830,000 hectares of farmland. Between the 2017/18 and 2023/24 harvests, not only did rainfed areas adopting cover crops and mulch show up to 40% less yield volatility compared to conventional systems, but also SLC's soybean yields were on average 12% higher than national levels. Regenerative agriculture not only mitigates climate risks, but serves as a strategic asset to boost competitiveness for agribusiness.[213] Firms that rely on outdoor workers can increase worker productivity by using sunlight-reflecting materials to reduce exposure and help to maintain worker capacity.[214]
- **Investor confidence improves:** Enhanced, resilient assets not only prevent costly repairs when impacts strike, but can also boost company creditworthiness and investor confidence. For example, electricity provider PG&E secured a credit rating upgrade in 2025 from Moody's after updating ageing infrastructure to build resilience against wildfire risk.[215]
- **Increased insurability:** When assets retain their value and risk is reduced, insurers stay in the market. In the face of several insurance carriers threatening to leave the Alabama housing market after Hurricane Ivan in 2004, the FORTIFIED programme offered grants for retrofitting over 50,000 homes and stabilised the market.[216] By remaining insurable, assets remain bankable.
- **New market opportunities emerge:** Climate resilience and adaptation are fast emerging as new frontiers for revenue growth and innovation. As extreme weather and slow-impact changes intensify, firms are capturing value by creating products, services and infrastructure that help customers adapt. Boston Consulting Group (BCG) and Temasek estimate that global demand for adaptation and resilience solutions will reach $500 billion to $1.3 trillion by 2030.[217] The market is already significant in solution areas like climate-resilient building materials ($220 to $255 billion today), climate analytics tools ($5 to $7 billion today), emergency medical products and services (up to $55 billion today) and with an already sizeable market in commercial crop seed and crop protection at $110 to $130 billion.[218]

210 Exelon, *2024 Sustainability Report: Lighting the Path to a Cleaner Future* (2025).
211 GIST Impact, *The 'Wide-Angle Lens' True Cost Accounting Study of Andhra Pradesh Community Managed Natural Farming* (APCNF) (2023).
212 iBid.
213 Food and Land Use Coalition, *Aligning Regenerative Agricultural Practices with Outcomes to Deliver for People, Nature and Climate* (2023)
214 Barrak Alahmad et al., 'A Modelling Study of Cool Surfaces and Outdoor Workers Productivity at San Francisco International Airport'. *PNAS Nexus* **4,** no. 1 (2024).
215 Simon Mundy, *When Will Companies Start Spending on Climate Adaptation?* (Financial Times, May 2025). Financial Times. Accessed 1 October 2025.
216 William Rabb, *Alabama's Wind-Mitigation Program Celebrates 50,000 Fortified Homes in the State* (Insurance Journal, September 2024) Insurance Journal. Accessed 1 October 2025.
217 BCG and Temasek, *The Private Equity Opportunity in Climate Adaptation and Resilience* (2025).
218 iBid.

- **A burgeoning investment theme for investors:** Providers of resilience solutions - from climate-smart agriculture to flood defences and resilient materials - are seeing facogrowing demand. Early adopters in sectors like real estate and infrastructure are gaining a competitive edge and investors are taking notice. Over 800 publicly listed companies providing adaptation and resilience solutions have been identified by tools developed by Lightsmith Group, MSCI and others, 28% of which are based in emerging markets and developing economies. Resilient solutions providers are also becoming an investment theme for private equity; new private equity strategies are taking shape across six high-growth subsectors including climate intelligence and climate-adapted agricultural inputs - each with multi-billion-dollar market potential and double-digit growth rates.

Investors report increases of between 1 and 44 times in enterprise value multiples (financial ratios used to value a company) for firms operating in the water resilience space, highlighting the commercial potential of the transition to resilient water and sanitation health (WASH) systems.[219] The launch of dedicated adaptation and resilience funds and taxonomies (including by Climate Bonds Initiative and Standard Chartered) signals growing investor confidence. Insurance products, in particular, are gaining traction in regions vulnerable to climate and nature impacts, with a rapidly growing market for catastrophe bonds which is now valued at $50 billion and expected to grow to $60 billion by the end of 2025. There have been record levels of issuance and the launch of the world's first exchange-traded fund based on catastrophe bonds this year.[220] Over the past year, catastrophe bonds have delivered returns of 14%, helping to fill the gap between rising demand for reinsurance and reduced capacity among traditional reinsurance providers.[221]

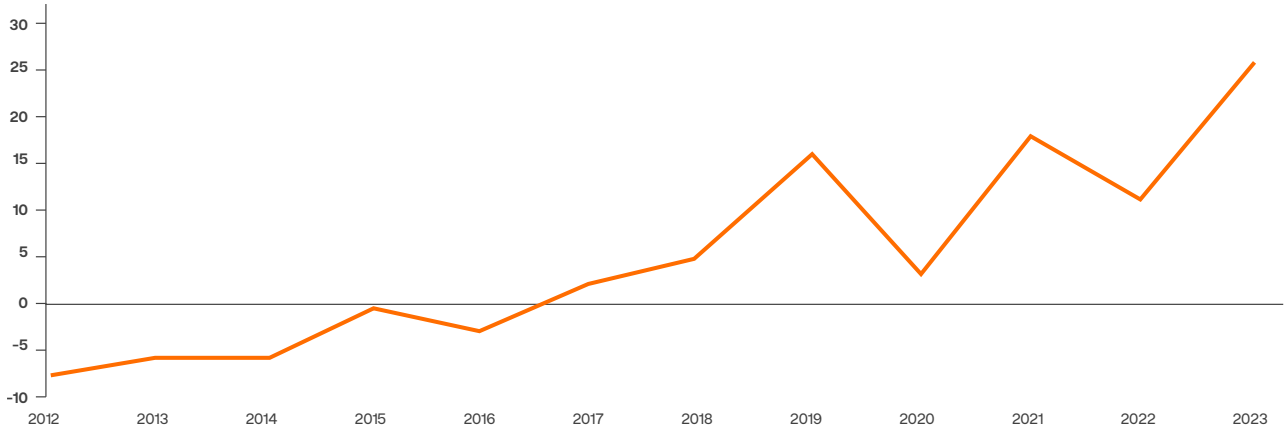
CASE STUDY 2.11

McCain Chips: Resilient Agriculture Increases Yields[222]

McCain's experience in New Zealand shows that regenerative practices can reverse stagnating yields and build long-term resilience.

Yield Trend Russet Burbank (average annual potato yields %):

- Extended rotation cycles from six to nine years to reduce disease pressure and enhance soil recovery.
- Included up to 14 crop species per crop-rotation in study exploring how diversified crop systems can strengthen ecosystem functions and lower input dependency.



219 BCG, *From Risk to Reward The Business Imperative to Finance Climate Adaptation and Resilience* (2023).
220 Gautam Naik, *Hedge Fund Fermat Sees 20% Surge in Catastrophe Bond Market* (Bloomberg, May 14 2025).
221 Ibid.
222 McCain, *Regenerative Agriculture Increasing Yields and Reducing GHG Emissions* (McCain, October 2024).

Countries:

Losses avoided and savings achieved

- **Economic losses avoided:** Dams, bridges and transport corridors designed or retrofitted to withstand climate hazards not only protect existing assets but also secure trade, mobility and market access, driving growth and enhancing the competitiveness of exports and small enterprises. In Brazil, making roads climate-resilient would cost $2 billion and avoid an estimated $47 billion in losses, according to the World Bank.[223]
- **Costs lowered:** Smart solutions can also lower the costs of resilience interventions. Nature-based coastal defence projects (e.g. mangroves and salt-marshes) can be between two and five times cheaper than engineered systems (e.g. submerged breakwater).[224]

Value unlocked

- **Growth is enhanced:** Modelling conducted as part of the World Bank's Country Climate and Development Reports finds that scaling adaptation interventions could generate a wide range of GDP gains, but could be as high as up to 15 percentage points by 2050 versus current policies in certain small island developing states such as St Lucia and Grenada.[225]
- **Jobs are generated:** Investing $350 billion into resilience interventions each year could generate 280 million jobs in EMDEs over the next decade (110 – 220 million direct and 70 – 150 million indirect jobs).[226] This is due to a significant need for labour-intensive activities in sectors like agriculture and upgrading infrastructure – with an estimated 80 – 160 million jobs generated in agriculture and 30 – 60 million jobs generated in construction over the next decade.[227] Gains are particularly significant in sub-Saharan Africa and Latin America and the Caribbean, where resilience investment needs are greatest.[228]
- **Social and economic returns are generated:** Across sectors, a synthesis of available benefit cost ratios (BCRs) by the Grantham Research Institute (GRI) suggests that investments in adaptation deliver a median of four times more benefits than costs. Moreover, available evidence additionally confirms a median economic internal rate of return (EIRR) of 25%, making it one of the best economic investments available.[229] This new data reinforces findings from the World Resources Institute, showing that every $1 invested in climate adaptation projects can yield over $10.50 in benefits, with an average economic annual return of between 20% and 27%.[230]
- **New industries develop and grow:** Protecting and expanding productive capital underpins key industries. The growing ecotourism industry is based on thriving biodiversity and landscapes. One-third of pharmaceuticals in use today were naturally derived or inspired by naturally occurring substances.[231] Every new drug discovered in tropical forests is worth an estimated $194 million to a pharmaceutical company and $927 million to society. In Bangladesh, planned improvements in riverbank protection are expected to safeguard approximately 2,500 hectares of land from erosion and flooding which will protect local livelihoods and assets. Beyond reducing disaster risk, the investment will also help revive inland water transport, enhance regional connectivity and stimulate trade. Improved navigation channels are projected to benefit around 100,000 people, offering safer, more reliable, and lower-cost transportation options.[232]

223 World Bank, *People in a Changing Climate: From Vulnerability to Action* (2024).
224 Narayan S, Beck MW, Reguero BG, Losada IJ, van Wesenbeeck B, Pontee N, et al. 'The Effectiveness, Costs and Coastal Protection Benefits of Natural and Nature-Based Defences'. *PLoS ONE* **11,** 5 (2016): e0154735.
225 World Bank, *People in a Changing Climate: From Vulnerability to Action-Insights from World Bank Group Country Climate and Development Reports Covering 72 Economies* (Washington, DC: World Bank, 2024).
226 Systemiq analysis. See Technical Annex for further detail. Analysis is on-going to inform the forthcoming Flagship report Steer et al (2025) Jobs and Skills for the New Economy: An Action Agenda for a People-Centered Climate Transition, to be launched ahead of COP30. There may be minor adjustments to analysis. This initiative is funded by GIZ, the Ares Foundation and NDC-P, and prepared by the World Resources Institute and Systemiq, and with contribution with several other partners including EDC, ADB, WBCSD, and LinkedIn
227 Ibid.
228 Ibid.
229 Grantham Research Institute, 'The Macroeconomic Case for Adaptation Investment' (2025, forthcoming).
230 WRI, *Strengthening the Investment Case for Adaptation: a Triple Dividend approach* (2024).
231 Deutz et al, *Financing Nature: Closing the global biodiversity financing gap* (The Paulson Institute, The Nature Conservancy, and the Cornell Atkinson Center for Sustainability, 2020)..
232 World Bank, *World Bank helps Bangladesh Improve Riverbank Protection and Navigability of the Jamuna River* (2023).

CASE STUDY 2.12

Costa Rica's Natural Capital Recovery: Resilience as a Growth Strategy

In the 1970s and 1980s, Costa Rica's deforestation rate was amongst the world's highest. Forest cover dropped from 55% in 1970 to 21% by the late 1980s. In response, the government introduced the Forestry Law and established a nationwide payments for environmental services (PES) programme. This incentivised landowners to conserve and restore forests, complemented by stricter land-use regulations, the expansion of protected areas and a national strategy to promote ecotourism and sustainable development.

Costa Rica saw remarkable results. By 2023, forest cover had rebounded to 59% of the country's territory, and more than 25% of land was under protection as parks or reserves. This recovery revitalised biodiversity and restored ecosystem services essential for agriculture, water regulation and disaster risk reduction.

PES has provided a stable income for rural communities, and underpinned huge expansion of ecotourism activity. Tourism now accounts for 8.2% of GDP, surpassing agriculture. Poverty rates in communities near protected areas have declined by 16%.[233] New forms of international finance are flowing in: between 2020 and 2022, Costa Rica received $135 million in payments for forest carbon sequestration.[234]

CASE STUDY 2.13

Community Efforts to Restore Mangroves as Resilient Natural Infrastructure

The Mangrove Breakthrough is a global initiative co-led by the Global Mangrove Alliance and the UN Climate Champions, aiming to secure the future of 15 million hectares of mangroves by 2030 through $4 billion in sustainable finance.

An example of its success can be found in India's Sundarbans where the women-led Green Brigade has restored mangroves since 2013 and is now reaping the benefits. Stronger riverbanks protect homes from flooding, reducing the risk of needing to relocate and rebuild homes, and healthier fish stocks are reducing the need to migrate for work.[235]

Another example is found in Indonesia where residents of Teluk Semanting village worked with the local government to protect 750 hectares of mangrove forest and established the locally-led mangrove management board. Today, the village has become a thriving ecotourism hub whilst healthier ecosystems have improved fishers' livelihoods.[236]

233 Science Daily, *Ecotourism Reduces Poverty Near Protected Parks, Research Shows* (Georgia State University, March 1 2014).
234 Sebastián Rodríguez, *How Costa Rica reversed deforestation and raised millions for conservation* (Dialogue Earth, January 7 2022).
235 The Nature Conservancy, *Restoring Mangroves in Non-protected Areas of the Sundarbans* (January 15 2025).
236 Yayasan Konservasi Alam Nusantara (YKAN), *The Positive Impact of 741 Hectares Mangroves in Semanting Bay* (March 21 2024).

BOX 2.5

Losses Reduced versus Value Unlocked

Preliminary analysis conducted by the Grantham Research Institute, drawing heavily on work by the World Bank, finds that adaptation and resilience interventions reduce climate damages by about 50% on average, demonstrating the effectiveness of investments.[237] However, this also means that resilience investments do not eliminate the full costs of inaction. Climate change will still impose residual damages, even with well-designed investments, reinforcing the critical importance of continued mitigation efforts.

Nonetheless, resilience investments still generate net benefits. Resilience investments unlock broader economic and social value, including productivity gains, efficiencies, improved health and educational outcomes, and other socioeconomic gains. Multiple studies demonstrate that, once these benefits are factored in, the returns on investment of resilience and adaptation are strong.

Fundamentally, the scale of resilience investment needed is much smaller than the cost of damages avoided and the value unlocked.

Scaling resilience investments in four key sectors for development could avoid $690-850 billion in annual socioeconomic losses by 2050.[238]

This figure does not capture value unlocked, meaning the returns are in fact even higher. The beneficiaries may also be different than the funders. Key findings include:

- **Resilient health systems could avoid $290 billion** in annual socioeconomic losses by 2050, with adaptation measures reducing losses by 14% compared to no action.[239] When value unlocked is considered as well as avoided losses, resilient health systems could deliver an average internal economic rate of return of 79% according to the WRI Triple Dividend.[240] They restore growth trajectories and also strengthen human capital as well as unlocking new dividends for education, productivity and development. Targeted interventions show similar payoffs. For example, every dollar invested in tackling undernutrition yields up to $23 in socioeconomic returns.[241] A dollar spent on immunisation generates up to $26 in benefits over ten years in low- and middle-income countries[242]. Investing in resilience is therefore vital to safeguard and amplify these gains. Carbon Disclosure Project's (CDP) 2025 Disclosure Dividend further underscores the business case: biotech, healthcare and pharma firms report a 7:1 benefit-cost ratio on climate adaptation investments, reflecting both avoided risks and new market opportunities.[243]
- **Resilient agricultural interventions could avoid USD 20 – 25 billion** in lost crop and livestock value alone per year, based on a 10% reduction rate for adaptation measures in this sector.[244] Studies by the Food and Agriculture Organisation of the United Nations (FAO) show that in several EMDE countries, every $1 invested has generated up to $6.1 in avoided losses and improved outcomes, including healthier livestock, sustained crop and dairy production, and stronger household food security.[245]
- **For WASH, scaling resilience investment could avoid $270 – 380 billion** in annual socioeconomic losses by 2050, based on a reduction rate of 17%.[246] ROI estimates, capturing both avoided losses and value unlocked, range from $0.60 to $3.90 per dollar invested.[247] These returns come from avoided losses, higher productivity, and reduced healthcare costs. Evidence shows every $1 invested generates positive returns through avoided losses, higher productivity, and reduced healthcare costs. In regions such as sub-Saharan Africa this can reach as high as $7 per $1, reflecting the higher vulnerability and potential for impact.[248]

237 Grantham Research Institute, 'The Macroeconomic Case for Adaptation Investment' (2025, forthcoming).
238 Grantham Research Institute preliminary analysis – 'The Macroeconomic Case for Adaptation Investment' (2025, forthcoming)
239 iBid.
240 World Resources Institute (WRI), *Strengthening the Investment Case for Climate Adaptation: a Triple Dividend Approach* (2024)
241 World Bank, *Investment Framework for Nutrition 2024* (2024).
242 IBid.
243 Carbon Disclosure Project (CDP), *Unlocking the Disclosure Dividend* (2025).
244 Hultgren, A. 'Impacts of Climate Change on Global Agriculture Accounting for Adaptation' *Nature,* Vol. **642** (2025)
245 FAO, Saving Lives, Time and Money: Evidence from Anticipatory Action (Food and Agriculture Organisation of the United Nations, 2025).; FAO, *The Impact of Disasters on Agriculture and Food Security Avoiding and Reducing Losses Through Investment in Resilience* (Food and Agriculture Organisation of the United Nations, 2023).
246 Grantham Research Institute preliminary analysis – 'The Macroeconomic Case for Adaptation Investment' (2025, forthcoming)
247 Systemiq analysis 2025. See Technical Annex for further detail.
248 Economist Impact, *Harnessing the Economic Benefits of Investment in Water, Sanitation and Hygiene in Africa* (2023).

- **Resilient power, transport and telecoms infrastructure systems could avoid $110 – 170 billion** in annual socioeconomic losses by 2050, with adaptation solutions reducing losses by 23%.[249, 250] Combining avoided losses and value unlocked can deliver a return as high as $8 to $11 in benefits over a decade per dollar invested according to the World Resources Institute (WRI).[251] Most of this comes from avoided losses, for example fewer damaged roads, ports or power plants, but significant gains also arise from lower operating costs, higher productivity and reduced greenhouse gas emissions.

The World Bank finds a 4:1 benefit-cost ratio across the full spectrum of resilience investment needed in low- and middle-income countries, amounting to $4.2 trillion in net benefits.[19] Meanwhile, companies themselves report ratios of 4:1 and 5:1 for climate-proofing transport, energy, and water infrastructure. This is based on their own assessments of risk exposure and response costs.[20]

BOX 2.6

Restoring Brazil's degraded lands to unlock growth[252]

Caminho Verde is a public policy launched by MAPA to promote the recovery of degraded pasturelands in Brazil, transforming them into more sustainable production systems aligned with national climate goals. The program combines low-carbon agriculture practices, crop-livestock-forestry integration, and improved access to rural credit and innovative financial instruments.

Estimates from TEEB Agriculture and UNEP Food Project indicate that recovering 30 million hectares of degraded pastures by 2030 could drive a cumulative real GDP increase of up to 1.6%. Increased production could also translate into food prices falling by 2.35% by 2030.

249 Grantham Research Institute preliminary analysis – 'The Macroeconomic Case for Adaptation Investment' (2025, forthcoming)
250 WRI's sectoral framework for 'Infrastructure' includes disaster risk management (DRM), early warning systems, energy, resilient cities and transport.
251 WRI (2025). Strengthening the investment case for climate adaptation: a triple dividend approach. NB WRI's sectoral framework for 'Infrastructure' includes disaster risk management (DRM), early warning systems, energy, resilient cities and transport.
252 Ministério da Agricultura e Pecuária / ESALQ-USP, Impacto da meta de recuperação de pastagens degradadas do Plano ABC+ no Brasil (29 April 2025).

BOX 2.7

Climate Investment Fund (CIF) Pilot Program for Climate Resilience - Key Benefits and Insights

The Climate Investment Fund's $1 billion Climate Resilience Programme - primarily delivered through its **Pilot Programme for Climate Resilience (PPCR)** - is one of the world's largest funding vehicles dedicated to helping countries to integrate climate resilience into national development planning. With operations in more than 30 countries, including in Africa, the Caribbean and South Asia, the PPCR provides concessional financing and technical support to build systemic resilience across critical sectors such as agriculture, water, health and infrastructure.

A key achievement of the program has been its ability to **embed resilience thinking at the institutional and policy level,** moving beyond project-based approaches. For example, in **Mozambique,** the program supported the establishment of a national climate change unit and helped mainstream climate risk into planning across ministries. In **Bangladesh,** the program focused on climate-resilient agriculture and food security, reliability of water supply and sanitation, and the resilience of coastal communities and infrastructure.

An important insight from the CIF approach is that **resilience is most effective when pursued as a cross-sectoral, systems-level investment,** not a siloed technical fix. The program emphasises local ownership, institutional capacity-building, and long-term financial sustainability. It also illustrates how international concessional finance, when strategically deployed, can de-risk larger climate investments, attract co-financing, and catalyse broader transformation. The CIF experience demonstrates that **effective resilience requires integration across governance levels, robust monitoring systems, and sustained political commitment.**

2.4.3 Financial, Fiscal and Social Stability Improves with Investment in Resilience

Financial stability improves

Resilience investments protect collateral value, stabilise loan performance and maintain assets' suitability for investment. Resilient and retrofitted properties are more able to retain their value after climate shocks, lowering the risk of loan defaults for creditors. For example, a US study of homes built to wind-resilient regulation standards found 50% lower mortgage-delinquency rates after hurricanes compared to homes not built to these standards.[253] Financial stability operates beyond physical assets and institutional lenders. For example, in Bangladesh, a micro-lending programme for farmers offered early-warning SMS alerts, fast-disbursing emergency credit and loans earmarked for resilient farming inputs. The programme found that repayment rates from farmers were higher, even after severe flooding, compared to a control village.[254]

Fiscal stability improves

Resilience helps governments maintain fiscal credibility by reducing the severity and frequency of disruption to output, prices and public services. Inflationary spikes are dampened, tax revenues stabilised, and emergency expenditures curbed. This frees up fiscal space for forward-looking investment. The evidence shows that when a country's ND-GAIN score for vulnerability to climate change improves by 10 points (because of resilience improvements), their sovereign bond spreads drop 37.5 basis points.[255] This offers real savings on the country's debt service. By creating more stable economic and fiscal conditions, resilience investments enable governments to plan proactively and attract better public and private investment, creating the conditions for long-term growth.

Social stability improves

By securing food, water, health, housing and livelihoods in the face of disruption, resilience investments help households avoid crises that can trigger dislocation, distrust and conflict.

253 Insurance Institute for Business and Home Safety (IBHS), *New IBHS, Corelogic Study Shows Modern Building Codes Cut Post-Hurricane Mortgage Delinquency Rates in Half* (August 9 2023).
254 Lane, G. *Adapting to Climate Risk with Guaranteed Credit: Evidence from Bangladesh* (2024).
255 Cevik, Serhan and João Tovar Jalles, *Feeling the Heat: Climate Shocks and Credit Ratings, IMF Working Paper No. 2020/286* (Washington DC: International Monetary Fund, 2020).

CASE STUDY 2.14

Nestlé's Value Chain Security Strategy[256]

Food and beverage company Nestlé sources critical raw materials like coffee, cocoa, dairy and grains from over 680,000 smallholder farmers globally. Nestlé's 2023 risk modelling projected that by 2040, climate change could cause significant yield variability in 12 core commodities, representing 90% of the company's total spend.

In response, Nestlé partnered with climate risk experts (Resilience, and Cambridge Judge Business School) to model vulnerabilities and integrate them into annual strategic reviews. Climate risk analysis is now embedded in procurement and environmental, social and governance (ESG) decision-making, aligned with Task Force on Climate-related Financial Disclosures (TCFD) and EU sustainability reporting standards. A large-scale regenerative agriculture programme distributes over 290 million improved coffee plantlets and provides technical assistance to farmers. Early warning systems and partnerships with local governments and NGOs strengthen farm and community adaptation. Coffee yields grew by up to 50%, bolstering farmer incomes, reinforcing supply chain resilience and long-term sustainability.

These interventions have secured supply stability and protected revenue, while strengthening Nestlé's leadership on climate and nature performance.

256 Nestle, Nestlé - Climate Change 2023 (2023); Nestlé, Climate Policy Engagement at Nestlé, 2023-2024, (2025).

2.4.4 When Investment Accelerates Development, Growth and Competitiveness are Bolstered

Stable, resilient economies that enjoy well-designed fiscal policies are empowered to free up fiscal space. They are able to respond to future shocks and invest in development to support long-term growth. With public spending focused on resilience and development rather than reactive spending, and fiscal space strengthened by stable revenues and robust tax collection, countries can break free from the trap of short-term costs and channel resources into long-term priorities. Protecting and expanding domestic assets (e.g. freshwater, forests and coastlines) can reduce import dependence and enhance competitiveness in international value chains.

For example, Singapore invested heavily in resilient physical and human capital to protect and enhance its position as a global logistics and innovation hub, strengthening its geostrategic position as a result (see Box 2.7).[257] Stability via resilience also improves a country's ability to secure private investment, as lower perceived risks reduce the cost of capital.

As stability and investment reinforce one another, and economies grow more robust, the capacity to invest in resilience further strengthens. This upward spiral allows communities, companies and countries to expand opportunities, take 'productive risks' rather than suffer from imposed risks,[258] and build long-term prosperity.

BOX 2.8

Singapore's Climate Resilience Success Story: Protecting a Global Logistics and Innovation Powerhouse

Singapore is a small country with a large population and limited natural resources. Climate change has exposed it to three principal threats: i) rising sea levels pose an existential risk, threatening to flood or permanently submerge low-lying areas; ii) rising temperatures could spread diseases, disrupt food imports, and damage biodiversity, including through coral bleaching and fish deaths; iii) extreme weather variability is intensifying wet and dry seasons, increasing the risk of flash floods and water shortages for its population and businesses.

