

Adaptation and Resilience: how donors can support mainstreaming into financial decision making and scaling up of private investment in solutions

Report

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Executive summary

Overview

Climate impacts are being felt globally and are projected to get worse. Adaptation needs are enormous, growing and urgent, and public finance alone will not meet the growing need. Scaling private investment in adaptation and resilience is therefore essential to meet adaptation goals around the world.

This report examines two aspects of this challenge: how to mainstream adaptation and resilience into financial decision-making, and how to scale private investment in adaptation and resilience solutions. The report provides an overview of the barriers and potential solutions to both, along with nine recommendations for donors to accelerate progress.

Understanding and managing physical climate risks

The private sector is increasingly expected to understand, disclose, and respond to two distinct categories of climate risk. Most firms have a more advanced understanding of *transition risks* relating to the economic transition to a low-carbon economy. However, the *physical risks* of climate change, such as impacts of changing rainfall patterns or increased storm severity are less well understood by most companies.

Adaptation and resilience are complex and private sector understanding of physical climate risks is growing but remains insufficient. Globally and especially in developing countries, too few companies are reporting on the physical climate risks they face, and the quality of this reporting remains weak. Understanding of vulnerability is a particular problem, with analyses frequently failing to address the underlying factors such as gender, socio-economic, or cultural status that means certain people tend to be worse affected than others in the same location.

As awareness grows, companies need to move from thinking about ‘adaptation of’ their operations, to the concept of ‘adaptation through’ their operations. This means acting in ways which strengthen the resilience of the communities, supply chains and workforce that they rely on.

Mainstreaming A&R into private sector financial decision-making

Individual investors and firms need to manage the risks from climate change that can affect their investments, businesses and supply chains. However, there are also wider systemic risks to communities, supply chains and economies from climate-related impacts such as changing rainfall patterns affecting agriculture or major storms or floods that can affect industrial regions. For this reason, regulators have a vital role in pushing companies to mainstream adaptation and resilience into their decisions.

The critical barriers to this mainstreaming include: i) weaknesses in the quality and availability of climate data down to local level in formats that are easy to use; ii) lack of awareness and knowledge, particularly of vulnerability and the complexity of intersecting climate risks; iii) limited transparency, with disclosure of physical climate risks still in its infancy; iv) weak incentives with climate risks often being seen as long term issues beyond the time horizon of business.

Nevertheless, there is a great deal of very promising activity underway and a set of emerging solutions. These include: i) industry and other initiatives to strengthen knowledge,

tools and best practice around managing physical climate risks; ii) voluntary and mandatory disclosure initiatives that have been very important in raising awareness amongst business; iii) investor and supply chain initiatives to address climate risks that can provide important incentives for businesses to think deeply about physical risks; iv) initiatives to address systemic risks to the financial sector including climate stress tests for insurance and financial sector institutions; v) national policies and regulation including climate change laws that address adaptation and resilience, and vi) green taxonomies that guide companies in understanding what activities or investments contribute to adaptation and resilience.

These initiatives are important, but there are two key weaknesses currently. Firstly, most of these initiatives are based in the global North and/or in multinational companies. Secondly, there is, so far, weak evidence about the effectiveness of these initiatives (little data about how widely they are used or how they affect decision-making). Donors can play an important role by supporting expertise in developing countries to develop and adapt tools and best practice to developing country needs. They can also play an important role in supporting developing country expertise to learn from and evaluate the effectiveness of these tools as part of accelerating mainstreaming of adaptation and resilience into financial decision-making.

Scaling private investment in A&R

Investment needs for adaptation and resilience vastly exceed the capacity of public investments and attracting private investment in adaptation and resilience solutions is essential. However, adaptation solutions are more diverse and locally specific than mitigation solutions, meaning markets have been smaller and more fragmented than for mitigation. Achieving the growth in private investment that is needed will require a massive effort by governments, regulators, financial institutions and businesses to create, shape and grow investable markets for adaptation and resilience goods and services.

The barriers to growing investment in adaptation and resilience solutions include: i) awareness and understanding of climate risk which is a barrier to developing projects and demonstrating the business case; ii) limited technical capacity to address climate risks and design and implement adaptation and resilience solutions; iii) limited market understanding which makes it harder for business offering adaptation and resilience good and services to start up, secure investment and to grow (especially SMEs); iv) challenges accessing finance and financial services, due to weak understanding by banks and financial markets and limited financial products tailored to adaptation and resilience markets; v) weaknesses in the institutions, policies and regulation which limit the number and scale of investible markets for adaptation and resilience solutions.

This last point is very important. Policy makers and regulators need to develop markets that enable attractive returns for providing goods and services that enhance the resilience people, infrastructure, economies or ecosystems. Annex A provides a list of potential adaptation markets, most of which would require proactive policy and regulatory action in most countries to realise their potential to attract investment.

The key solutions that can support this acceleration are emerging: i) translating national adaptation goals into clear investment priorities providing clear signals to the private sector; ii) proactively engaging private companies in developing countries on adaptation risks and vulnerabilities; iii) supporting bankable project pipelines; iv) using risk tolerant financial instruments to attract financing for adaptation and resilience investments; v) developing tailored financial products for specific risks such as resilient infrastructure bonds and weather insurance products; vi) supporting banking services for companies providing

adaptation and resilience goods and services; vii) enabling policies which encourage demand for adaptation and resilience goods and services.

Developing countries face the greatest adaptation challenges, particularly least developed countries, but these are also the ones with weakest private sector enabling environments and financial markets. Donors therefore have an important role to play in supporting developing countries to scale up of adaptation and resilience solutions. This includes increasing risk tolerance of key development finance institutions to increase investments in least developed countries.

Figure 1 (below) provides a diagrammatic summary of the barriers and solutions for mainstreaming adaptation and resilience (managing physical climate risks) in financial decision-making and for scaling private investment in adaptation and resilience solutions.

Our report offers nine recommendations for the role of donors to support private investment in adaptation and resilience (see chapter 5 for details):

Mainstreaming adaptation and resilience into financial decision-making

1. Ensure universal availability of quality data on climate risks covering vulnerability, hazards and exposure.
2. Support capacity to develop, adapt and implement tools to manage physical climate risks, and to build evidence about what works.
3. Support financial sector regulators in developing countries to drive understanding of physical climate risk including disclosure.

Scaling private investment into adaptation and resilience solutions

4. Support developing countries to translate adaptation priorities into financing and investment strategies.
5. Help developing countries create or shape private sector markets in key sectors to secure investment in adaptation and resilience.
6. Support national development banks and local commercial banks to invest in resilience and adaptation.
7. Develop climate risk mitigation facilities and increase risk appetite for MDB and DFI investments in LDCs.
8. Continue to support pipeline development for adaptation and resilience investments.

Cross-cutting

9. Mainstream private investment in adaptation into existing green growth and private climate finance projects

Figure 1: Summary of barriers and solutions for increasing private investment in adaptation and resilience

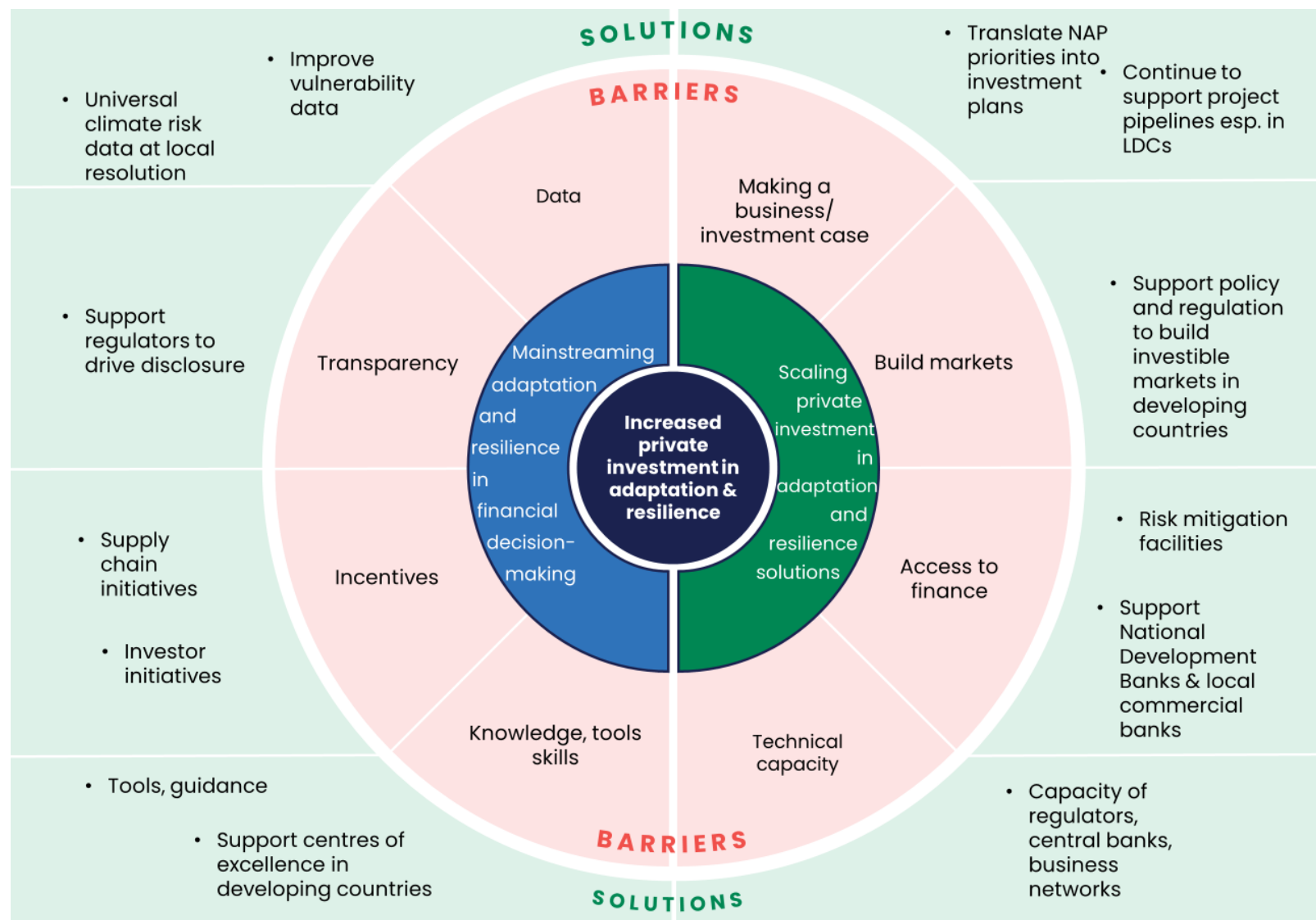


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List of abbreviations

A&R	Adaptation and resilience
CDP	Carbon Disclosure Project
DFIs	Development finance institutions
ECB	European Central Bank
EU	European Union
FCDO	Foreign, Commonwealth & Development Office
IIGCC	Institutional Investors Group on Climate Change
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
MDBs	Multilateral development banks
NDCs	Nationally Determined Contributions
OECD	Organisation for Economic Co-operation and Development
OPM	Oxford Policy Management
UNEP	UN Environment Programme

1 Introduction and methodology

1.1 Adaptation needs and investments

Climate impacts are being felt globally and are projected to get worse, even on optimistic assessments of future trajectories for global emissions. Current trends point to temperature rise in excess of 2°C in the period 2041-2060. By 2100, estimates range from 1.4°C for a very low GHG emissions scenario, to 4.4°C for very high GHG scenarios.¹ Projected adverse impacts and related losses and damages from climate change escalate with every increment of global warming. Every additional 0.5°C of temperature exacerbates 127 key risks identified by the IPCC, affecting biodiversity, water, food, human health and infrastructure.² Natural disasters doubled in the period 2000-19 compared to 1980-99. Climate-related disasters account for much of the difference, rising from 3,600 to 6,700, affecting 4.2 billion people, and resulting in almost USD 3 trillion in losses.³

Adaptation needs are enormous, growing and urgent: UNEP's 2023 Adaptation Gap report assesses current adaptation investment needs of developing countries to be between USD 194 billion and USD 366 billion a year⁷. Current investments fall way short of this need. International finance flows for adaptation are just USD 21 billion. CPI's latest data estimate that current investments are USD 63 billion⁴. There is a need for a massive scaling of capital for climate change adaptation. Although annual climate investment needs are large, the amount required is a fraction of the estimated losses likely to be incurred if we continue with business-as-usual investments that cause global temperature increases well above 1.5°C.⁴

There are strong benefits from early investment in adaptation and failing to invest in adaptation now will lead to higher costs in the future. The Global Commission on Adaptation highlighted the positive return on investment from adaptation investments. It found that a USD 1.8 trillion investment in key adaptation areas could yield USD 7.1 trillion in net benefits, with the benefit-cost ratio ranging from 2:1 to 10:1, and in some cases even higher.⁵ The five investments the Global Commission report showcases are early warning systems, climate-resilient infrastructure, improved dryland agriculture, mangrove protection, and investments in making water resources more resilient.⁵ Where granular data exists, this global opportunity is increasingly being translated into local stories on the benefits of early investments in resilience. In the United States, for example, the National Institute of Building Sciences estimates investing in physical assets to support climate resilience saves up to USD 10 per USD 1 invested⁶.

