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Underfinanced. Underprepared.

Inadequate investment and planning on climate adaptation leaves world exposed

Adaptation Gap Report 2023

ISBN: 978-92-807-4092-9
Job number: DEW/2583/NA
DOI: https://doi.org/10.59117/20.500.11822/43796

Suggested citation: United Nations Environment Programme (2023). *Adaptation Gap Report 2023: Underfinanced. Underprepared. Inadequate investment and planning on climate adaptation leaves world exposed.* Nairobi. https://doi.org/10.59117/20.500.11822/43796

Production: Nairobi
URL: https://www.unep.org/adaptation-gap-report-2023

Co-produced with:

UN environment programme | copenhagen climate centre

WASP WORLD ADAPTATION SCIENCE PROGRAMME

Supported by:

MINISTRY OF FOREIGN AFFAIRS OF DENMARK

CLARE CLIMATE ADAPTATION & RESILIENCE
UK International Development
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Acknowledgements

The United Nations Environment Programme (UNEP) would like to thank the report's Steering Committee members, the lead and contributing authors, the reviewers and the project coordination team for their contribution to the development of this report.

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LANGUAGE EDITING AND TRANSLATION OF THE EXECUTIVE SUMMARY

Strategic Agenda

DESIGN AND LAYOUT

Phoenix Design Aid (figures), Strategic Agenda (layout), Beverley McDonald (cover)

THANKS ALSO TO:

UNEP: Angeline Djampou, Dany Ghafari, Selma Hedges, Andrea Hinwood, Jason Jabbour, Paz López-Rey, Anita Mujumdar, Jane Muriithi, Lou Perpes, Pinya Sarasas, Ying Wang, Edoardo Zandri.

The 2023 edition of the Adaptation Gap Report is supported by the Environment Fund – UNEP's core financial fund. UNEP would like to thank the Danish Ministry of Foreign Affairs for their support to the production of this report. In addition, the finance chapter and assessment have been supported by the ECONOGENESIS project, funded by aid from the Government of the United Kingdom and by the International Development Research Centre, Ottawa, Canada as part of the Climate Adaptation and Resilience (CLARE) research programme, as well as the ACCREU Project, funded by the HORIZON Europe Research and Innovation Action (RIA) and UK Research and Innovation under the United Kingdom Government's Horizon Europe Guarantee.

Glossary

The entries in this glossary are primarily taken or modified from definitions provided by reports published by the Intergovernmental Panel on Climate Change (IPCC) or previous editions of the Adaptation Gap Report.

Adaptation: The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects (IPCC 2022[1]).

Adaptation costs: Costs of planning, preparing for, facilitating and implementing adaptation measures, including transaction costs (IPCC 2007[2]).

Adaptation gap: The difference between actually implemented adaptation and a societally set goal, determined largely by preferences related to tolerated climate change impacts and reflecting resource limitations and competing priorities (UNEP 2014[2]).

Adaptation limits: The point at which an actor's objectives (or system needs) cannot be secured from intolerable risks through adaptive actions (IPCC 20221).

- Hard adaptation limit: No adaptive actions are possible to avoid intolerable risks.
- Soft adaptation limit: Options are currently not available to avoid intolerable risks through adaptive action.

Adaptive capacity: The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences (IPCC 2022[1]).

Baseline: The state against which change is measured. It might be a current baseline, in which case it represents observable, present-day conditions. It might also be a 'future baseline', which is a projected future set of conditions excluding the driving factor of interest. Alternative interpretations of the reference conditions can give rise to multiple baselines (IPCC 2007[2]).

Exposure: The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected (IPCC 2022[1]).

Hazard: The potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources (IPCC 2022[1]).

Impacts: The consequences of realized risks on natural and human systems, where risks result from the interactions of climate-related hazards (including extreme weather and climate events), exposure and vulnerability. Impacts generally refer to effects on lives; livelihoods; health and well-being; ecosystems and species; economic, social and cultural assets; services (including ecosystem services); and infrastructure. Impacts may be referred to as consequences or outcomes and can be adverse or beneficial (IPCC 2022[1]).

Loss and damage: There is no agreed definition for loss and damage. IPCC (20221) distinguishes between Loss and Damage (title case), which is used to refer to political debate under the United Nations Framework Convention on Climate Change (UNFCCC), and losses and damages (sentence case), which is used to refer broadly to harm from (observed) impacts and (projected) risks and can be economic or non-economic. In practice, loss and damage is most commonly understood as the adverse effects of climate change that are not or cannot be avoided by mitigation and adaptation efforts (van der Geest and Warner 2020[4]).

Maladaptation: Actions that may lead to increased risk of adverse climate-related outcomes, including via increased vulnerability to climate change, diminished welfare, or increased greenhouse gas (GHG) emissions, now or in the future. Maladaptation is usually an unintended consequence (IPCC 2022[1]).

Mitigation (of climate change): A human intervention to reduce the sources or enhance the sinks of greenhouse gases (IPCC 2022[1]).

Resilience: The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure. Resilience is a positive attribute when it maintains capacity for adaptation, learning and/or transformation (IPCC 2022[1]).

Residual risk: The risk related to climate change impacts that remains following adaptation and mitigation efforts. Adaptation actions can redistribute risk and impacts, with increased risk and impacts in some areas or populations, and decreased risk and impacts in others (IPCC 2022[1]).