To address these challenges, Singapore has introduced a range of resilience measures, including:

- **Sea level rise - coastal protection and innovative infrastructure:** To address rising sea levels, Singapore is investing heavily in coastal defences and advancing research and engineering solutions. It also mandates that all new infrastructure be built at least four metres above sea level, with even higher elevation standards - over five metres - set for critical port and airport developments.
- **Rising temperatures - urban cooling and nature-based solutions:** Singapore mitigates urban heat by significantly expanding green cover, increasing its tree-planting rate, and reserving 10% of land for parks. It also deploys district cooling systems to achieve economies of scale.
- **Extreme rainfall and dry spells - integrated water management and resilience planning:** To manage rainfall extremes, Singapore enhances drainage systems and flood barriers, with two-thirds of its land surface functioning as water catchment. It secures long-term water supply through a blend of flood control, water harvesting, community spaces, and seventeen reservoirs as part of its broader water resilience strategy. The country has also built three desalination plants, with two more planned. This integrated approach strengthens water security and climate resilience, supporting uninterrupted industrial operations and a dependable environment for investment, innovation and logistics.[259]

Together, these efforts protect essential assets - including ports, data centres and transport networks - ensuring operational continuity and reinforcing Singapore's reputation as a reliable global logistics and trade hub.[260] These interventions also support a more liveable, attractive urban environment for global talent and businesses, while reducing energy demand, enhancing Singapore's appeal as a leading innovation centre and sustainable business destination.[261]

257 Singapore Ministry of Foreign Affairs, *Towards a Sustainable and Resilient Singapore* (2019).
258 World Bank, *World Development Report 2014: Risk and Opportunity* (2014). When people feel protected against imposed risks (such as storms, disasters, or disease), they are more likely to take 'productive risks' - investing in education, improving housing, or starting a business - which drive long-term growth and development.
259 Centre for Liveable Cities Singapore, *A Resilient Singapore* (2018).
260 Singapore Ministry of Foreign Affairs, *Towards a Sustainable and Resilient Singapore* (2019).
261 Ibid.

Chapter Three

Resilience is the Investment Agenda of the Twenty-First Century

Resilience is a strategic decision. Climate and nature impacts are unavoidable, but building resilience is a choice. With the right investments, policies, and institutional coordination to protect and grow productive capital, governments and firms can blunt impacts, protect development gains and unlock new sources of growth and stability.

Resilience is not a separate budget line or growth strategy from development and climate spending, and it is not a replacement from investments in decarbonisation; it's about doing development better. Resilient investments and policies stretch scarce budgets: they avoid repeated repair costs, reduce downtime and deliver co-benefits in jobs, health and productivity.[262] Aligning climate goals with national development plans has the potential to lift tens of millions out of poverty, and drive growth.[263]

262 World Resources Institute, *The Triple Dividend of Resilience: Realising Development Goals through Resilient Investments* (Washington, DC: World Resources Institute, 2015).
263 The Organisation for Economic Cooperation and Development, *Aligning Development Co-operation and Climate Action: The Only Way Forward* (Paris: OECD Publishing, 2019).

3.1 Investment Scale and Needs

Meeting this resilience agenda requires significant new spending – both public and private.

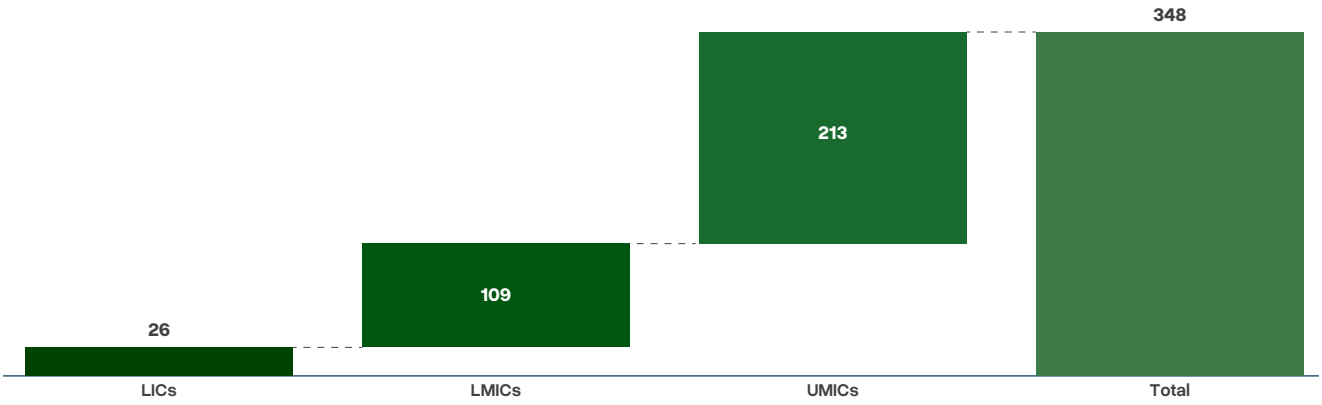
Our analysis – which draws on the updated United Nations Environment Programme (UNEP) Adaptation Gap Report 2025 – finds $350 billion is needed annually by 2035 in emerging markets and developing economies (EMDEs) to close core resilience gaps[264] – **see Exhibit 3.1.** This will be equivalent to 0.5% of EMDEs' GDP,[265] and is a recurring investment need: resilience-building must be sustained and updated year after year.

This captures public-focused interventions – such as major flood protection investment or adaptive social protection – as well as interventions that typically have both public and private costs and benefits, for example climate-smart agriculture.[266] This estimate does not include interventions by private companies that are confined to their own assets or operations, or investments by households, which UNEP AGR estimates will be several hundred billion dollars per year by 2035.[267] Nor does this figure include funding for losses and damages, estimates for which range from $20 billion–$580 billion per year by 2030.[268]

Exhibit 3.1 The Additional Resilience Investment Need by 2035 in Emerging Markets and Developing Economies

Developing countries investment needed[1] ($ billion by 2035, US$2023 prices)

Estimates draw largely from 2025 UNEP Adaptation Gap Report (Forthcoming)

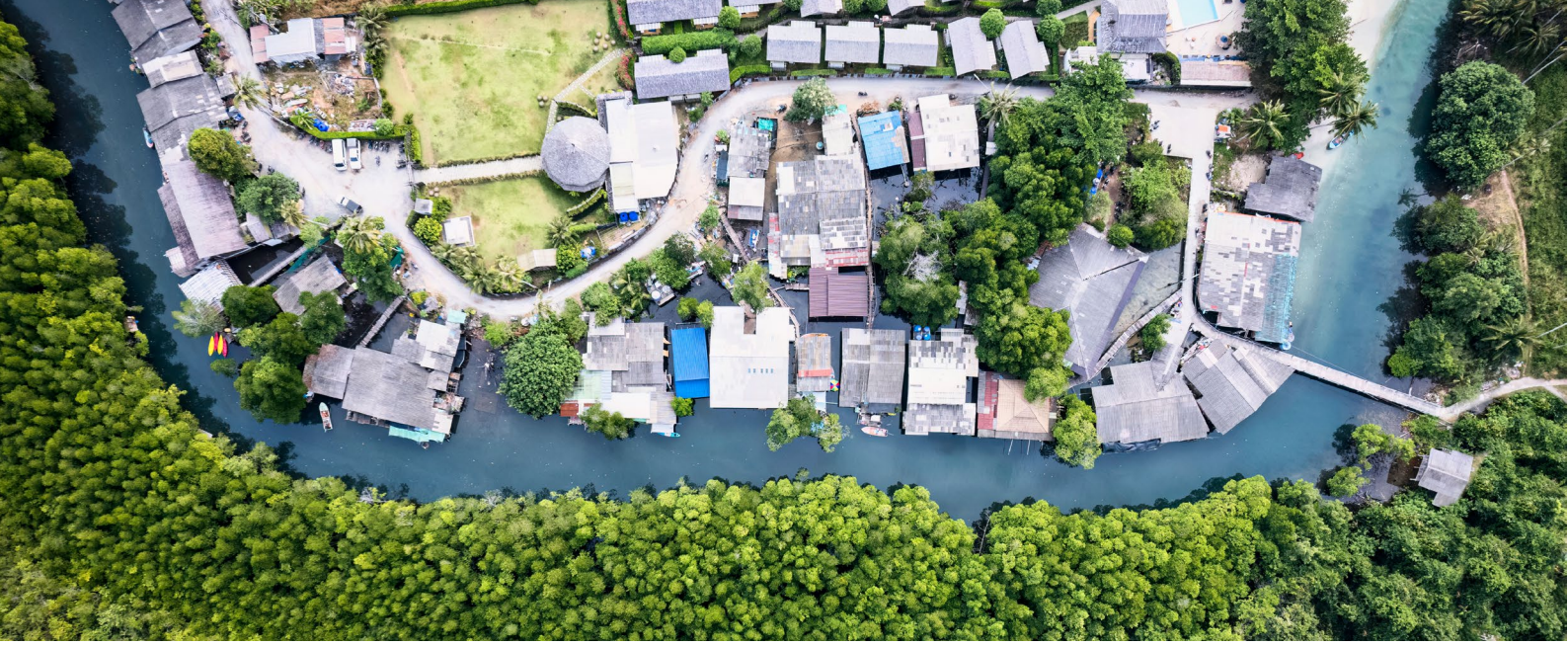


Notes: (1) The values shown are for the non-annex 1 countries as defined by the United Nations Framework Convention on Climate Change, focusing only on low-income countries (LICs), low- and middle-income countries (LMICs) and upper-middle income countries (UMICs). (2) UNEP Adaptation Gap Report 2025 (forthcoming), covering adaptation estimates for agri-food, disaster risk reduction, health, fisheries and marine, energy and transport infrastructure, coastal protection and river flood protection. These sector results are only presented as aggregate numbers for country income groups. Systemiq conducted analysis to expand UNEP AGR estimates for certain sectors, drawing on sources including Carapella et al. (2023), Aggarwal et al. (2024) and World Bank/UNESCO data on capital expenditure for education, Waldron et al. (2022). See Technical Annex of this report for further detail. Note the figure captures public-focused interventions, as well as interventions that have both public and private costs and benefits, for example climate-smart agriculture. It does not include interventions by private companies that are confined to their own assets or operations. The numbers are expressed in constant 2023 USD.

Building resilience requires that all investments become resilient, as well as making new investments to tackle new risks. First, redirecting and scaling existing investments to ensure they are resilient. For example, when building a new road, that investment should factor in financing to ensure the road is built resilient to slow-onset and acute climate impacts. Second, there is a need for new investments that tackle specific climate and nature risks, such as a new sea wall, or new cooling facilities.

Where possible, investments that boost resilience and reduce emissions at the same time can maximise returns. Chapter 6 identifies 15 impactful 'A&R Best Buys' Adaptation & Resilience opportunities across sectors, including climate-resilient crop varieties and irrigation systems; vaccines for climate-sensitive diseases and vector-control measures; and mangrove protection and restoration.

264 *UNEP AGR Adaptation Gap Report 2025* (forthcoming).; Systemiq analysis (education, water and sanitation) See Technical Annex for further detail.
265 $350 billion is 0.05% of projected GDP of emerging markets and developing economies in 2035. Based on IMF (2024) GDP projections until 2030 in current prices for each country income group, deflated to 2023 USD prices
266 Our analysis presents a central estimate of investment needs to 2035. Other studies report a range of estimates, reflecting either finance needs identified by countries themselves (e.g. UNEP AGR 2023) or differences across scenario assumptions
267 *UNEP AGR Adaptation Gap Report 2025* (forthcoming)
268 Center for Climate and Energy Solutions, *Understanding Financing for Loss and Damage Under the UNFCCC* (August 2024).



Over half of the annual investment needed is in coastal and river flood protection, power and transport infrastructure, and the built environment.[269] This includes investments into interventions such as sea walls and dykes, or climate-resilient roads. Approximately one-seventh of the investment need is in the agri-food sector, for interventions such as climate-resilient varieties, sustainable soil management systems and water management.

Across sectors, resilience interventions cover a broad range of categories. They include hard infrastructure (dykes, stormwater systems, climate-resilient new roads and bridges), nature-based solutions (wetlands, mangroves, urban parks that buffer flooding), and social investments (social protection, water conservation, disease control). They also encompass information and institutional systems (early-warning networks, risk mapping, disaster planning, climate data services) and financial tools like social safety nets, catastrophe insurance pools, and weather-indexed crops insurance. Together, these investments protect and expand the productive capital that underpins resilient economies.

In practice, one can group resilience investments into roughly four categories:

- **Infrastructure:** Retrofitting and upgrading roads, bridges, ports, power grids, buildings and water and sanitation systems, as well as building resilient infrastructure such as coastal defences. This also includes 'green infrastructure' - for example urban parks, green roofs and walls, wetlands or mangrove restoration - which provide both mitigation and adaptation co-benefits.
- **Targeted (sectoral) interventions:** On-the-ground measures such as drought-tolerant crops and irrigation in agriculture, improved water management (e.g. rainwater harvesting), public health programmes to manage heatwaves and disease vectors, and disaster-resilient school and clinic facilities.
- **Enabling systems and institutions:** Such as early warning and climate information systems, hazard zoning and building codes, disaster preparedness planning, community education and training, social protection programmes that cushion shocks and cross-sectoral coordination bodies.
- **Insurance:** Such as public-private crop and livestock insurance, sovereign catastrophe pools, parametric weather and flood cover, weather derivatives, catastrophe bonds and microinsurance.

Governments and financiers are already experimenting with instruments to embed resilience in capital flows - from resilience bonds and blended finance facilities, to guarantees that de-risk private investment and resilience criteria in green bonds and loan covenants. The common thread is not raising entirely new pools of money, but steering existing capital more effectively into projects that reduce risk and protect returns. These tools are explored in greater depth in Chapter 4; the key point here is that the resilience agenda is as much about **how** we invest as **how much** we invest.

269 Systemiq analysis, drawing on *UNEP AGR Adaptation Gap Report 2025* (forthcoming). See Technical Annex for further detail.

3.2 The Critical Role of Policy

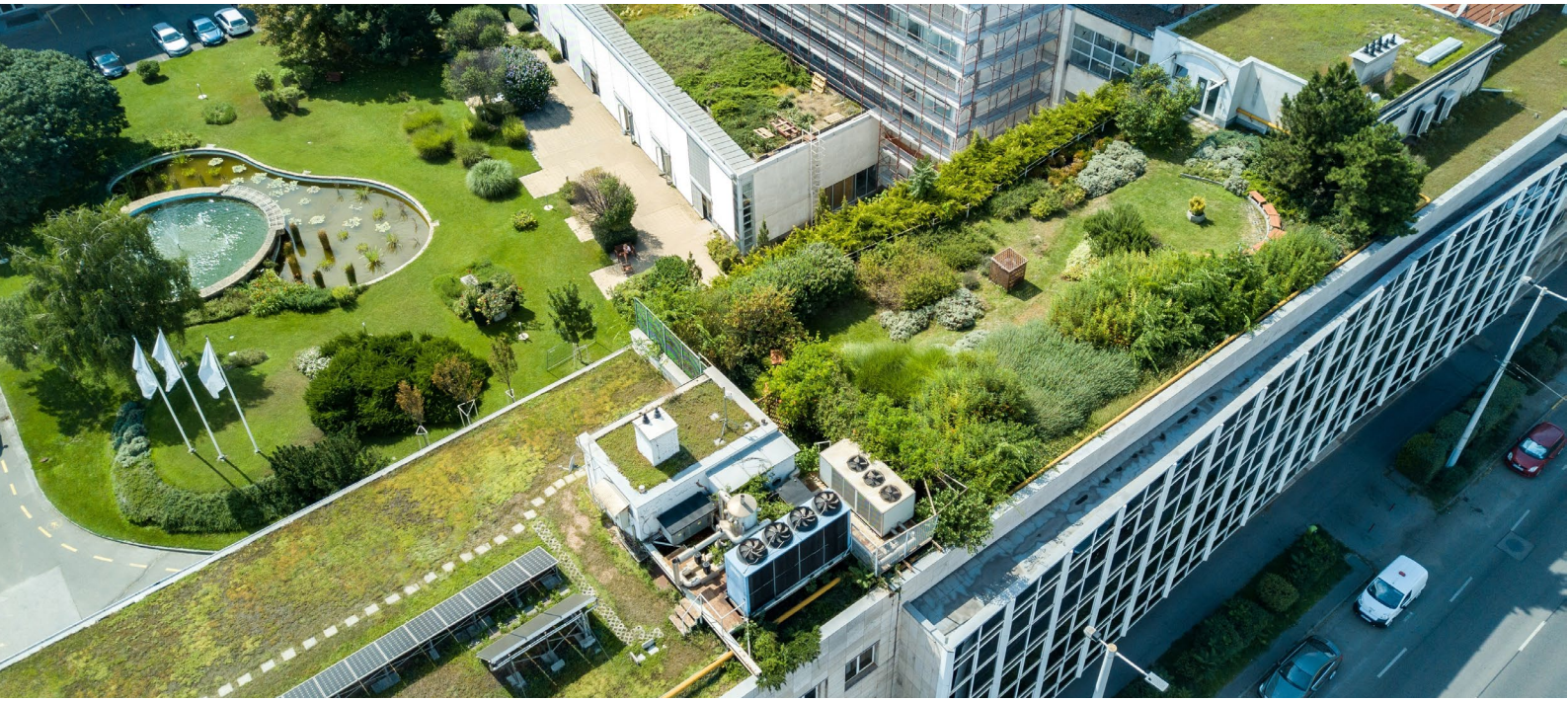
Policy can incentivise markets to deliver resilience. Left unchecked, capital tends to chase short-term returns, under-pricing long-term risks and overlooking distributional impacts. Policy is what converts resilience from a niche into a mainstream investment opportunity.

Three functions are unique to governments and economic policymakers:

- **Correcting mispriced risk:** Climate and nature shocks are not yet fully priced into assets, credit ratings, or fiscal projections. Governments can mandate risk disclosure, integrate climate shocks into debt sustainability analysis, and require stress-testing of public budgets and financial institutions. These steps make invisible liabilities visible, shifting incentives for both investors and lenders.
- **Preventing lock-in:** Once infrastructure is built, mistakes last decades. Codes, standards and land-use planning are public responsibilities. Requiring resilience in public procurement and regulation ensures that every new dollar invested – public or private – builds future-proof rather than stranded assets.
- **Protecting equity and fiscal stability:** Resilience has distributional consequences. Poorer households and smaller firms are least able to absorb shocks, and their losses quickly cascade into fiscal crises through defaults, revenue shortfalls and emergency spending. Social protection systems, targeted subsidies and public safety nets are therefore not just welfare measures; they are core instruments of macroeconomic stability.

Internationally, governments also set the terms for concessional finance and blended models that bring resilience within reach for emerging markets and developing economies.

The essential point here is that policy is what forces long-term risk into today's investment calculus. Without it, resilience remains a good idea; with it, resilience becomes the operating logic of economies.

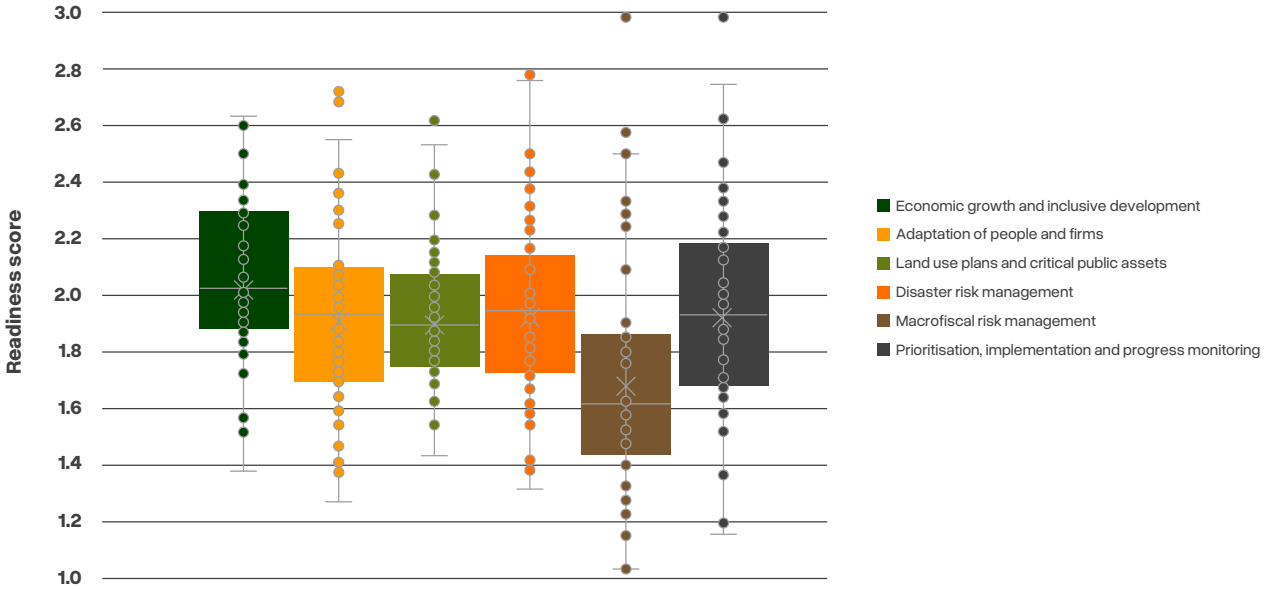


CASE STUDY 3.1

World Bank Adaptation and Resilience Assessments[270]

Well-designed adaptation policies and systems are critical to ensure that both public decisions and private investments take current and future climate and nature risks into account. But not every country has the same resources or readiness. To close the gap, the World Bank has assessed adaptation and resilience readiness in 45 countries – using their Adaptation Principles framework to pinpoint where progress is underway and where support is needed. The assessments surface critical gaps and identify priorities, alongside proven successes and practical lessons that countries can replicate and scale, offering a roadmap for action. Key priorities that emerge include:

- climate data and early warnings, based on high-quality, publicly available data on climate change and hazard risks
- resilient infrastructure and planning, including building codes and land use plans that incorporate physical risks, nature-based solutions and technical reforms
- risk management and social protection that protect communities and secure development gains
- macroeconomic resilience, based on interventions and frameworks to address climate- and nature-related fiscal and financial risks
- institutional coordination and local action, including strengthening local governance to deliver risk-informed services and community needs



CASE STUDY 3.2

Resilient Economies Index - Global Center on Adaptation

The GCA Resilient Economies Index takes stock of the climate adaptation landscape in 54 African economies. It assesses the exposure of the economy to climate impacts, the robustness of the government policies to build resilience, and the scale and quality of financial flows to implement adaptation action. Highly-ranked economies demonstrate encouraging policy developments, while underlining the need to consider adaptation across all development planning, and to make priorities more actionable by clearly articulating metrics, responsibilities and financing needs.

The index also shows that while some countries are deploying more effective financial mobilisation strategies, a general scale-up of finance for resilience remains necessary. A growing 'debt wall' constrains countries' ability to invest in resilience, with 62% of adaptation finance in Africa currently provided as debt. This limits fiscal space and undermines long-term adaptation capacity.

Country-specific exposure of infrastructure and impacts on future economic prosperity complete the picture, helping to guide strategic policy improvements, and bolster the argument for enhanced funding for adaptation as a driver of economic security and prosperity.

270 World Bank, *Rising to the Challenge: Boosting Adaptation and Resilience for Development* (2025).

Chapter Four

Financing Resilience

The financial system shapes where investment flows – and whether or not it builds resilience for households, governments and businesses.

Whether it's a family recovering after a flood, a government funding early warning systems, or a company adapting its supply chain, the financial system ultimately determines what gets built or protected – and who is left exposed.[271]

Yet today's financial system does not adequately account for the true returns from resilience – a costly oversight. Risk models don't give sufficient weight to investments that reduce exposure, preserve value and stabilise returns, so resilience remains chronically undervalued.

As outlined in Chapter 2, this creates systemic risk for the financial system itself. As asset quality deteriorates and physical risks mount, credit performance and returns are put at risk. Default rates can spike under adverse climate scenarios.[272] Returns are more volatile for lenders and investors, increasing the likelihood of financial distress – particularly in highly leveraged sectors.

By contrast, scaling investment in resilience enables financial institutions to reduce their exposure to default events and stranded assets. With resilience built into loan terms, project design and credit models, institutions face fewer shocks to their bottom line. This translates into smoother returns, stronger credit performance and more sustainable pipelines. Rather than pulling back from regions vulnerable to climate and nature impacts, lenders gain confidence to finance climate-smart development.

BOX 4.1

The Risk of a Climate and Nature 'Minsky Moment'

Without proactive investment in resilience, the financial system faces a real chance of a climate and nature 'Minsky moment' – a sudden, disorderly repricing of assets when physical risks and contingent adaptation liabilities are recognised all at once. What looks stable today can unravel rapidly when lenders, investors and insurers simultaneously update their assumptions.

This repricing could cascade across multiple fault lines of the financial system:

- **Mortgage and real estate markets:** Properties exposed to flooding, wildfires or coastal erosion could see sharp declines in value as insurers withdraw and mortgages default. In the US., home insurers already declined 37% of claims in 2023, up from 25% twenty years ago[273]. In high-risk geographies, default rates could spike by up to 5% under adverse climate scenarios, putting banking systems under strain.[274]
- **Sovereign debt markets:** Countries highly exposed to climate shocks may suddenly face higher risk premiums or even credit downgrades. If adaptation liabilities are belatedly priced into debt sustainability analyses, investors could flee precisely when fiscal space is most constrained.
- **Insurance and reinsurance markets:** As risks become more frequent and predictable, traditional risk-pooling breaks down. We are already seeing 'blue-lining' – insurers withdrawing from entire regions such as California, Florida, and parts of Australia. This not only leaves households and businesses unprotected, but undermines the credit security that insurance provides to lenders.
- **Capital flows in regions vulnerable to climate and nature impacts:** Once risk models update, capital could pull back en masse from the very places where investment is most needed. Instead of financing adaptation, investors could retreat, creating a vicious cycle of underinvestment, rising vulnerability and further capital flight.

The danger is not just individual asset losses, but a vicious cycle: falling asset values weaken balance sheets, which trigger risk aversion, which accelerates capital withdrawal, which further depresses asset values. That is the essence of a climate and nature 'Minsky moment'.

By contrast, scaling investment in resilience provides the shock absorbers the system needs. Resilient assets, infrastructure and communities reduce default probabilities, sustain insurability and stabilise sovereign credit. In other words, resilience is not only a development imperative, but a systemic risk management strategy for global financial stability.

271 United Nations Office for Disaster Risk Reduction, *Global Status of Multi-Hazard Early Warning Systems* (2024).
272 Scope Ratings, *Stress-Testing European Banks for Climate-Related Losses* (2025).
273 Insurance Information Institute, *Home Insurance Claim Trends in the US* (2024).
274 Network for Greening the Financial System, *Climate Scenarios for Financial Stability* (2023).

Today, resilience investment flows fall far short of needs. Only about $54 billion flows annually into climate resilience - roughly one-seventh of the $350 billion investment needed. The gap is widening as climate risks escalate. Resilience spending is analogous to maintenance of productive capital: it must be renewed continuously to sustain benefits.