Despite the clear signs of accelerating climate risks and impacts worldwide, the adaptation finance gap is widening, and now stands at between USD 194 billion and USD 366 billion per year. Adaptation finance needs are 10-18 times as great as current international public adaptation finance flows – at least 50 per cent higher than previously estimated.

UNEP Adaptation Gap Report 2023.⁷

Most tracked investment in adaptation currently comes from the public sector, and there is little prospect of the public sector filling this investment gap. The report notes the lack of robust data on the scale of private investment in adaptation,⁷ The Adaptation Gap report notes that data tends to miss investments by companies through their own balance sheets; furthermore, small and medium-sized enterprises tend not to disclose climate investments. But unless the underreporting of private investment is massive, public

investment still accounts for the vast majority of investment in adaptation.⁴ However, there is little prospect of public funds being able to expand to fill the adaptation gap – this makes expanding private investment in adaptation critical.

1.2 Methodology

This study was undertaken over an eight-week period. There were five main steps to the methodology:

- 1) Literature review and evidence analysis by the team.
- 2) Analysis of data:
 - a. Mainstreaming adaptation and resilience into financial decision-making: map key policy, regulatory, supervisory, risk assessment and disclosure frameworks for influencing adaptation and resilience; assess their adequacy and evidence they are being applied; assess the gap between need and current application.
 - b. Scaling private investment in adaptation and resilience solutions: summarise/categorise climate risks; barriers to adaptation and resilience investment and summarise solutions and business models; identify current interventions to accelerate private investment and assess their adequacy.
 - c. Recommendations: prioritise options for accelerating progress; assess the role of donors/ international community in the prioritised actions (e.g., multilateral development banks (MDBs), the International Monetary Fund (IMF), development finance institutions (DFIs), bilateral donors, foundations etc.) in undertaking / supporting the actions needed; recommend optimal approaches.
- 3) Identification of key themes and emerging findings by the team and discussion with FCDO staff in three mini-workshops.
- 4) Limited set of targeted interviews with key stakeholders.
- 5) Refining and finalising recommendations, including final workshop with FCDO.

1.3 How to navigate this report

In addition to this introductory chapter, this report has four parts:

- Chapter 2 focuses on the understanding of adaptation and resilience risks by the private sector.
- Chapter 3 explores the issues of mainstreaming adaptation and resilience in financial decision-making.
- Chapter 4 examines the scope to scale private investment in adaptation and resilience solutions.
- Chapter 5 concludes with recommendations for accelerating progress on private investment in adaptation and resilience.

2 Understanding adaptation and resilience risks

2.1 Private sector awareness of adaptation and resilience risks

The physical risks of climate change have leapt up the agenda in recent years, for a series of reasons:

- 1) The increase in costly weather events attributed to climate change.
- 2) Initiatives such as the Task Force on Climate-related Financial Disclosure have helped raise awareness that businesses need to take these risks seriously.
- 3) Regulators are becoming alive to the physical risks climate change poses for their economic sectors, responding with regulatory tools.
- 4) Consumers are becoming more aware of adaptation challenges and hold companies responsible for managing climate risks within their business operations and supply chains that may impact communities

Private sector awareness of the need to address adaptation and resilience is limited but growing. A range of drivers are pushing larger private sector players to mainstream climate risk into enterprise risk management⁸ (see Box 1); and to recognise the need to enhance adaptive capacity in companies, global supply chains, and frontline communities. This means they: i) **analyse the physical climate risks** they face, understanding the complexities and vulnerabilities; ii) **invest in positive solutions** that address these risks; iii) **avoid investments that are maladaptive** (make things worse) for either their operations or for other people, businesses or ecosystems.

Climate risk worsens a wide range of business risks. At the micro-economic level, climate risk has been mapped against and seen to increase risk, across 64 separate business risk vectors (spanning strategy, operations, finances, human resources, marketing and sales, and compliance and legal). For example, companies may experience operational disruptions from damage to vital infrastructure caused by climate hazards; production shortfalls and procurement problems when workers, communities and resources that serve the supply chain are adversely impacted; and logistics failures when transport routes are shut down by extreme weather.

Box 1: Private sector leaders are recognising the materiality of climate risks

The World Economic Forum gathers views annually on the evolving global risks landscape from business leaders across 121 economies. The World Economic Forum's 2023 Global Risks Report⁹ reflects views from thousands of business leaders across these economies. Climate risks dominated the list of the top ten risks and were identified as the risks for which the private sector feels the least prepared.

BlackRock calculates a 275 per cent increase in major hurricane risk by 2050; the Financial Stability Board estimates the total stock of manageable assets at risk to be USD 43 trillion, between now and the end of the century. Swiss Re has concluded that alterations in land and ocean ecosystems and the associated acceleration of biodiversity loss will jeopardize USD 42 trillion of global GDP.

The near-term outlook is equally troubling. Analysis by Mercer, the world's largest human resources consulting firm, estimates the cumulative global cost of climate change related impacts on the environment, health, and food security will reach USD 2-4 trillion by 2030.

Almost 8000 companies have signed-up to the gold-standard Science-based Targets Initiative, with 3000 of these committing to net-zero greenhouse gas emissions no later than 2050.¹⁰

2.2 Defining adaptation and resilience

Defining adaptation itself can be a barrier because the definition has been complex, unclear and contested. Historically, the IPCC has defined resilience as 'the ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions'.¹¹

The IPCC Sixth Assessment Report presented the concept of 'climate resilient development' as an integrated process of reducing greenhouse gas emissions to avoid unmanageable climate change (decarbonisation), while enhancing capacity to moderate harm from unavoidable climate change (adaptation). The IPCC describes *physical climate risk* as the result of dynamic interactions between *climate-related hazards*, *exposure* to those hazards, and the underlying *vulnerability* of the affected human or ecological system that makes them more susceptible to harm.

Adaptation is the process of adjustment to actual or expected climate change and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. One way to understand this is through investing in six so-called 'Capital Assets' to enhance adaptive capacity.¹² These are interdependent capacities that, together, address the underlying causes of vulnerability such as poverty, inequality, and environmental degradation. The six capital assets are: **human, social, natural, physical, financial** and **political**. This analytical approach was first developed as part of a systems approach to understanding resilience to flood-related shocks and stresses, developed by the Zurich Flood Alliance in 2016¹³ and has since become widely used.¹⁴

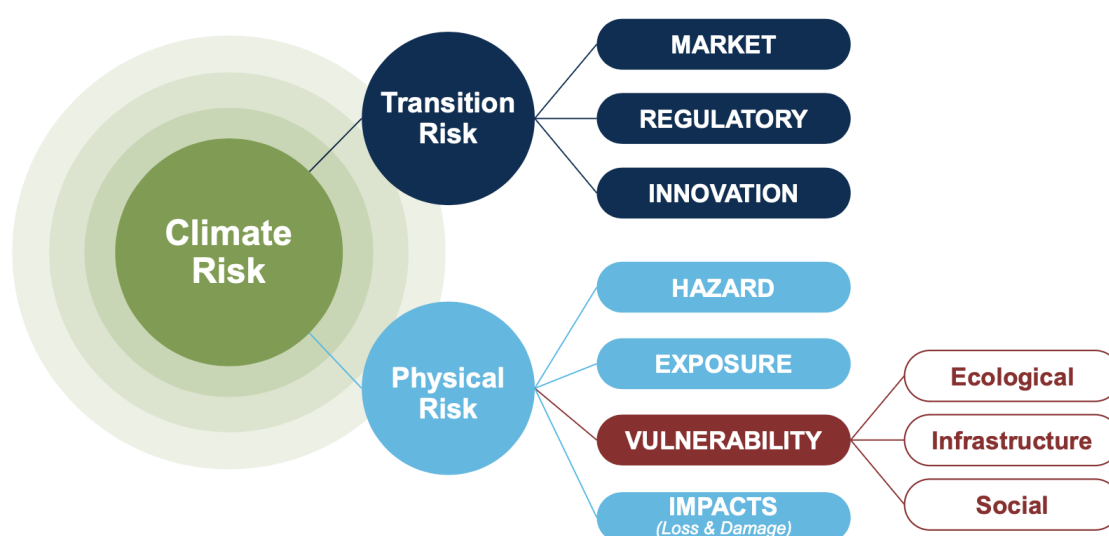
2.3 Understanding adaptation and resilience risks

Increasing private sector investment in adaptation requires a robust understanding of climate risk, and an expanded sense of the foundational building blocks of climate

resilience. Whilst understanding of risk in the private sector is growing, it remains weak overall; firms are lagging behind in addressing risk and enhancing adaptive capacity⁷.

The private sector is expected to understand, disclose, and respond to two distinct categories of climate risk.¹⁵ *Transition risks* are the policy, legal, technological, and broader market drivers that are designed to sunset the high-carbon economy of today, and catalyse the development of the low-carbon and resilient economy of tomorrow. *Physical climate risks* are the potential for adverse consequences for human or ecological systems resulting from climate change (See Figure 2).

Figure 2: Climate risks faced by private companies



Importance of understanding vulnerability: according to the IPCC, in the near term (up to 2040), the scale of climate risk depends more strongly on changes to vulnerability and exposure than on differences in hazards between emissions scenarios.² This means addressing issues such as the absence of human rights and the presences of structural inequalities becomes central to managing climate risk.

These three dimensions of climate risk (vulnerability, exposure and hazard) result in *impacts* – the consequences of realised risks on natural and human systems.

Observed impacts on human systems already include: increased morbidity and mortality from extreme heat and weather; an increase in climate-related food-borne, vector-borne, and water-borne diseases; increased water insecurity; a decrease in food production in some regions leading to climate-driven food insecurity, supply instability, and malnutrition; flooding in coastal and other low-lying cities and regions; and increase in climate-related involuntary migration and displacement.²

2.4 Deepening understanding of resilience: moving from ‘adaptation of’ to ‘adaptation through’

Private sector interventions in adaptation and resilience can have positive and negative benefits on other companies, neighbouring communities, ecosystems and economies. Therefore, private sector approaches and government regulators need to consider these

wider impacts to ensure that the solutions chosen are beneficial for companies and society more broadly. One way to think about who benefits from adaptation interventions is the concept of ‘adaptation of’ (or ‘resilience of’) and ‘adaptation through’ (‘resilience through’) – see Box 2.