Risk: The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. In the context of climate change impacts, risks result from dynamic interactions between climate-related hazards with the exposure and vulnerability of the affected human or ecological system to the hazards (IPCC 2014[5]; IPCC 2022[1]).

Vulnerability: The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and the lack of capacity to cope and adapt (IPCC 2022[1]).

1 https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_Annex-II.pdf.
2 https://www.ipcc.ch/site/assets/uploads/2018/02/ar4-wg2-app-1.pdf.
3 https://www.unep.org/resources/adaptation-gap-report-2014.
4 https://doi.org/10.1080/14693062.2019.1704678.
5 https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-AnnexII_FINAL.pdf.

Along with other women in Mangatsiotra village in Madagascar's coastal Vatovavy Fitovinany region, Vivienne Rakotoarisoa uses a reed known locally as Rambo to weave together a mat to sell at a nearby market. Having previously relied heavily on rice farming - where harvests have been hampered by unpredictable rainfall in recent years - this climate-resilient crop is able to withstand periods of erratic rainfall, providing Vivienne and her family a more stable source of income in the face of a changing climate.

More information at: https://www.unep.org/news-and-stories/story/bend-never-break-weaving-climate-proof-future

Photo: © UNEP / Lisa Murray

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To help 43 communities in White Nile State, Sudan to adapt to climate change, a UNEP-led project has harnessed nature-based solutions to rehabilitate 3,792 hectares of forests and rangelands and has helped 8,389 households have access to climate change-resilient food and water sources.

More information at: https://www.unep.org/explore-topics/climate-action/what-we-do/climate-adaptation/ecosystem-based-adaptation/ecosystem-17

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Foreword

In 2023, climate change yet again grew more disruptive and deadly. Temperature records toppled, globally and regionally. Storms, floods, heatwaves and wildfires caused devastation. These intensifying impacts tell us two things: the world must urgently cut greenhouse gas emissions and it must increase adaptation efforts to protect vulnerable populations. Neither is happening.

The *Adaptation Gap Report 2023: Underfinanced. Underprepared. Inadequate investment and planning on climate adaptation leaves world exposed* finds that progress on adaptation is slowing across all three areas annually assessed – finance, planning and implementation – when it should be rapidly accelerating. This has massive implications for people left to face the full force of climate impacts without any shield and, as a result, for losses and damages – which are worldwide, but most forcefully felt in the developing countries least able to deal with them.

Based on a detailed update, the adaptation finance gap now stands at US$194–366 billion per year, with adaptation finance needs in developing countries likely to be 10–18 times as great as finance flows – over 50 per cent higher than the previous range estimate. At the same time, new adaptation projects are being added more slowly and the number of new national adaptation planning instruments is plateauing.

The new finance gap results from growing needs coupled with adaptation finance flows to developing countries declining 15 per cent in 2021 to around US$21 billion. Considering that the finance needed to implement domestic adaptation plans in developing countries is currently estimated at US$387 billion per year until 2030 – most of which will require international support to deliver – this is a hugely worrying deceleration. Neither the goal of doubling 2019 international finance flows to developing countries by 2025 nor a possible new collective quantified goal for 2030 will significantly close the finance gap on their own. Therefore, finding new ways to deliver finance for adaptation action is essential.

This report identifies seven ways to increase finance, including through domestic expenditure, international finance and the private sector. Additional avenues include remittances, increasing and tailoring finance to small and medium enterprises and a reform of the global financial architecture, as proposed by the Bridgetown Initiative – an action plan set forth by Barbadian Prime Minister Mia Mottley. The loss and damage fund will also need to move towards innovative financing mechanisms to reach the necessary scale.

Even if the international community were to stop emitting all greenhouse gases today, it would take decades for the climate to stabilize. Climate disruption is here to stay for the long haul. I urge policymakers to take heed of this report and make COP 28 the moment that the world committed fully to insulating low-income countries and disadvantaged groups from damaging climate impacts.

Inger Andersen
Executive Director
United Nations Environment Programme

Executive summary

Despite the clear signs of accelerating climate risks and impacts worldwide, the adaptation finance gap is widening and now stands at between US$194 billion and US$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.

This is the main conclusion of a comprehensive assessment of the literature and new analyses to provide updated estimates of the costs and needs of adaptation in developing countries, as well as the international finance flows required to address these needs. The report also provides updates on adaptation planning and implementation and concludes that global progress on adaptation is slowing rather than showing the urgently needed acceleration.

In view of ever-increasing weather extremes such as a multi-year drought in East Africa, flooding in China and Europe, and extreme heat and wildfires in the United States of America and Canada, among others, narrowing the adaptation finance gap is of particular importance because of the high benefits that investments in adaptation can offer in terms of reducing climate risks and improving equity and climate justice. Left unchecked however, increasing climate risks will inevitably lead to more climate-related losses and damages. Therefore, the Adaptation Gap Report 2023 (AGR 2023) also focuses on loss and damage to support Parties in the negotiations following the decision at the twenty-seventh session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 27) in Sharm El-Sheikh to establish a loss and damage fund and funding arrangements for vulnerable developing countries.