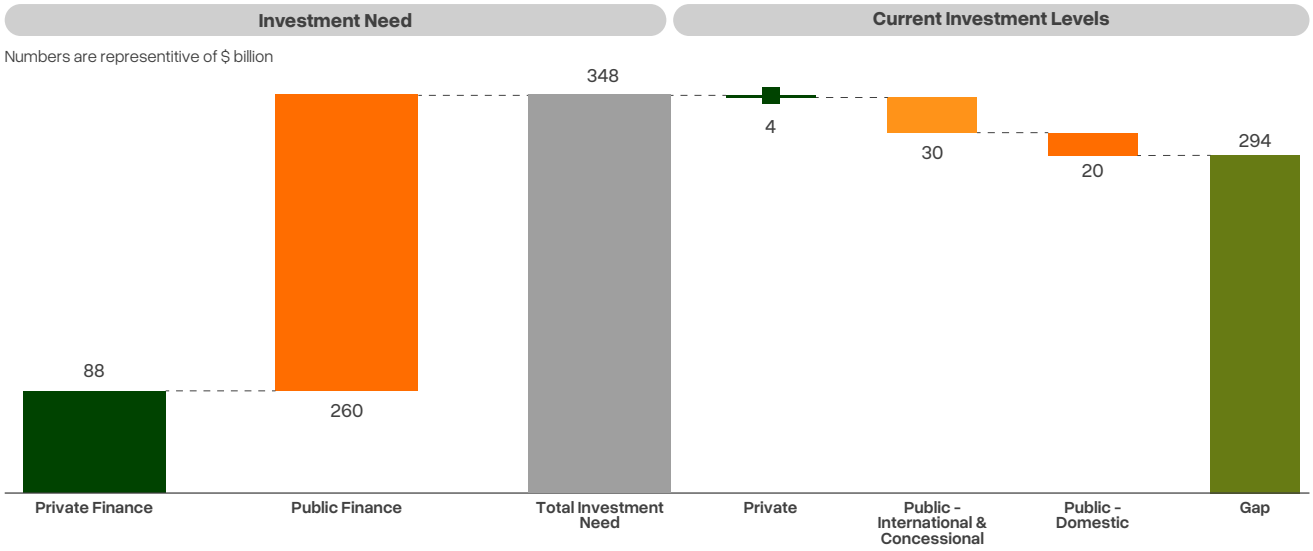
Every missed dollar today compounds future costs in disaster relief, reconstruction and lost growth. Conversely, investment in resilience pays recurring dividends: smoother returns for investors, lower fiscal volatility for governments and faster recovery for households and firms.

4.1 Public and Private Roles in Resilience Finance

Closing the resilience financing gap means recognising that both private and public finance are essential - but for different reasons.

This section provides further insight into the above numbers, outlining the scale and characteristics of resilience investments that are best suited to different financing sources, the financing gap faced today, and key levers to mobilise and redirect capital.

Exhibit 4.1 Investment Need Versus Current Investment Levels to Build Resilience



Sources: Investment Need - UNEP (2025), IMF (2024), Waldron et al (2022), IMF (2023), World Bank (2025); Current Investment Levels - UNEP (2024), Climate Policy Initiative (CPI, 2024), ClimateWorks Foundation (2023). See Technical Annex for further detail.

There are three main sources of finance for resilience:

- **Private finance** should be directed towards interventions that generate savings (including avoided losses or efficiency measures) or revenues that can be captured by the private sector;
- **International public finance** should close the gap between the investment need and what can be raised by private and domestic public capital, while delivering on internationally agreed finance commitments;
- **Domestic public finance** can be directed towards productive public investments in interventions that generate savings or socioeconomic returns, such as enhanced productivity, jobs or improved population health.

BOX 4.2

Households

The financing flows and investment needs associated with households are not included in our analysis, due to insufficient data and methodological challenges. However, households play a critical role in financing resilience. Individuals are already spending significant amounts of their own resources on adaptation, making households a 'fourth category' of financing flows beyond private investment, domestic public spending and international concessional finance.

Methodological challenges to determine investment flows remain, as highlighted by Climate Policy Initiative (CPI) and others, since much of this spending is diffuse and not systematically reported. Nonetheless, it is clear that increased investment by households is needed by 2035, with supported needed to ensure those from low-income households have access to solutions like increased air conditioning coverage.

4.1.1 Private Finance

Approximately 25% of resilience investment needs in emerging markets and developing economies (EMDEs) - or $90 billion - lie in sectors that could have the potential for predictable revenues or cost savings.

Private sector opportunities are stronger in mature and stable markets; in fragile states, achieving 25% private investment is not estimated to be currently possible, as a range of barriers mean revenue models do not work.

Commercial agriculture, transport, real estate and water and waste management are prime examples:

- **Agriculture:** Climate-smart irrigation and drought-tolerant seeds can improve yields while reducing input costs. For example, Vietnam's agricultural restructuring plan boosted rice productivity while enhancing climate resilience, strengthening export competitiveness.[275]
- **Water and sanitation:** Investments in water and sanitation offer returns through increased efficiency and lower maintenance costs. Utilities that invested in resilient systems in Latin America reduced leakage losses by up to 40%, improving both financial performance and service reliability.[276]
- **Real estate:** Private developers and property owners who invest in resilience measures can see clear ROI in reduced damage and operating costs. However, there is a clear role for policymakers and regulators to set building codes and incentives, and partner on financing tools to crowd-in private finance. A study of homes in Lagos, Nigeria found that climate change impacts increase tenant vacancy and repair costs, creating a clear incentive for developers to scale resilient building practices.[277]

These sectors can attract private capital in some contexts and countries, especially when projects are structured with user fees, public-private partnerships (PPPs), or cost-savings that investors can capture. Taking steps to increase the share of investments that can be privately financed in EMDEs can help to address the financing gap.

BOX 4.3

Estimating the Private Finance Potential

UNEP AGR estimates the realistic private sector potential for publicly-oriented national adaptation funding at 15 to 20% by 2035.[278] This varies by country grouping – with higher numbers in upper-middle-income countries and lower in low-income countries. The Returns on Resilience report takes a maximalist approach, using a 25/75 public vs. private sector split for national adaptation funding. This assumes that all theoretical private sector potential is realised, in all countries and sectors, reflecting an aspirational view of what could be achieved under improved policy and market conditions, and increased use of public finance to catalyse private investment, even if not yet present in EMDEs. IHLEG similarly assumes 25% private for publicly-oriented investments.

275 World Bank, *Vietnam Agricultural Restructuring Plan - Resilient Rice Support* (2023).
276 Inter-American Development Bank, *Resilient Water Utilities in Latin America: Case Studies on Climate Adaptation* (2022).
287 Peter et al., 'Effects of Climate Change on Residential Properties in Wemabod Estate, Ikeja, Lagos State, *Nigeria'. Frontiers in Sustainable Cities Vol. 6*, (2024).
278 UNEP AGR (forthcoming) *Adaptation Gap Report* (2025).

At present, just $4 billion is flowing each year from private sources into publicly orientated resilience interventions in EMDE countries.[279] This leaves an $85 billion financing gap.[280]

With the amount of international public and concessional finance trending dowards, there is a critical need to scale as much capital from the private sector as possible. Key levers to mobilise private investment into resilience interventions include:

Putting nature on balance sheets

A large share of resilience investments is devoted to strengthening capital, which is currently not valued on public or private balance sheets. By enabling companies to recognise the value of natural capital (e.g. through pricing carbon, water or biodiversity using markets, regulation or taxes) governments can help encourage greater private investments, and shift existing investment flows towards greater resilience.

Ensuring that all investments are resilient

Financial institutions can make resilience a core requirement in financing and corporate decision-making, reinforced by policy and regulation. This requires a relatively small uplift in cost - the World Bank estimates that an investment of 5% of an asset's value is required to climate-proof it.[281] Resilience covenants in loan agreements and green bond frameworks can ensure that financed projects meet adaptation standards. For example, a Latvian power utility embedded flood protection measures into its green bond framework for renewable energy and grid efficiency, illustrating how financial instruments can be designed to ensure financed projects integrate resilience measures.[282] On the corporate side, redirecting capital expenditure into resilient supply chains - for example, investing in heat-resistant logistics infrastructure - helps safeguard business continuity.

Creating new markets and instruments

Private investors and financiers who develop and scale resilience markets and financial innovations can benefit from rapidly growing demand for solutions. Identifying and developing instruments that help to develop and create demand for pipeline, or manage risk to enable private financial institutions to engage in transactions, is critical to catalyse private investment. Not all these instruments are suited to the communities and countries that are poorest and most vulnerable to climate and nature impacts, who may struggle to meet even low interest repayments.[283]

They include:

Capital mobilisation instruments

- Direct investments that crowd-in capital from financial institutions - such as PPPs, green bond issuances and outcome-based structures.
- Intermediated investments - such as EMDE-based infrastructure funds and global sector-based funds that mobilise institutional capital alongside concessional capital, guarantees and project preparation support and securitisation, to transform illiquid financial assets into tradeable securities. Specialised adaptation and resilience (A&R) funds, investing in these types of technologies, are starting to be launched (see Box 4.5).

Risk mitigation, credit enhancement and risk transfer products

- Guarantee companies such as InfraCredit in Nigeria and Dhamana Solutions in Kenya can directly mobilise institutional capital by improving credit rating, and lowering real and perceived risk, to reduce the cost of capital.
- First-loss tranches and blended finance instruments can improve the risk-return profile to catalyse private investment.
- Catastrophe bonds and resilience-linked loans can transfer risk away from governments and communities, providing liquidity after disasters. Investors can help expand resilience-focused markets, such as climate-smart agri-inputs, resilient building materials, water management, climate analytics platforms and insurance.

Resilience markets and nature-based transactions

- Carbon- and nature-based transactions can localise resilience benefits in communities threatened by climate and nature impacts.

The innovation ecosystem for adaptation and resilience solutions requires a major scale-up to meet the new risks we're facing, and to support start-ups and innovators to develop solutions to an investable stage. Scaling A&R-focused incubators and accelerators will help entrepreneurs grow. Philanthropic and public funders have a critical role to play, providing grants and catalytic capital at the pre-seed and seed stages, while governments and private venture capitalists must match mitigation-level support for early-stage research and acceleration.[284]

279 Estimates of private sector flows are likely underestimates, as they exclude small enterprises and households, focus largely on firms' own adaptation needs, and face measurement challenges due to limited typologies and differing understandings of what constitutes private sector resilience.
280 It is important to note however that data on private sector resilience investments is also limited by the fact that it is difficult to distinguish from 'well designed' business investments and resilience investments.
281 World Bank, *The Costs of Adapting to Climate Change for Infrastructure* (World Bank Group, 2010).
282 Climate Bonds Initiative, *Climate Resilience Principles: A framework for Assessing Climate Resilience Investments* (Climate Bonds Initiative, 2019).
283 Watkiss and England, *Adaptation Finance and the Private Sector: Opportunities and Challenges forDeveloping Countries* (Zurich Climate Resilience Alliance, 2025).
284 Tailwind Futures, *The Adaptation & Resilience Innovation Playbook* (Tailwind Futures, 2024).

BOX 4.4

Transaction Archetypes to Scale Capital for Resilience Projects - FSD Africa

Scaling finance for A&R outcomes is particularly challenging. It is difficult to standardise A&R solutions due to varied local impacts, responses and political and economic environments. Several transaction archetypes have the potential to attract private finance into national resilience priorities, both from international financial centres such as New York or the City of London, and relatively untapped in-EMDE sources.

Direct investments

These would seek to crowd in African financial institutions to A&R-aligned projects, for example in agriculture, housing, utilities and energy. The following three archetypes could be locally led, but supported by multilateral development banks (MDBs), development finance institutions (DFIs), philanthropy and climate funds as needed, with standardised roles for different investor types to help scale these models:

- **Public-private partnerships (PPPs)** can ensure local priorities are addressed, while giving investors reliable financial returns. Though PPPs could be fully private and commercial, many often need first-loss capital or guarantees to attract private capital. This is especially true in emerging markets, where revenue predictability and policy and regulatory stability are less certain.
- **Green bond** issuances targeted at climate adaptation needs could be a powerful catalyst for mobilising private capital at scale, while providing transparency to allay greenwashing concerns. A growing asset class, they could be sovereign-level, sub-national or private (e.g. from financial institutions or real sector corporates) in issuances in line with developing frameworks. Concessional support can help to compensate for increased complexity and reporting costs.
- **Outcome-based** structures can help tackle specific climate challenges - such as water scarcity and extreme heat - although these require careful tailoring, and concessional or public engagement in their mechanism design.

Intermediated investments

- **EMDE-based infrastructure funds** can mobilise local pension (and sovereign wealth) capital for investment, alongside concessional capital and guarantees to invest in resilience-building projects. Dual mandates across adaptation and mitigation could diversify risk and meet investors' return expectations. Innovative structures can support up-front blending of private and philanthropic funding, alongside investment in platforms (i.e. not projects). This would support developers to develop projects - critical for building a pipeline of bankable deals.
- **Global sector-based funds,** including listed vehicles, could help link institutional capital from developed economies with African institutions. These funding sources would include (re)-insurers, pools of high net worth and institutional investment. By providing finance alongside project preparation support - at differing stages of the continuum of capital - sector-based funds can act as targeted debt-financing vehicles to support medium-sized tickets otherwise not big enough for major capital markets players.
- **Securitisations** can provide local investors with risk diversification. Adaptation-related asset flows such as water, waste, transport or urban infrastructure could be targeted by pooling illiquid financial assets, such as loans or receivables, and transforming them into tradeable securities bought and sold in the capital markets..

Guarantee companies

These have proved to be effective at reducing the cost of capital to well below what is ordinarily available, and encouraging capital-market-leading innovation. Emerging guarantee companies, such as InfraCredit in Nigeria, and Dhamana Solutions in Kenya, offer 100% guarantees ('wraps') for long-term finance in local currency. Guarantee companies can work to directly mobilise institutional capital in infrastructure priorities and support pipeline development, but they also offer an independent voice on project structuring and private capital mobilisation.

Carbon- and nature-based transactions

These can have an outsized and positive impact on vulnerable communities, by localising resilience benefits in communities otherwise threatened by climate and nature impacts. Carbon markets can generate co-benefits alongside emissions reduction, although this is highly contingent on project design, governance structures and enabling policy environments.

CASE STUDY 4.1

IFC's Building Resilience Index (BRI)[285]

The BRI is a web-based tool that evaluates the resilience of buildings to natural hazards such as floods, storms, earthquakes and fires. Using hazard data and a structured questionnaire on design, materials and operational features, it assigns standardised ratings (e.g. AA, A, B), with a '+' for buildings that ensure continuity during disasters through measures such as backup power, water supply and emergency protocols.

For financial institutions and insurers, the BRI provides a practical benchmark to assess risk exposure in property portfolios, inform lending and underwriting decisions, and strengthen climate resilience screening in investment strategies. A number of financial institutions, including the Kenyan Green Building Society in Kenya, are looking to refine the BRI to local contexts - a critical step to enable locally planned activity to secure investment.

BOX 4.5

Dedicated Climate Adaptation and Resilience Funds[286]

The rise of funds dedicated to adaptation and resilience signals growing recognition that resilience solutions can generate growth opportunities and attractive returns for investors.

Examples include:

Lightsmith Climate Resilience Partners

A $185 million fund investing in growth- and venture-stage companies driving climate resilience in water, food, risk analytics and agriculture.

Notable deals:

- **WayCool -** Agriculture supply chain platform, $100 million Series D funding
- **Solinftec -** Digital agriculture platform, $60 million Series C funding
- **SOURCE -** Hydro panel technology provider, $50 million Series C funding

Mirova Environment Acceleration Capital Fund

A$250 million European venture fund backing smart cities, agri-tech and circular economy solutions.

Notable deals:

- **GridBeyond -** AI-enabled distributed energy software, $57 million Series C funding
- **Naïo Technologies -** Agri-robots to improve farming efficiency, $33 million growth/expansion
- **Vestack -** Software and hardware for sustainable building, $21 million early stage VC

InsuResilience Investment Fund Private Equity II

A $100 million target fund investing across Asia, Africa and Latin America in insurtech and agri-tech solutions for climate resilience.

Notable deals:

- **Pula -** Insurance for farmers against climate risks, $20 million Series B
- **Newe Seguros -** Insurance for rural crops, infrastructure and SMEs, $8 million growth/expansion
- **Igloo -** Insurtech platform covering farmland, $27 million Series B

285 International Finance Corporation, *Innovative Move to Help Boost Climate Resilience of Buildings in Vietnam (Foster Sustainability, 2023).*
286 Daniel Oehling et al., *The Private Equity Opportunity in Climate Adaptation and Resilience* (BCG, Temasek and Ecosperity, 2025).

4.1.2 Public Finance

Approximately 75% of resilience investments in EMDEs – or $260 billion – are best suited to public funding.[287]

The high share of publicly funded investments is due to many interventions having strong public good characteristics: they deliver broad social, health and environmental benefits that are difficult to monetise.

Just $50 billion flows into resilience investments from public sources in EMDEs, leaving a $212 billion financing gap. This includes proactive resilience investment, not reactive public budget expenditure for climate emergencies – in some cases labelled loss and damage under the UNFCCC – which today can reach up to 9% of GDP in many countries.[288]

Targeting International Public and Concessional Capital

International public and concessional finance must bridge the gap between the total investment need, and what could come from private and domestic public sources. Scaling these sources is critical to deliver on negotiated agreements.

Financing gap: Today, an estimated $30 billion international public finance flows into resilience investment in EMDE countries, far below the investment need.[289] Trends in international development aid suggest that, without action, the financing gap will grow.

Targeting concessional finance: Scarce concessional finance – in the form of grants, first-loss capital, and ultra-cheap loans – must be deployed where it delivers the greatest leverage.
This is not simply about supporting the lowest-income countries. It is about aligning flows with climate vulnerability and fiscal fragility: the places where risks are highest, capacity to absorb shocks is lowest, and the investment case needs a nudge to become viable.

Concessional finance today is spread too thinly, often dictated by donor preferences rather than objective measures of climate and fiscal risk.
Yet the data are clear:

- **Highly exposed countries face disproportionate costs:** For Small Island Developing States (SIDS), climate shocks have costs of approximately 1% in direct losses on average, and a further 1% to 2% in indirect losses annually.[290]
- **Debt burdens limit room to manoeuvre**: More than half of low-income countries are at high risk of debt distress, meaning adaptation costs translate directly into fiscal crises.[291]
- **Markets do not price resilience:** Sovereign spreads for countries vulnerable to climate and nature impacts are found to be higher than fundamentals suggest, therefore reflecting risk perceptions rather than enabling increased resilience investments. United Nations Development Programme (UNDP) finds that subjectivity in sovereign ratings costs Africa over $24 billion in excess interest, and $46 billion in foregone lending.[292] Efforts to improve default data availability are critical to help address inflated risk perceptions – including the Global Emerging Markets Risk Database (GEMs) Consortium, which pools anonymised data from multilateral development banks (MDBs) and development finance institutions (DFIs) on defaults, credit rating migrations and recoveries for loans extended in EMDEs. This enables investors to better assess and price the real risks of investing in these markets.

Without concessional support, these countries cannot make the upfront investments needed to break the cycle of shocks, leading to fiscal stress, in turn leading to underinvestment and resulting in more shocks.

287 Systemiq analysis. See Technical Annex for further detail.
288 WMO, *State of the Climate in Africa 2023* (2024).
289 Systemiq synthesis, drawing on Waldron et al., *Global Landscape of Climate Finance 2024* (Climate Policy Initiative, 2024) and International Development Finance Club, *IDFC Green Finance Mapping Report 2024* (International Development Finance Club, 2024). See Technical Annex for further detail.
290 Panwar et al., *The Price of a Changing Climate: Extreme Weather and Economic Loss and Damage in SIDS* (ODI, 2024).
291 Shane Romig, *Record IDA Replenishment Essential as Debt Crisis Looms* (World Bank News, 2024) accessed 02 October 2025.
292 Regional Bureau for Africa Strategy, Analysis and Research Team, *Reducing the Cost of Finance for Africa: The Role of Sovereign Credit Ratings* (United Nations Development Programme, 2023).

BOX 4.6

The Climate Finance Vulnerability Index (CLiF)[293]

One approach under development to guide allocation of concessional resources is the Climate and Finance Vulnerability Index (CLilF). Developed by Columbia University Climate School with the support of the Rockefeller Foundation, it combines three dimensions of risk into a single score:

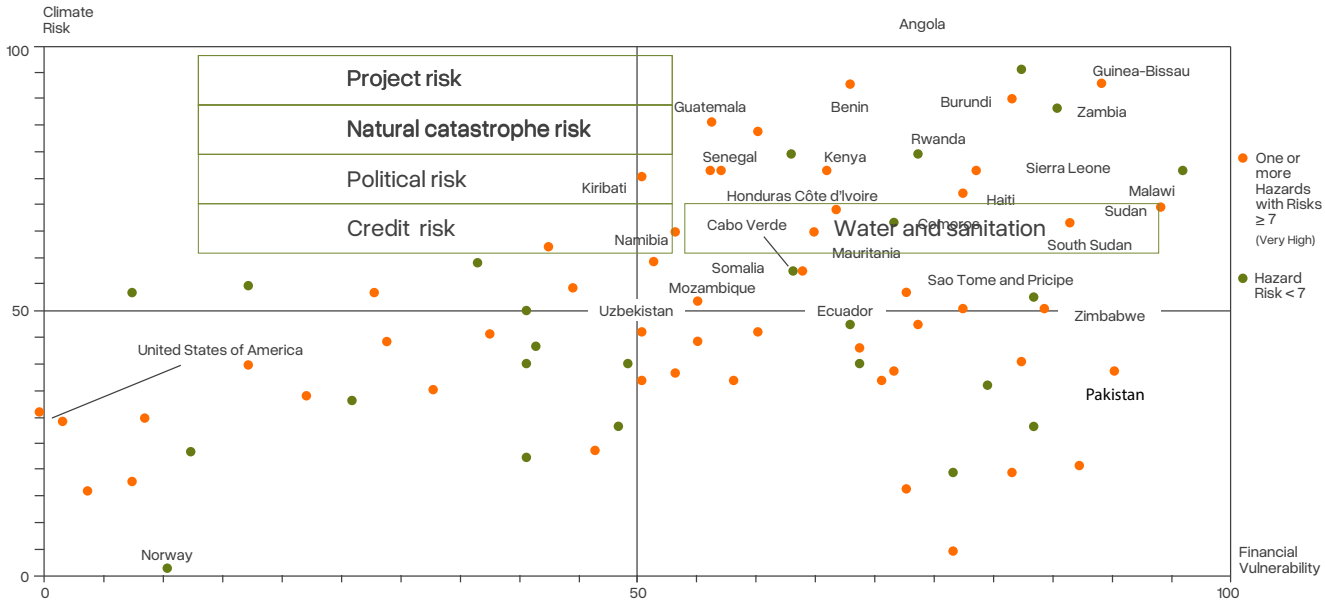
- **Climate risk:** Considers disaster risks for optimistic and pessimistic scenarios, including data such as the frequency and severity of floods, droughts, storms, as well as vulnerability and adaptive capacity.
- **Financial vulnerability:** Considers debt sustainability, financial integration and financial sophistication, including data on debt levels, fiscal balances and access to external financing.a
- **Governance:** Assesses eight variables including government effectiveness, rule of law and political stability.

Together, these indicators provide a snapshot of where climate shocks are most likely to generate fiscal crises:

- **Low-income African economies:** Economies such as Malawi and South Sudan face high hazard exposure, narrow fiscal space and limited reserves.
- **Small Island Developing States:** SIDS including Haiti and Kiribati rank near the top: extreme hazard exposure combined with small economic bases and high debt burdens.
- **Middle-income but fragile economies:** Economies such as Pakistan's combine high physical risks (e.g. floods) with weak fiscal buffers and rising debt.

By bringing these dimensions together, CLiF illustrates how concessional finance could be directed more strategically - to countries where climate shocks are most likely to cascade into fiscal distress, amplifying development setbacks. Countries in the top right corner of the resulting matrix could be targeted for scarce concessional finance.

Exhibit 4.2 CliF-VI: Projected Vulnerability of Selected Countries Under a 2050 Pessimistic Scenario



293 Columbia Climate School, *Technical Methodology Climate Finance Vulnerability Index (CliF-VI)* (National Center for Disaster Preparedness, Center for Global Energy Policy, Columbia University, 2025).

BOX 4.7

Bridging Public and Private Finance: The Role of Blended Finance

Public finance should play a catalytic role, attracting more private investment to adaptation and resilience projects. Governments and public financial institutions, including MDBs, can crowd-in private capital by bridging affordability gaps and scaling the use of catalytic instruments. This includes supporting early-stage project preparation, such as feasibility studies and pipeline development. Instruments like credit guarantees and blended finance structures can reduce the risks of investing in new resilience markets, enabling private financiers and investors to engage in projects that otherwise might not attract investment.

Blended finance therefore plays an important strategic role in shaping markets, and in derisking and bringing forward adaptation solutions in areas where there is commercial potential, especially given that adaptation is still a very novel area for many investors. Based on historical deals, key sectors are likely to be agriculture, biodiversity and ecosystems, infrastructure, and water.[294]

Analysis of data from Convergence - a blended finance network - finds that every $1 of public finance (both concessional and non-concessional) mobilises 51 cents of private finance.[295] There is therefore a clear need to enhance the design and targeting of blended finance instruments to increase leverage ratios, and target public investment to scale these solutions.

CASE STUDY 4.2

Climate Policy Initiative: The Global Innovation Lab for Climate Finance

Over the past decade, the Global Innovation Lab for Climate Finance (The Lab) has become a leading incubator for adaptation finance, mobilising over $1.2 billion across 81 investment vehicles-more than 20 of them focused on adaptation. These approaches demonstrate how capital can be structured to address climate risks:

- **Catalyst Fund:** Provides early-stage equity and venture support to African startups developing climate-resilient technologies.
- **Blockchain Climate Risk Crop Insurance:** A blockchain-based, weather-indexed insurance platform for smallholder farmers in sub-Saharan Africa, enabling fast, low-cost payouts after extreme weather events.
- **Climate Resilience and Adaptation Finance and Technology Transfer Facility:** A growth equity fund backing companies with proven climate resilience solutions, from weather analytics to drought-resilient seeds, paired with technical assistance to scale into new markets.
- **Restoration Insurance Service Company:** A social enterprise that sells parametric insurance to coastal communities, and reinvests premiums in mangroves and green-to-grey infrastructure, reducing risk while strengthening livelihoods.

294 Watkiss and England, *Adaptation Finance and the Private Sector: Opportunities and Challenges for Developing Countries* (Zurich Climate Resilience Alliance, 2025).
295 Ibid.

In addition to supporting countries vulnerable to climate and nature impacts to invest in resilience, scarce concessional finance should be targeted towards recovery to climate and nature impacts that do not generate financial or even broader economic returns.

These are costs that domestic governments alone struggle to shoulder. For example, rebuilding schools and hospitals after a storm is critical for human welfare, but does not protect or expand productive capital beyond the original assets.