Box 2: Understanding ‘resilience of’ and ‘resilience through’

Historically, companies had a narrow understanding of the boundaries of both risk and adaptation, and therefore sought to enhance the **resilience of their own operations**. This might involve, for example, building flood defences around their site, reinforcing concrete walls of factories in the face of extreme weather, or building dams to secure scarce water supplies. However, these solutions frequently proved ineffective or counterproductive (‘maladaptive’).

Onsite flood defences and reinforced concrete would protect factories, but not the workers who staff the assembly lines. This would mean that after a storm, the facility was intact – but production was still halted, because workers were trapped in communities impacted by the storm. Similarly, mining companies that built dams to provide water for the extraction of lithium secured their own water supplies, but elevated tensions with water-stressed neighbouring communities, leading to reputational damage with investors and communities.

Consequently, more thoughtful companies began to look for ways to protect their assets *and* build the resilience of communities. This would mean building **resilience through their interventions**. For example, investing in nature-based solutions, such as restoring wetlands, mangroves and aquifers, would help to secure their own water needs while expanding water access for communities and generating other sustainability co-benefits.

Another way of looking at the same issue is to consider three types of interventions companies can make in adaptation and resilience:

1. **Adapting companies’ own operations to be more resilient.** This involves companies implementing adaptation solutions to make their own operations and supply chains more resilient, and to avoid disruptions and loss of profits from climate risks. Such activities are categorised as ‘adapted activities’ under the EU sustainable financing taxonomy.
2. **Provision of adaptation solutions.** This involves enterprises in the real economy that produce adaptation goods and non-financial services, such as flood forecasting, drought resistant seeds, etc. Such activities are categorised as ‘adaptation enabling activities’ under the European Union (EU) sustainable financing taxonomy,
3. **Provision of finance for adaption solutions.** This includes commercial banks, microfinance institutions, or investors offering financial products for others to implement or enable adaptation solutions. This could range from microfinance and mobile banking to support smallholder women farmers, to funding of a desalinisation plant, to supporting mass restoration of mangroves and wetlands. It should also consider ways to make existing assets more resilient in the face of changing climate risks. For example, the changing nature of North Atlantic hurricanes mean a more loss and damage is caused by flooding rather than high wind speeds. This poses challenges for the insurance industry and communities, as historically, infrastructure including homes has been covered for wind insurance but not for flooding¹⁶.

3 Mainstreaming adaptation and resilience into financial decision-making

3.1 Introduction

Mainstreaming understanding of climate risk and adaptation into financial decision-making means ensuring that businesses understand and act on the physical risks of climate change as part of their enterprise risk management. Mainstreaming matters because, as chapter 2 shows, failure to address physical climate risks can threaten the viability of investments, companies, industries, supply chains communities, economies or even countries (for example, low-lying small island states).

Figure 3: The ecosystem for mainstreaming adaptation and resilience risks in financial decision-making

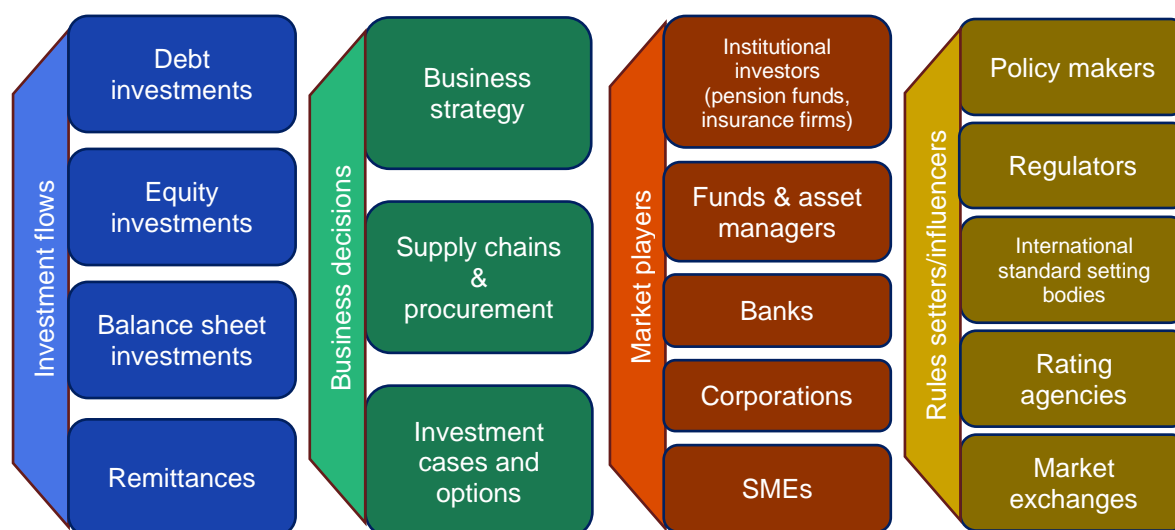


Figure 3 sets out elements of the ecosystem for mainstreaming: **investment flows** (including debt, equity, balance sheet investments and remittances), **business investment and purchasing decisions**, **private sector market players**, and the **organisations that set and influence market rules**.¹⁷

All these actors and elements of the ecosystem must be considered. It is important to consider balance sheet investments, not just ‘flows’ of debt and equity. Similarly, national investments and business matter as much or more than international or multinational businesses. Finally, it is understandable that attention is paid to large companies’ business decisions and investments – but SMEs are critical for livelihoods in most countries, and their decisions related to climate risks have major cumulative impacts.

3.2 Barriers to private sector understanding & management of physical risks

Compared to transition risks and carbon reduction, adaptation and resilience are more complex concepts, requiring a wider variety of interventions, all of which are locally specific

and require bespoke analysis. This is very challenging for all companies, even the largest. A review of 2000 voluntary disclosure reports from 2019 concluded that companies underestimate the cost of climate change, misdiagnose climate risk, and strategies for resilience are pursued sporadically and inconsistently²³. There are a number of important barriers to private sector companies understanding physical risks:

Lack of data. Absent or poor data, or lack of data that is accessible or usable by the private sector is an important barrier. There are weaknesses in data quality, availability, reliability and time-lags impact the scope and extent of scenario analysis and the disclosures on metrics and targets. Data on climate risks is often scattered (for example, data on hazards and exposure and data on vulnerability may be held separately and in different formats). Climate data is often not available at local resolutions needed to understand climate impacts on business operations. There is a need for publicly available and regularly updated data, in formats that are accessible to the private sector, covering hazards, exposure and vulnerability.

Lack of awareness and knowledge. Companies struggle with the complexity of intersecting climate risks and impacts. Corporate understanding of physical climate risk skews towards a focus on exposure of assets to climate hazards, with little attention to underlying vulnerability – particularly the underlying weaknesses within workforce and frontline communities. The IPCC has identified ‘failure to address social vulnerability’ as a critical capacity gap that hinders adaptation².

Limited transparency. It is well established that the disclosure initiatives have been important for driving awareness and early action on physical climate risks so far. However, the level and quality of disclosure remain limited, even in OECD countries. Disclosure requirements have been mostly voluntary so far, although over the last year or two, OECD countries have started to introduce mandatory disclosure requirements.

Weak incentives. Businesses often seek to ensure break-even on new investment in short time periods which can make longer term investments in adaptation less viable. In countries with high financing costs (characteristic of most developing countries) these timelines can be contracted further to reduce the time to break even, compounding the problem. More importantly, given the fact that addressing adaptation and resilience risks can have important medium to long-term environmental, social and economic benefits or costs, there are important reasons to drive private sector action further and faster than the private sector would do on its own, or than voluntary initiatives alone will enable.

3.3 Existing frameworks and initiatives for mainstreaming adaptation and resilience into financial decision-making

These limitations in the way adaptation and resilience risks are assessed and managed are recognised by many government, industry and financial sector leaders. There are therefore a wide array of initiatives seeking to address the problem. Table 1 provides an overview of these initiatives along with examples.

Table 1: Current initiatives to promote mainstreaming of adaptation and resilience risks in financial decision-making

Barriers	Approach	Examples
Lack of data	Strengthen data availability	Vulnerability and risk assessments (e.g., Nepal has vulnerability and risk information, but only limited local level data) National data platforms
Lack of awareness and knowledge	Knowledge, tools, best practice	Network for Greening the Financial System UNEP-FI Adaptation and Resilience Investors Collaborative (ARIC) database of climate risk tools Various peer networks, e.g., Global Adaptation & Resilience Investment Working Group Industry body groups (insurance industry, institutional investors, etc.)
Limited transparency	Disclosure	Task Force on Climate-Related Financial Disclosures Task Force on Nature-based Financial Disclosures Carbon Disclosure Project (CDP) Securities and Exchange Commission mandatory disclosure regulation
Weak incentives	Investor initiatives	Institutional Investors Group on Climate Change Adaptation and Resilience Investors Collaborative
	Supply chain initiatives	Unilever sustainable sourcing Better Cotton
	Financial sector initiatives	The World Bank Risk Stress Test Bank of England Climate Biennial Exploratory Scenario European Central Bank economy-wide climate stress test
	National policy and regulation	Various country/ regional taxonomies (e.g. Sri Lanka Green Taxonomy , EU taxonomy , ASEAN taxonomy) International Platform on Sustainable Finance Climate change laws (UK, China, Chile, Bahamas) Nationally Determined Contributions (NDCs) National Adaptation Plans

Strengthen data availability

Ensuring available, accessible data

This is a critical priority, and a foundation for other action. Developing countries need to be supported to ensure publicly available climate data in a form that enables private sector players to interpret that data. The tools to address absence this exist, but the effort to address the problem is scattered. Investment is needed to ensure there is universal availability of good quality data, at local levels of resolution which includes vulnerability information. Furthermore, the data needs to be embedded in national institutions that can gather, hold, curate and update this data. Finally, the data must be local, but internationally comparable.

A multi-donor push to systematically address this issue can help overcome the problem that the most vulnerable countries tend to have the worst available data. The climate data that is needed by the private sector is also needed by the public sector for priorities including Early Warning Systems and social protection so a push to achieve universal coverage is likely to be widely accepted.

Knowledge sharing, tools, best practice

There is a huge amount of work underway to develop tools to help businesses and financial institutions assess and manage physical climate risks. Many new industry peer groups and networks have developed tools and guidance. Many of the initiatives underway are new, and innovation is taking place fast as recognition grows about the scale and urgency of the problem and the opportunity of private investment in adaptation and resilience solutions.

However, despite such innovation, these are largely focused on large, global companies and there is still much more to do to: i) ensure tools are adapted to different sectors and types of decision-making; ii) adapt tools to different geographies, especially developing country needs and contexts; iii) ensure tools are based on the most up-to-date science; iv) build evidence of the effectiveness of the different tools.

There are some limitations of existing risk assessment tools. **Climate risk assessments tend not to address the complexities of interactions and networks.** A recent evaluation of 16 Climate Risk Assessment tools, frameworks and resources found that most tools fail to adequately account for vulnerability; they over-emphasise quantifying risk and measuring adaptation outcomes, leading to techno-economic measures that may ultimately result in maladaptation; and they fail to compound and cascade risks across sectors and regions. A separate review of 120 climate risk assessment methodologies,¹⁸ a review of resilience measurement frameworks,¹⁹ and commentary from experts in the climate risk assessment space came to similar conclusions.²⁰

Donors can support this transformation through expanded technical assistance facilities, and by enabling multi-stakeholder partnerships and lesson-learning between leading banks, companies, and think tanks in developed countries with those engaged in science, policy, and adaptation practices in emerging markets and developing countries.

Disclosure

Compelling companies to disclose climate risk is an increasingly popular instrument within the regulatory toolbox. The Task Force on Climate Related Financial Disclosures established a market-driven initiative in 2016, with guidelines for voluntary consistent climate-related financial risk disclosures in mainstream financial filings¹⁵. However, there are big variations in the quality of disclosures; many fail to provide meaningful information for investors. Banks, energy, manufacturing, telecommunications, technology and transportation companies tend to score higher for their disclosures.