Global temperatures and climate impacts and risks continue to rise, highlighting the urgent need for rapid acceleration of global adaptation action.

Current climate action is woefully inadequate to meet the temperature and adaptation goals of the Paris Agreement. While global average temperatures are already exceeding 1.1°C above pre-industrial levels, current plans reflected in the nationally determined contributions (NDCs) are putting us on a path towards 2.4°C–2.6°C by the end of the century. Even if the rise in temperature eventually slows as a result of more ambitious collective climate change mitigation efforts, climate risks will accelerate with every fraction of a degree because of the compounding and cascading nature of climate-related impacts.

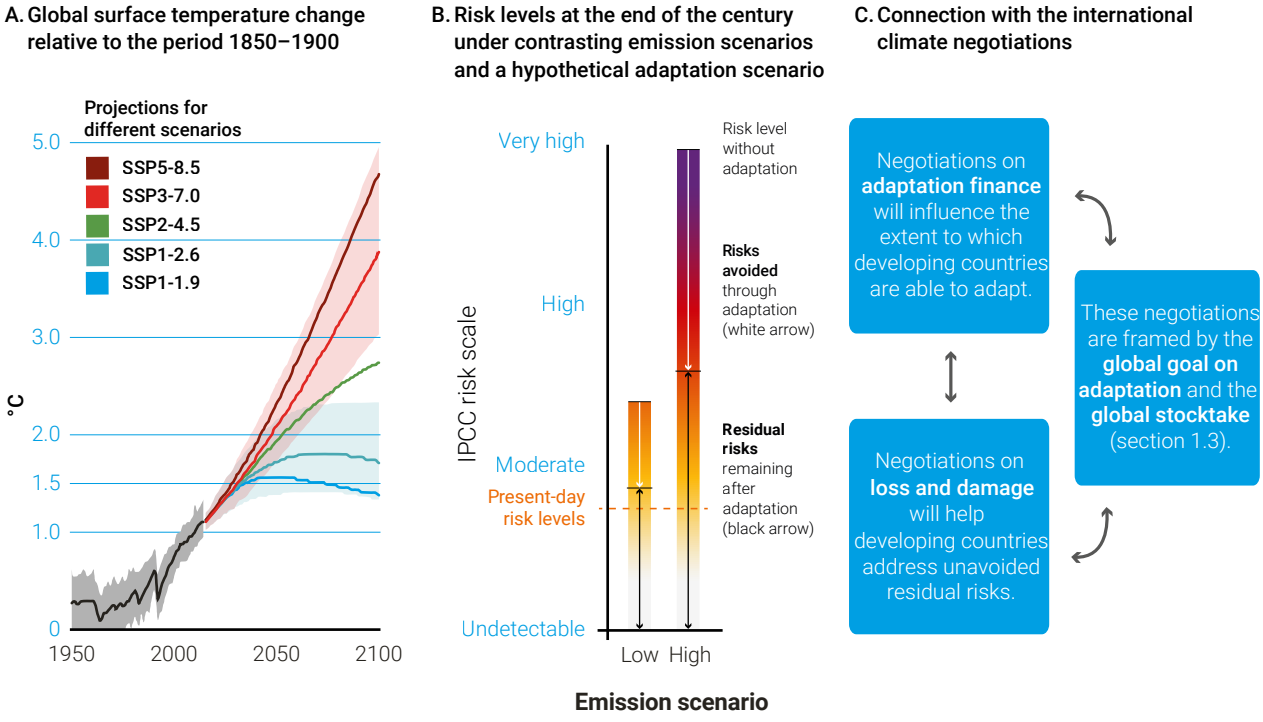
In addition, the Intergovernmental Panel on Climate Change (IPCC) concludes that residual climate risks – that is risks remaining after ambitious adaptation efforts – will persist even if the Paris Agreement goals are reached. Residual climate risks, in turn, will inevitably lead to both economic and non-economic losses and damages (figure ES.1). This demonstrates the importance of accelerating and scaling up both mitigation and adaptation action, to respectively avert catastrophic climate change and minimize the climate impacts that remain. In addition, more focus must be placed on anticipatory, just and effective adaptation action and support.

One out of six countries still does not have a national adaptation planning instrument and more must be done to close the remaining gap.

Five out of six Parties to the United Nations Framework Convention on Climate Change (UNFCCC) have established at least one national adaptation plan, strategy or policy, and just under half of them have two or more national-level instruments, which serve to replace or update the initial ones (figure ES.2). Moreover, 25 per cent of countries have put in place legal instruments that require national governments to plan for adaptation. There has also been significant improvement in certain aspects of the potential adequacy and effectiveness of adaptation planning[1] since 2021. Both findings suggest a growing determination to address climate risks, but more needs to be done to ensure implementation of planning instruments. Meanwhile, 15 per cent of Parties still do not have a national adaptation planning instrument, and the rate of increase dropped from 4 per cent to 1 per cent in 2022. While half of the 29 countries without any such instrument are in the process of developing one, most of them are particularly vulnerable to climate impacts, and more must be done to support them to close the remaining gap faster.

1 In the absence of an agreed definition, potential adequacy and effectiveness of national adaptation planning processes are assessed through using comprehensiveness, inclusiveness, implementability, integration, and monitoring and evaluation as proxy metrics.