This is essentially the domain of loss and damage – the irreversible impacts of climate change that occur despite mitigation and adaptation efforts. For this reason, the costs associated with these interventions are not included in the $350 billion resilience investment need discussed above. There are emerging channels designed to meet this need, including the United Nations (UN) fund for responding to Loss and Damage (FRLD). Directing concessional resources toward such unavoidable costs ensures that limited public and international funds are used where they are most essential, while freeing up domestic budgets and private investment for areas that can yield sustainable returns.

Domestic Public Finance

Domestic public finance can be targeted towards productive public investments in interventions that generate savings or socioeconomic returns. Examples include health systems prepared for heatwaves or pandemics, and ecosystem protection. Here, benefits are spread out widely across society, rather than captured by a single group, making it difficult to generate the kinds of direct revenues or cost savings that would attract significant private investment:

- **Healthcare:** Systems prepared for heatwaves or pandemics are crucial for protecting populations during crises. Yet the value lies in avoided deaths, illness, and social disruption, which are diffuse public goods rather than direct revenue streams.
- **Disaster recovery and reconstruction:** Restores livelihoods, but creates no revenue stream.
- **Ecosystem protection:** Provides critical services such as flood control and carbon sequestration benefits, but these are spread across multiple households and groups, with no single actor capturing the full financial value.

The vast majority of these investments deliver socioeconomic returns once avoided losses, productivity gains and fiscal stability are properly accounted for. A resilient health system reduces mortality, boosts worker productivity, and avoids emergency costs – yet most of these benefits sit outside conventional ROI models. Similarly, avoided flood damage does not show up in cash flow projections, even though it strengthens both household income and sovereign balance sheets.

BOX 4.8

Blended Finance in Action – BlueOrchard's InsuResilience Fund

Through its Climate Innovation Facility, British International Investment (BII) invested in BlueOrchard's InsuResilience Investment Fund, a pioneering blended finance vehicle that expands climate risk protection in emerging markets. BII helped mobilise investment by providing $2.25 million in first-loss cover, de-risking early participation and crowding in commercial investors. In total, the Fund has mobilised over $250 million in private capital and provided affordable insurance to more than 40 million people worldwide. By strengthening local insurers and extending coverage to smallholder farmers and microenterprises, it has increased financial resilience and built more stable insurance markets across climate-vulnerable economies.

Source: British International Investment, Building Climate Resilience Where It's Most Needed (BII, 2024).

Financing gap

An estimated $20 billion flows into resilience investments from public EMDE sources each year.[296]

The amount flowing into proactive investment pales in comparison to reactive expenditure, with many African countries diverting up to 10% of their budgets to responding to climate extremes.[297]

Mobilising investment

- **Repurpose harmful subsidies:** Governments can redirect subsidies that currently exacerbate vulnerability to climate and nature impacts. For example, phasing out fossil fuel subsidies that distort energy markets and lock-in carbon-intensive pathways, releasing funds for resilient renewable energy systems like solar micro-grids, or shifting irrigation subsidies away from water-intensive practices toward water-efficient technologies such as drip-irrigation. By repurposing subsidies, governments can better align fiscal policies with resilience goals.
- **Redirect public investments:** Governments can ensure that all public investments are resilient by default. This means applying resilience standards across all public infrastructure - from flood-proof roads, to schools built with heat-resistant materials, to hospitals equipped with backup power systems for emergencies. This is not just about physical infrastructure: governments can adapt social protection budgets into climate-linked safety nets, for example by scaling up cash transfers after extreme weather events. This ensures that public investments consistently help to build long-lasting, resilient development.
- **Raise government revenues through targeted, progressive taxes:** Taxing high-income high emitters represents an opportunity to raise funds from those most responsible for causing harm, while limiting pressure on lower-income groups. For example, countries, cities and regions are increasingly turning to tourism fees, with funds channelled to adaptation and development projects.

  Other developments include the Global Solidarity Levies Task Force, which proposes levies on under-taxed, high-emission sectors such as private jets as a means to generate predictable public finance to support developing countries in mitigation and adaptation efforts.[298] Similarly, the International Maritime Organisation's IMO Net-zero Framework implements a global carbon pricing scheme on international shipping emissions, with revenues raised intended to fund mitigation and adaptation efforts in countries vulnerable to climate and nature impacts.[299] Countries can also pull established levers to increase tax-to-GDP ratios, such as reducing exemptions and loopholes, encouraging businesses and workers to enter the formal sector, and improving tax administration.
- **Raise new public finance through financial instruments:** Instruments such as green bonds for adaptation and resilience-linked projects and priorities, and resilience-linked sovereign debt, allow countries to connect financial terms to resilience outcomes, reducing borrowing costs when targets are met, while simultaneously channelling funds into protective infrastructure and community preparedness. Tourism and disaster levies can provide a predictable, timely source of revenue for coastal protection, with modest surcharges on airline tickets, hotel stays or cruise ship docking, earmarked for investments in mangroves or seawalls. Governments can also access international climate finance through funds like the Green Climate Fund or the newly operational UN FRLD. By strategically combining these mechanisms, governments can diversify their revenue sources and strengthen resilience.

While these levers can do much to mobtilise capital, they are not readily available - or cannot raise sufficient funds to meet the investment need - in countries that are highly exposed to both physical and financial risk. Efforts can continue to develop smart instruments that enable private finance to flow, but in these countries, international concessional finance is needed to support investments in resilience.

CASE STUDY 4.3

Greece's Climate Crisis Resilience Tax

Introduced in 2024, Greece's Climate Crisis Resilience Tax is a nightly fee applied to all guests staying in hotels, apartments, villas and short-term rentals, with rates varying according to accommodation type and time of year. Estimates of expected revenues from the tax range from €200 to €400 million per year. These revenues are used to fund climate resilience efforts, disaster recovery and sustainability infrastructure to help Greece address environmental challenges such as wildfires caused by increased tourism.

296 Waldron et al., *Global Landscape of Climate Finance 2024* (Climate Policy Initiative, 2024); International Development Finance Club, *IDFC Green Finance Mapping Report 2024* (International Development Finance Club, 2024).
297 World Meteorological Organization, *State of the Climate in Africa 2023* (Geneva: World Meteorological Organization, 2024).
298 Global Solidarity Levies Task Force, *Climate and Development Action Requires Political Will and Financial Support* (2023), accessed 06 October 2025.
299 International Maritime Organization, *IMO Approves Net-Zero Regulations for Global Shipping* (International Maritime Organization latest news, 2025) accessed 02 October 2025.

CASE STUDY 4.4

Africa Adaptation Acceleration Program (AAAP) - Global Center on Adaptation (GCA)

GLOBAL CENTER ON ADAPTATION

Co-designed between the African Development Bank and GCA, and endorsed by the African Union, AAAP is climate-proofing $25 billion of investments to accelerate climate change adaptation by 2025. Since its launch in January 2021, the programme is delivering results for the continent's most vulnerable people. In partnership with governments, academia, community-based organisations and international financial institutions, AAAP has helped shape over $19 billion in investments that will build climate resilience for over 180 million climate-vulnerable people and generate around 1.2 million jobs in over 30 countries. Climate-proofed projects span critical thematic areas including food security, infrastructure and nature-based solutions, urban and water, youth jobs and climate finance.

4.2 The Role of Pre-arranged Finance

Insurance and other pre-arranged financing instruments are essential for resilience. They provide liquidity when shocks occur, reduce fiscal disruption, and lower the long-term costs of disasters.

Yet they remain underutilised: 98% of government crisis financing is not pre-arranged, even though 35% of crises can be modelled..[300] In emerging and developing markets, insurance coverage and uptake are limited. In some advanced economies, the affordability and availability of insurance is shrinking as climate risks rise. This calls for new approaches from countries, public finance providers, insurers and regulators.

300 High Level Panel on Closing the Crisis Protection Gap, *Crisis Protection 2.0: Future-Proofing Our World. A Roadmap To Close the Crisis Protection Gap Through Pre-arranged Finance* (Centre for Disaster Protection, 2025).

4.2.1 Pre-arranged Finance for Fiscal Stability

Pre-arranged finance instruments give governments predictable liquidity when disasters strike, helping them avoid fiscal crises and recover more quickly.

Best practice is to adopt a risk-layered approach – combining a range of instruments tailored to a country's risk profile, and complemented by risk reduction and disaster preparedness measures.[301]

Such approaches typically include tools to address both high-severity and lower-severity events. These tools not only provide liquidity but can also incentivise stronger risk management. Yet they come at a cost: both the capacity to set up and the need for technical understanding, and the requirement to pay for returns and principals – or in the case of insurance, annual premiums. To be sustainable, they should be institutionalised within national strategies and budget frameworks, and supported by work to strengthen domestic financial institutions. This helps ensure continued protection beyond electoral cycles, and with support from public finance institutions expands affordable access to companies and households for broader coverage. Risk-layering approaches apply to all countries. For climate-vulnerable governments these would often comprise:

Disaster reserves

- Reserve funds are a key instrument in managing disaster risk and form an important component of a government's broader risk-layering strategy. Classified as a risk-retention tool, reserves are generally best suited for addressing high-frequency, low-impact events.[302]

Contingent credit lines

- These are loan instruments approved in advance of a crisis and disbursed once a specified trigger is met, making them a form of risk retention. The World Bank's Catastrophe Deferred Drawdown Option (Cat-DDO) is a prominent example, providing rapid post-disaster financing typically upon the declaration of a national emergency. However, uptake has historically been limited and fragmented, which led the World Bank to expand and repackage the instrument under its Crisis Preparedness and Response Toolkit.[303]

Climate-resilient debt clauses (CRDCs)

- A pause clause is a provision in sovereign debt contracts that allows a borrower to temporarily suspend debt service (interest, principal, or both) when a predefined event occurs. The World Bank Group's CRDCs provide such pauses for climate-vulnerable countries and shocks such as droughts, floods, and health emergencies. To date, 20 countries have included CRDCs in their borrowing arrangements.[304]

Insurance

- Insurance is a risk-transfer tool, where a country can pay a premium in return for underwriting a specified risk. Parametric insurance provides a pre-agreed payout when a trigger – such as the intensity of a hurricane – is met. The Caribbean Catastrophe Risk Insurance Facility (CCRIF) has paid out nearly $400 million to countries using parametric coverage, often within days of disaster events, aiding recovery. It is expanding its offering to the private sector, including protecting utilities companies.[305] The Africa Risk Capacity (ARC), Pacific Catastrophe Risk Insurance Company (PCRIC) and Southeast Asia Disaster Risk Insurance Facility (SEADRIF) are all contributing increasing sovereign-level disaster coverage, and expanding to the private sector, using non-profit insurance models.

Catastrophe bonds (cat bond)

- Cat bonds are an insurance-linked security that enable governments to transfer extreme disaster risk to capital markets. These bonds are issued with predefined conditions of an extreme event (such as wind speed or earthquake intensity) that determine whether a payout is made. If an event meets the conditions, bond investors forfeit all or part of their principal, which is redirected to the affected country. If no qualifying event occurs, the principal is returned to bond investors. Mexico's $595 million cat bond transferred hurricane and earthquake risk to capital markets, providing multi-year cover up to 2028 at a predictable cost, following a previous cat bond executed in 2020 that paid out $60 million.[306]

301 Toro et al., , *Strategies for Paying Less on the Disaster Bill* (World Bank Blogs, 2023).
302 World Bank, *Disaster Reserve Funds* (2023).
303 World Bank, *World Bank Group Announces Comprehensive Toolkit to Support Countries After Natural Disasters* (World Bank Group website, 2023) accessed 02 October 2025.
304 World Bank, *Crisis Preparedness and Response Toolkit* (World Bank Group website, 2025) accessed 02 October 2025.
305 Conor Meenan, *Hurricane Beryl: Record Parametric Payouts Underline the Evolution of CCRIF's Role in the Caribbean* (Centre for Disaster Protection blog, , Centre for Disaster Protection, 2024).
306 The World Bank, *Case study: World Bank Catastrophe Bonds Provide Mexico with $595 million Financial Protection against Hurricanes and Earthquakes* (The World Bank, 2025).

4.3 The Case for Insurance to Enable Resilience

EMDE countries hold vast investment potential, but too much capital remains sidelined by rising risks, limited fiscal buffers and uncertainty. Insurance can unlock this capital by reducing the risk of financial losses, giving households, businesses and investors confidence to plan and invest. Insurance is not only a tool for managing shocks, but a foundation for resilience and long-term growth.

In advanced economies, where insurance is used more widely by households and businesses, growing climate risks are making some markets less insurable. Insurers are beginning to withdraw where profitability is no longer viable – a trend already visible in parts of California, where escalating wildfire risks have driven major exits,[307] and in Australia, where premiums are reportedly becoming unaffordable.[308] Regulatory environments and policy distortions such as mispriced subsidies can further undermine insurability, as again demonstrated in California.[309] This underscores a paradox: as risks intensify, access to insurance diminishes, reinforcing the need to invest in resilience to reduce underlying hazards. Resilience can restore insurability.

To fully realise its potential, insurance must be understood not just as a financial product, but as a catalyst embedded both across public policy frameworks and private markets.

Its potential contributions span three dimensions:

- **Generating risk insights to guide resilient development:** By quantifying disaster risks and their financial impacts, insurance capabilities can provide critical data for governments, businesses and communities. These insights can shape decisions on where to build – or where to avoid building – while guiding the design and implementation of risk-reduction measures
- **Transferring risk and incentivising risk reduction:** Insurance can deliver predictable and timely finance when crises occur, reducing fiscal volatility and speeding recovery. Policies can also incentivise risk reduction and help keep premiums affordable – for example, by providing lower premiums for best-practice standards in building design or enforcing stronger safety codes. Howden estimates that strategic investments of $6 billion in enhanced risk management could have halved the $75 billion in losses from the 2025 Los Angeles wildfires, highlighting the scale of avoided costs.[310] Insurance can also enable blended finance through de-risking – for example lowering the cost of guarantees and other credit-enhancement mechanisms by absorbing part of the underlying risk – making blended finance structures more affordable and scalable.
- **Mobilising long-term capital for sustainable growth:** Insurers collectively manage about one-third of global assets (approximately $40 trillion),[311] and therefore have significant influence in directing investment flows. Allocating more of these assets toward resilient infrastructure, particularly in EMDEs, can mitigate rising climate risks linked to insurers' liabilities. As Swiss Re and Allianz have noted, this strategy is vital not only for global resilience but also for the long-term profitability and stability of the insurance industry itself.[312]

307 StateFarm, *State Farm General Insurance Company: Update on California* (2024).
308 Josh Nicholas and Jonathan Barrett, *Why Insurance Premiums are Squeezing Australians and Fuelling Inflation* (The Guardian, 2024).
309 Economist, *Parts of America are becoming uninsurable* (2023).
310 Howdens, *The Insurability Imperative: Using Insurance to Navigate the Climate Transition* (2025).
311 IAIS, *Global Insurance Market Report (GIMAR)* (2024).
312 Swiss Re, *Sustainable Infrastructure – The Time is Now* (2020).; Allianz, *Climate change: Our Responsibility to Act* (2025).

4.3.1 Narrowing Insurance Protection Gaps

In regions vulnerable to climate and nature impacts, insurance penetration is extremely low, while losses from natural catastrophes are disproportionately high.

In many countries, penetration remains below 1% – leaving households and businesses to absorb shocks directly. Years of development progress can be wiped out in a single event. In Mozambique, for instance, low insurance coverage meant that most of the $2.9 billion burden in damage from Hurricane Idai – equivalent to 10% of GDP – fell on the government and international donors.[313]

The impact can be even more extreme for small island states: over a single night in 2017, Hurricane Maria caused damage equal to 226% of Dominica's GDP, forcing a major diversion of resources from development to recovery.[314]

In EMDEs, efforts to scale insurance are already taking shape. The Bridgetown Initiative (see Box 4.9) advocates for expanding the use of insurance , while the Vulnerable 20 Group is calling for greater funding for the Global Shield – a country-led process for modelling and implementing pre-arranged strategies.[315] A joint initiative between the Insurance Development Forum and the Bridgetown Initiative has also set out a strategic approach to scaling pre-arranged finance and insurance across key actors (see Box 4.8).[316] This could narrow protection gaps, while also contributing an estimated $100 to $200 billion annually to climate finance by enabling new investment.[317]

313 Mozambique Government, *Mozambique Cyclone Idai: Post Disaster Needs Assessment* (2019).
314 IMF, *Dominica Disaster Resilience Strategy* (2021).
315 CVF-V20, *Climate Vulnerable Forum (CVF) Leaders Declaration* (2024).
316 Insurance Development Forum and Bridgetown Initiative, *From Risk to Resilience: How Insurance can Mobilise Disaster Finance and Climate Investment in Vulnerable Economies* (2025).
317 Ibid.

BOX 4.9

Strategic Approach and Impact of Scaling Insurance and Pre-arranged Finance in EMDEs

If pursued together, four practical leverage points could significantly accelerate insurance-based resilience in EMDEs:

- EMDE Governments can adopt integrated disaster risk management in EMDEs, quantifying protection gaps and integrating pre-arranged finance into budget responses and financing strategies.
- MDBs and equivalent institutions can integrate pre-arranged finance into their lending and investment frameworks, including through risk layering, contingent components, risk transfer and shock-resilient loan instruments.
- Insurers can expand their risk-management offerings to incentivise risk reduction, and unlock their potential to deploy investments in EMDEs.
- EMDE regulators can design flexible regulatory frameworks to encourage experimentation, facilitate inclusive insurance models and align with international standards for innovative solutions.

Together, these leverage points can unlock better coordination, more capital and scalable solutions across the risk-financing ecosystem - from governments and insurers, to MDBs and regulators.

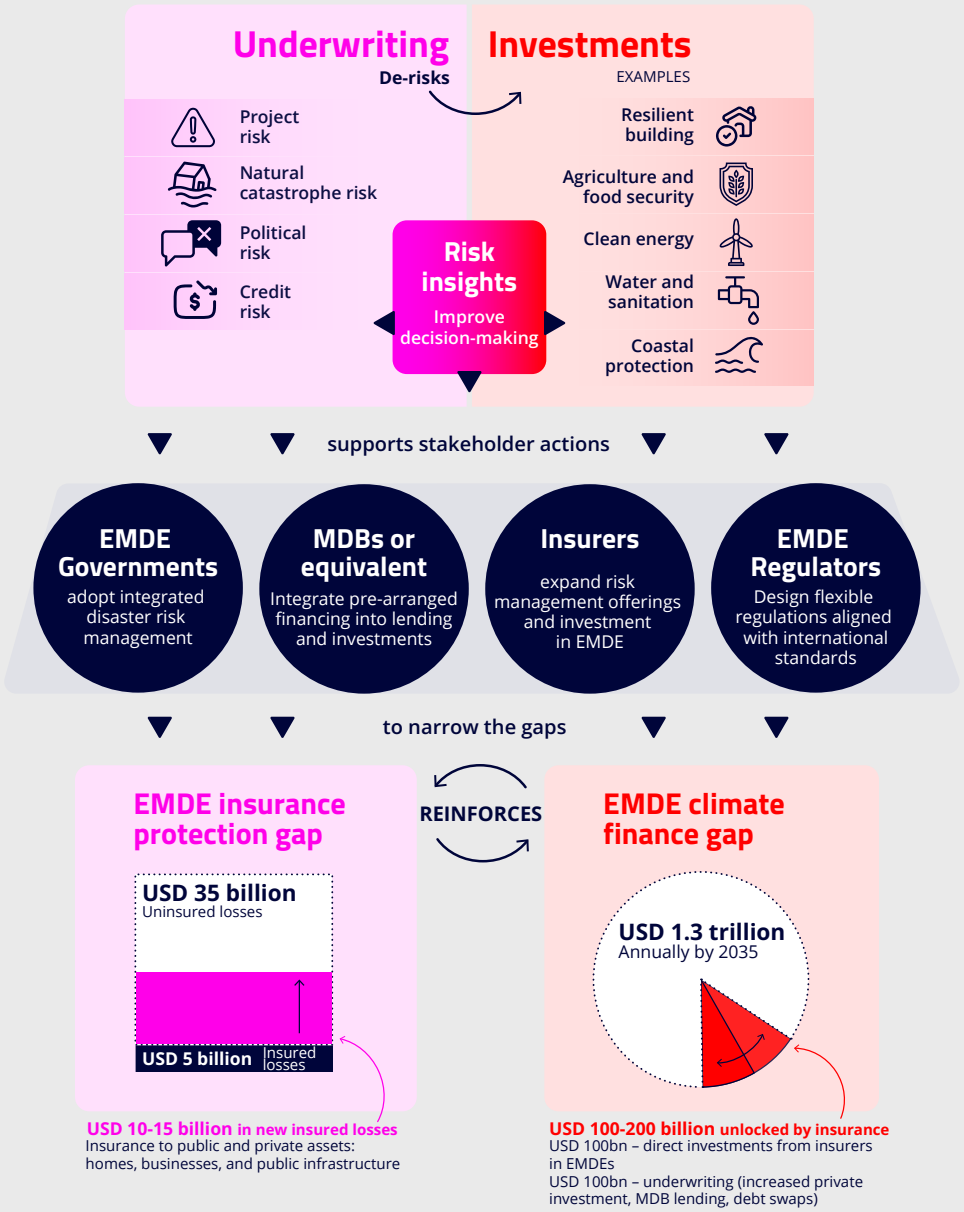


Exhibit taken from Insurance Development Forum and Bridgetown Initiative, From Risk to Resilience: How Insurance can Mobilise Disaster Finance and Climate Investment in Vulnerable Economies (2025)

In short, insurance and pre-arranged finance should not be treated as side instruments, but as core elements of the resilience finance architecture.

For both advanced economies and EDMEs, this core architecture will need to be rapidly evolved and adapted as climate risks grow to reduce disaster-related costs, and to sustain attractive investment environments.

BOX 4.10

Reform of the Financial System - Bridgetown Initiative[318]

The Bridgetown Initiative is a call for urgent and decisive action to reform the international finance architecture to better address the climate crisis faced by countries vulnerable to climate and nature impacts, and support the achievement of the UN's Sustainable Development Goals (SDG). It is championed by Mia Amor Mottley, prime minister of Barbados.

The priorities set down in Bridgetown Initiative 3.0 focus on three pillars:

- **Changing the rules of the game:** Reforming the governance and policies of international financial institutions to give developing economies a stronger voice, addressing debt burdens that currently hinder resilience investments and making climate finance more accessible for climate-vulnerable countries, in recognition that building resilience is critical to development.
- **Shock-proofing economies:** Strengthening resilience by enhancing disaster preparedness and pre-arranged financing, ensuring climate-vulnerable nations have the fiscal space to invest in resilience and recover from climate shocks.
- **Scaling financing:** Mobilising trillions in capital for climate action and the SDG, leveraging public and private funds, external and domestic capital, and exploring innovative financing sources, channelled through country-owned platforms to deliver on national plans.

318 Bridgetown Initiative. *Bridgetown Initiative on the Reform of the International Development and Climate Finance Architecture – Version 3.0 (final draft).* (2024).

SECTION III

Call to Action

Unlocking the Returns on Resilience

We know what needs to be done. The costs of inaction far exceed the costs of action, with high rates of return to public and private resilience investments. Yet resilience remains underfunded.

Market failures, institutional weakness and imbalances in the global financial system hold back investment. Upfront costs and long payback periods deter investors seeking returns. Interventions can struggle to secure private capital, since many benefits are captured as avoided losses or spillovers that do not flow into balance sheets. In emerging markets and developing economies (EMDEs), these barriers are sharper still: high capital costs, limited fiscal space and weaker buffers suppress demand.

Together, six systemic barriers stall progress:

1. Mispriced risks and returns

The economic value of resilience is still poorly measured and rarely reported. Governments struggle to quantify the fiscal impact of climate shocks, businesses cannot show resilience-adjusted profitability and investors lack a proper understanding of risks or benchmarks to assess opportunities. As a result, resilience is perceived as a cost, not a source of returns.

2. Fragmented and underdeveloped markets

Resilience investments are diffuse, spanning many sectors or business units. In some cases, resilience investments centre on retrofitting existing assets, reducing their visibility as a distinct asset class. Clear 'resilience offerings' are only starting to be defined and there remains a lack of clarity about investable project opportunities. Innovation in resilience solutions remains underfunded due to a lack of shared metrics to measure success, insufficient regulatory clarity and financing programmes, and a nascent ecosystem of accelerators and incubators. Pure play adaptation start-ups make up 12% of all climate tech startups, but receive only 3% of the total $4.5 billion funding.[319] Resilience remains sidelined in economic and financial decision-making. Today's macroeconomic and investment tools do not considerresilience because it was not a priority when the tools were developed many decades ago. Decision-makers need to switch both mentally and operationally towards treating resilience as an investment opportunity.

3. Externalities and misaligned incentives

Many resilience investments have strong 'public good' characteristics, meaning that without supporting policies and public investments they are underprovided by the private sector.
Yet rather than aligning private sector incentives with the need to invest in resilience, existing subsidies, price signals and regulations often encourage behaviour that undermines resilience. Fossil fuels are subsidised, exacerbating the climate challenge; crops are subsidised in floodplains; building regulation allows vulnerable construction and insurance premiums don't reflect exposure. These signals entrench fragility instead of rewarding resilience.

4. Tragedy of the horizon

Governments, businesses and financial institutions tend to prioritise short-term returns and electoral or market cycles, rather than long-term risks. Because the most severe consequences of climate change and nature loss will materialise beyond these decision-makers' immediate timeframes, there is little incentive to allocate capital today towards resilience measures.

5. High cost of capital

Many of the countries and communities that are most affected by climate change and nature loss are poor, and face high costs of capital. Even when the returns on resilience are strong, public budgets are stretched, and private investors demand returns that countries that are poorer and vulnerable to climate and nature impacts cannot meet. These countries and communities cannot finance resilience investments on their own without support.

6. Weak capacity and information gaps

Ministries, municipalities and firms often lack the tools, skills and institutions to plan and deliver resilience investment. Local and national public authorities lack the capacity to make and enable the necessary investments. Reliable risk data is patchy, technical expertise is limited and institutions are overstretched.