What started as a voluntary set of guidelines is now increasingly turning into mandatory rules. As of March 2024, Brazil, Hong Kong, Japan, New Zealand, Singapore, Switzerland, the UK, EU and the US have made Task Force on Climate-related Financial Disclosure reporting mandatory for certain entities.²¹ In the US, the Securities and Exchange Commission published its new climate disclosure rules on 6th March 2024²² requiring public companies to disclose climate-related risks that have had or are reasonably likely to have a material impact on business strategy, operations, or finances condition. The US requirements include disclosing activities to adapt to a material climate-related risk, the expenditures incurred; and company processes for identifying, assessing, and managing material climate-related risks.

Moreover, the recent growth in climate-related financial disclosure creates a business-to-business pressure to understand and manage climate risk. By October 2021, 1,069 financial institutions responsible for assets of USD 194 trillion had committed to implement the TFCF's recommendations.²³ However, in its 2023 and final status report, the TFCF found

that disclosure against company strategy resilience to be the weakest of the disclosure categories: 'The least disclosed recommended disclosure for all three years reviewed was the resilience of companies' strategies under different climate-related scenarios, with only 11% disclosing this information in 2022'.²⁴

Despite the limitations of disclosure reporting so far disclosure remains very important for driving awareness, quality of analysis and skill improvement in the private sector. It also supports investor and supply-chain initiatives. Driving disclosure in developing countries in appropriate and tailored ways is particularly important for improving private sector resilience to climate change. It is particularly important to avoid the notion that addressing physical climate risks that only big, rich or Western companies need to do. It is therefore important to support developing country leaders and voices to encourage disclosure. It will also be important to support developing country regulators to encourage and incentivise disclosure for large companies and companies in high-risk sectors.

Investor initiatives

The growing awareness of physical climate risks by large companies has led to a wide range of investor initiatives to develop tools for understanding climate risks for different asset classes, sectors, geographies, and investor types. A number of investors are seeking to improve the resilience of their portfolios by proactively seeking green investments,²⁵ and requiring more detailed analysis and disclosure of physical climate risks from their investees. Investor networks such as the UNEP-Finance Initiative Adaptation and Resilience Investors Collaborative and Global Adaptation & Resilience Investment Working Group are developing investor guidance and tools, to help investors understand resilience risks in different sectors and asset types.^{26, 27}

Whilst there is limited evidence on the impact of these initiatives, there is evidence that investor initiatives are having an impact on the behaviour of large corporations, and in turn creating pressure for action through supply chains. For example, the Panama Canal Authority plans to integrate adaptation spending into over USD 8.5 billion in expected capital investments through the next five years.²⁸

Launched in 2017, sustainability-linked finance has become the fastest-growing sustainable finance instrument, with over USD 809 billion issued up to January 2022. Sustainability-linked finance mobilises capital to support the borrower's improved environmental, social, and governance performance. These financial instruments incentivise the pursuit of sustainability targets by tying pricing – usually through interest rates – to the achievement of both qualitative key performance indicators and quantitative sustainability performance targets across a range of sustainability issues.

Supply chain initiatives

The private sector is increasingly taking a lead in enhancing adaptation across complex global supply chains, sometimes in the form of so-called collaborative initiatives, designed to aggregate the influence of multiple companies; on other occasions, with direct intervention through a vertical supply chain; through a variety of market-based mechanisms and conditionalities; and finally, through corporate philanthropy. Collaborative initiatives are now operating across most industries and cover both mitigation and adaptation. Some examples include:

- Companies in the consumer products and food sectors using the Global Organic Textile Standard, Textile Exchange's Organic Content Standard, and the Better Cotton Initiative.²⁹

- The Climate Smart Mining Initiative, established jointly by the World Bank and International Council on Minerals and Metals, with participation from leading mining companies and governments. The initiative focuses on the 17 critical minerals and metals that are essential for decarbonization and looks at how to make mining communities more resilient. Today, this involves work across the Lithium Triangle in South America (Bolivia, Argentina and Chile) and the Copper Belt that spans the Democratic Republic of Congo and Zambia.³⁰

Direct interventions to enhance the adaptive capacity of a company's own supply chain are also growing. For example, Anglo American is working on the concept of a 'waterless mine', to enhance natural capital covering water volumes and access for its own operations and for neighbouring communities.³¹ In the aftermath of Typhoon Haiyan in the Philippines in 2013, Coca-Cola provided direct cash injections into small businesses who sell Coca-Cola products in the Philippines, as a stimulus to enhance adaptive capacity and get these businesses back up and running and selling drinks again.³²

The Panama Canal Authority manages a watershed spanning almost 3000 km², providing drinking water for more than 50 per cent of Panama's total population. The Authority works to enhance adaptive capacity across the six capital assets. For example, it provides payment for ecosystem services to encourage the uptake of sustainable agriculture and protect water availability and quality for both its operations and those depending on the watershed for potable water.³³

Financial sector initiatives

Macro-financial regulation aims to mitigate systemic risk to the financial system. Banks are already required by regulators to carry out stress tests for financial risks, to test whether they have enough capital to survive a crisis scenario. There are now moves to stress test for climate risk. In June 2021, the Bank of England announced that it was undertaking the first comprehensive stress test of climate risks for the UK's biggest banks and insurers. This would test viability under three scenarios: early global action to cut carbon dioxide emissions; delayed action; and no action beyond what is already committed³⁴. The ECB is undertaking stress testing at the time of writing³⁵, while the People's Bank of China has already conducted stress tests³⁶. As with other stress tests, central banks could use the results to impose new requirements on commercial banks to hold more capital, if their existing investments are considered high risk.

National policy and regulation

Many of the initiatives documented are global in nature, driven by international organisations, investors or large companies. However, action is needed at national level for developing countries to ensure that private sector companies in their countries are effectively understanding and managing adaptation and resilience risks. This action starts with high-level policy signals, through national adaptation plans and associated tools. According to UNEP, 85 per cent of countries have established at least one national adaptation plan, strategy or policy, and just under half of them have two or more national-level instruments. Moreover, 25 per cent of countries have put in place legal instruments that require national governments to plan for adaptation.⁷ However, action by industry and business policymakers and regulators will also be needed.

Taxonomies There is a need to develop national and regional taxonomies which identify activities that contribute to building climate adaptation and resilience. Such taxonomies allow governments to identify target areas for climate adaptation and resilience investment; they also help financial institutions and regulators measure the alignment of financial flows with climate goals. In addition, taxonomies provide a framework that can serve as the basis for

labelling standards. There is a lot of diversity and innovation in taxonomies currently, and there is scope for common elements of best practice to be adopted across countries to make compliance by companies easier.

3.4 Developing evidence on what works

A key broader point that cuts across the barriers and initiative for mainstreaming adaptation and resilience into financial decision-making is weakness in evidence of what works. There is abundant literature about initiatives and the need for action, much of which is captured in our references (41). Some organisations are seeking to collate, organise and categorise the tools and knowledge available (for example, the UNEP-Finance Initiative's database of 60 risk assessment tools under the Adaptation and Resilience Investors Collaborative).

However, there is very weak evidence about the extent of uptake of the various tools and initiatives, such as how many companies are using them. There is even less evidence on their effectiveness. Nor is there yet meaningful data on the quantum of resources that are shaped by better understanding of physical climate risks. Whilst this is partly because many of these tools are very new, the lack of evidence is a major gap, and is likely to slow the pace of adoption. There is a need for systematic learning, evaluation and research that will support rapid evolution and update. This work should include, and preferably be driven by, organisations based in the global south.

Whilst there is little evaluative data, Table 2 provides our assessment of the coverage and influence of different initiatives on decision-making. These assessments can also change according to the way initiatives are implemented, for example, voluntary standards can be made mandatory by regulators, which may change their coverage or influence.

Table 2: Adequacy and implementation status of current frameworks

Framework	Coverage	Voluntary/ Mandatory	Influence on decision-making	What more is needed?
Knowledge sharing, tools for businesses	High	Voluntary	Low – skills to apply tools take time to develop	'Global south' capacity to develop, refine and adapt tools and best practice to their contexts. Support evidence generation to understand what works.
Disclosure	Medium	Mostly voluntary in developing countries	Medium	Continue to support disclosure, drive quality and support feedback loops (e.g., analyses of disclosure report, investor use of them).
Investor initiatives	Medium	Mandatory	Medium-high	Encourage continued investor and supply chain initiatives. Ensure regulation is compatible and supportive.
Supply chain initiatives	Low-medium	Voluntary	Medium-high for downstream supply chain to comply	
Supervision	Low	Mandatory	Medium when results published	Encourage development of tools for central banks in developing countries.

National policy and regulation	High	N/A	Medium	Support developing country leadership, regulatory capacity and policy maker/regulator peer networks.
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Developing country leadership

A particular role for the international community may be in supporting governments to establish high-level policy signals on this issue, and support policymaker and regulatory capacity. Adaptation and resilience leadership is currently mostly coming from companies and regulators in OECD countries. This is a point the authors have picked up at multiple points in this report given its importance. Supporting developing countries' capacity and leadership amongst policymakers, regulators and the private sector will strengthen the generation of solutions appropriate for developing countries, and ensure their implementation is appropriate to different developing country contexts.

4 Scaling up private investment in adaptation and resilience solutions

4.1 Introduction

There are signs of growing international momentum behind private investment in adaptation, but the levels of investment remain tiny compared to need. There is an urgent need to mobilise private finance given limitations to public and donor financing available to respond to climate resilience and adaptation challenges. This requires significant scaling of private finance for climate adaptation and resilience. In this section we highlight the major barriers to this scaling, solutions to address these and promising initiatives.

4.2 Key barriers to scaling private investment in adaptation and resilience solutions

The private sector and its diversity of actors play multiple roles in building climate resilience. Enterprises can both consume or produce goods and services which help to build resilience to climate change. The past five years has witnessed more private sector financing into adaptation in sectors highly disrupted by climate change – such as food production, water, infrastructure and disaster risk management. In Annex A, we further break down these sectors into potential investment opportunities, highlighting some of the main barriers to investment. Addressing the acute underinvestment in goods and services that builds resilience to climate change requires overcoming multiple barriers.

Barriers exist – relevant to both public and private investment – that are preventing or slowing the adoption of adaptation practices, services, and technologies at the required scale, especially in developing countries^{37,38}. Some of the key barriers are illustrated in Figure 4, and further detailed below.

Figure 4: Barriers to engagement and investment in climate adaptation



Awareness / knowledge of climate information and adaptation options

As chapter 2 and 3 have illustrated, companies are limited in their understanding about how and why they should invest into adaptation solutions, due to a lack of information and understanding of current vulnerabilities and predicted future impacts of climate change. There is very little available data and information at sector-level on climate risks to appropriately inform investment decisions.

There is a general lack of awareness of both risks and opportunities of climate change, and poor availability of reliable and accurate data on vulnerabilities and risks. Climate models are complex and require advanced skills to interpret them effectively. Where data does exist, 'translating' it into sector-specific analysis or shorter time horizons is rarely facilitated. In addition, there remains a lack of investment-relevant and usable tools, such as risk assessment tools, to integrate considerations of long-term climate trends into site-specific decision-making. Operationally, there is a limited number of analytical providers that can assess physical climate risks. Sources of data are different, and there is an asymmetry of information across different datasets on climate risks and risk-mitigation measures.³⁹ Even where the risks are evaluated, they can be costly – this acts as a further disincentive to businesses investing in climate adaptation.