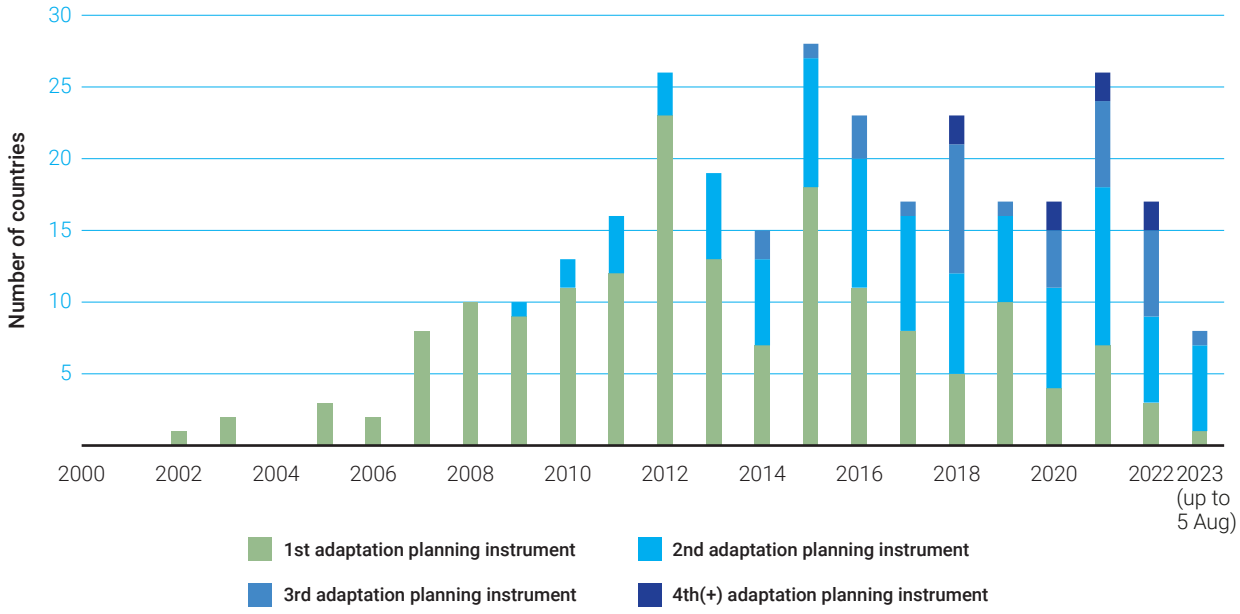
Figure ES.1 The conceptual landscape of the Adaptation Gap Report series: connecting temperature change and levels of climate risk and adaptation with the international climate negotiations



Source: Panel A inspired by IPCC (2022, 2023). https://www.ipcc.ch/report/ar6/syr/figures/figure-spm-4 and https://www.ipcc.ch/report/ar6/wg1/figures/summary-for-policymakers/. Panels B and C: Authors' own elaboration.

Note: SSP stands for shared socioeconomic pathway.

Figure ES.2 Number of national adaptation planning instruments published globally each year, as at 5 August 2023



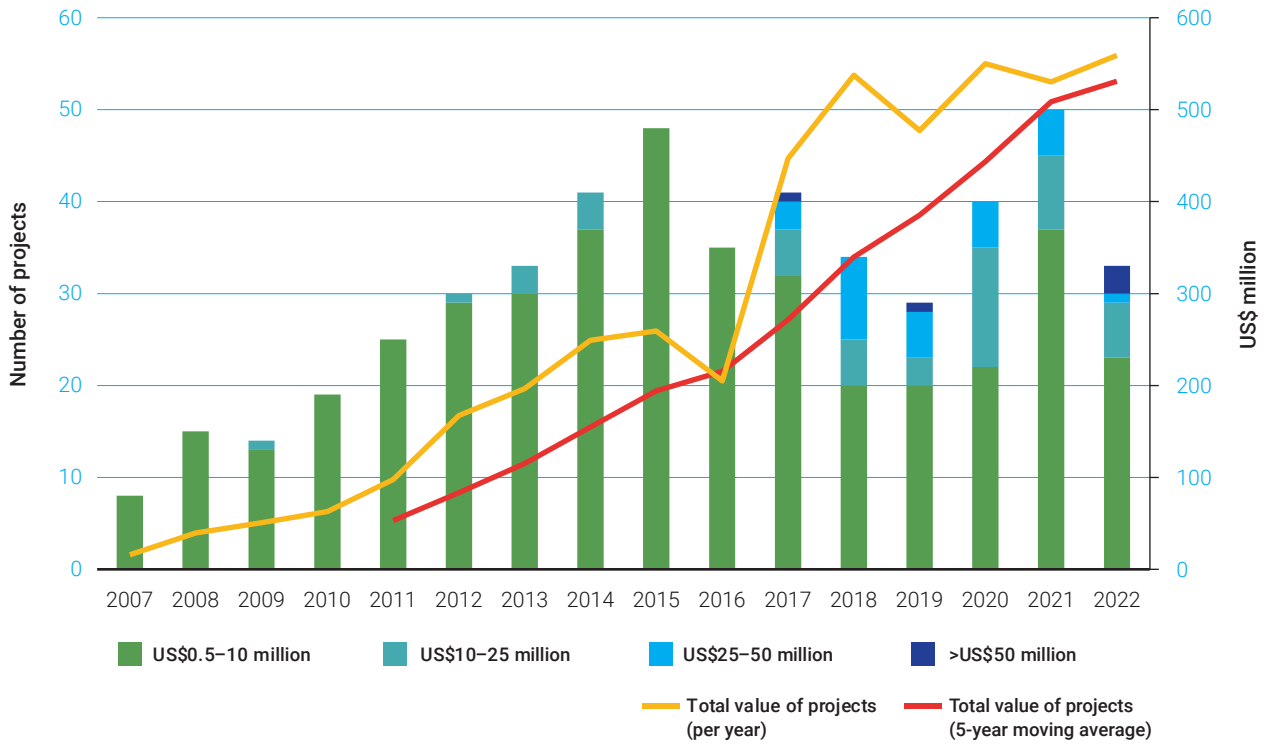
Progress in adaptation implementation in developing countries is plateauing.