319 Tailwind Futures, Final Tailwind Playbook (December 12, 2024).

Exhibit 4 The Barriers in Brief

Barrier	What it means in practice	Why it matters	Examples
Mispriced risks and returns	No common metrics, resilience not priced in.	Under-investment, misperception of resilience as pure cost.	After the 2017 hurricanes, many Caribbean governments struggled to show credit agencies how resilience investments improved their fiscal outlooks, keeping borrowing costs high.[320]
Fragmented and underdeveloped markets	Lack of clear resilience offerings to invest in.	Under-investment, lack of familiarity and ease of investment.	High-cost technologies like solar irrigation systems struggle to attract investment due to steep up-front costs, limited financing options and uncertainty, making funding support essential.[321]
Tragedy of the horizon	Investors prioritise short-term over long-term gains.	Under-investment; resources flow to fragile assets; new assets are not built to last.	US homes located in floodplains sold in the last twenty years are overvalued by an estimated $44 billion because buyers are not factoring in future damage and the cost of insurance.[322]
Externalities and misaligned incentives	Subsidies and rules reinforce vulnerability.	Resources flow to fragile assets, not resilient ones; new assets are not built to last.	In India, subsidised electricity for groundwater pumping accelerates aquifer depletion and undermines water resilience.[323]
High cost of capital	High cost of capital, limited fiscal space.	Resilient projects remain unfunded despite high ROI.	African renewable projects often face double the financing costs of OECD peers, stalling investments to build grid-resilience despite proven returns.[324]
Weak capacity and information gaps	Patchy data, overstretched institutions.	Slows delivery, widens gap between evidence and action.	Many Pacific Island states lack climate-adjusted GDP and exposure data, limiting their ability to negotiate concessional finance, or design resilient budgets.[325]

BOX C

Global Survey of Ministries of Finance[326]

A first-of-its-kind survey of 59 ministries of finance (MoFs) conducted by the Coalition of Finance Ministries for Climate Action reveals a striking consensus: climate and nature risks are now seen as macro-critical. Nearly 90% of respondents identified climate-related physical shocks as threats to GDP, public finances and debt sustainability. Ministers from EMDEs were even more likely to view these risks as acute.

Yet there is a stark readiness gap. Only one in three finance ministries view climate action as part of their core mandate. Less than half (44%) have ever quantified the costs of adaptation or resilience-building, and only 26% have assessed their adaptation finance needs. Four in five ministries report they lack sufficient staff or expertise to evaluate climate risks, and 56% use no dedicated models to assess the impacts of climate or nature shocks on economic performance.

As part of the survey, ministries identified a need for support to boost their climate-related analytical capabilities, more granular analytical tools and models, standardised data sources and methodologies, and increased external collaboration as key priorities. A broader effort is needed to strengthen fiscal and economic modelling capacities in finance ministries, and to co-develop tools that integrate climate risk and resilience investment into core fiscal frameworks.

320 Caribbean Development Bank, *Caribbean after Hurricanes Irma and Maria: Fiscal and Economic Impacts* (Bridgetown: Caribbean Development Bank, 2018).
321 UNDP, *Adaptation Gap Report* (2024).
322 Hino, M. & Burke, M. 'The Effect of Information About Climate Risk on Property Values'. *PNAS* Vol. **118**, No. 17 (2021).
323 Government of India and World Bank, *Groundwater Management and Energy Subsidy Reform in India* (New Delhi and Washington, D.C: Government of India and World Bank, 2021).
324 International Energy Agency (IEA), *Renewables 2022: Analysis and Forecast to 2027* (Paris: IEA, 2022).
325 Pacific Community (SPC), *Strengthening Climate and Disaster Risk Data in Pacific Island Countries* (Suva: SPC, 2023).
326 Grantham Research Institute, *LSE, Coalition of Finance Ministers for Climate Action, A Global Survey of Ministries of Finance* (2025).

BOX D

Assessing National Adaptation and Resilience (A&R) Readiness[327]

The World Bank's Country A&R Readiness Assessments provide a whole-of-economy diagnostic to benchmark how prepared countries are to scale adaptation and resilience investment. The framework applies the Bank's Adaptation Principles across six pillars:

- Resilient foundations
- Adaptation of firms and people
- Land use and protection of critical public assets and services
- Capacity to cope and recover
- Macro-fiscal risk management
- Governance and monitoring

The assessments have been applied in 45 countries, offering a comparable, decision-orientated baseline of strengths and weaknesses, and surfacing where support is most needed. They have also been embedded in the World Bank's Country Climate and Development Reports (CCDRs) – for example in Türkiye, Peru and China – to inform the sequencing of policy actions and investment. Governments and partners can use the A&R Readiness Assessments to prioritise reforms and investments, track progress consistently over time and align national resilience efforts with global adaptation goals.

None of these barriers can be tackled with a single fix. Each cuts across governments, businesses, finance and international institutions. Getting the right foundations in place throughout economic and financial systems is critical to price, prioritise, plan and scale resilience.

The subsequent sections outline key opportunities to address barriers to investment and unlock the returns on resilience.

Chapter 5 identifies key priorities for finance ministries, business leaders, investors, financial institutions and other financial system actors, and where momentum is building behind these priorities. It looks at countries globally, not just in EDMEs.

Chapter 6 drills down into 15 impactful A&R Best Buys. These A&R Best Buys consist of solution areas that are needed to protect lives, livelihoods, economies and ecosystems today, especially in climate-vulnerable areas like low- and middle-income countries, where adaptive capacity is often limited and impacts are most severe, risking development progress.

327 World Bank, *Rising to the Challenge: Success Stories and Strategies for Achieving Climate Adaptation and Resilience* (Washington, DC: World Bank Group, 2024).

Chapter Five

Priority Actions for Economic and Financial Decision-makers

COP30 offers a critical opportunity to pivot from raising awareness to implementation - the moment when the world aligns around resilience as the shared investment agenda.

The Brazilian Presidency has placed unprecedented political focus on adaptation and resilience, providing much needed space for a reimagining of priorities and next steps, alongside mitigation efforts. Building on existing coordination mechanisms like the Race to Resilience and Sharm El Sheikh Adaptation Agenda, hundreds of stakeholders are working with the Brazilian Presidency and High-Level Champions to spotlight a number of global initiatives that can serve as vehicles to address risks and opportunities identified in this report. They are importantly taking a multi-year frame, looking to 2028 when the United Nations' next 'Global Stocktake' takes place to assess progress on the Paris Agreement and set corresponding ambition. Among categories of action that stakeholders have identified to enhance the returns on resilience, a series of priorities emerge within three categories of action.

5.1 Delivering on Country Priorities: Turn National Adaptation Plans (NAPs) Into Investable Resilience Strategies

Delivering NAPs means developing credible, costed investment pathways and strategies – co-owned by ministries of finance and environment – that identify priority resilience investments, clarify investment needs and financing sources, and plot the policies and financing mechanisms needed to get finance flowing. These must be embedded at the heart of long-term development planning processes, sectoral plans and budget cycles. NAPs can set the blueprint and policy signals for financial and economic decision-makers. Nonetheless, these key groups can also help lay the foundation for investable NAPs by embedding resilience into their own investment decision-making. In turn, this will help drive greater returns.

Country platforms provide a promising channel to address financing constraints by supporting the development of resilience investment strategies and facilitating collaboration of multiple actors to implement these.

Their success hinges on strong country ownership, governance units to drive coordination, institutional capacity, and their positioning within a longer-term structural logic, based on a country's resource endowment and exposure to physical risk, sectoral transitions and credit vulnerabilities. Strong engagement with investors to clarify the instruments they would set up and invest in, and with subnational actors to develop projects, is particularly important for resilience projects that are aligned with public priorities. Many climate-vulnerable countries are still exploring the concept, assessing its relevance to their contexts, while others are already laying foundations and putting in place enabling conditions. In Box 5.1, the African Climate Foundation outlines the principles of good Country Platform design.

The adaptation and resilience 'best buys' identified represent high-impact, cost-effective solution areas that can be – and already are – built into many NAPs. These are ripe areas for financing across funder types (see Chapter 6). Ultimately however, countries should identify the right set of solutions most needed to mitigate and adapt to their localised risks.

CASE STUDY 5.1

What Does a Credible, Costed Pathway Look Like? Lessons From Barbados's Investment Plan for Prosperity and Resilience

In 2023, Barbados launched its Investment Plan for Prosperity and Resilience[328]. This presents a pipeline of projects that build on Barbados' strengths. It offers core lessons in developing a credible national pathway that can attract investment, and deliver resilience at scale:

- **Align national strategy with competitive advantage:** A strong pathway begins with a clear vision rooted in the country's development goals, risk landscape and economic potential. This requires mapping existing strategies – such as nationally determined contributions, national adaptation plans and fiscal frameworks – and identifying sectors where natural resources and capabilities create a competitive edge for a green transition.
- **Build a robust investment pipeline:** Turning vision into action means identifying high-impact projects that are technically and financially viable. This demands rigorous project preparation, strong financial modelling and tailored investment vehicles to crowd-in capital – underpinned by clear investment criteria centred on equity, sustainability, and resilience.
- **Ground the financing strategy in macroeconomic realities:** To secure investor confidence, the plan must demonstrate how proposed investments affect debt sustainability, fiscal space and long-term growth, linking resilience directly to macroeconomic stability and offering credible asks across concessional, market and domestic finance.

328 Government of Barbados, *Barbados 2035: A Plan for Investment in Prosperity & Resilience* (2024).

BOX 5.1

Country Platforms - African Climate Foundation

Country platforms are gaining traction as governments seek structured ways to attract investment into their NAPs and NDCs. Recognised in the COP30 action agenda as a promising mechanism to mobilise adaptation finance, these platforms can provide a strategic, coordinated national response and facilitate mainstreaming resilience into development.

Yet their success hinges on strong country ownership, institutional capacity and their positioning within a longer-term structural logic, based on a country's resource endowment and exposure to physical risk, sectoral transitions and credit vulnerabilities. Many climate-vulnerable countries are still exploring the concept, assessing its relevance to their contexts, while others are already laying foundations and putting in place enabling conditions.

Country platforms offer multiple benefits: they enable cross-sectoral prioritisation and a programmatic, portfolio-based approach to adaptation. Bundling projects can improve bankability, attract new sources of funding and support complementary ecosystem services. Platforms also strengthen project pipelines, align them with national priorities and demonstrate political support - all of which increase investor confidence. In this way, country platforms can accelerate adaptation finance and unlock transformative resilience.

The African Climate Foundation's Adaptation and Resilience Investment Platform (ARIP) programme supports countries in this journey - helping them explore, establish, and operationalise country-led investment platforms. ACF provides technical assistance to: (i) identify national resilience priorities and develop investment-ready projects; (ii) enable early investor engagement and resource mobilisation; and (iii) strengthen governance, coordination, and stakeholder engagement.

CASE STUDY 5.2

Private Finance Fuels Africa's City-Based Pipeline Platform - FSD Africa

Africa's cities face increasing risks from climate change. Munich Re estimates that between 2019 and 2023, natural catastrophes caused over $32 billion in losses in Africa. Rapid urbanisation, informal settlements and inadequate infrastructure worsen the impacts. Lagos is highly exposed to sea-level rise, extreme precipitation and heatwaves. It faces a $40 billion 'cost of inaction' by 2050.[329]

African nations need around $70 billion for adaptation per year, but today they receive only $13.8 billion.[330] Just 5% of this originates from private sector sources. With constrained public fiscal resources in Africa, much more private adaptation finance must be mobilised to close the gap.

Since 2022, Financial Sector Deepening Africa and others have supported the Lagos State Government to develop the Lagos Climate Adaptation and Resilience Plan (LCARP). Through project acceleration (supported by grant capital and technical assistance), LCARP is helping to trigger the establishment of long-term public-private financing platforms to develop, structure and implement adaptation projects.[331]

The platform underpins project pipeline development, financing mechanisms and prospective funder engagement under a central city-wide governance structure, supported by policy and regulatory technical assistance and partnerships. The goal is to become a permanent self-sustaining vehicle for adaptation finance.

LCARP has developed a pipeline of 40 projects (14 bankable), secured whole-of-government buy-in and engagement from across the Lagos State Government ministries, departments and agencies, and engaged over 150 investors. To date, it has helped secure $575 million in project funding, with another $100 million or more in the pipeline. Two prominent infrastructure projects – in waste-to-energy and waste water treatment – worth $1.2 billion are currently entering feasibility studies. Strong political backing from Lagos leadership helps to sustain momentum.

329 MunichRe, *The Price of Natural Catastrophes in Africa: Insights into the Most Recent Losses* (2024); Lagos State Government, *Lagos Climate Adaptation & Resilience Plan*: https://lcarp.ng/ (2024).
330 Climate Policy Initiative, *Landscape of Climate Finance in Africa* (2024).
331 Lagos State Government, *Lagos Climate Adaptation & Resilience Plan*: https://lcarp.ng/ (2024).

5.2 Embedding Resilience into Economic and Financial Decision-making

Every economic and financial decision-maker – in government, business or finance – can take actions with outsized, cascading effects. In the public sector, finance ministries can integrate resilience into growth models, debt strategies and budgets; central banks can incorporate shocks into financial stability assessments and regulators can adjust prudential rules to account for physical risk. In the private sector, CEOs can acknowledge physical risks impact their business and develop integrated strategies to bolster operations, innovation and supply chains;[332] investors can apply resilience-adjusted valuations and insurers can develop products that reward risk reduction.

At the portfolio level, investors can prioritise a set of high-impact interventions that deliver maximum socioeconomic returns.

In Chapter 6, BCG identifies a set of best buys that are particularly well suited for lower-middle-income countries (LMICs).[333]

A growing list of decision-makers are taking steps to integrate resilience investment strategies, signal a shift to markets, shape incentives for others and demonstrate that resilience creates value. COP 30 can provide a platform to share these experiences, and host discussions around how more economic and financial decision-makers can take up actions to unlock the returns on resilience. Exhibit 5.1 outlines key opportunities for action and examples of leadership where these are starting to take off.

Exhibit 5.1 Embedding Resilience into Investment Decisions – Priority Actions and Emerging Momentum

Decision-maker	Key Opportunities for Action:	Barriers addressed:
Public sector		
Finance Ministries	• embed the benefits of resilience into macroeconomic forecasts and fiscal policy; • prioritise investments that protect and grow productive capital; • engage across ministries to reform subsidies, rules and regulations to incentivise investment in resilience.	• mispriced risks and returns; • externalities and misaligned incentives; • constrained finance.
Example The Government of Uganda's Ministry of Finance is embarking on an initiative to integrate resilience investments into their macrofiscal and public financial management frameworks. This work will develop a methodology to integrate climate and nature resilience investments into growth projections, debt sustainability, sovereign risk assessments and medium-term expenditure plans.		
Planning and coordination ministries	• use spatial risk maps and climate-nature risk data to guide land use, infrastructure and sectoral investment decisions.	• mispriced risks and returns; • externalities and misaligned incentives; • weak capacity.
Example Since 2015, Costa Rica has used SIMOCUTE (Sistema Nacional de Monitoreo de la Cobertura y Uso de la Tierra y Ecosistemas) – a national platform that uses integrated land use and ecosystem monitoring to inform policy-making. The Mapping Nature for People and Planet initiative, launched in 2021, also uses spatial data to identify areas critical for delivering ecosystem services such as water storage, water filtration and disaster risk reduction, which has been used to inform their National Adaptation Plan.		
Central Banks and Regulators	• integrate resilience into monetary policy, prudential supervision and financial stability frameworks.	• mispriced risks and returns; • externalities and misaligned incentives.
Example Banco Central do Brasil (BCB) has made the integration of social, environmental and climate risks into governance and risk management mandatory for financial institutions, expecting to shift from voluntary to compulsory compliance. New disclosure requirements under Public Consultation CP100 aims to align the Brazilian financial system with global standards like Task Force on Climate-related Financial Disclosures (TCFD) and International Sustainability Standards Board (ISSB), improving transparency and risk management. In parallel, initiatives like the Rural Credit Bureau and the LIFT Data program address key data gaps, enhancing risk assessment and supporting the innovation environment in the Brazilian financial sector.		

332 WBCSD, *Physical Risk and Resilience in Value Chains: CEO Handbook on Executive Engagement* (2025)
333 The A&R Best Buys analysis was undertaken by BCG based on analysis of countries' NAPs and Technology Needs Assessments, consultations with 50+ climate and development experts across governments, funders, NGOs, and the private sector, and extensive literature review.

Decision-maker	Key opportunities for action:	Barriers addressed:
Private sector		
Credit rating agencies	• integrate resilience into sovereign ratings to better capture fiscal capacity, vulnerability and creditworthiness.	• mispriced risks and returns; • constrained finance.
Example S&P Global Ratings' has appointed a Global Climate Adaptation and Resilience Specialist to increase in-house capacity to account for resilience in ratings. This represents a first step towards recognising the credit benefits of adaptation interventions. Most credit rating agencies are still focusing on improving the measurement and integration of climate vulnerability into their ratings (e.g. Fitch's new climate KPI, the Climate Vulnerability Signals).		
Business CEOs, CFOs, CROs and Legal Officers	• develop resilience strategies and investments across core functions, identifying when to stop, start, or scale investments.	• mispriced risks and returns; • fragmented and underdeveloped markets.
Example 66% of businesses in the EU recognise the threats of physical climate risks, although only 22% have an adaptation strategy in place.[334] AstraZeneca conducted deep-dive climate risk assessments on its most critical sites, which triggered a series of assurance investments into several manufacturing plants.[335]		
Insurance and reinsurance companies	• develop tools and markets that reward resilience and reduce systemic exposure.	• mispriced risks and returns; • constrained finance.
Example The catastrophe bond market is now valued at $50 billion and expected to grow to $60 billion by the end of 2025, with record levels of issuance and the launch of the world's first exchange-traded fund based on catastrophe bonds this year.[336] Over 2024, catastrophe bonds have delivered returns of 14%, helping to fill the gap between rising demand for reinsurance and reduced capacity among traditional reinsurance providers.		
Private finance institutions, asset owners and managers	• embed climate risk and resilience assessments in disclosure, risk-return assessments and portfolio decisions.	• mispriced risks and returns; • fragmented and underdeveloped markets; • constrained finance.
Example IFM Investors has embedded climate resilience into its infrastructure equity portfolio strategy by systematically assessing physical climate risks and requiring investee companies to act on them. The firm applies climate risk screening due diligence, favouring assets that have invested in adaptation, and obliges every acquired asset to prepare and implement a climate transition plan covering both mitigation and adaptation.[337]		
Development finance		
IMF	• embed resilience in growth and debt models to support fiscal stability and poverty reduction.	• mispriced risks and returns; • constrained finance.
Example The IMF's ongoing process to update its Debt Sustainability Analysis aims to improve the incorporation of climate and nature-related risks. In addition to better capturing the impacts of climate change, recommendations from across expert and advisory bodies include ensuring that the benefits of resilience-building investments are factored into growth projections.		
Multilateral Development Banks and Development Finance Institutions	• tie concessional finance and guarantees to resilience metrics so that countries can both attract more investment and count on predictable fiscal space when shocks hit.	• constrained finance; • weak capacity.
Example The Resilience Challenge by the Adaptation & Resilience Investors Collaborative* is a collaborative initiative of DFIs that aims to overcome barriers that currently limit the scale of adaptation and resilience finance. It provides a common approach - a flexible set of criteria - that make it easier for public investors to work together, for private sector co-investors and investees to engage on deals with greater clarity, and ultimately to mobilise more private capital into A&R. The Challenge helps investors to integrate resilience into their own portfolios and also demonstrate to partners and markets how resilience is being delivered.		

334 Simon Mundy, *When Will Companies Start Spending on Climate Adaptation?* (Financial Times, May 2025) Accessed 1 October 2025.
335 WBCSD, *Business Leaders Guide to Climate Adaptation and Resilience* (2024).
336 Gautam Naik, *Hedge Fund Fermat Sees 20% Surge in Catastrophe Bond Market* (Bloomberg UK, May 14 2025).
337 Ceres, *Investing in Resilience: Three Case Studies in Climate Adaptation* (June 24, 2025).
* The Adaptation and Resilience Investors Collaborative https://www.unepfii.org/climate-change/adaptation/adaptation-and-resilience-investors-collaborative/

Decision-maker	Key opportunities for action:	Barriers addressed:
Development finance (continued)		
National Development Banks	• embed resilience into core investment criteria, including pricing climate and nature risks in lending; • provide support to grow resilience in the market, including pipeline development and project preparation.	• mispriced risks and returns; • fragmented and underdeveloped markets; • constrained finance.
Example India's National Bank for Agriculture and Rural Development (NABARD) integrates climate and nature risks into its lending in key development funds. Additionally, the Bank prepares annual plans to quantify investment opportunities in adaptation and resilience, and supports the development of the resilience market through project pipeline and preparation in areas such as water-harvesting infrastructure, climate-resilient farming and livelihood diversification.[338]		
Donor governments	• scale the use of mechanisms that direct concessional finance to fill critical gaps in countries that are highly financially and physically vulnerable to climate and nature impacts, and for urgent repair and recovery costs.	• constrained finance.
Example The High-Level Panel on Closing the Crisis Protection Gap brings together 20 leaders from across sectors and geographies who are calling for the proportion of crisis finance that is prearranged to increase tenfold by 2035.[339] The panel includes current and former government representatives of the UK, Barbados, the Philippines, Egypt and Malawi and sets out and advocates for a strategic roadmap to deliver on this vision.		
Philanthropies	• meet countries where they are at; supporting the implementation of resilience investment strategies that are aligned with national priorities; • provide catalytic funding and technical support to build market solutions, including early-stage innovation and solutions that generate maximum socioeconomic returns.	• constrained finance.
Example Launched in 2025, The ClimateWorks Adaptation & Resilience (A+R) program brings together more than 70 philanthropic organisations through its Adaptation & Resilience Collaborative (ARC) to scale locally led solutions that protect people and livelihoods from escalating climate risks. ARC convenes funders from across issue areas to coordinate strategies, share learning, and accelerate collective impact. In 2025, the program launched the Adaptation & Resilience Fund (A+R Fund) to deploy catalytic grantmaking that supports people-centered solutions, strengthens local systems, and unlocks broader flows of capital. Together, these initiatives are helping philanthropy align, invest and learn to close the adaptation finance gap and build resilience at scale.[340]		

338 World Resources Institute (WRI), *National Development Banks Can do More to Help Drive Countries' Green Transformations* (2025).
339 Centre for Disaster Protection, *Future-Proofing Our World: A Roadmap to Close the Crisis Protection Gap through Pre-arranged Finance* (2025).
340 ClimateWorks Foundation, *Foundations Launch $50 Million Adaptation and Resilience Fund for Communities Facing Climate Risks* (August 5 2025).

5.3 Getting Key Enablers in Place

Turning the resilience opportunity into reality requires a set of enabling actions that no single actor can deliver. These are the shared foundations - the data, tools and frameworks - that allow decision-makers to measure what matters, align on goals and track progress.

The discussions that informed this report indicate that momentum and collaboration are growing in the following areas with the potential to enable resilience investment at scale:

Pricing resilience risks and returns:

- The economic value of resilience remains poorly understood and rarely reported. Government and community leaders need to better understand the fiscal impact of not just climate and nature impacts but also the positive impact of resilience investments. Alongside this, CEOs and CFOs need to quantify resilience-adjusted profitability under a range of scenarios, and investors need better risk models, benchmarks, metrics and data to assess opportunities.

Develop a shared risk typology across systems:

- There is currently no shared definition of resilience investments. This makes it harder for investors to navigate opportunities and channel resources at scale into resilience. Increasing numbers of actors from public and private sectors are working together on a common framework for how climate and nature risks accumulate across physical, natural, human and social capital. There are emerging efforts. The Climate Bonds Initiative (CBI),[341] Tailwind[342] and the African Financial Alliance on Climate Change[343] are among those developing taxonomies for resilience investment, or embedding adaptation and resilience into transition taxonomies.

  In parallel, there are efforts to improve the integration of taxonomies. These are driven by CBI, GARI Group, and by standard-setting efforts from the International Transition Plan Network. These initiatives, if successful, would create a shared language across sectors, reducing fragmentation and enabling alignment on systemic exposure.

Improving access to physical risk data:

- Economic and financial decision-makers, particularly in emerging markets and developing economies, lack access to high-quality, comparable, geolocated risk data. This perpetuates the mis-pricing of risk, by undermining the capacity to account for the cost of climate and nature impacts in investments made today. Leaders from the insurance sector and technology and data companies are increasingly coming together with potential users of physical risk data to explore how to address this. Continued investment to generate and make accessible reliable, high-quality data would create a shared baseline of exposure, enabling better fiscal planning, investment choices and insurance pricing.

Tracking progress and positive outcomes of resilience investments:

- As the delivery of resilience investments scales up, there is a need to converge around a coeherent set of metrics to track progress – not just in terms of progress, but in terms of positive impacts for communities, companies and countries. This can help to inform approaches with best practice examples, avoid maladaptation, and strengthen the investment case. The Global Goal on Adaptation represents an important step towards developing the metrics to understand, monitor and assess resilience-building efforts and their impact.

341 Climate Bonds Initiative, *Climate Bonds Resilience Taxonomy* (accessed 1 October 2025).
342 Tailwind Futures, *Tailwind Taxonomy for Adaptation and Resilience Investments, May 2024* (accessed 1 October 2025).
343 African Development Bank, *Africa's Financial Industry Validates Continental Sustainable Finance Taxonomy* (2024).

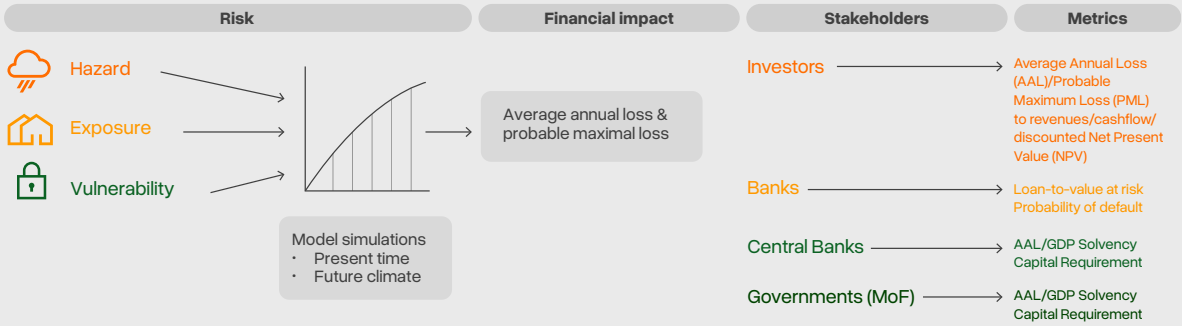
BOX 5.2

Quality Risk Analysis and Common Metrics for Resilient Investment Decision-making

UNDRR
UN Office for Disaster Risk Reduction

With support from the UK's Foreign, Commonwealth and Development Office, the United Nations Office for Disaster Risk Reduction (UNDRR) is fostering practical, tailored collaboration between climate, disaster risk, insurance and financial regulatory institutions to provide common, quality risk analysis and common metrics for resilient investment decision making. Tools under development aim to help public and private sector partners make better use of average annual loss projections and related metrics in their work, and show more clearly the benefits across economies of safeguarding investments in the wake of more intense and frequent disasters.