Technical capacity

Within companies, there is a general lack of awareness and capacity to respond to climate risks, particularly for SMEs. Within businesses there may be inadequate legal, technical, and financing expertise to produce high quality climate-relevant business and investment propositions. There may also be a lack of expertise to implement these new, more resilient practices. To build awareness and interest amongst companies, it is necessary to highlight the potential extent of the risks, and the business case for change.

Business / investment case barriers

The benefits of climate-resilient investments typically manifest over longer timeframes, while businesses face pressure to make investment decisions based on short-term factors. Climate risks and uncertainties are neither adequately understood, nor accurately priced into financial models and projections. Adaptation metrics can be more complex to define and may be case-specific. This makes it even more challenging for businesses and investors to appraise the contributions (in terms of climate adaptation) of their projects, and for enterprises and financiers to compare alternative investment options. This combination of factors means that businesses providing adaptation and resilience goods and services are less likely to develop, and investors are less likely to invest. These barriers are considerably more significant for SMEs in developing countries.

Early-stage and innovative resilience and adaptation technologies and services often take time to achieve market acceptance, and in some cases the demand for them is still very nascent. The limited investable prospects for adaptation action are exacerbated by several additional factors common across developing countries. They tend to have smaller economies, fewer business players, and underdeveloped financial and capital markets.⁴⁰ Furthermore, commercial financiers often lack the risk appetite to design tailored investment solutions, to overcome the traditional financing constraints of SMEs which are important in the sectors most vulnerable to climate change, such as agriculture, water, and land use.⁴¹ SMEs are side-lined from investment opportunities because of their relatively small size (leading to higher transaction costs), and by their risk profile (as a result of a lack of financial records and information, weak governance, minimal accounting functions, and poor ability to show or provide collateral).

Finding investment for climate-resilient infrastructure projects is extremely challenging, as it requires large initial investments and, in most cases, long-maturity financing to match the long payback period over which the project becomes commercially viable. Commercial viability is also tied to project revenue generation (such as user charges), susceptible to political and regulatory risk. Traditionally, most large infrastructure projects and services have been provided by public bodies, who do not meet the operating standards of investors. To incentivise the private sector requires robust public-private partnerships, where the public body continues to play an enabling role. These complexities and risks deter investor appetite.

Access to finance and financial products

Adaptation technologies face many of the same generic financial barriers as private sector investment in developing countries. The high cost of capital in most developing countries and the high transaction costs associated with disaggregated (often small) investments, often unfamiliar to the investor, result in costly high-interest rates. Short repayment periods (typically under 12 months) are standard for many developing countries' banks, which are faced with their own capital constraints, and likely to be unfamiliar with the cash flow of adaptation-specific businesses or investments. Collateral requirements from banks often disadvantage many small businesses, and as with the capital and prudential constraints placed on banks, many of these barriers derive from financial legislation. These barriers are particularly restrictive for SMEs in developing countries, due to their limited financial capacity to fund upfront costs of investment and lack of collateral.⁴²

Climate adaptation-based start-ups often have no track record, and there is a prevailing caution over financing early-stage technologies. The absence of early-stage private equity firms or venture capital will stifle entrepreneurs entering the market. There is also a lack of innovative financial products available in many developing countries' markets which can help to deal with climate risks. One obvious market is insurance; such markets are typically undeveloped and expensive, making the transfer of risk through insurance inaccessible or unaffordable.

Institutions, policies, and regulations that support investment in adaptation

Private capital responds to the incentives generated by regulatory and policy frameworks. Current regulatory frameworks in developing countries may discourage climate-resilient practices – for example, subsidies for agriculture and water-use hinder the switch to more sustainable and resilient practices. This is exacerbated by a lack of strong 'business multipliers' to help enterprises, including sharing information on climate change, commodity platforms for establishing a joint strategic direction or membership, or basic project preparation facilities to help companies attract investment for more climate-resilient goods and services.

More broadly, private capital requires a stable investment environment, in which investors can trust governments to provide a degree of regulatory stability, enforceable laws, and the protection of property rights (both intellectual and physical) among other factors, with effective regulations and political stability particularly important to foreign direct investment. The main risks relate to regulatory, foreign exchange and sovereign risk. While significant adaptation investment will be needed in the developing world, these countries often score poorly on the metrics which are essential to stimulating investment. Many of the most vulnerable countries and markets which are most in need of building a more resilient economy are also the markets perceived to be the riskiest to investors.

The business-enabling environment itself may have weaknesses requiring reform, such as taxation, fees, or misallocated subsidies; business regulations, tariff and nontariff barriers, and planning and zoning regulations (for example, facilitating maladaptive coastal development); and weak property and intellectual property rights, which can be further compounded by weak contractual enforcement and access to legal support (something that might be especially critical for forming and delivering complex PPPs). Strong regulatory bodies are required to enforce these regulations, which may also be lacking in developing countries.

4.3 Solutions, projects and business models to attract private investment into adaptation and resilience

There are promising trends to help overcome the barriers and stimulate private finance for adaptation. This section provides evidence through a selection of case studies which highlight key implementing actors, the activities, and examples of implementation. Table 3 provides an overview of these with more detail in the rest of the section.

Table 3: Key initiatives for scaling private finance for adaptation and resilience

Barriers	Solution	Examples
Clear policy signals	Translating climate adaptation priorities into financing/investment strategies.	NDC investment plans
Awareness and knowledge, technical capacity	Sharing of climate information on exposure, vulnerabilities and targeted outreach to companies	Climate data
	Disclosure of climate risks	CDP
Access to finance	Supporting bankable climate smart business and investment cases	The Dutch Fund for Climate and Development. World Bank Climate Innovation Center
	The use of risk tolerant financial instruments	Blended finance instruments, Climate Investor 2.
	Development of climate risk mitigation financing products	Climate insurance, parametric insurance, climate bonds.
Institutions, policies, and regulations	Enabling policies to stimulate climate A&R investment	National and sectoral regulation to build investible markets
	Banking regulations and supervision	Bank of England climate-scenario analysis and stress testing

Translating climate adaptation priorities into financing/investment strategies

Over the past decade, there has been increased support to countries to communicate their adaptation intentions, including their NDCs and NAPs. While adaptation planning has improved understanding of the nature of climate risks, countries must now translate adaptation priorities into actual financing and investment. Only one-third of countries have set aside financial resources to support their identified adaptation options through budget allocations, and even fewer have considered incentives to encourage investment in adaptation priorities⁴³.

There are a few emerging examples of adaptation financing strategies. Box 3 illustrates one of these from Kenya. However, most governments require support in translating adaptation into concrete policies, budgets, and investment plans. These investment plans are important

to send clear signals to the private sector about government priorities. Well-costed, realistic investment strategies which identify specific investment priorities can provide the certainty that private sector players need to prepare and develop complex projects^{44,45,46}.

Box 3: Emerging adaptation financing strategies in Kenya

In 2020, Kenya published a financing strategy for its NDC. Its objectives were to cost priority climate actions, to consider the funding available through government sources, and to evaluate funding gaps requiring private and international support. The strategy is guided by the 2016 National Policy on Climate Finance that creates legal, institutional, and reporting frameworks for Kenya to access and manage climate finance, consistent with the institutional structures and framework set out in Kenya's Climate Change Act, 2016. It estimates a USD 40 billion financing gap between 2020 and 2030 to implement priority mitigation and adaptation actions. This includes actions across social protection and disaster risk management, agriculture and food security, and water and irrigation.

Source: United Nations Development Programme 2020⁴⁷

Sharing climate information on climate exposure, vulnerabilities and risks, and targeted outreach to companies

Generating and sharing information on the impacts of climate change – across vulnerable sectors, actors, and businesses – builds awareness and enhances companies' ability to factor climate risks into their overall investment decision-making. Increasingly, climate data is being made available from national meteorology centres and/or from open platforms, such as the World Bank Climate Change Knowledge Portal. Various tools have been designed that help businesses assess the impacts and risks to vulnerable sectors⁴⁸. For example, see Box 4 for an illustration of how improving access and building private sector capacity to use climate information is central to their engagement.

Box 4: Climate Resilient Agribusiness for Tomorrow (CRAFT)

Under the CRAFT programme, climate projection modelling was carried out by the Climate Change Agriculture and Food Security programme (CCFAS) to better understand how climate change will impact specific staple crops in Kenya, Tanzania, and Uganda. Higher resolution models based on thresholds for the selected value chains were produced. This information was then shared within workshops, bringing together companies and other stakeholders to understand the impacts on their businesses. This allowed companies to adjust their business models to build for greater resilience to future climate impacts. It also offered opportunities for new businesses to enter the market, and catalytic finance was provided to support them.

Supporting bankable climate smart business and investment cases

Countries have a variety of adaptation investment needs: from large infrastructure projects to smaller local transactions, supporting smallholder farmers. Each investment has different needs. Project preparation and/or technical support facilities can assist across the many phases of project development, de-risking project pipelines and ensuring companies deliver high social and environmental impacts from investments – for example, see Box 5.

Box 5: The Dutch Fund for Climate and Development (DFCD)

The DFCD enables investment into companies delivering climate change adaptation and resilience in developing countries. It is managed by Climate Fund Managers, WWF-Netherlands, and SNV (a global development partner), and led by FMO (the Dutch Entrepreneurial Development Bank). The fund deploys public and private capital in pursuit of impactful climate adaptation investments. It includes an Origination Facility, managed by SNV and WWF, to identify and work with companies by providing grants and technical assistance to graduate highly impactful, climate resilient, business cases in highly vulnerable landscapes. The DFCD is designed to link prospects with potential investors at the earliest stage, and to provide life-cycle financing, starting from grants for identification and support, to structuring the prospect, through to investment and possibly re-financing.

Market studies can assist businesses in understanding climate-resilient investments, mobilising companies to implement adaptation strategies, and exposing opportunities for potential investors in a given country. Where business opportunities are identified, there may be the need to stimulate companies supplying these goods and services – using incubators, accelerators, or venture capital funds – to support start-ups and early-stage companies to drive climate-smart solutions. Most public infrastructure projects currently being funded do not yet incorporate climate risk mitigation measures – due to a lack of regulatory requirement, and uncertainty around the value of these measures. There is growing recognition and interest in incorporating climate risk into public-private partnership contracts structuring business and investment. For example, the Public Private Infrastructure Advisory Facility is doing this through their PPP toolkit.

Using more risk-tolerant financial instruments to attract climate adaptation financing

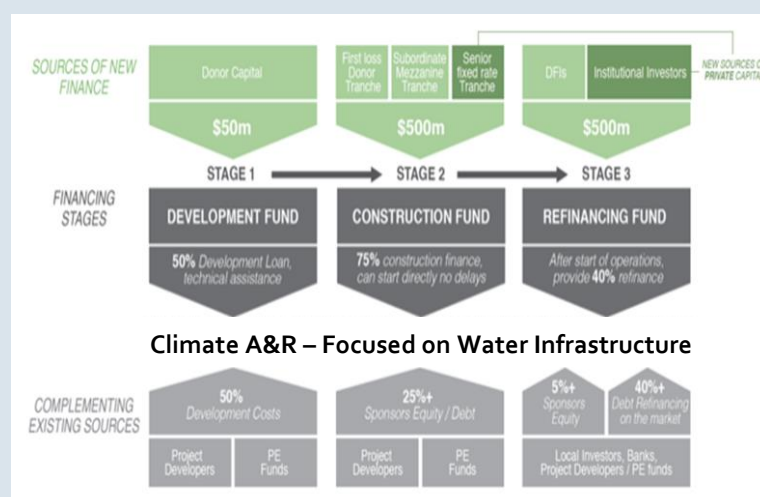
To stimulate investment, financial solutions must be more responsive to the risk profile of adaptation projects in developing countries. The availability of concessional capital is key to deploying financial instruments to reduce risks and encourage adaptation investment. A particular need is for financial instruments that can mitigate early-stage project risks. These financial instruments can potentially mitigate risks and attract investors to adaptation actions. This has been shown through the success of Climate Investor 2 in mobilising public and private finance for climate adaptation (see Box 6). Donors recognise the importance of risk mitigation measures to stimulate investment in climate solutions, through supporting efforts on various risk mitigation mechanisms (for example, the Emerging Market Climate Action Fund and the Green Guarantee company). There is a need to learn lessons from these developing facilities and seek to repeat their success to scale investment into climate adaptation and resilience. Donors should continue to provide leadership in this effort.