The number of adaptation actions supported through the four international climate funds[2] was lower in 2022 than in the previous year but their value has been rising due to investments in very large projects (figure ES.3). This probably does not reflect a trend, but rather points to fluctuations driven by non-climate-related events such as COVID-19 and the war in Ukraine. While there is significant variability in both value and number of new projects, the financial value continues to grow whereas the number of new projects appears to have stagnated for the past decade.

This means that the gap between implementing adaptation actions and the accelerating climate risks is widening.

Considering that the AGR's first detailed analysis of adaptation communications shows that a majority of actions implemented by developing countries depend on external financial support, failure to reinvigorate investments in adaptation action will inevitably lead to more unabated climate impacts and subsequent loss and damage. This will make debt-ridden developing countries even more vulnerable to climate-related extreme events and slow onset changes and is particularly true for least developed countries (LDCs) and small island developing States (SIDS).

Figure ES.3 Number of new adaptation projects funded through the UNFCCC climate funds



Estimated adaptation costs and needs for developing countries are significantly higher than previous estimates, with a plausible central range of US$215 billion to US$387 billion per year this decade.

This year's AGR has undertaken a comprehensive assessment of the literature and has commissioned new studies to provide updated estimates, using two major evidence lines. First, based on modelling analysis, the AGR 2023 estimates the costs of adaptation for developing countries (i.e. non-Annex I countries) in this decade at approximately US$215 billion per year (range: US$130 billion to US$415 billion). These adaptation costs are projected to rise significantly by 2050 because of growing climate risks. Second, the AGR 2023 has also assessed the adaptation finance needed to implement domestic adaptation priorities, based on extrapolation of costed NDCs and national adaptation plans (NAPs) to all developing countries. These are estimated to be US$387 billion per year (range: US$101 billion to US$975 billion) in this decade. The estimated new range of US$215 billion to US$387 billion per year is significantly higher than earlier AGR estimates and is equivalent to between 0.6 per cent and 1.0 per cent of all developing countries' gross domestic product (GDP) combined.

2 Adaptation Fund, Green Climate Fund, and the Global Environment Facility's Least Developed Countries Fund and Special Climate Change Fund.

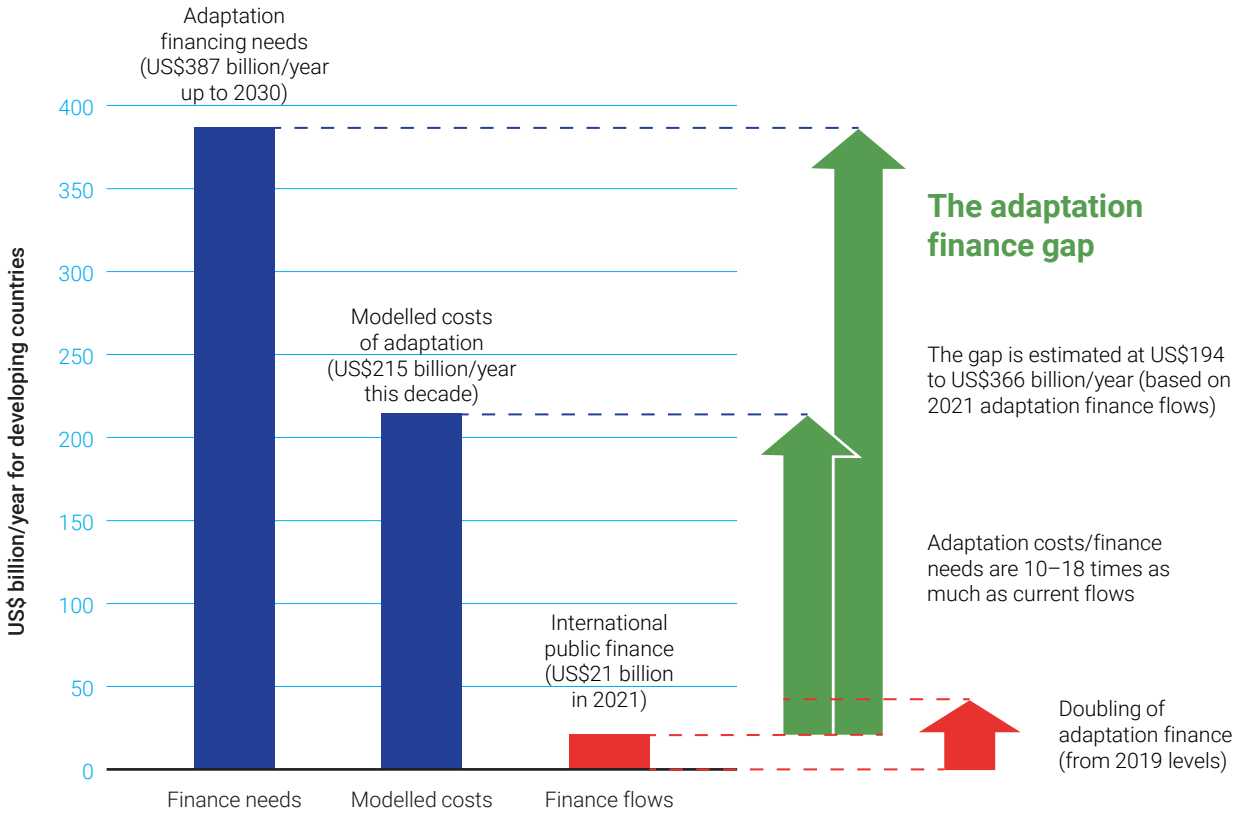
Despite the urgent need to accelerate and scale up international public adaptation finance to developing countries, these flows have declined since 2020.