Analytics will empower countries to better quantify hazard risks and the economic and social benefits of building resilience both in reducing direct losses and in knock-on effects such as debt, access to credit and insurability. Technical refinements are underway and consultations with governments and private sector entities across a spectrum of scales and regions show strong demand. The team aims to have the first cohort of products in the first quarter of 2026 and is looking for partners to scale-up to global coverage.



Source: Kirsch-Wood, UNDRR 2025 (forthcoming)

In the lead-up to COP30, actors can rally to build ambition around the individual steps to embed resilience, and join initiatives that can drive systemic change and unlock the returns on resilience.

Chapter Six

Adaptation and Resilience Best Buys

Transformative Actions to Build Climate Resilience and Achieve Development Outcomes

Previous chapters articulate the case for elevating resilience into the investment agenda. This chapter identifies impactful adaptation and resilience (A&R)[344] opportunities across sectors that are highly impacted by climate change and critical for driving economic stability and growth. These A&R Best Buys are solution areas that protect lives, livelihoods, economies and ecosystems today, especially in climate-vulnerable low- and middle-income countries (LMICs) where adaptive capacity is often limited.

344 Climate adaptation is the proactive adjustment to actual or expected climate impacts, while resilience is the capacity of systems to prepare, withstand and recover. Together they form complementary approaches to addressing the physical risks and impacts of climate change.

6.1 Introduction

There is an urgent need to mobilise finance for A&R. Climate impacts are intensifying, threatening progress to economic development and human well-being.

Communities in LMICs are especially vulnerable due to their high exposure to climate hazards alongside typically limited adaptive capacity and financing. Despite its importance, A&R remains significantly underfunded (see Chapter 3 for estimates of resilience finance needs and flows). These gaps are compounded by declining aid flows, fiscal pressures in LMICs, and increasingly scarce grant finance, making it essential to maximise the climate and development impact of every concessional dollar. Furthermore, current efforts are often fragmented and insufficient: only 65 countries have National Adaptation Plans (NAPs), many of which are not costed and lack pipelines of specific projects to attract financing from diverse funders.[345]

Beyond the need, A&R also presents a major investment opportunity. It is essential to limit losses and damages, to generate value and to drive sustainable development.

Every dollar invested in adaptation can potentially yield over 10 dollars in economic benefits across the 'triple dividend' of avoided losses, induced economic return and wider social and environmental co-benefits.[346] For example, agricultural adaptations such as climate-resilient crops and irrigation systems safeguard yields and boost farmer incomes even in the absence of extreme weather events. Some investments can also generate financial returns (e.g. multiple A&R solution sectors have earnings before interest, taxes, depreciation, and amortisation (EBITDA) margins in the double digits), and A&R is a key capital deployment and allocation opportunity for financiers, with the market of solutions projected to grow to up to $1.3 trillion annually by 2030.[347] The private sector is increasingly recognising both the need to safeguard assets, supply chains and operations from physical risks, and the potential to benefit from rapidly expanding markets for A&R solutions and technologies. This private sector engagement is critical given the limits of public and philanthropic capital. Importantly, every type of funder – public, private and philanthropic – has an opportunity to finance A&R in ways aligned with their mandates and risk-return profiles.

345 NAP Global Network, *Sector Integration - NAP Trends Dashboard,* Accessed October 7 2025.
346 Brandon et al. *Strengthening the Investment Case for Adaptation* (World Resources Institute (WRI), 2025.
347 Boston Consulting Group and Temasek, *The Private Equity Opportunity in Climate Adaptation and Resilience* (2025).

Now is the moment to act. With only five years left to achieve the SDGs, impact depends on a focused set of investments that can shift outcomes at scale.

This requires clarity on critical and impactful A&R solutions, actionable and investable pipelines across LMICs, mobilisation of finance from all funder types, and leveraging science, innovation and traditional knowledge to develop and deploy the most effective solutions.

To this end, A&R Best Buys represent 15 high-impact solution areas that can already generate strong socioeconomic returns (see Exhibit 6.1). The A&R Best Buys are critical solutions for LMICs facing diverse climate hazards, and simultaneously enhance climate resilience and deliver development outcomes aligned with the SDGs. They are strongly aligned with LMIC priorities as outlined in NAPs, the primary vehicle by which countries articulate their climate risks and A&R funding needs. Furthermore, they unlock the 'triple dividend' of avoided losses, induced economic returns and wider social and environmental benefits - such as strengthening food security, bolstering GDP growth, jobs and income, and reducing morbidity and mortality from climate-sensitive diseases.

They also leverage technology and innovation to drive impact - an imperative given the need to accelerate progress at an unprecedented pace and to tap into new and cost-effective solutions to address mounting challenges and declining aid funding.

The A&R Best Buys span six impact sectors, reflecting how climate impacts are experienced across systems. These are broadly aligned with sectors prioritised by the Global Goal on Adaptation and include i) food; ii) water; iii) health; iv) infrastructure; v) community and business; and vi) nature, ecosystems and biodiversity. The A&R Best Buys also include cross-cutting enablers such as information, technology and planning that support and amplify impact across sectors. These sectors are deeply interconnected: progress in one often relies on improvements in the others. Among them, food and health are especially critical, as they underpin human well-being and economic stability, jobs and growth. Food systems are central to food security and livelihoods in LMICs, where agriculture accounts for a large share of GDP and employment, and are particularly climate-sensitive. Health systems, meanwhile, are the front line for protecting lives and sustaining productivity amid rising climate risks. Both sectors are foundational to resilient economies and societies more broadly in LMICs. For this reason, many A&R Best Buys focus on food and health, and this report explores exemplar solutions in these sectors in greater depth.

BOX 6.1

A&R Best Buys Methodology

The A&R Best Buys were identified through a structured process. A long list of solution areas was drawn from studies on emerging innovations, international agendas (e.g. Sharm el-Sheikh Adaptation Agenda), sectoral frameworks (e.g. WHO framework for Climate Sensitive Health Risks), and major global adaptation taxonomies like the Climate Bonds Initiative Adaptation and Resilience Taxonomy, and the Tailwind Taxonomy for Adaptation and Resilience Investments. From this list, we conducted analysis of National Adaptation Plans and Technology Needs Assessments across LMICs, reviewed reports and academic literature, and consulted 50+ climate and development experts from governments, funders, NGOs, and the private sector. We assessed alignment with global goals like the Sustainable Development Goals and sectors highlighted in the Global Goal on Adaptation, and considered social, economic, and environmental impact, as well as innovation and feasibility. These Best Buys are not prescriptive, but rather a starting point to guide discussion and inform country- and locally-led adaptation planning. It is also important to note that all the Best Buys and many adaptation and resilience solutions that were not prioritised in this list are important to build a resilient society, depending on the risks, needs, and priorities of any specific locale. See Technical Appendix for more detail.

Exhibit 6.1 The 15 Adaptation and Resilience Best Buys

Resilience sector		Best Buy	Description	Exemplar solutions	Primary impacts
Food	1	Crop resilience	Inputs, tools and practices that help farms withstand climate shifts (e.g. drought) that affect crop yields and increase productivity	Climate-resilient/hybrid varieties, irrigation systems, biofertilisers	Increased productivity, which enhances farmer incomes and livelihoods, improves food security and diet quality and drives environmental co-benefits, economic stability and growth including GDP and job creation
	2	Livestock, fisheries and aquaculture resilience	Improved breeds, feeds, animal health, and pasture/pond management practices that increase productivity	Alternative feed innovations, animal disease management, fish and livestock breeds better suited to the environment	
Water	3	Water collection and storage	Nature-based or grey solutions to capture and manage water resources	Rainwater harvesting systems, watershed restoration	Increased water security including quantity and quality, which improves health outcomes and economic stability and growth
Health	4	Prevention and control of climate-sensitive diseases	Approaches that reduce burden and accelerate eradication of climate-sensitive diseases (e.g. malaria driven by increased flooding)	Disease surveillance systems, vaccines for climate-sensitive diseases, vector control measures	Reduced disease burden, morbidity and mortality; increased access to essential healthcare services including maternal, newborn and child health services due to fewer closures or interruptions in fixed health facilities, which protect lives and livelihoods and drive economic stability and growth
	5	Improving nutrition	Measures to protect nutrition and child growth amid rising climate risks	Food fortification, multiple micronutrient supplementation	
	6	Health systems resilience	Strengthened health facilities or mobile care for increased access, supply chains, and workforce capacity	Reduced facility dependence, strengthening health product supply chains	
	7	Heat mitigation	Strategies to reduce extreme heat-related deaths, illness, and system strain including for maternal, newborn, and child health	Heat action plans, passive cooling infrastructure, early warning systems for heatwaves	
Infra-structure	8	Energy infrastructure resilience	Resilient power systems that sustain communities and critical services amid climate disasters	Solar microgrids, battery storage	Minimised service disruptions and damages, keeping essential services and economies running amid climate events
	9	Coastal and riverine infrastructure resilience	Engineered or nature-based defenses to minimise impacts from coast and river floods	Mangrove protection and restoration, urban drainage and stormwater management	
Community and business	10	Early warning systems	Monitoring and communication tools to alert communities to prepare before disasters strike	Disaster risk early warning system, agriculture early warning system	Faster recovery and financial protection for households and SMEs, reducing poverty
	11	Financial inclusion, insurance and social protection	Financial tools and safety nets for preparedness and disaster recovery	Adaptive social protection, index-based insurance, financial innovation	
Nature, ecosystems and biodiversity	12	Terrestrial protection and rehabilitation	Healthy land ecosystems to ensure continued resilient resources, ecosystem services	Reforestation, assisted natural regeneration, wildfire prevention	Preserved biodiversity and natural buffers against climate risks; continued access to ecosystem services
Cross-sector enablers	13	Climate information systems	Access and availability of integrated weather- and climate-data systems for decision-making	Spatial data collection tools, improved weather data availability and seasonal forecasts	Adaptation solutions and emergency response measures reach and are co-created with vulnerable populations – quickly, reliably and securely to enable communities to build back in a more resilient way
	14	Planning, preparation and response	Informed planning, readiness, and response to reduce losses and speed recovery	Anticipatory action plans, national and sectoral adaptation plans	
	15	Digital public infrastructure	Digital systems and services to help climate solutions scale	Digital identity systems, inclusive digital payment platforms	

6.2 Deep Dive on the A&R Best Buys

Food

Heat stress, prolonged droughts, shifting rainfall patterns and more severe flooding are increasingly disrupting the agriculture sector, which absorbs 26% of the economic impact of climate disasters.

The impact increases to 83% for drought in developing countries[348] and drought frequency is rising, having increased by 29% between 2000 and 2022 and affecting 55 million people each year.[349] These risks are especially severe in low-income countries, where agriculture supports a large share of employment (57% versus 26% for the world)[350] and where up to 183 million additional people could face hunger regardless of the warming scenario.[351]

In sub-Saharan Africa, the sector represents more than 15% of GDP[352] and roughly half of employment,[353] with smallholders - who manage 80% of farms and produce most of the region's food[354] - at the front line of rising climate risks. Consequently, around 97% of countries prioritise agriculture, livestock or food security in their NAPs given their prominent role in national food security, economies and livelihoods, and linkages with other sectors and natural ecosystems.[355] Solutions that promote more resilient and productive practices across the value chain are essential, including pre-harvest production practices and post-harvest practices such as reducing food loss and waste.

348 Food and Agriculture Organization of the United Nations (FAO), FAO's Work on Climate Change (2019).
349 World Meteorological Organization (WMO), *Droughts Threaten Sustainable Development* (June 16 2022).
350 World Bank / International Labour Organization (ILOSTAT), *Employment in Agriculture and Value Added of Agriculture, Forestry and Fishing in Sub-Saharan Africa* (2025).
351 Intergovernmental Panel on Climate Change (IPCC), *Special Report on Climate Change and Land* (2025).
352 World Bank, Agriculture, Forestry, and Fishing, Value Added (% of GDP).
353 World Bank, Employment in Agriculture (% of total employment).
354 Xu, J.; Elmustafa, A.; Weldegebriel, L.; Negash, E.; Lee, R.; Meng, C.; Ermon, S.; Lobell, D. HarvestNet: A Dataset for Detecting Smallholder Farming Activity Using Harvest Piles and Remote Sensing, in Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition. (2024).
355 NAP Global Network, NAP Trends: Sector Integration - Agriculture, crops, livestock, and / or food security (63/65 countries) Accessed October 7 2025.

Climate change is projected to have a staggering impact on global crops, cutting yields by up to 12% by 2050.[356]

Impacts in Africa could be especially severe, with crop yields projected to drop 18% by 2050.[357] This is on top of the more than 30% decline in agricultural productivity growth due to climate change since 1961 - the steepest decline of any region worldwide.[358]

Crop resilience offers a powerful adaptation response by enabling farmers to increase and stabilise yields per hectare through healthier soils, resilient crop inputs and sustainable water management practices. In turn, this allows farmers to safeguard their incomes and livelihoods and to diversify into more nutritious crops, cash crops or other income-generating activities. Crop resilience drives strong benefits, particularly among small-scale producers (SSPs) and women. Every $1 spent on agricultural research and development (R&D) can generate benefit-cost ratios between 2:1 and 17:1.[359]

Exemplars[360]

Climate-resilient varieties are developed through selective breeding to withstand climate extremes like drought and flooding and to resist pests and disease. Scaling their adoption can increase yields while preserving crop quality and nutritional value. By boosting output per hectare, these varieties help curb land-use change, avoid habitat loss, lower associated emissions and protect farmer incomes. In Bangladesh, for example, the adoption of flood-tolerant rice varieties has increased farmer profitability by 55%.[361] Similarly, drought-tolerant maize has boosted yields by an average of 44% per hectare in Malawi, helping farmers strengthen both production and food security.[362] These varieties can also lessen input intensity - such as fewer pesticide applications for disease-resistant lines - creating positive economic and environmental impacts.

Irrigation systems utilise technologies like solar pumps, low-cost drilling and drip irrigation to deliver water efficiently to croplands. When deployed where local rainfall patterns are suboptimal for local crops, irrigation systems buffer crops against drought, erratic rainfall patterns, and high temperatures, which is particularly important as global agricultural water scarcity is projected to worsen in up to 84% of croplands.[363] To remain sustainable, irrigation requires safeguarding natural water sources or implementing water storage measures, such as rainwater harvesting systems. When designed and managed effectively, climate-resilient irrigation can more than double agricultural productivity while using less land and water.[364]

Biofertilisers like microbial fertilisers can complement conventional inorganic fertilisers - which remain important, particularly in Africa, where the African Union has set usage targets - while still providing the nutrient inputs needed to raise yields. Biofertilisers can deliver both adaptation and resilience outcomes (e.g. higher yields, increased incomes and richer soil biodiversity), along with indirect mitigation benefits in some cases (e.g. lower greenhouse gas (GHG) emissions from reduced synthetic fertiliser use). When adopted by SSPs, biofertilisers can improve soil health, enhance nutrient availability for crops and ultimately enhance crop yields up to 65% depending on crop variety and geography.[365]

356 Sue, W; De Cian, E; N. Ministry, M. *'Global vulnerability of crop yields to climate change.'* Journal of Environmental Economics and Management 109 (2021).
357 Philip Kofi Adom, *The Socioeconomic Impact of Climate Change in Developing Countries in the Next Decades* (Center for Global Development, 2024).
358 World Meteorological Organization (WMO), *State of the Climate in Africa* (2022).
359 Global Commission on Adaptation, Adapt Now: A Global Call for Leadership on Climate Resilience (2019).
360 Selection of exemplar solutions was based in part on innovative and A&R Best Buy-aligned solutions identified in: Innovation Commission for Climate Change, Food Security and Agriculture, Priority Innovations And Investment Recommendations for COP28 (University of Chicago, 2023).
361 Bairagi, S.; et al. *'Flood-tolerant rice improves climate resilience, profitability, and household consumption in Bangladesh'* Food Policy 102 (2021).
362 Katengeza, G.; Holden, S.; et al. *'Productivity Impact of Drought-Tolerant Maize Varieties Under Rainfall Stress in Malawi: A Continuous Treatment Approach'* Agricultural Economics 52 (2021).
363 Rao, P.; et al. *'Global Agricultural Water Scarcity Assessment Incorporating Blue and Green Water Availability Under Future Climate Change'* Earth's Future (AGU) (2022).
364 World Bank, *Transforming Lives Through Climate-Resilient Irrigation: Game Changers for a Livable Planet* (2024).
365 Pei, X.; et al. *'Effects of Biofertilizer on Yield and Quality of Crops and Soil Properties Under Field Conditions in China: A Meta-Analysis'* Agriculture 15,(2025):1066 .

Climate-resilient agricultural practices such as crop-livestock integration, shade trees and intercropping improve soil health, pest and drought resilience and water retention. This leads to an increased and stabilised yield per acre, especially in drought-prone areas, while diversifying farmer incomes across more output types.

Enablers of scale

Effectively scaling crop resilience depends on solutions that expand farmers' access to knowledge and finance to improve adoption. **Improved weather and seasonal forecasts** can be delivered through strengthened digital public infrastructure, observation networks (e.g. automatic weather stations, radar, and low-cost sensors) and localised, AI-enhanced models that produce impact-based warnings and recommended actions. Improved forecasting benefits farmers by enabling them to be better prepared. In Mongolia and Ethiopia, for example, investing $1 in anticipatory action for food security and agriculture has resulted in $7 in avoided losses and added benefits for beneficiaries.[366] **AI-enabled advisory, including crop measurement, evaluation and monitoring tools,** delivers timely advice on crop, water and pest management that is more precise and affordable than traditional face-to-face advisory. These services are highly cost-effective. AI-driven approaches can help farmers increase crop yields by up to 25%,[367] while digital climate-informed advisory services have been shown to raise incomes by a similar margin[368] while also improving profitability through optimised input use. Such practices also generate environmental co-benefits, including reduced pesticide use and more efficient water management.[369] On the financing side, inclusive mechanisms like innovative credit, insurance products and digital payments help farmers access low-cost financing. **Carbon crediting mechanisms for agriculture,** if designed to benefit SSPs, could unlock additional sources of capital from climate mitigation funders and investors to enable more resilient and productive agriculture.

366 FAO, *Return on Investment of anticipatory action interventions* 2022.
367 Hossain, M.A. et al. *'Smart Farming Revolution: AI-Powered Solutions for Sustainable Growth and Profit'* Journal of Management World 2 (2025).
368 Ferdinand et al. *A Blueprint for Digital Climate-Informed Advisory Services: Building the Resilience of 300 Million Small-Scale Producers by 2030* (Global Center on Adaptation, 2021).
369 World Economic Forum, *Innovation with a Purpose: The role of technology innovation in accelerating food systems transformation* (2018).

Livestock, fisheries and aquaculture resilience is critical to food security, nutrition and livelihoods, particularly in developing countries.

Livestock contributes an average of 40% of agricultural GDP in developing countries, supporting over 1.3 billion people globally who depend on the sector for their livelihoods.[370] Aquatic foods supply approximately 17% of animal protein consumed globally, reaching over 50% in parts of Asia and Africa.[371]

Strengthening the resilience of these sectors - by improving breeds, animal health and feed practices - can boost farmer incomes, strengthen food security, and reduce environmental impacts under growing climate pressures like extreme heat. With targeted investment, these sectors can become more efficient and deliver strong mitigation and environmental co-benefits while enhancing resilience and livelihoods. In LMICs, where meat and dairy consumption remain far below that of high-income countries, such improvements are central to advancing both nutrition and sustainable development.

Exemplars

Alternative feed innovations such as treated crop residue improved feed (CRIF), black soldier fly (BSF) meal, and fermented feed proteins give smallholders affordable, nutrient-dense feed sources, while also lowering the climate footprint of livestock systems. For instance, broiler diets in Kenya with 20% BSF meal delivered a benefit cost ratio above 2:1 while maintaining growth.[372] **Resilient livestock breeding** involves conventional cross-breeding or selective breeding programs that combine lines known for high productivity with breeds that have specific resilience traits (e.g. local breeds that tolerate heat or resist diseases). By enhancing productivity per animal, such programs reduce land, feed and water demand for the same output, cutting overall GHG emissions intensity. **Animal disease management solutions,** including vaccines and veterinary health services, grounded in a One Health approach that integrates animal, human and environmental health, help prevent productivity losses from climate-sensitive pathogens and mitigate the risk of zoonotic spillover. **Aquaculture breeding and management solutions** focus on expanding access to high-performing breeds, strengthening hatcheries, and improving pond practices to raise productivity and incomes. In Bangladesh, for example, trials showed that tilapia breeds better suited to their environment grow at least 27% faster than local breeds, which means less feed and energy are required per kilogram of fish produced, limiting emissions and making systems more resilient to feed and temperature shocks.[373]

Enablers of scale

These solutions are enabled by strong systems for delivery, finance and information. Expanding veterinary and extension networks, input distribution and women-inclusive market models ensures smallholders can access and adopt new technologies. Climate information and advisory systems can provide timely seasonal forecasts and disease early warnings. Models that combine weather, grazing and vet-report data can flag livestock-disease risk and optimise vaccination routes. In aquaculture, advanced technologies (e.g. computer-vision tools analysing tank footage) can calibrate feeding in real time, cutting feed waste. Financial instruments such as index-based livestock insurance, bundled credit, and digital payments can help farmers absorb shocks and access new technologies. At the funder level, carbon credit markets tied to rangeland restoration or low-emission practices can mobilise new flows of capital.

370 FAO HLPE-FSN, *Livestock, Engine For Economic Growth And Sustainability* (October 13 2022).
371 FAO, *Record Fisheries and Aquaculture Production Makes Critical Contribution to Global Food Security* (June 29 2022).
372 Waithaka, M.K. et al. *'Evaluating the Growth and Cost-Benefit Analysis of Feeding Improved Indigenous Chicken with Diets Containing Black Soldier Fly Larva Meal',* Frontiers in Insect Science 2 (2022).
373 Tran, N. V. et al. *'Growth, yield, and profitability of GIFT and non-GIFT strains in Bangladesh'* Aquaculture (2021).

Water

Climate change is disrupting the global water cycle, triggering more frequent and intense floods and droughts, posing risks to water security. At least 50% of the global population is exposed to highly water-stressed conditions for at least one month a year, and approximately 25% face extremely high water stress.

By 2050, one billion more people will live with extremely high water stress even under optimistic warming scenarios.[374] Investing in water security is critical to ensure both reliable quantity and quality across space and time. With proven socioeconomic returns and measurable impact, water resilience is not only a development priority but also a macro-critical investment and foundation for resilient and long-term growth. Reliable water systems drive productivity, reduce business disruption and operational costs, unlock new market opportunities and improve health outcomes. Responding to mounting water risks, approximately 90% of countries prioritise water or sanitation in their NAPs.[375]

#3 WATER COLLECTION AND STORAGE

Today, one in four people lack access to safely managed drinking water.[376] Water collection and storage through grey, nature-based and hybrid solutions strengthen the capacity of systems and communities to capture and manage water for year-round use.

Exemplars

Rainwater harvesting systems, such as demi-lunes and zai pits, are low-cost and highly scalable solutions in areas lacking piped infrastructure. These systems bolster the resilience of rain-fed agriculture and can improve crop yields. Adoption currently remains limited, requiring more investments in training for rainwater harvesting techniques in arid farming regions. Commercial rainwater harvesting, especially in areas with public and community spaces close to farmland, can help address rainwater supply gaps.

374 Samantha Kuzma, Liz Saccoccia and Marlena Chertock, *25 Countries, Housing One Quarter of the Population, Face Extremely High Water Stress* (World Resources Institute, 2023).
375 NAP Global Network, *NAP Trends: Sector Integration - Water and / or sanitation (58/65 countries)* Accessed October 7 2025).
376 WHO and UNICEF JMP, *Progress on Household Drinking-Water, Sanitation and Hygiene 2000-2024: Special focus on inequalities* (2025).

Nature-based solutions, including **watershed restoration** and urban interventions such as greening and restoration and protection of marshlands, can increase water storage, protect against floods, and ensure supply during droughts. This supports potable, agricultural and industrial water use. Beyond water collection and storage, interventions are needed to ensure water quality and sanitation, and to manage water resources and use. Digital innovations such as **IoT sensors and AI** enable real-time monitoring, optimise distribution, reduce losses, provide reliable data for early warning systems, and improve the efficiency of water resources, assets and infrastructure management. Wastewater reuse and recycling in communities, agriculture and industries are also important, including through innovative solutions like **closed-loop off-grid sanitation technologies,** and **wastewater-to-energy** and **nutrient recovery** solutions.

Enablers of scale

To achieve the benefits of water resilience, effective governance is critical, requiring clear policies, institutional frameworks and political will to formulate inclusive water rights and pricing mechanisms. Taking a systems approach when designing water solutions is important to manage maladaptation risks; for example, building a dam on the wrong branch of a river can provide water for agriculture but also increase sinking in cities downstream because of reduced sediment flows.

Health

Climate change heightens health risks, not only through more frequent heatwaves, floods, storms and droughts, but also through gradual shifts in temperature, humidity and precipitation that push diseases like malaria and dengue into new regions and longer seasons.

These changes in climate and disease prevalence harm people, strain health systems, disrupt medical supply chains, and make surveillance and outbreak control harder and costlier. By 2030, direct damage costs to health, excluding costs in agriculture, water and sanitation, could reach between $2 billion and $4 billion annually (See Chapter 2 for estimates of the economic costs of health impacts).[377] Solutions that address direct and indirect impacts of climate on health outcomes and health systems and facilities are essential. Over 90% of countries prioritise health in their NAPs.[378]

#4 PREVENTION AND CONTROL OF CLIMATE-SENSITIVE DISEASES

Prevention and control of climate-sensitive diseases involve a package of public health interventions that aim to reduce the transmission of diseases.

Malaria cases are projected to rise by about 121 million between 2030 and 2049 in sub-Saharan Africa as extreme weather disrupts access to care and control, leading to more than 550,000 additional malaria deaths on the continent between 2030 and 2049.[379]

Financing prevention and control not only reduces mortality but also creates a buffer that prevents climate-related outbreaks from escalating and overwhelming health systems. By 2050, investments in prevention, diagnostics and treatment could prevent up to 45% of additional deaths from diseases exacerbated by climate change, which is equivalent to about 6.5 million lives saved.[380]

377 Excludes costs in health-determining sectors such as agriculture and water and sanitation; WHO, Climate Change and Health - Fact Sheet (2023).
378 NAP Global Network, *NAP Trends: Sector Integration - Health (60/65 countries)* Accessed October 7 2025).
379 Boston Consulting Group and Malaria Atlas Project, *Climate Impacts on Malaria in Africa* (2024).
380 WEF, *Healthcare in a Changing Climate: Investing in Resilient Solutions* 2025.