Box 6: The Climate Investor

Established by Climate Fund Managers, Climate Investor 2 is an example of a blended public and private finance vehicle which seeks to simplify and accelerate project financing for private sector climate adaptation projects. The different stages of finance include the Development Fund which provides technical assistance and project development funding to generate a pipeline of bankable climate adaptation projects. The structure avoids complex negotiations with multiple financiers by making available equity financing for a large part of the construction costs through its Construction Equity Fund.

Climate Investor 2 utilises blended finance at two levels: at the overall facility level, where the concessional Development Fund aims to mobilise private capital into the other two funds targeting later project stages; and within the 3-tier structure of the Construction Equity Fund.

It is currently deploying significant capital into climate adaptation projects in the Construction Equity Fund itself, each offering a unique risk-return profile to appeal to different developing countries.



Developing climate risk mitigation financing products

There are a growing number and diversity of financial instruments being designed in direct response to increasing climate risks and impacts. Governments and donors can help to increase the availability and diffusion of climate risk services and products. Some of the evolving financial instruments and products are highlighted below.

Resilient (infrastructure) bonds: In 2023, the Climate Bond Initiative produced a white paper providing a blueprint for the development of a climate resilience classification framework, with the primary objective of promoting and facilitating investment in climate resilience through capital markets. Resilience bonds create incentives for investment in adaptation via a resilience rebate, turning avoided losses into a revenue stream. This approach builds upon the concept of a resilience dividend. While there is currently a lack of investible opportunities, more examples are emerging^{49,50}. International institutions and national and regional governments are showing an increased appetite for investing in climate adaptation.

Catastrophe Bonds: In the event of a disaster, catastrophe (or cat) bonds cover losses beyond the capacity of insurers or governments, by transferring risk to the capital market (often based on a parametric trigger, rather than incurred losses like conventional insurance). There are multi-country climate risk pools, such as the African Risk Capacity (ARC) and the Caribbean Catastrophic Risk Insurance Facility (CCRIF), offering parametric insurance in the event of hurricanes, floods, and other weather-related events. British International Investment recently committed USD 15m for the InsuResilience Investment Fund Private Equity II, which has mobilised USD 90m. The fund makes direct investments in business models at the forefront of providing climate insurance to underserved communities.

Weather-based Insurance: Climate insurance shares and spreads the financial consequences of physical climate risks. Zambia is an example of a country with widespread

uptake of weather-based insurance. Key success factors for Zambia were the ability to engage the local insurance industry to offer appropriate insurance products, and that the government prepaid for the 'drought and excessive rainfall' index insurance. There are various types of weather-based insurance: for example, in index insurance, insurers pay out benefits based on a predetermined level of variation of a given measure. Pooled insurance mechanisms involve a group of companies joining together to secure better insurance rates and coverage plans, by virtue of their increased buying power as a bloc.

Bank climate finance for adaptation: the banking sector has an important role to play in redirecting capital flows to activities that support climate adaptation. Regulators, including central banks, are playing a critical role in enabling green financial products through regulation, taxation, or incentives. More banks are providing concessional credit lines; for example, the Development Bank of South Africa (see Box 7). To spur innovation, more local banks are being supported by international development banks, such as ADB or World Bank, providing the initial credit for the local bank to on lend. There is a growing recognition of the key role local banks can play, given their local knowledge and ability to work with multiple clients.

Box 7: Development Bank of South Africa (DBSA)

The DBSA is providing a leadership role in the Southern Africa region in attracting climate finance and mobilising the private sector to invest into climate adaptation and mitigation. DBSA is a government-owned DFI, established in 1983, with the mandate to promote economic growth as well as regional integration for sustainable development projects and programmes in South Africa, the Southern African Development Community, and the wider Sub-Saharan Africa. The DBSA provides dedicated advisory, investment, and implementation support to access funds from climate funding mechanisms to support countries to meet their SDGs and NDCs. It is accredited to the Global Environment Facility (GEF) and Green Climate Fund (GCF), as well as being an active member of the International Development Finance Club (IDFC), supporting the identification and piloting of climate change financing instruments and products, created to catalyse private sector capital into climate change projects in the region. Under support of the GCF Private Finance Facility in 2018, the DBSA established a pioneering green bank model, de-risking and increasing the bankability of climate projects to crowd-in private sector investment. It was the first such model in Africa. The DBSA also works with DFIs and commercial banks to attract long term capital.

4.4 What further actions are needed to scale private investment in adaptation and resilience?

While the above initiatives offer promising developments to stimulate private finance for climate adaptation and resilience, they continue to be limited in application, stimulating levels of private finance far below what is needed. There is the need to further scale up and replicate these initiatives while at the same time supporting deeper reform to mainstream climate risks across financial decision making. In this section we highlight some of the broader reforms needed to provide a framework to scale private investment in climate A&R. The totality of interventions is presented in Table 3.

Enabling policies which stimulate demand for climate adaptation and resilience goods and services

Governments should create a regulatory environment that incentivises the private sector to respond to climate risks. Policymakers, regulators, and public institutions need to put in place the basic regulatory framework which provides the right signals to the market to stimulate investor appetite for climate adaptation and resilience.

The policy environment across government ministries must be aligned to climate change adaptation investment, and adaptation must be mainstreamed within existing national planning, evaluation systems, and development and growth priorities, to integrate climate risks across sectors and scale finance.

Banking instruments

Standards and Bonds: To promote the use of sustainable financing instruments in channelling capital to projects aligned with a climate smart economy, standards and labels are needed. These may come from industry groups and associations, but regulators and governments must play a role, providing guidance and encouraging standardisation and adoption. Governments could consider issuing a climate bond (or preferably a climate resilience bond) following industry standards to mobilise greater private investment for climate adaptation.

Supporting LDCs and the most vulnerable countries

While it is clear governments and financial sector regulators will need to take significant steps to better integrate climate-related risks into economic and financial decisions, there remain significant gaps in information and capacity, especially in developing countries. Most efforts are only beginning to develop in regions with more developed economies. There is the need to share lessons and support through technical assistance facilities between leading banks, companies, and think tanks in developed countries with those engaged in science, policy, and adaptation practices in emerging markets and developing countries. This also requires the continued sharing of information on climate risks, and making this information public, especially to vulnerable developing countries.

5 The role of donors to address priorities for action: recommendations

Whilst much of the work needed to understand and manage physical climate risks will be undertaken by the private sector, donors can play an important role in accelerating progress in developing countries – where the risks are often greatest. We have provided eight recommendations on how donors can help accelerate progress, three relating to mainstreaming, four focused on scaling financing for solutions and one which is cross-cutting. At the end of this chapter, Table 4 offers the authors’ headline assessment of the scale, timing, complexity and priority of the recommendations which aims to offer a starting point for donors considering how to engage.

Mainstreaming adaptation and resilience into financial decision-making

Recommendation 1: Ensure universal availability of quality data on climate risks covering vulnerability, hazards and exposure

<i>What</i>	Systematic push from donors to support accessible data and metrics on vulnerability, hazard and exposure to local levels of resolution everywhere. Data should be nationally owned, internationally comparable, publicly available and regularly updated.
<i>How</i>	<ul style="list-style-type: none"> • Global initiative to support nationally owned climate data in every country. • Big push to ensure vulnerability data is integrated so it is used in companies’ analysis of physical risks. • Advocate for global goal ensuring quality, accessible and localised data on physical climate risks everywhere in the world (linked to the UNSG’s 2030 goal on Early Warning Systems). • Donors support national institutions to publish, curate, and regularly update this data.
<i>Why</i>	Effective, comprehensive, accessible and internationally comparable data on climate hazards is a fundamental necessity for understanding climate risks for the private sector, just as it is for the public sector. Such data is available down to local level in some countries but not all. A global goal by 2030 is achievable and appropriate given importance of getting this foundation for action in place.

Recommendation 2: Support developing country capacity to develop, adapt and implement tools to manage physical climate risks, and to build evidence about what works

<i>What</i>	Support capacity in developing countries to develop, adapt and implement tools to manage physical climate risks in business and investment decision making, and to build evidence about what works.
<i>How</i>	<p>Donors can provide three types of support to developing countries to strengthen private sector management of physical climate risks:</p> <ul style="list-style-type: none"> • Support centres of excellence in developing countries (in government, think tanks or industry bodies) to create or adapt appropriate tools for developing country contexts. Donors may consider engaging global philanthropic foundations who provide significant think tank, academic and civil society support on net zero to do the same in the adaptation and resilience space.

	<ul style="list-style-type: none"> • Expand tools for critical sectors and SMEs, so they are not left behind as large businesses improve their understanding of physical climate risks. • Understand what works. There is lots of good innovation underway, but little systemic evaluation and learning. Invest in capacity in developing countries to understand what works to accelerate adoption of best practice.
<i>Why</i>	<p>There is a huge amount of vital and welcome innovation underway on tools for private sector analysis of physical climate risks, but these are far from being widely applied, nor are they of consistently high quality. Furthermore, most tools have been developed by and for OECD countries. Support is required for developing countries' capacity and leadership, so that such tools are developed to meet their specific needs.</p> <p>Donors should support leadership (regulators, think tanks and governments), knowledge, and innovation networks on these topics within developing countries. These will be critical to accelerating the adoption of effective regulation properly adapted to developing country contexts.</p>

Recommendation 3: Support financial sector regulators in developing countries to drive understanding of physical climate risk including disclosure

<i>What</i>	Support Central Banks, financial regulators and industry groups to strengthen disclosure on physical climate risks by companies in developing countries.
<i>How</i>	<ul style="list-style-type: none"> • Support analysis of disclosure and encourage feedback loops (e.g., think tank analysis, private sector body peer reviews, investor use of disclosure information). • Support tools to make disclosure easier for small companies. • Support regulators to understand, monitor and lead disclosure in their countries, including regulatory capacity to introduce disclosure requirements at the right time. • Support Central Banks and other regulators to supervise economy-wide and company-level understanding of physical climate risks, including through appropriate climate stress testing for key industries (e.g. finance)
<i>Why</i>	<p>Transparency by companies on their understanding of adaptation and resilience risks is an important driver of risk assessment and skills, and often the first step to identifying actions companies need to take to strengthen resilience. Transparency also provides important evidence for other initiatives.</p> <p>Even if disclosure is voluntary, regulatory leadership will be important to underline that this matters: governments, regulators and industry leaders can stress the obligations companies have to their hinterlands and frontline communities. Currently, the fastest progress on disclosure is OECD countries, but firms in developing countries also face equal or greater risks.</p>

Scaling private investment in adaptation and resilience solutions

Recommendation 4: Support countries to translate adaptation priorities into financing and investment strategies

<i>What:</i>	Support developing countries to translate adaptation goals into priority investments and set clear policy signals for investors.
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<i>How:</i>	<ul style="list-style-type: none"> • Work with governments to translate the NAP into an investment strategy to prioritise options where private sector investment can be identified. • Build the capacity of Ministries of Finance to understand which adaptation objectives can secure private investment, and which need blended or pure public investment. • Support greater private sector involvement in formulating the next generation of NAPs.
<i>Why</i>	<p>Studies on climate change have improved understanding of the nature of climate risks and adaption needs. However, few countries have translated their climate adaptation needs into financing and especially investment priorities. Large domestic or multinational corporations, SMEs and smallholder farmers require investment at different stages of their business life cycles, from R&D to climate-proofing existing assets. This all has implications for their attractiveness to different potential financiers. It is necessary to clearly articulate country investment needs and match them to investors, covering a range of financiers offering a diversity of financial instruments. This needs to be led by the Ministries of Finance and Economy, working in close collaboration with the Ministries leading on climate change.</p> <p>To stimulate private sector engagement and investment in companies supplying climate adaptation goods and services, countries must better understand enterprises' motivations and opportunities, including identifying climate adaptation activities that present the greatest commercial opportunities.</p>