International public climate finance flows to developing countries decreased by 15 per cent to US$21.3 billion in 2021 after having increased to US$25.2 billion between 2018 and 2020. In contrast, mitigation finance continuously increased over the same period, setting an important precedent. Meanwhile, international public adaptation finance over the past five years has also suffered from a low disbursement ratio, at 66 per cent, as compared to the overall development finance disbursement ratio of 98 per cent. This indicates that there are barriers specific to adaptation, such as low grant-to-loan ratios, and lack of knowledge about adaptation policies. To ensure adaptation finance flows from developed to developing countries double to reach about US$40 billion by 2025 as pledged at COP 26 in Glasgow, finance providers must on average increase annual adaptation flows by at least 16 per cent between 2022 and 2025.

The adaptation finance gap is likely 10–18 times as great as current international adaptation finance flows – at least 50 per cent higher than previous range estimates.

The adaptation finance gap – that is the difference between estimated adaptation financing needs and costs (US$215 billion to US$387 billion) and finance flows (US$21.3 billion) – has grown. The AGR 2023 estimates that the plausible central adaptation finance gap for developing countries is currently in the range of US$194 billion to US$366 billion per year. While the doubling of adaptation finance by 2025 and the new collective quantified goal for 2030 that is under deliberation will be instrumental in helping to close this finance gap, the increase in international public finance alone is unlikely to close it. For example, achieving the goal of doubling adaptation finance (by 2025) would only reduce the gap by between 5 per cent and 10 per cent.

Figure ES.4 Comparison of adaptation financing needs, modelled costs and international public adaptation finance flows in developing countries



Note: Values for needs and flows are for this decade, while international public finance flows are for 2021. Domestic and private finance flows are excluded.

Nonetheless, greater international public adaptation finance could still effectively reduce climate risks and deliver high benefits. For instance, studies indicate that US$16 billion invested in agriculture per year would prevent about 78 million people from starving or chronic hunger because of climate change impacts. Similarly, every US$1 billion

invested in adaptation against coastal flooding leads to a US$14 billion reduction in economic damages. Therefore, more must be done to bridge the adaptation finance gap. However, due to budgetary constraints, countries are often inactive, adapt reactively and/or rely on international support, causing overall costs to rise, limiting effectiveness and leading to maladaptation.

Gender equality and social inclusion are inadequately included in adaptation finance needs and flows.

There is global recognition that climate change can exacerbate inequality in multiple dimensions of social identity, including gender, indigeneity, age, ethnicity, migrant status or disability. At the same time, adaptation activities considering gender and other social identities are linked with higher effectiveness in achieving their objectives. The AGR 2023 has analysed the integration of gender equality and social inclusion[3] in costed NDCs and NAPs. It finds that only 20 per cent of these plans have a dedicated budget for such activities, and that the amount allocated is generally low, averaging 2 per cent. Of the international public finance for adaptation that is also tagged with gender equality as a principal objective, only 2 per cent is assessed as gender-responsive, with a further 24 per cent considered gender-specific or integrative. Other aspects of social inclusion also receive little attention among both finance flows and needs. These findings highlight the need for greater transparency and consistency in the reporting of gender equality markers, and that climate finance providers must increase adaptation funding that is responsive to gender and social inclusion in order to support more equitable and effective adaptation.

Bridging the adaptation finance gap requires more international, domestic and private finance, ideally a reform of the global financial architecture and better international cooperation.

Domestic expenditure and private finance are potentially important sources of adaptation finance, but quantitative estimates are not yet available because their flows remain difficult to track. Nonetheless, domestic budgets are likely to be a large source of funding for adaptation in many developing countries, ranging from 0.2 per cent to over 5 per cent of government budgets. There is also fragmented evidence of increasing private-sector adaptation interventions all over the world and in most sectors (e.g. water, food and agriculture; transport and infrastructure; tourism). These include 'internal investments' by large companies, financial institutions' provision of finance for activities that contribute to adaptation, and companies' provision of adaptation goods and services. In addition, non-financial private-sector actions could have substantial impacts in reducing risks over time. For example, engineering, design, insurance, and lending practices and standards are moving towards incorporating climate science into their benchmarks, requirements and guidelines. However, neither domestic expenditures nor private finance flows are likely to bridge the adaptation finance gap alone, especially in low-income countries including LDCs and SIDS, and there are important equity issues related to using these flows to fill the gap in these countries.