Exemplars

Vaccines for climate-sensitive diseases (e.g. typhoid conjugate vaccines and oral cholera vaccines) offer a cost-effective method of prevention when paired with community outreach. For example, routine dengue vaccination in Thailand, beginning with cohorts at age six, has contributed to 100,000 fewer disability-adjusted life years (DALYs) and over $1.8 billion in savings over 20 years.[381] Vaccines are particularly effective for climate resilience because they prevent extreme weather driven spikes in disease and are durable to changes in disease seasonality. **Vector control,** like insecticide-treated bed nets, indoor residual spraying, larval source management, and quick-deploy spatial emanators, emit active ingredients that deter or kill biting vectors. In Kenya, WHO-supported trials of a spatial emanator prevented approximately one in every three malaria infections in children.[382] Vector-borne diseases are particularly sensitive to both long-onset climate impacts on range, seasonality and biting behaviour, as well as extreme weather impacts on protection and care. Vector control therefore offers a critical first line of defense against disease transmission. **Integrated disease surveillance systems** monitor wastewater, environmental conditions and disease vectors to detect outbreaks early and enable rapid, targeted responses to limit spread. AI-assisted analytics can overlay clinical, vector and environmental signals to predict hotspots weeks ahead and target testing, stockpiles and community campaigns. In Senegal, for example, real-time malaria surveillance has been critical to the country's malaria elimination efforts, contributing to a 30% drop in malaria cases between 2015 to 2016.[383]

Enablers of scale

Preventing and controlling climate-sensitive diseases requires a combination of related health interventions such as climate-resilient infrastructure and service delivery through resilient health systems. It can further be supported by interventions in other sectors such as clean water and sanitation efforts that reduce disease incidence.

#5 IMPROVING NUTRITION

Climate change is eroding crop yields and decreasing micronutrient density in agriculture and fisheries from changing precipitation patterns, intensifying drought and extreme weather events.

Between 2024 to 2050, 40 million additional children could be stunted, and an additional 28 million children could be wasted due to climate change without proper intervention.[384]

Improving nutrition refers to interventions that ensure individuals can maintain adequate and diverse dietary intake in the face of extreme weather events, even as food systems are weakened due to climate impacts. Nutrition investments are among the most cost-effective development actions: every $1 spent fighting undernutrition yields about $23 in economic benefits, with a total estimated economic benefit of approximately $2.4 trillion from scaled-up interventions.[385]

381 Shen, J. et al. *'Vaccination Strategies, Public Health Impact and Cost-Effectiveness of Dengue Vaccine TAK-003: a modeling case study in Thailand'* PLOS Medicine (2025).
382 Ekodir, S.M. et al. *'Initial Community Response to a Novel Spatial Repellent for Malaria Prevention in Busia County, Kenya'* Malaria Journal 24 (2025).
383 PATH, *Charting the Path to Malaria Elimination - Senegal Case Study* (2018).
384 Gates Foundation, *Goalkeepers 2024 Report: The Race to Nourish a Warming World* (2024).
385 Shekar, M. et al. *Investment Framework for Nutrition 2024. World Bank* (World Bank, 2024).

Exemplars

As climate change increases risks of food insecurity, diet-related illness and extreme heat exposure, solutions are needed that ensure vulnerable populations can still access adequate nutrition. **Food fortification** adds key nutrients to commonly consumed foods, improving diets at scale without requiring behaviour change. Programs such as biofortified staples or iodised salt provide large-scale, low-cost delivery of essential nutrients to at-risk populations. Studies show that every $1 invested in large-scale food fortification delivers $27 in economic returns.[386] **Multiple micronutrient supplementation (MMS)** during pregnancy can reduce maternal and child mortality and improve cognitive development. MMS has shown benefit-cost ratios of at least 41:1 across 33 LMICs,[387] making it a highly effective health investment.

Enablers of scale

Scaling these solutions means ensuring quality and affordable access for those who need them most. This means strengthening supply chains for essential nutrition products such as MMS with reliable procurement and last-mile delivery; mobilising financing for R&D on climate-resilient formulations and nutrition solutions that improve nutrient absorption; and pairing delivery programs with targeted subsidies and community outreach to drive adoption.

#6 HEALTH SYSTEMS RESILIENCE

Climate change is amplifying health threats at a scale that could overwhelm already strained health systems in LMICs. Without action, climate-related health impacts could drive at least $21 trillion in economic costs in LMICs by 2050 (See Chapter 2 for estimates of the economic costs of health impacts).[388]

Health systems resilience refers to the ability to withstand, adapt to and recover from climate disruptions while continuing to deliver essential care. This requires resilient health infrastructure, secure supply chains, trained, protected, and readily-available health workers, and climate-integrated emergency preparedness. Adaptation investments in health can result in an average economic internal rate of return of more than 78% by reducing preventable mortality, improving public health, and enhancing economic productivity, particularly for vulnerable populations.[389]

Exemplars

Reducing dependence of care delivery on facilities is essential to diversify delivery options and ensure continued and increased access to critical commodities and health services during and after climate events. This includes emergency care, sexual, reproductive, maternal and newborn health, infectious disease management, and chronic disease management, supported by solutions such as mobile health teams, point of care solutions (e.g. point of care ultrasounds, safe birth kits, rapid diagnostic tests), and self-care tools. These approaches are particularly important during floods and power outages, where fixed facilities may be inaccessible or non-functional. Strengthening **health product supply chains** through cold chain resilience, local pre-positioning of health commodities closer to communities, secured pharmaceutical production, and improved logistics also helps ensure continuity in the delivery of life-saving supplies such as vaccines and medicines. These systems are essential to avoid cascading health system failures during climate emergencies.

386 Rodger Voorhies, *Agricultural Innovation and Improved Nutrition are Necessary for a Climate-Stressed World* (Gates Foundation, 2023).
387 Verney, A.M.J. et al. *'Multiple Micronutrient Supplementation cost-benefit tool for informing maternal nutrition policy and investment decisions'* Maternal & Child Nutrition (2023).
388 World Bank, *The Cost of Inaction: Quantifying the Impact of Climate Change on Health in Low- and Middle-Income Countries* (2024).
389 Returns refer to the Economic Internal Rate of Return (EIRR); Brandon et al. *Strengthening the Investment Case for Climate Adaptation: A Triple Dividend* (World Resources Institute, 2025).

Enablers of scale

Effective health system resilience requires integration with water, sanitation and physical and digital infrastructure. Facilities need backup energy systems, reliable communications, roadway access, and access to safe water. Countries can also invest in health workforce capacity and climate-specific training to ensure continuity of care. Real-time health data and early warning networks support crisis anticipation and rapid deployment. Predictive AI models (e.g. facility-level digital twins) can forecast energy load, guide mobile-team deployment and detect cold chain failures before spoilage. When delivered well, resilient health systems save lives, protect livelihoods and reduce poverty, while delivering high socioeconomic returns.

#7 HEAT MITIGATION

By 2100, between 48% and 74% of the global population is projected to be exposed to dangerous levels of extreme heat for at least 20 days a year, depending on future emission scenarios.[390]

Children and pregnant women are especially at risk. Climate change was responsible for 32% of heat-related neonatal deaths between 2001 and 2019.[391]

A 2024 meta-analysis across 66 countries found the likelihood of a preterm birth rises by about 4% for every 1°C increase in heat exposure and 26% during heatwaves.[392, 393] Hotter conditions are also linked to higher rates of stillbirth, postpartum haemorrhage and hypertensive disorders, with disproportionate impacts on low-income women and outdoor workers. Recent research shows that in The Gambia, pregnant agricultural workers are often exposed to dangerous heat, with the risk of fetal strain increasing by about 12% for each 1°C rise in the heat index.[394] Heat mitigation can reduce excess mortality, ease health system strain and lower the risk of chronic and acute malnutrition.

Exemplars

Heat action plans, which combine early warning systems with outreach and local planning, reduce mortality and ease pressure on health systems during extreme heat events. For example, in Ahmedabad's heat action plan, temperature forecasts, colour-coded alerts, public guidance and cooling centres helped avert nearly 1,200 deaths annually and has since been scaled across Indian states and cities.[395] **Passive cooling infrastructure** such as green roofs and cool roofs can reduce indoor temperatures by between 2°C and 5°C,[396] and increasing the area under tree canopy cover by between 10% and 30% can reduce localised air temperatures by up to 1.5°C.[397] AI-derived heat maps from satellite and street-level data could help identify cool roof potential, urban tree planning, and cooling centre locations for maximum exposure reduction. **Early warning systems for heatwaves** give hospitals, local governments and households critical lead time by flagging high-risk days in advance.

Enablers of scale

Scaling heat mitigation requires anticipatory local planning and cross-sector coordination to ensure critical services like utilities, health and emergency services are equipped. Heat action plans should be considered alongside other sector plans (e.g. water) and ideally should feature investable initiatives. Urban design for cooling should be embedded in building codes, procurement and maintenance. Reliable, climate-resilient power (with backup) must keep cooling centres, clinics and communications online. Targeted outreach and social protection, such as heat alerts, hydration and shelter access, and employer hot-work protocols, ensure last-mile reach.

390 Mora, C. et al. *'Global Risk of Deadly Heat'* Nature Climate Change 7 (2017).
391 Dimitrova et. al., *'Temperature-Related Neonatal Deaths Attributable to Climate Change in 29 LMICs',* Nature Communications 15 2024.
392 Lakhoo, D.P. et al. *'A Systematic Review and Meta-Analysis of Heat Exposure Impacts on Maternal, Fetal and Neonatal Health',* Nature Medicine 31 (2024).
393 London School of Hygiene and Tropical Medicine, *Climate Change and Maternal, Newborn and Child Health: Time for Action* (2025).
394 Bonell, A. et al. *'Environmental Heat Stress on Maternal Physiology and Fetal Blood Flow in Pregnant Subsistence Farmers in The Gambia'* The Lancet Planetary Health 6 (2022).
395 Hess, J.J. et al. *'Building Resilience to Climate Change: Pilot Evaluation of the Impact of India's First Heat Action Plan on All-Cause Mortality'* Journal of Environmental and Public Health (2018).
396 COP28 Presidency and World Health Organization (WHO), Prospectus of Climate and Health Solutions (2023).
397 Jones et al. *Prioritizing Heat Mitigation Actions in Indian Cities: A Cost-Benefit Analysis under Climate Change Scenarios* (World Bank, 2024).

Infrastructure

Coastal and riverine flooding, storm surges, extreme heat and extreme weather events are causing costly disruption to infrastructure in LMICs, where over 90% of urban expansion takes place near hazard-prone areas such as floodplains.[398]

Building resilient infrastructure is critical - 60% of the infrastructure needed by 2050 has not yet been built and without resilience, between $732 and $845 billion are expected in global annual losses.[399] Infrastructure resilience delivers strong socioeconomic returns: every $1 spent on resilient infrastructure in LMICs yields $4 in net benefits.[400]

#8 ENERGY INFRASTRUCTURE RESILIENCE

Affordable, reliable and clean electricity is essential for resilient societies. Climate change is straining energy systems through risks of grid failures during heatwaves, direct asset damage during extreme events, and indirect losses associated with service disruption.

Energy infrastructure resilience is needed to ensure power systems can withstand climate-related shocks and stresses while continuing to deliver reliable electricity for critical sectors. For example, ensuring the continued operation of health facilities and equipment, telecommunications services, and agricultural processing and cold chain storage. In 2023, 750 million people globally lacked access to electricity with a disproportionate burden in sub-Saharan Africa, where 80% of the people who lack access live.[401] Reliable power is also a foundation for economic growth, and these stresses may further widen the gap with particular impacts on low-income populations and women.

398 Sameh Wahba Mami Mizutori, *As Climate and Disaster Threats Rise, Let's Double Down on Resilient Infrastructure* (World Bank, 2019).
399 Coalition for Disaster Resilient Infrastructure (CDRI), *Global Infrastructure Resilience: Capturing the Resilience Dividend* (2023).
400 Hallegatte et al. Lifelines: *The Resilient Infrastructure Opportunity* (World Bank, 2019).
401 International Energy Agency (IEA), *Access to Electricity - SDG7: Data and Projections* (2024).

Exemplars

Solar microgrids offer a decentralised and climate-resilient power source for critical facilities, especially in off-grid or weak-grid regions. When paired with **battery storage,** these systems ensure continuous electricity, even during grid failures. Storage also pushes clean energy assets into underserved rural areas, which is a powerful pathway to inclusive adaptation and mitigation. **Smart grid management** further strengthens resilience by equipping utilities with automation and digital controls that can detect and isolate faults, reroute power and integrate distributed renewables.

Enablers of scale

Diversification, targeted redundancy and decentralisation of energy sources are important to ensure power is always available for critical services like healthcare, emergency services and communications amidst climate events. Along with modernisation and the hardening of aging infrastructure using climate-resilient materials and improved maintenance, smart technologies are also needed to protect long-term performance and avoid costly deterioration. AI-based forecasting and microgrid energy-management systems improve dispatch during heatwaves and extreme events, while anomaly detection flags components at risk.

#9 COASTAL AND RIVERINE INFRASTRUCTURE RESILIENCE

Coastal and riverine infrastructure resilience refers to the capacity of communities and ecosystems in these areas to withstand, adapt to and recover from flooding, storm surges and the chronic impacts of sea level rise.

This includes physical adaptations ranging from engineered defenses to nature-based solutions that together reduce flood risks and support rapid post-disaster recovery.

Exemplars

Mangrove protection and restoration provides a living defense against storms and flooding, absorbing wave energy and storm surges, and dampening flood impacts on communities and infrastructure. The benefits of mangrove preservation and restoration can be up to 10 times the costs through avoided losses from coastal flooding and increased non-market benefits on forestry, fisheries and recreation.[402] **Urban drainage and stormwater management systems,** such as upgraded culverts, permeable pavements and floodable parks, protect growing cities from increasingly intense rainfall events by averting flood damage and accruing additional savings in healthcare costs and welfare gains from upgrading informal settlements. Water treatment facilities that prevent untreated water from flooding into communities, combined with effective waste management systems that keep drainage networks clear, help to reduce flood impacts and maintain public health and environmental safety. **Human-engineered flood defenses,** such as modular barriers, flood gates and detention basins, provide strong protection for cities and infrastructure against riverine and coastal flooding. The global flood defense and drainage market could grow at a compound annual growth rate (CAGR) of between 7% and 10% over the next five years, driven by flood-defense products, followed by procurement, construction and maintenance services businesses.[403]

402 Global Commission on Adaptation, *Adapt Now: A Global Call for Leadership on Climate Resilience* (2019).
403 Boston Consulting Group and Temasek, *The Private Equity Opportunity in Climate Adaptation and Resilience* (2025).

Enablers of scale

Achieving coastal and riverine resilience in LMICs requires a comprehensive approach that blends engineered solutions, nature-based solutions, proactive routine maintenance, and capacity-building (e.g. technical engineering capabilities). Hybrid solutions - complementing traditional hard structures such as sea walls, dykes, and floodgates with natural defenses such as mangrove forests, wetlands and reefs - often provide lower-cost and more sustainable protection. Recent evidence shows that together, green and grey infrastructure can yield more resilient outcomes than grey alone.[404]

404 Stormwater Management' JAWRA Journal of the American Water Resources Association 59 (2023).

Community and business resilience

Climate change is directly disrupting lives, livelihoods, and economies worldwide. Climate weather and water disasters increased five-fold over the 50 years between 1970 and 2019.[405]

Between 2000 and 2019, natural hazard-related disasters such as floods and storms have affected over 4 billion people and caused nearly $3 trillion in economic losses.[406]

Estimates show that between 32 million and 132 million people could fall into extreme poverty by 2030 due to the impacts of climate change under various scenarios.[407] Communities are increasingly vulnerable as floods, storms, and heatwaves damage homes and strain urban infrastructure such as waste management systems. Businesses face rising costs and revenue losses from damaged assets, higher operating expenses and supply chain disruptions.

#10 EARLY WARNING SYSTEMS (EWS)

Early warning systems (EWS) are integrated platforms that monitor climate risks, predict impacts and communicate alerts, enabling authorities and at-risk communities to act before disasters strike.

Strengthening EWS is highly cost-effective and can generate average benefit-to-cost ratios of 10:1.[408]

The World Bank estimates that EWS helped avoid between $360 and $500 billion in asset losses and between $600 and $825 billion in welfare losses between 1978 and 2018.[409] Countries with less comprehensive multi-hazard EWS have a disaster-related mortality ratio that is almost six times higher than those with comprehensive or substantial coverage. Yet large coverage gaps remain: 45% of reporting countries lack capacity for multi-hazard EWS[410] and only one third of Small Island Developing States (SIDS) have multi-hazard EWS in place.[411]

405 World Meteorological Organization (WMO), *Atlas of Mortality and Economic Losses from Weather, Climate and Water-Related Hazards (1970-2019)* (2021).
406 UNDRR, *The Human Cost of Disasters: An Overview of the Last 20 Years (2000-2019)* (2020).
407 Jafino, Bramka Arga; Walsh, Brian James; Rozenberg, Julie; Hallegatte, Stéphane, *Revised Estimates of the Impact of Climate Change on Extreme Poverty by 2030* (World Bank, 2020).
408 Global Commission on Adaptation, *Adapt Now: A Global Call for Leadership on Climate Resilience* (2019).
409 World Meteorological Organization, *The Triple Dividends of Early Warning Systems and Climate Services* (2024).
410 World Meteorological Organization, *Global Status of Multi-hazard Early Warning Systems: 2024* (2024).
411 ibid.

Exemplars

Disaster risk EWS, such as flood and storm monitoring systems, use satellite data, hydrological models and community sensors to alert populations before an event hits. These systems are critical for avoiding loss of life and damage. For example, Cyclone Idai caused the loss of 603 lives and $3 billion in damages in Mozambique in 2019. The government developed a comprehensive EWS and when Cyclone Freddy hit in 2023, there was a two thirds reduction in lives lost and 83% reduction in damages compared to the prior event.[412] Modern EWS increasingly embeds AI-based forecasting to translate climate risks into area-specific actions and enable targeted alerts (e.g. automated SMS warnings). Agriculture EWS, meanwhile, integrates satellite data and weather forecasts with on-the-ground information to provide location-specific advisories on heat, rainfall, soil moisture and vegetation. More broadly, early warning systems and global weather data can boost smallholder farmers' annual income by $95 to $170 per household by 2030.[413]

Enablers of scale

An effective EWS rests on four pillars that must all be in place: i) risk knowledge based on climate information systems, including disaster data and risk assessment; ii) detection, monitoring and forecasting of climate risks; iii) communication systems to reach all people with actionable, understandable warnings; and iv) community response capabilities. Significant political support, ICT infrastructure, weather monitoring infrastructure, community engagement, and capacity building are all needed to support these efforts.

#11 FINANCIAL INCLUSION, INSURANCE AND SOCIAL PROTECTION

Financial inclusion, insurance and social protection refer to systems that provide individuals and businesses with access to financial services, risk transfer mechanisms and safety nets that help them prepare for, cope with, and recover from extreme weather events.

Empowering low-income households with financial tools and safety nets has high socioeconomic benefit: even conventional post-disaster support has shown benefit-cost ratios above 1:3 across 117 countries.[414] Forecast-based cash transfers sent before a flood hits can significantly reduce losses. For example, ahead of the severe flooding in Bangladesh in 2020, families who received an early cash payment were 36% less likely to go a day without eating during the flood, were more likely to evacuate, and were 8% less likely to lose livestock.[415]

412 World Meteorological Organization, *The Triple Dividends of Early Warning Systems and Climate Services* (2024).
413 UNDP, *The Human and Economic Impact of Digital Public Infrastructure* (2023).
414 Hallegatte, S.; Vogt-Schilb, A.; Bangalore, M.; Rozenberg, *J. Unbreakable: Building the Resilience of the Poor in the Face of Natural Disasters* (World Bank, 2017).
415 World Food Programme, *Acting Before a Flood to Protect the Most Vulnerable* (2021).

Exemplars

Adaptive social protection (ASP) systems go beyond traditional safety nets by building systems that can anticipate, absorb and respond to shocks - whether climate-related, economic, health or conflict-driven. In the past decade, countries have shown how ASP systems can evolve into a dynamic resilience tool. For example, Pakistan's Ehsaas Emergency Cash Program delivered emergency cash to around 15 million families during the early stages of the COVID-19 pandemic.[416] ASP systems also enable the creation of responsive social registries and the data rails for government-to-person payments. Contingent lines of credit (CLOCs) and post-disaster credit lines give governments rapid liquidity to fund anticipatory cash transfers and other required payments linked to extreme weather events. **Index-based insurance products,** which trigger payouts based on satellite or weather data, are used to protect farmers, fishers and small enterprises from climate-related losses. However, as climate events become more frequent and severe, the effectiveness of such instruments can be constrained by rising premiums and reduced pooling efficiency. As a result, index-based insurance is best deployed as part of a broader set of solutions, complemented by measures that reduce underlying risk exposure. Other financial innovations include asset collateralised loans, credit innovations for post-harvest seasons, pay-at-harvest insurance, and emergency flood loans.

Enablers of scale

Implementation at scale is enabled by: policy coordination between social welfare, disaster management, climate and other sectoral agencies to ensure solutions reach the last mile; integration of climate information and early warning systems to trigger timely, evidence-backed support; capacity-building programs for financial literacy and behaviour change to drive adoption; and digital infrastructure.

416 Noor Rehman Khan, *Ehsaas Emergency Cash Program: Using Big Data for Rapid Expansion During the COVID-19 Pandemic* (World Bank, 2021).

Nature, ecosystems and biodiversity

Climate change is disrupting more than 80% of ecological processes, degrading terrestrial, marine, and wetland ecosystems, and driving biodiversity loss.[417]

If the climate and nature emergency is not addressed, the world could face losses of $10 trillion in real GDP by 2050, undermining livelihoods and economies that depend on nature.[418] The challenge is acute in LMICs, where more than 80% of countries prioritise ecosystems, biodiversity, environment and natural resources in their NAPs.[419]

#12 TERRESTRIAL PROTECTION AND REHABILITATION

Terrestrial protection and rehabilitation refers to the conservation, restoration and sustainable management of forests, rangelands and other terrestrial ecosystems.

These interventions reduce climate vulnerability by preventing erosion, restoring soil fertility, retaining water and reducing risk from floods and landslides. A study of global priority areas for ecosystem restoration found that restoring just 15% of converted lands could prevent 60% of projected species extinction while also delivering emissions mitigation benefits.[420]

Exemplars

Reforestation and assisted natural regeneration restore degraded forests, rebuild ecosystem services, and increase resilience to drought and floods. **Wildfire prevention** such as early dry season burning and managed grazing reduces the buildup of flammable biomass, lowering the risk of catastrophic wildfires and protecting ecosystems.

Enablers of scale

To unlock impact, land protection and rehabilitation efforts should be locally led, gender-inclusive, and supported by strong policy alignment, secured land tenure, and incentives for long-term stewardship. Bundling with other nature-based solutions increases ecological impact and risk reduction. Leveraging nature financing mechanisms like payment-for-ecosystem-services schemes or carbon/biodiversity credits can also unlock more sources of capital for implementation. Success requires robust monitoring, measurement, reporting, and verification (MMRV) systems to ensure accountability that restored ecosystems continue to deliver resilience dividends over time.

417 IUCN, Climate Change Specialist Group Report 2024-2025 (2025).
418 Johnson et al. *Global Futures: Modelling the Global Economic Impacts of Environmental Change to Support Policy-Making* (World Wildlife Fund, 2020).
419 NAP Global Network, *NAP Trends: Sector Integration - Ecosystems, Biodiversity, Environment and / or Natural Resources (54/65 countries)* Accessed October 7 2025.
420 Strassburg, B. B. N., et al. *'Global Priority Areas for Ecosystem Restoration'* Nature 586 (2020).

Cross-sector enablers

#13 CLIMATE INFORMATION SYSTEMS

Climate information systems are integrated networks and tools that collect, analyse, and disseminate weather and climate data to support early action and adaptation.

They underpin effective adaptation across sectors like agriculture, energy and health that need reliable climate data and forecasts for decision making.

Exemplars

Spatial data collection tools, such as remote sensing and ocean observation systems, generate geoinformation about the physical environment in real-time to support risk mapping, monitoring and adaptation planning. **Weather data availability and seasonal forecasts** provide probabilistic predictions of climate anomalies weeks to months in advance, helping governments, farmers and businesses prepare and respond to extreme weather events. AI-enhanced models, when fine-tuned with local observations, can significantly outperform traditional forecasts in data-sparse regions. In 2024, researchers demonstrated that AI-based flood forecasting achieved five-day advanced forecast reliability that was similar or better to 'nowcasts' (zero days of lead time) in predicting extreme riverine events.[421] When paired with high-quality, low-cost observational data, localised AI-enhanced forecasts can help overcome the challenges of conventional weather models in LMICs.

Enablers of scale

Making climate information systems effective in LMICs requires investments that increase the availability, accessibility and quality of climate data. This means investing in open data platforms and AI-enhanced models that have been fine-tuned with local observations. It also involves strengthening local capacity to interpret and apply information in decision-making, and building robust local datasets that increase the accuracy and granularity of forecasts and risk assessments. Early warning systems (EWS) build on this data backbone by converting forecasts into risk thresholds, alerts and standard operating procedures. When linked together, these investments directly support timely planning, preparation and responses that help communities act before disasters strike.

421 Nearing, G., Cohen, D., Dube, V., et al. *'Global Prediction of Extreme Floods in Ungauged Watersheds'* Nature 629 (2024).

Planning, preparation and response refers to the cycle of upfront planning, implementing proactive adaptation and preparedness measures for extreme weather events, and coordinated response and recovery efforts to minimise damage when these events occur.

This equips at-risk communities and institutions with a roadmap to anticipate, absorb and adapt to extreme weather events before they strike, rather than reacting after the fact.

Exemplars

Anticipatory action plans for climate disasters are pre-agreed protocols that release funding and trigger preparedness measures (e.g. evacuation, livestock relocation and aid distribution) before a forecasted shock occurs. While these short-term measures are essential, they should be complemented by longer-term strategies such as national and sectoral adaptation plans that integrate climate risk into development priorities. **National adaptation plans (NAPs)** are country-led strategies that integrate climate risk into development planning across key sectors like health, agriculture and infrastructure. For NAPs to be most effective, they should be integrated into wider economic and development planning frameworks, with strong commitments from ministries of finance and planning. This integration ensures that adaptation priorities are embedded into national budgets and investment strategies and enables coherence with long-term economic goals. In addition, NAPs should be translated into financeable project pipelines with suitable entry points for various funders including the private sector.

Enablers of scale

Planning, preparation and response are enabled by robust data and technology (e.g. climate and weather information systems, forecasting and modelling), which also enable effective early warning systems. The technical foundations need to be complemented by strong institutional coordination and leadership (including political will and climate champions within institutions) and by adequate financing (both through investable packages for donors and climate-adaptation-integrated national budgets). In addition, capacity building from national to local levels is critical to ensure climate risk assessments and adaptation plans are robust and can equip communities to act.