Recommendation 5: Help developing countries create or shape private sector markets in key sectors to secure investment in adaptation and resilience

<i>What</i>	Support sector line Ministries, and key regulators in developing countries to develop taxonomies, climate adaptation and resilience standards and regulations that can be adapted and applied across geographies.
<i>How</i>	<ul style="list-style-type: none"> • Focus on key sectors where private investment is viable and can bring significant public good adaptation benefits. • Work with key selected governments and key regulators to build taxonomies, standards, metrics, and regulatory provisions that could be scaled and adapted across countries. Aim to accelerate replication and support scaling and aggregation of investments for larger volume instruments such as resilience bonds. • Enhance cooperation between the adaptation and private sector development communities in country.
<i>Why</i>	Government drives to meet NDCs/NAPs will necessitate new policies and regulations towards lower emissions and climate resilient development. Countries need support to frame adaptation goals and set clear policy signals which will trigger demand for climate resilient goods and services. There is also a need to clearly articulate what constitutes climate A&R investment. Developing taxonomies (e.g., the Climate Resilience and Adaptation Financing Taxonomy) and climate/resilience bonds are important in providing clearer signals to investors. Banks are now using these to track flows for adaptation and resilience, but they require convergence into a consistent taxonomy, sector standards and metrics (for example, though working with global and regional bodies such as ASEAN).

	<p>More broadly, the policy environment needs to be aligned for climate change adaptation investment across ministries, and adaptation to be mainstreamed within existing national planning and evaluation systems.</p> <p>Priority markets will vary from country to country, and the focus should be on those sectors or markets with greatest potential in each country.</p>
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Recommendation 6: Support national development banks and local commercial banks to invest in resilience and adaptation

<i>What</i>	Support national development banks (NDBs) and local commercial banks to mobilise, intermediate and channel adaptation and resilience finance.
<i>How</i>	<ul style="list-style-type: none"> • Build capacity in suitable institutions and encourage climate funds and DFIs to provide further support. • Provide targeted support from bilateral donors around strengthening their environmental, social and governance (ESG) standards, accessing more financing, and building capacity to support the climate agenda. • Support capacity development of local commercial banks to support lending to adaptation and resilience technologies, especially for SMEs
<i>Why</i>	<p>NDBs and commercial banks have a critical role to scale adaptation finance flows: NDBs can provide longer-term, more affordable financing than available on the market, and combined with their detailed knowledge of local markets and relationships with local private and public sectors, they possess important comparative advantages over the multilateral and bilateral financing system. NDBs are well placed to mobilise, intermediate and channel climate-smart finance and investment, if capacitated by DFIs and climate funds to strengthen their governance, and access more concessional finance.</p> <p>Local commercial banks are very important for financing the range of projects that will be needed, especially at local level. Supporting improved understanding and ability to appraise climate resilience risks and technologies will help local commercial banks to make informed lending decisions. This is important to avoid risk-aversion from preventing financing for viable adaptation and resilience projects.</p>

Recommendation 7: Develop climate risk mitigation facilities and increase risk appetite for MDB and DFI investments in LDCs

<i>What</i>	To mitigate the investment risks common in adaptation projects and in many developing countries, financial instruments and transaction structures are needed that can deal with higher levels of risk than existing instruments can manage. DFIs have a crucial role in supporting LDCs, SIDS and FCAS countries to help de-risk adaptation investment. However, they should be ready to take greater risk in LDCs to drive market development.
<i>How</i>	<ul style="list-style-type: none"> • Donors should continue to support and scale innovative risk mitigation mechanisms. • Support the development and application of financial instruments and products which respond directly to climate risks (e.g., climate insurance, cat bonds, resilience bonds, and blended finance facilities). • Influence contributors and shareholders to increase risk appetite of DFIs.

	<ul style="list-style-type: none"> Revisit the rates of return required by DFIs on concessional resources, and the 'hurdle rates' of bilateral DFIs.
<i>Why</i>	<p>Investing in climate A&R requires financial instruments that can mitigate early-stage project risks (e.g.: early-stage equity financing, special-purpose vehicles that provide high-risk capital, risk-sharing facilities, and off-take agreements) tailored to the needs of the country, the investors, and ultimately the companies that require the capital.</p> <p>Risk mitigation instruments are also being designed to address specific climate risks and impacts (including climate risk insurance, cat bonds, resilience bonds, debt for climate swaps and through structured blended finance facilities). Novel life-cycle funding facilities such as Cl2 must be replicated to scale up investments in climate adaptation.</p> <p>Risk mitigation facilities and blended finance can tip the balance but are not substitutes for continued support for investment climate reforms.</p> <p>It is often MDBs and DFIs who will run, anchor or demonstrate these facilities. MDBs and DFIs are committed to increasing their investment in climate change adaptation. Given these are riskier investments, they must be willing to take on more risk.</p> <p>Promising initiatives include early-stage funding of new technologies before they are market-ready; soft loans to infrastructure projects that add resilience into their designs at additional cost; and guarantees to take first loss to encourage direct lending for adaptation projects. However, evidence shows a limited use of subordinate instruments by MDBs and DFIs, suggesting that blended finance may not be meeting the risk-mitigation needs of the private sector in challenging markets.</p> <p>Conservative financing models and required returns are constraining risk appetite and the ability to engage. These should be differentiated by the level of development and adaptation needs of the country of investment, to help companies in vulnerable regions provide goods and services that build resilience to climate change.</p>

Recommendation 8: Continue to support pipeline development for adaptation and resilience investments, especially in LDCs and small island developing countries

<i>What</i>	There is a clear need for early-stage support to build a pipeline of business prospects to bridge the gap between grants and later-stage investment.
<i>How</i>	<ul style="list-style-type: none"> Share climate information and undertake targeted outreach, especially highlighting opportunities for companies to enter the market. Support to structure investment cases through project preparation facilities. Stimulate supply through incubators, accelerators, and availability of early-stage private equity and venture capital funds.
<i>Why</i>	Adaptation investments are often diverse, locally specific and of small size. Developing investible projects can be complex and costly, and this is often under resourced. Support for business pipeline development can involve a number of stages, from upstream activities such as conceptualisation and identification through to downstream activities in financial structuring and transaction support. Each stage requires specific expertise. Technical support facilities, incubators and

accelerators should target those countries where the capacity and private sector is less developed. Venture capital, angel capital and private equity funds are critical to stimulate investment into new climate A&R businesses.

Cross-cutting

Recommendation 9: Mainstream private investment in adaptation into existing green growth and private climate finance projects

<i>What</i>	Use existing projects and instruments to support private investment in adaptation and resilience, where these are appropriate
<i>How</i>	There are a large range of existing donor projects on private investment for climate change and green growth. There are also projects on private sector development. Developing entirely new programmes will take time and a quick way for donors to contribute to this agenda would be to integrate adaptation into these projects (most of which focus on decarbonisation).
<i>Why</i>	Where it is not already integrated, mainstreaming adaptation and resilience into existing green growth projects, and mainstreaming thinking on private investment into adaptation and resilience projects will be important. This matters for demonstrating leadership and building momentum around a complex, difficult topic. Existing programmes can also be powerful ways to support the capacity in developing countries that is needed.

Table 4 offers the authors' headline assessment of the scale, timing, complexity and importance of the recommendations which aims to offer a starting point for donors considering how to engage.

Table 4: Priority, timing and headline approach for recommendations

Recommendation	Nature of intervention	Timing	Complexity	Priority
1: Ensure universal availability of quality data on climate risks covering vulnerability, hazards, and exposure.	Global coverage, country action	5 yrs	Coordinated global approach, funding	High
2: Support capacity to develop, adapt and implement tools to manage physical climate risks, and to build evidence about what works	Global	1-3 yrs	Funding support to key developing country institutions	High
3: Support financial sector regulators in developing countries to drive understanding of physical climate risk including disclosure	Global coverage, country action	1-3 yrs	Funding support to key developing country institutions	Medium
4: Support developing countries to translate adaptation priorities into financing and investment strategies	Country action	1-3 yrs	Technical support to governments	High
5: Help developing countries create or shape private sector markets in key sectors to secure	Country action	5-10 yrs	Technical support to governments and regulators	High

investment in adaptation and resilience				
6: Support national development banks and local commercial banks to invest in resilience and adaptation	Country action	5-10 yrs	Some new approaches will be needed	Medium
7: Develop climate risk mitigation facilities and increase risk appetite for MDB and DFI investments in LDCs	Country action	5 yrs	Know-how exists although further innovation required	Medium
8. Continue to support pipeline development for adaptation and resilience investments	Country action	3-5 yrs	Know-how exists although further innovation required	Medium
9: Mainstream private investment in adaptation into existing green growth or private climate finance projects	Various	1-3 yrs	Use existing know how where possible	Medium

Annex A Priority investment sectors for adaptation and key barriers to investment

Investment sub sectors	Climate resilience	Potential/barriers to investment
Agriculture, Forests and Land use		
<i>Improved livestock systems</i>	Improved breeding strategies, livestock management systems and production adjustments reduce vulnerability of livestock and pastoralists to climate shocks (heat stress; access to water and fodder).	<ul style="list-style-type: none"> - Changes favour more intensive, sedentary livestock systems which require significant investment. - More viable for countries with high/growth demand for dairy. - Can be combined with better manure management by using biogas digestors and improved grazing practices.
<i>Sustainable aquaculture</i>	<p>A climate resilient livelihood option, particularly in deltas, due to sea-level rise and salinity intrusion.</p> <p>Offers a more diversified farm income and food source that increases resilience.</p>	<ul style="list-style-type: none"> - The business case has been proven in many locations. - High upfront costs. This can be partially overcome through support from an off taker or credit facility. - Potential negative environmental impacts (water use, deforestation etc). - Meeting certification standards overcome this.
<i>Climate resilient seeds</i>	Improved varieties can be more heat tolerant, pest resistant, salinity or water tolerant in response to climate changes.	<ul style="list-style-type: none"> - Need for upfront investment in R&D. This may require partnership with research organization and extension. - Requires well-functioning seed systems. - Investment needed along the value chain, often in combination with the provision of key services, such as credit.
<i>Irrigation efficiency and expansion</i>	<p>Reduced vulnerability to water scarcity.</p> <p>Improved soil quality and fertility.</p>	<ul style="list-style-type: none"> - Reasonable return on investment, especially if water is priced correctly. - Relatively high capital investments may lead to slow uptake. - For small-scale irrigation schemes there is a continued need to demonstrate benefits to local users. - Low awareness and perceived need. - Policy or price incentives would change this.
<i>Conservation / organic/ regenerative agriculture</i>	<p>Reduced water usage in water-scarce environments.</p> <p>Enhanced soil productivity.</p> <p>Increased soil organic carbon storage.</p>	<ul style="list-style-type: none"> - Investment case viable in water constrained environments. - Upfront costs are barrier to smallholder farmers to switch practices.