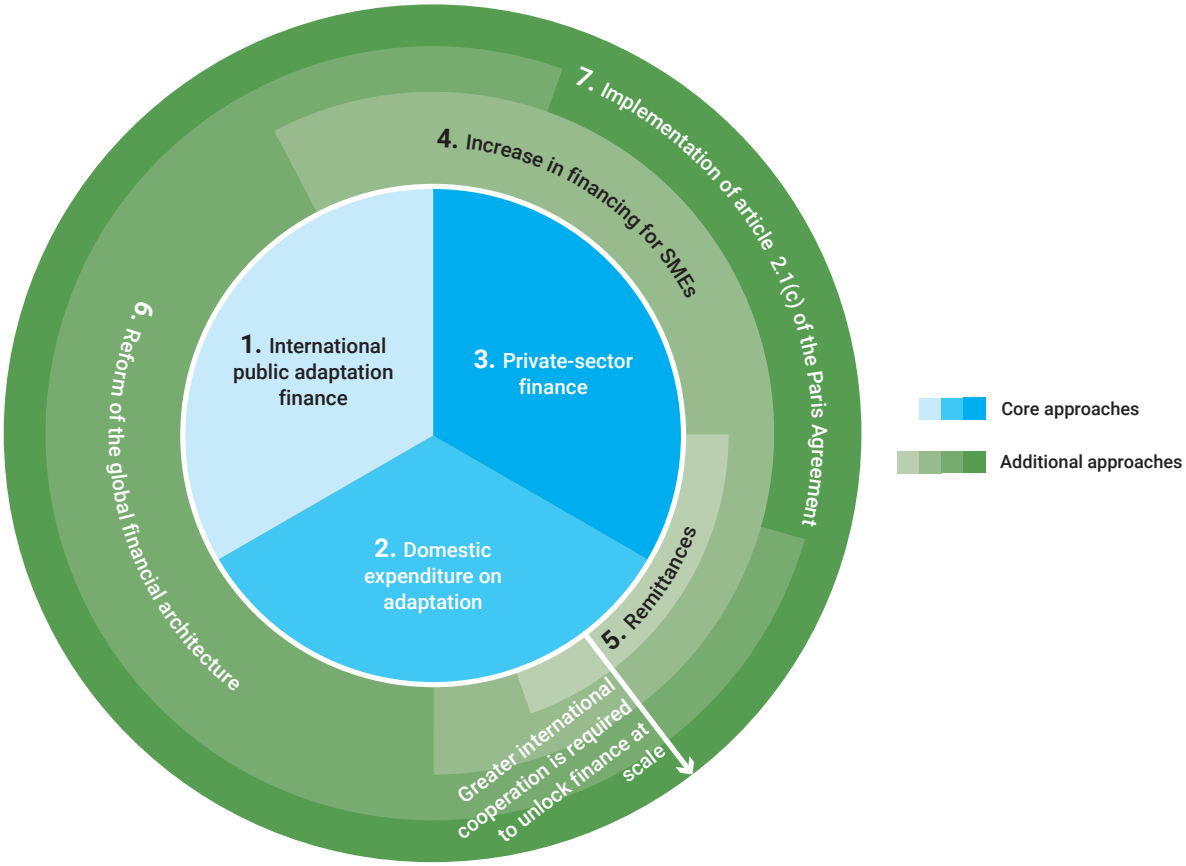
This report identifies seven ways to bridge the adaptation financing gap (figure ES.5). The core continues to be dominated by (i) **international public adaptation finance**, (ii) **domestic expenditure on adaptation** and (iii) **private-sector finance for adaptation**, even if relative contributions to closing the adaptation finance gap remain uncertain. Four additional potential approaches to bridge the finance gap are identified: (iv) **remittances** by migrants to their home countries which often contribute significantly to GDP, (v) **increasing finance tailored to small and medium-sized enterprises** since they comprise the bulk of the private sector in many developing countries, (vi) **reform of the global financial architecture**,[4] for instance as proposed by the Bridgetown Initiative, which has enormous potential to support developing countries in boosting their resilience against future climate shocks, including through changes in managing vulnerable countries' debt burden, and (vii) **implementation of article 2.1(c) of the Paris Agreement** on making finance flows consistent with a pathway towards low-carbon and climate-resilient development.

It is important to note that these seven ways offer different opportunities and constraints across countries – for example, LDCs rely most heavily on international support, in particular grants – and bridging the adaptation finance gap requires attention to both quantitative and qualitative aspects such as access to finance and equity.

3 Gender equality and social inclusion (GESI) was analysed based on an approach that included four categories of progressively greater gender and social inclusion: blind; specific; integrative; and responsive.

4 This includes the Bretton-Woods Institutions (World Bank and International Monetary Fund) and the World Trade Organization, together with other international financing institutions, such as multilateral development banks.