Digital public infrastructure (DPI) includes core systems like digital IDs, interoperable payment platforms and data exchange layers that enable timely, inclusive and efficient service delivery.

These common platforms allow governments and other actors to quickly and efficiently deliver targeted information, cash assistance and essential services to citizens.

In the context of climate adaptation and resilience, DPI amplifies the impact of other investments, for example delivering digital emergency payments to affected individuals, tailoring agricultural advisory services based on location-specific data, integrating data on local climate vulnerability to inform emergency supply stockpiling, and enabling EWS. These actions not only help to protect communities and assets during a climate event, but also to build back quickly and in more resilient ways.

Exemplars

With robust DPI, early warning data can be turned into **targeted emergency alerts and cash transfers** to at-risk families. **Inclusive digital payment systems** also enable governments to deliver rapid, direct financial assistance to affected households during climate events. For example, Pakistan launched an integrated national socioeconomic registry linked to its national ID and digital social protection system, which was leveraged to target payments to 1.76 million households following the floods in 2022.[422]

Enablers of scale

Scaling DPI for climate resilience benefits from last-mile connectivity, affordable mobile access and digital literacy so that even the most at-risk populations can access digital solutions. Interoperability and data protection standards and regulations are also needed to ensure digital solutions leverage common infrastructure while maintaining privacy and security.

422 Guven, M.; Majoka, Z.; Jamy, G. N.; et al. *The Evolution of Benazir Income Support Programme's Delivery Systems: Leveraging Digital Technology for Adaptive Social Protection in Pakistan* (World Bank, 2024).

6.3 Key Considerations for Funders

Every type of funder - public, private, and philanthropic - has an entry point for financing A&R Best Buys in a manner aligned to the nature of their capital (Exhibit 6.2): that is to say, their political or multilateral mandates, fiduciary duty, target risk-return profile, investment duration, and the prudential regulations to which they must adhere (e.g. solvency).

While many A&R solutions and projects offer attractive business models for return-seeking funders, others remain public goods that generate important socioeconomic returns. This makes it critical to have collaboration across financial actors to layer different forms of capital into a financing ladder that can move solutions from pilot to proof of concept to scaled implementation. Despite the barrier to financing A&R solutions today, there remains an attractive and growing opportunity for commercial capital, including investors and corporates, not only to protect value at risk but also to generate return from new profit pools.

Philanthropic capital

Philanthropic capital is risk-taking and flexible and thus well-suited for funding public goods and innovation proof-points of A&R solutions. Philanthropic capital, primarily via grants but also via program-related investments such as debt, equities and guarantees at below-market terms, delivers risk-tolerant, flexible capital that is ideal for investing in R&D and innovation, demonstrating technical or commercial proof-of-concept, and supporting enabling environments (policy, capacity, and safeguards). Although philanthropic capital is limited, it can play a critical catalytic role. Philanthropies have the agility to innovate and pilot A&R solutions, proving the effectiveness of new solutions and reducing their costs, thereby de-risking subsequent investment and crowding-in scale finance providers like governments and commercial investors.

Public finance

Public finance from international or domestic sources, while less flexible than philanthropy, supports provision of public goods at scale and helps maximise development and climate impact. Donor aid (ODA) provides grant funding to scale pilots into national programs, deliver technical assistance, build local capacity, and subsidise private models to improve access or enhance benefits for vulnerable communities. This form of international public finance is especially critical for LMICs that do not have the fiscal space to finance projects that are essential for community resilience but may not be immediately revenue-generating or have clear paths for return, especially when they offer public goods with benefits beyond country borders. Domestic public finance helps anchor A&R solutions in national and sub-national budgets and public priorities, creating long-term policy alignment and strengthening sustainability of solutions that depend in-part or in-full on the public sector. Public development banks also play a key role in lending and scaling of solutions locally.

Further along the risk-return spectrum, concessional capital, that is investment offered below-market terms, helps bridge the gap between successful pilots and sustainable commercial scale for A&R solutions.

This finance can come from a range of development financiers including multilateral development banks (MDBs), national development banks, multilateral climate funds and the catalytic envelopes within the balance sheets of development finance institutions (DFIs) as well as from high-net-worth individuals and family offices looking to deploy capital for impact using a range of instruments. These providers typically aim to balance impact with financial return (the balance varies by institutional mandate) and can often underwrite large-scale or aggregated projects, typically through concessional loans, first-loss capital, guarantees, project-preparation facilities, or policy-based financing with embedded technical assistance (TA). They participate in blended finance transactions and can offer favourable terms like long maturity. These entities also use in-house tools like standardised key performance indicators (KPIs) and safeguards to build market confidence.

Businesses, commercial financial institutions, and institutional investors invest commercial capital in A&R solutions.

This happens through their own operations, project finance, or funds once models are validated and risk-return models are appropriately calibrated. A survey of over 1,900 global executives across corporates in 16 industries found that companies estimated over $400M at stake (average per company) due to physical risk by 2030, and these same companies found a 1% median revenue benefit from climate adaptation efforts and a more than 10% return on investment from climate risk projects.[423]

Insurers also play an important role in this space and can incentivise and enable adoption of A&R solutions that reduce risk by offering lower premiums for more resilient assets. In addition to the massive deployment opportunity of between $0.5 trillion and $1.3 trillion a year by 2030, commercial investors can already access exposure to A&R solutions that fit their traditional mandates.[424] For example, climate intelligence (e.g. hazard warning and risk analytics) is expected to grow by 15% (annual CAGR) over the next five years, making it a fit for venture capital and growth equity investors, while climate-adapted agricultural inputs (e.g. climate-resilient varieties) could grow by between 4% and 7%, making it a fit for later-stage private market investors in addition to corporates.[425] Where there remain barriers to investment, commercial investors can finance A&R solutions as co-investments alongside concessional players, where high-risk tranches are de-risked by concessional financing through guarantees, first-loss tranches, and other instruments. Private capital is essential to achieve scale but will only flow where risk-return is viable, underscoring the importance of other finance providers at earlier stages and at more concessional levels in the capital stack, such as philanthropies and public finance.

Finally, each form of capital across the risk-return spectrum can deploy finance for A&R solutions and help address the operational bottlenecks that limit finance flows. To transform NAPs into pipelines of investable projects, LMIC governments often need support for implementation readiness (e.g. technical assistance and project structuring), and financing for pilots, among others. For all types of A&R solutions, robust climate data is needed to localise risk assessment and demonstrate impact, and the standardisation of KPIs, metrics, and safeguards can enable more scale and replication in A&R financing.

423 Boston Consulting Group, *How Companies Are Tackling the Climate Challenge—and Creating Value* (2025).
424 Boston Consulting Group; Temasek, *The Private Equity Opportunity in Climate Adaptation and Resilience* (2025).
425 Ibid.

Financiers such as development finance institutions (DFIs) can offer transparent funding windows to enable A&R project developers and emerging asset managers to better access their capital while attracting more risk/return-constrained investors to new markets.

Both public and commercial financial institutions also play a role in designing replicable instruments and aggregating investments into funds or platforms that meet commercial investors' scale requirements to mainstream A&R as an investment theme.

Exhibit 6.2 Entry Points for Financiers

Funder type	Adaptation financing instrument deployed	Illustrative funder entry points *Based on the degree of solution adoption in a local context*[2]			Examples for an A&R solution *Climate-resilient/hybrid seeds*
		Research and development	Early pilots to scale-up	Large-scale implementation	
Philanthropies and HNWIs	100%[1]				Catalyse commercial interest by funding early proof-of-concept trials and publishing open data on resilient varieties
Governments (including bilateral donors and domestic public finance)	88%				Finance programmes that deploy farmer training and subsidies for climate-resilient seeds or R&D partnerships
Multilateral Climate Funds	77% 18%				Deploy package of grants and concessional loans for boosting agricultural sector in LMICs, including through climate-resilient seeds
Bilateral Development Finance Institutions	18% 70%				Finance social enterprises to expand their local seed-production capacity
Multilateral Development Banks	14% 27% 57%				Invest in multi-country programmes that scale deployment of climate-smart seed and technology packages to smallholders
Companies	91%				Develop and bring drought-tolerant seed varieties to market
Commercial financial institutions	21% 69%				Lend to distributors to purchase inventory from seed companies
Institutional investors					Finance growth facilities for regional seed platforms expanding into LMICs

Legend: Financial instruments deployed

- Grants
- Project-level market-rate debt
- Corporate/Platform equity
- Low-cost project debt
- Project-level equity
- Other

Legend: Typical funder entry point

- More common

1 Not reflected in CPI; assumption based on conversations with experts; data does not include all likely HNWI investor participation; 2. Excludes maturity of enabling environment (e.g. policy, standards)
Source: Climate Policy Initiative (CPI), Global Landscape of Climate Finance (2024) – data supplement; data only provides instrument breakdown for adaptation finance to all countries – we assume the same breakdown for adaptation finance to LMICs only; Expert interviews; BCG analysis

6.4 Key Considerations for Prioritising A&R Solutions

There are six key considerations that advocates, funders and policymakers should keep in mind when assessing A&R funding opportunities.

Prioritise human welfare
A&R investments should deliver the greatest benefits to at-risk populations, especially in the world's poorest countries where poverty and poor health can exacerbate the impacts of extreme weather events. With limited aid and rising debt, scarce resilience resources should focus on solutions that most improve the human condition and alleviate suffering.

Support country ownership and priorities
A&R is most effective when driven by national and local priorities. Funders should align investments with country-led strategies such as NAPs and broader economic development policies to ensure coherence across agendas. Locally-led adaptation ensures solutions reflect context-specific risks, draw on local knowledge and avoid fragmentation or limited impact from top-down, donor-driven priorities.

Balance global solutions with local contexts
While many high-impact solutions are widely applicable across geographies, their effectiveness ultimately depends on tailoring to specific contexts. A&R is inherently place-based: interventions must reflect local climate risks, geophysical conditions, and sectoral and country priorities. The opportunity lies in striking the right balance: replicating proven global approaches to achieve scale, while implementing them in a localised manner that maximises socioeconomic returns.

A&R should be systematic within and across sectors
Climate risks and development challenges are interconnected and cannot be effectively addressed through isolated, single-solution approaches. Prioritising the most impactful interventions is critical, but these should also be designed, financed and implemented in integrated 'bundles' that reinforce one another. For instance, financing resilient agriculture will only achieve impact if water security is also addressed. This requires holistic planning and cross-department coordination, alongside enabling policies and funding approaches that strengthen entire systems.

Manage risk of maladaptation
A&R Best Buys are actions that can be taken by funders now, but it is important to factor in cascading risks to ensure solutions minimise unintended risks and deliver long-term benefits. Poorly designed interventions can increase vulnerability or create inequities.

Invest across time horizons
Funders can balance support for 'no-regrets' measures that are ready to be scaled now (e.g. early warning systems) alongside longer-term investments that build foundational resilience (e.g. climate-resilient infrastructure), while also investing in innovation that will be critical for addressing future needs. A balanced portfolio maximises near-term and lasting resilience.

6.5 Conclusion

The 15 A&R Best Buys offer actionable, financeable opportunities that are broadly applicable and can be tailored to local priorities.

These offer countries and funders a practical path to protect lives and livelihoods, stabilise critical services, and unlock socioeconomic co-benefits. There are clear entry points across philanthropy, development finance, corporates and commercial finance in which capital can be put to work now.

Conclusion

At COP30, governments, civil society, businesses, investors and financiers will gather to push resilience higher up the economic and political agenda.

The challenge is not new plans, but delivery. Resilience is no longer a side-agenda — it is the foundation of growth and stability. If governments, businesses, investors and civil society act together, they can flip the spiral from escalating costs to rising returns. The choice is clear: delay and face mounting losses, or act now to secure stronger, safer, more competitive economies that deliver for all.

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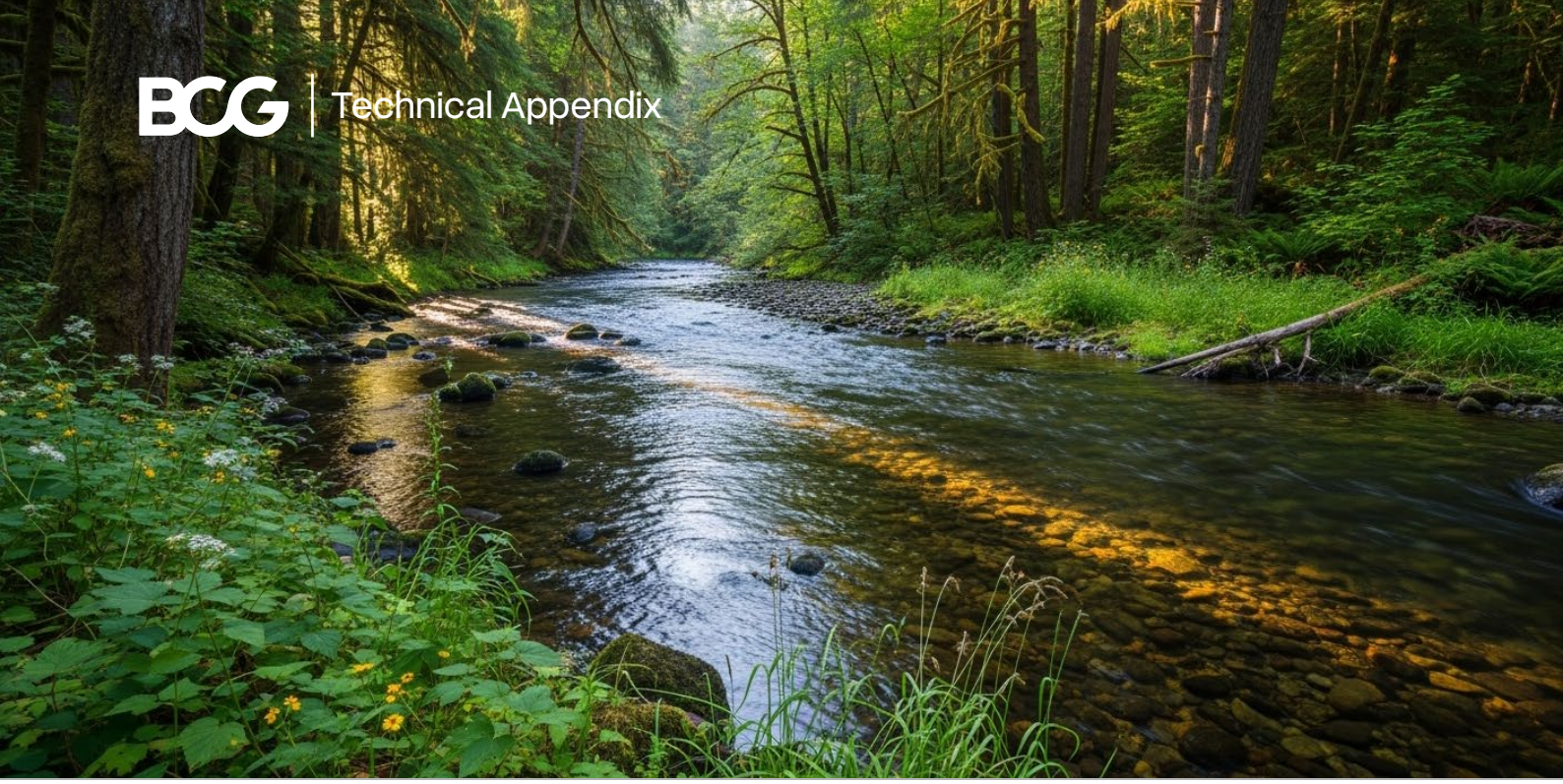
Returns on Resilience:

Investing in Adaptation to Drive Prosperity, Growth and Competitiveness



Methodology

To identify the 15 A&R Best Buys, we began with a long list of 30-40 A&R solution areas based on more than 10 A&R taxonomies (e.g. Climate Bonds Initiative Adaptation and Resilience Taxonomy, UNEP Taxonomy of Adaptation Technology for Country Technology Needs Assessments, Tailwind Taxonomy for Adaptation and Resilience Investments), sectoral frameworks (e.g. WHO framework for Climate Sensitive Health Risks) and global agendas (e.g. Sharm El-Sheikh Adaptation Agenda) and refined them to a list of 31 for analysis:

Food

Ensuring food security through resilient production practices

- Crop resilience including irrigation systems
- Livestock, fisheries and aquaculture resilience
- Precision agriculture and digital tools

Minimizing food loss and waste

- Post-harvest handling and storage
- Transportation and distribution

Water

Securing adequate water supply

- Water collection and storage

Ensuring water quality and sanitation

- Water quality and sanitation

Managing water resources and use

- Water use monitoring and efficiency
- Water generation alternatives

Health

Protecting health from climate impacts

- Heat mitigation
- Respiratory health
- Prevention and control of climate-sensitive diseases
- Mental and psychosocial health
- Improving nutrition

Strengthening health systems and facilities

- Resilient health systems
- Resilient healthcare facilities

Infrastructure

Making infrastructure resilient

- Transport infrastructure resilience
- Energy infrastructure resilience
- City/Community infrastructure resilience
- ICT infrastructure resilience
- Coastal and riverine infrastructure resilience

Nature, ecosystems and biodiversity resilience

Safeguarding biodiversity of ecosystems
- Preservation of biodiversity hotspots

Conservation of terrestrial, marine, and wetland ecosystems
- Terrestrial protection and rehabilitation
- Marine protection and rehabilitation
- Wetland protection and rehabilitation

Community and business

Strengthening community preparedness
- Early warning systems

Building economic and social resilience
- Financial inclusion, insurance and social protection
- Supply chain resilience

Cross-cutting enablers

- Climate information systems
- Planning, preparation and response
- Digital public infrastructure

We then down-selected to 15 A&R Best Buys based on a series of analyses set out below.

1. Broad applicability in LMICs

We performed primary analysis (see Exhibit 5) of 15 National Adaptation Plans (NAPs) across countries facing a range of climate impacts (e.g. droughts and flooding) and representing various types of economies (e.g. agriculture). We quantified the number of NAPs in which the A&R solution was cited as a key priority (see Exhibit 6).

We additionally quantified the number of times A&R solutions were prioritised in countries' Technology Needs Assessments, leveraging the UNEP Taxonomy of Climate Change Adaptation Technology summary report (see Exhibit 7).[426]

Exhibit 5 Countries included in NAP analysis

Geography	Country	Climate impacts	Largest economy sector
Africa	Kenya	Droughts, flooding	Agriculture
	Congo, D.R.	Deforestation, flooding	Natural resources
	Ethiopia	Droughts, flooding	Agriculture
	Burkina Faso	Droughts, flooding	Agriculture
	Zambia	Droughts, flooding	Services
	South Africa	Droughts, flooding	Services
East Asia and Pacific	Cambodia	Flooding, heatwaves	Agriculture
	Kiribati	Sea level rise, storm surges	Services
	Philipines	Typhoons, sea level rise	Services
South Asia	Pakistan	Flooding, glacial melting	Services
	Bangladesh	Flooding, cyclones	Agriculture
	Nepal	Glacial melting, flooding	Services
Middle East	Jordan	Droughts, water scarcity	Services
Latin America and Caribbean	Haiti	Hurricanes, flooding	Agriculture
	Brazil	Deforestation, heatwaves	Services

426 UNEP DTU Partnership and Green Technology Center, Taxonomy of Climate Change Adaptation Technology (2021).

Exhibit 6 NAP analysis highlights key A&R solution areas needed in countries with a focus on LMICs

Resilience sector	In Bold: Best Buys	Number of countries prioritising solution area (out of sample of 15 LMIC NAPs across Geographies)
Food resilience	**Crop resilience**	15
	Livestock, fisheries and aquaculture resilience	14
	Post-harvest handling and storage	7
	Precision agriculture and digital tools	7
	Transportation and distribution	6
Water resilience	**Water collection and storage**	13
	Water quality and sanitation	13
	Water use monitoring and efficiency	13
	Water use alternatives	6
Health resilience	**Health systems resilience**	12
	Prevention and control of climate-sensitive diseases	11
	Health-care facilities resilience	6
	Heat mitigation	6
	Respiratory health	6
	Improving nutrition	5
	Mental and psychological health	2
Infrastructure resilience	City/Community infrastructure resilience	14
	Coastal and riverine infrastructure resilience	12
	Energy infrastructure resilience	10
	Transport infrastructure resilience	10
	ICT infrastructure resilience	3
Community and business resilience	**Early warning systems**	13
	Financial inclusion, insurance and social protection	12
	Supply chain resilience	6
Nature, ecosystems and biodiversity resilience	Preservation of biodiversity hotspots	13
	Terrestrial protection and rehabilitation	12
	Wetland protection and rehabilitation	6
	Marine protection and rehabilitation	4
Cross-sector enablers	**Climate information systems**	14
	Planning, preparation and response	14
	Digital public infrastructure	1

Source: Country NAPs from: Bangladesh, Brazil, Burkina Faso, Cambodia, Democratic Republic of Congo, Ethiopia, Haiti, Jordan, Kenya, Kiribati, Nepal, Pakistan, Philippines, South Africa, and Zambia.

Exhibit 7 TNA analysis highlights key A&R solution areas needed in countries with a focus on LMICs

Resilience sector	In Bold: Best buys	Percentage (count) of prioritised sector adaptation technologies per solution are (N=71 countries completed as of 2021)
Food resilience (N = 196)	**Crop resilience**	**87%** (171)
	Precision agriculture and digital tools	**6%** (12)
	Livestock, fishery and aquaculture resilience	**5%** (9)
	Transportation and distribution	**2% (4)**
Water resilience (N = 163)	**Water collection and storage**	**47%** (76)
	Water use monitoring and efficiency	**44%** (72)
	Water use alternatives	**6%** (9)
	Water quality and sanitation	**4%** (6)
Health resilience (N = 2)	Health-care facilities resilience	**100%** (2)
Infrastructure resilience (N = 50)	**Coastal and riverine infrastructure resilience**	**96%** (48)
	Energy infrastructure resilience	**2%** (1)
	City/Community infrastructure resilience	**2%** (1)
Community and business resilience (N = 19)	**Early warning systems**	**84%** (16)
	Financial inclusion, insurance and social protection	**16%** (3)
Nature, ecosystems and biodiversity resilience (N = 24)	**Terrestrial protection and rehabilitation**	**75%** (18)
	Marine protection and rehabilitation	**25%** (6)
Cross-sector enablers (N = 33)	**Climate information systems**	**67%** (22)
	Planning, preparation and response	**33%** (11)

Note: N = number of adaptation technologies prioritised by 71 countries
Source: Taxonomy of Climate Change Adaptation Technology (2021), TNA database

2. Sector expert consultation

We performed expert interviews for each sector including i) food; ii) water; iii) health; iv) infrastructure; v) community and business; and vi) nature, ecosystems and biodiversity. We asked experts to qualitatively assess each A&R solution based on the following dimensions (see summary rubric in Exhibit 8):

- Potential for social impact (qualitatively ranked within each sector) using prompts to consider elements such as impact on mortality or morbidity, access to healthcare and impact on at-risk populations such as women or children.
- Potential for economic impact (qualitatively ranked within each sector) using prompts to consider elements such as job creation, income increase, economic or labour productivity, asset loss avoidance and GDP growth.

We additionally asked experts to qualitatively assess each A&R solution for the following dimensions:

- Feasibility of implementation (using a scale of: significant / some / minimal barriers). Considering elements such as the existence of enabling conditions, technological readiness, capacity needs, scalability and regulatory hurdles.
- Potential for positive environmental impact (using a scale of: no / maybe / yes co-benefits). Considering elements such as mitigation, ecosystem or water co-benefits.
- Funder interest (using a scale of low / strong evidence). Evidence of potential funder interest across public, private and philanthropic funders.
- Cost effectiveness (using a scale of: low/strong evidence). Evidence of cost-effectiveness.

Exhibit 8 Rubric for prioritisation and assessment of A&R Best Buys

	Key indicators	Low impact / readiness / interest	Moderate / readiness / interest	High impact / readiness / interest
Key prioritisation criteria	Spectrum of ranking	←	●	→
	Economic impact e.g. Job creation, income increase, economic or labour productivity, asset loss avoidance, GDP growth	• Expert ranked as **lower** impact; typically ranked in **bottom 3rd within sector** **AND / OR** • **Low impact demonstrated** in case studies or **less impact compared to other solutions** in solution area	• Expert ranked as **moderate** impact **AND / OR** • **Less impact compared to other solutions** in solution area	• Expert ranked as **higher** impact; typically ranked in **top 3rd within sector** **AND / OR** • **Significant impact demonstrated** in case studies
	Social impact e.g. Impact on morbidity access to healthcare, conflict, impact onat-risk populations such as women or children			
	Broad applicability e.g. Mentions in NAPs or TNAs, number of people potentially impacted, scale of intervention, size of geography impacted	• **<33% of NAP mentions** **AND / OR** • Low applicability due to the nature of the intervention	• **34 - 66% of NAP mentions**	• **>67% of NAP mentions** **AND / OR** • High applicability due to the nature of the intervention
	Implementation feasibility e.g. Existance of enabling conditions (infrastructure, digital), technological readiness, education/ capacity needs, scalability, regulatory hurdles	• **Significant barrier on enabling** condition or **technological** readiness (e.g. nascent technology) • **High regulatory** hurdle	• **Some barriers,** but can be overcome (e.g. education, scale, regulatory)	• **Minimal barriers, relative to other solution areas** • **Known solutions** • Demonstrated prior implementation with moderate hurdles
Evaluated, but not used for prioritisation	**Additional considerations**	✗ No	= Maybe	✓ Yes
	Natural impact e.g. Water efficiency, ecosystem restoration, emission mitigation	• There are **no co-benefits** with natural systems	• There **may be co-benefits** with natural systems	• There **are co-benefits** with natural systems
	Additional considerations	✗ No	✓ Yes	
	Funder interest Public, private, philanthropic / HNWI	• **Low or no evidence** in expert interviews	• **Strong evidence** in expert interviews and/or case studies	
	Cost effectiveness e.g. Level of impact for amount spent	• **Low or no evidence** in expert interviews	• **Strong evidence** in expert interviews and/or case studies	

3. Secondary research

To validate the results of the consultation with sector experts, we reviewed more than 100 reports including scientific articles, sector reports, and adaptation synthesis reports (e.g. NAP aggregation) from leading climate and development organizations (e.g. UN, WHO, FAO, CGIAR, World Bank, IPCC, GCA, WEF, WWF, CDRI, OECD, WMO, GCF).

4. Climate and development ecosystem consultation

We further consulted more than 50 ecosystem actors across more than 25 organisations including global development and climate organisations, universities, public, private, and philanthropic funders, and NGOs to review the A&R Best Buys list against both climate and development objectives (results not shown).

5. Alignment with global goals

We confirmed that each A&R Best Buy aligns with the UN's Sustainable Development Goals and with sectors and preliminary indicators that have been published for the Global Goal on Adaptation.