Investment sub sectors	Climate resilience	Potential/barriers to investment
		<ul style="list-style-type: none"> - Support needed to ensure access to inputs and training. - Company off-take agreement (and provision of credit) can support shift in practices. - May need carbon revenues to make business case. - Growing market demand.
<i>Shifting to more climate resilient crops</i>	For the coastal provinces subject to increased salinisation there is the need to transition to alternative crops. Some more salt-tolerant crops include coconut, fresh-brackish agriculture, salt-tolerant fruit, vegetables, rice-shrimp systems.	<ul style="list-style-type: none"> - General farmers resistance to change crops even when climate risks are high. - Off-take agreements can help. - Companies may be unwilling to invest into new crops. - There may be a need for government incentives to attract investors to vulnerable places.
<i>Services – cold chain</i>	Over 30 per cent of all produced human food is wasted or lost, which undermines the adaptive capacities of vulnerable populations through decreased food availability and reduced incomes. Improved storage and cold chains can significantly reduce food loss.	<ul style="list-style-type: none"> - High upfront costs of equipment. Agreement on usage can reduce risks. - Good potential for returns from investment if demand is there. Mobile units can help reach demand. - Provides opportunities for SMEs to enter the supply chains of international markets, exporting temp sensitive products. - Barriers tend to be policy (in distribution services industries) and the logistical difficulties and delays.
<i>Agro-forestry</i>	Soil fertility improvements. Enhanced adaptive capacity of farmers through reduced financial and market risks relating to climate related shocks from monoculture production systems.	<ul style="list-style-type: none"> - Low adoption rates due to the initial capital outlay and the delayed return on investment. - Investment case should focus on intercropped trees with good market potential (e.g., fruit trees). - Could be triggered by policy requirements or off-take requirements.
<i>Inclusive Forestry Plantations</i>	An estimated 500 million ha could be available for the re-establishment of forests on lands previously forested. This is often degraded and sloping areas. Replanting helps to build resilience of large, degraded areas.	<ul style="list-style-type: none"> - Adequate returns in those regions appropriate for timber production (fast growing tropics with larger land areas). - Need for emphasis on technological and silvi-cultural improvements, and a rigorous approach to environmental and social values. - Stricter requirements from consumer countries on the legality and sustainability of timber (certified) provides a strong market signal.

Investment sub sectors	Climate resilience	Potential/barriers to investment
<i>Deforestation free production</i>	Forest loss exposes the soil and makes it more vulnerable to climate hazards. There is a need to ensure production does not cause further forest degradation and loss.	<ul style="list-style-type: none"> - National or international regulation will spur the market for deforestation-free production (e.g., EUDR). - Commitment of companies for deforestation-free production. - National regulation and enforcement capacity will be key.
<i>Peatland restoration</i>	Improved hydrology and soil enhancement. Improved livelihoods and enhanced adaptive capacity of local communities.	<ul style="list-style-type: none"> - Growth in forest carbon asset class due to Net Zero commitments and Nature Based Solutions movement. - Regulatory environment in Indonesia and Malaysia (where most peatland is) will be key. Both are developing carbon markets.
<i>Novel technologies</i>	Technological and associated management improvements can help to enhance the food system and reduce pressure on ecosystems. Provides climate resilient livelihood options.	<ul style="list-style-type: none"> - May require R&D to test and trial new technologies. - High risk for investors but has potential to provide significant returns if the technology is adopted and scaled. - Growth of venture funds for companies working on plant-based foods/ ingredients, food technology, and alternative proteins provides investors options.
<i>Productive energy services</i>	<p>Provides opportunities to reduce GHG through reduced use of fossil fuels and biomass.</p> <p>Access to clean energy for different companies improves their ability to respond to weather related shocks.</p> <p>Support energy access more broadly by providing electrification to underserved communities making them more resilient.</p>	<ul style="list-style-type: none"> - High upfront and investment costs. - Regulation on renewable energy making this more commercially viable. - Potentially misunderstood or mistrusted novel technologies. - Lack of standards and quality assurance track record of suppliers. - Non-existent or outmoded financing availability for new technologies.
Water and coastal		
<i>Water treatment</i>	<p>Industry and municipal drinking water storage and treatment. Specifically, treatment technologies (chemicals, filters, ultraviolet, etc.) to improve microbiological and chemical quality of water.</p> <p>Builds resilience where there are scarce freshwater supplies.</p>	<ul style="list-style-type: none"> - Opportunities for small-scale decentralised alternatives where municipal water systems are unavailable or unreliable. - Scaling opportunity for improved low-cost technologies. - Can be undertaken with renewable energy sources (e.g., solar based water treatment).

Investment sub sectors	Climate resilience	Potential/barriers to investment
<i>Water supply and distribution</i>	Investment in municipal water use operational efficiency, particularly the reduction in non-revenue water (esp. leakage), can significantly reduce the pressure on available water resources and contribute to adaptation to climate change.	<ul style="list-style-type: none"> - Requires significant investment into infrastructure and high costs. - Revenue streams are dependent on fees for water. - Companies may need to enter into Public Private Partnerships or require some form of public support. - Potential environmental impacts of construction.
<i>Desalinisation</i>	Investment in desalination facilities contributes to building. Resilience to droughts through the augmentation of water supplies. Their application in water scarce areas make them highly relevant to contribute to adaptation to climate change.	<ul style="list-style-type: none"> - Requires high level of investment into desalinisation technologies. - Significant environmental impact and energy use. - Need for clean energy sources.
<i>Coastal protection and sustainable use</i>	Ecosystem-based solutions utilise the natural capacity of wetlands, tidal marshes, mangroves, dunes, and coral reefs. They provide natural defence against coastal flooding and storm surges by wave energy dissipation and erosion reduction, helping to stabilise shore sediments.	<ul style="list-style-type: none"> - Long lead-time before returns generated; likely requires blended finance solutions covering early-stage costs. - High costs of project development and need for patient capital. - Lack of clear revenue streams. There may be a need to tap into different revenues streams, for examples through carbon payments.
Disaster risk management		
<i>Climate proofed infrastructure</i>	Drainage, public buildings, and other infrastructure are increasingly vulnerable to climate impacts, such as flooding; necessary to invest into infrastructure which builds resilience to climate risks.	<ul style="list-style-type: none"> - Investment case is often dependent on supporting standards (e.g., building standards) and regulations. - In many cases private-public partnerships will be needed. - Guarantees and underwriting of possible risks may be required to encourage private sector entrance and investment.
<i>Climate resilient energy infrastructure</i>	Energy infrastructure is increasingly vulnerable to climate change impacts, particularly infrastructure in areas prone to severe weather and water shortages. Climate changes are projected to affect infrastructure throughout all major stages of the energy supply.	<ul style="list-style-type: none"> - High costs and risks of infrastructure. - The need for government support and potential private-public partnership. - Feed-in tariff will impact revenue generation.

Investment sub sectors	Climate resilience	Potential/barriers to investment
<i>Climate resilient transport technologies</i>	Sea-level rise due to climate change is increasing coastal flooding, leading to damage at ports, roads, railways, and coastal airports, and causing disruptions of operations and shipping. Tropical storms also lead to widespread disruption to traffic and unsafe travel conditions.	<ul style="list-style-type: none"> - Need clearer understanding on what resilience looks like for the transportation sector (e.g., adoption of global standards). - Lower prioritisation for investments due to relatively higher costs. - Regulatory hurdles, political instability, and lack of transparency in the investment process.
<i>Climate early warning systems</i>	Early warning systems (EWS) include detection, analysis, prediction, and then warning dissemination followed by response decision-making and implementation. EWS aims to avoid or reduce the damages caused from hazards.	<ul style="list-style-type: none"> - Lack of willingness of consumers to pay with the expectation that public authorities should provide this service. - Private sector investment has therefore remained limited, and financing has relied significantly on the public sector.
<i>Climate information services</i>	Involves the production, translation, transfer, and use of climate knowledge and information in climate-informed decision-making, which helps groups to better anticipate and manage adverse climatic conditions.	<ul style="list-style-type: none"> - Business engagement has met challenges due to difficulties in maintaining systems beyond pilot project stage, due to technical, institutional, design, financial and capacity barriers. - Requires a supporting environment, in the capacity of national meteorological and extension services.
<i>Access to Clean Energy</i>	Improved access to clean energy can be associated with reducing sensitivity and exposure and increasing adaptive capacity during adverse effects of shocks and stresses.	<ul style="list-style-type: none"> - High upfront and investment costs; and compared to other investment types, long payback periods. - Potentially misunderstood or mistrusted novel technologies. - Lack of standards and quality assurance of suppliers. - Non-existent or outmoded financing availability.
Financial Products and Services		
<i>Access to credit</i>	With access to credit, farmers can invest into various goods and services which make their operations more productive, and more resilient to climate risks.	<ul style="list-style-type: none"> - Those living in the poorest and most vulnerable communities have the least possibility to provide collateral to secure credit. - Support regulations, policies and programmes that may be needed in-country to enable access to credit for people living in poverty (banking reforms, collateral requirements). - Provide more flexible conditions for people on the lowest incomes (e.g., collateral requirements).

Investment sub sectors	Climate resilience	Potential/barriers to investment
<i>Climate lending products</i>	The loan products on offer tend to be insufficiently adapted to the realities of climate change adaptation. Financial products require the adjustment of grace periods and loan terms and other concessional terms. MDBs, could support local FI through a guarantee-mechanism that will take first losses.	<ul style="list-style-type: none"> - Lack of awareness and understanding of climate risks from borrowers (and lenders). - Loan terms tend to not be attractive for long term horizons. - Regulations on collateral requirements tend to be a barrier for many SMEs.
<i>Insurance products for low-income, vulnerable households</i>	Formal, market-based (re)insurance spreads risk and provides a financial buffer against the impacts of climate change. It helps vulnerable households and firms gain resources to recover from disasters such as flooding.	<ul style="list-style-type: none"> - Low demand has prevented the growth of commercial markets insurance for low-income populations. - General lack of awareness and recognition of benefits has hampered demand. - Payment terms may need to be tailored to the cashflow of households and local context.
<i>Climate insurance</i>	Climate insurance shares and spreads the financial consequences of physical climate risks. It provides protection by agreeing to compensate for a specified loss or damage in return for payment of a specified premium. There are various types of insurance; for example, with index (parametric) insurance, insurers pay out benefits based on the predetermined level of variation of a given measure (e.g., days without rain) against an index.	<ul style="list-style-type: none"> - Low demand has prevented the growth of commercial markets for weather index insurance, suggesting that insurance is unlikely to reach a market-priced solution. - Schemes may require public subsidy and/or regulation. - Success and private sector entry when scale can be reached. For example, linking to existing government subsidy programmes.
<i>Catastrophe Bonds/ Resilience Bonds</i>	In the event of a disaster, cat bonds cover losses beyond the capacity of insurers or governments by transferring risk to the capital market (often based on a parametric trigger) Resilience bonds are a type of cat bond, allowing governments to raise debt for projects that fund climate change adaptation.	<ul style="list-style-type: none"> - Currently there is an insufficient supply of issuances. - There is insufficient demand from mainstream investors, and a lack of engagement from rating agencies. - Regulation hinders growth and there is a need for regulation that promotes growth of this asset class.

Annex B Stakeholders consulted

Name of the Stakeholder	Organisation
Paul Smith	UNEP-FI
Mahesh Roy	Institutional Investors Group on Climate Change
Will Mac Farland	SNV DFCD
Daniel Farchy	GCF Private Sector Facility
Martin Ewald	EMCAF
Christopher Marks	GAIA Fund
Sashi Jayatileke	USAID
Jacob Thoppil	CIF
Ede Ijjasz-Vásquez	GCA
Stuart Brocklehurst	University of Exeter
John Mc Ginley	Mekong Strategic Capital
Wilder Mc Coy	Climate Fund Managers
Arjun Bhalla	International Finance Corporation (IFC)
Irina Likhachova	International Finance Corporation (IFC)
Roop Singh	Red Cross Red Crescent Climate Centre
Gabriella Saiz	Panama Canal Authority
Bhim Adhikari	International Development Research Center

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