Figure ES.5 Seven ways to bridge the adaptation finance gap



Slow and insufficient action on mitigation and adaptation is increasingly translating into soft and hard limits to adaptation, some of which may have already been reached.

One of the ways in which loss and damage from climate change arise is when efforts to avoid or minimize climate impacts through mitigation and adaptation fail. The points at which adaptation fails to avert climate impacts are called the limits to adaptation, which can be 'hard' or 'soft'.

Hard limits are those that arise in systems and that can only be averted through mitigation of greenhouse gases. Climate-sensitive ecosystems, such as coral reefs and the cryosphere, may be among the first to experience hard adaptation limits leading to both intrinsic and instrumental loss and damage.[5]

Soft limits are those that can be avoided or minimized through more concerted efforts at adaptation, though the limits may change over time as a result of shifts in both climate acceleration and technological and political development, or as the evaluation of trade-offs changes. By far the best and most cost-effective ways to reduce both hard and soft adaptation limits is through greatly accelerated investments in mitigation and adaptation but, considering the level of climate change already embedded in the system, some soft and even hard limits may be unavoidable.

Lack of conceptual clarity is a clear barrier to making political and operational progress on loss and damage.

While there is no universally agreed definition, conceptualizations range from considering all anthropogenic climate change impacts as loss and damage, to only considering impacts that occur after limits to adaptation have been reached as loss and damage. Justice is a major theme underpinning the conceptualizations of loss and damage, including by the UNFCCC, recognizing that losses and damages are experienced most harshly by those least responsible for or most sensitive to climate change: developing countries and vulnerable members of society.

5 Intrinsic values are revealed, for example, in World Heritage listings and people's connections to places and values, so there is no commensurable substitute to their loss or damage. Instrumental values are those that arise from the goods and services provided by ecosystems to those who depend on them directly or indirectly.

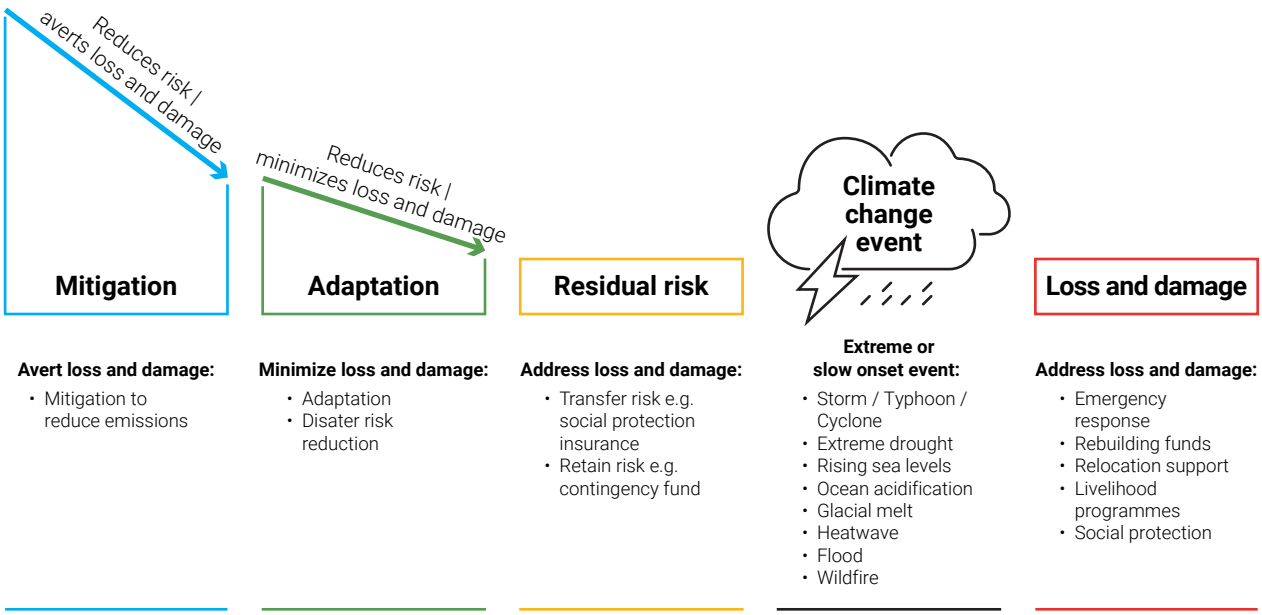
There is also general agreement that losses and damages can be categorized as economic or non-economic. Economic losses and damages (ELD) include impacts that can be assigned a monetary value, such as damages to infrastructure or loss of earnings or productivity. Non-economic losses and damages (NELD) encompass a wide spectrum of impacts that are not easily assigned a monetary value, such as loss of life, health or mobility; loss of territory, cultural heritage, or Indigenous or local knowledge; loss of biodiversity and so on. While there are well-established quantitative methods to assess ELD, for NELD the assessment is mainly qualitative, but it is important to avoid missing the climate impacts that cannot be priced. Because of this lack of clarity among stakeholders, there is an urgent need to reach international consensus on key concepts to ensure accelerated progress and operationalization of loss and damage, including the new loss and damage fund and funding arrangements agreed at COP 27 in 2022.

Loss and damage is increasingly mentioned in NAPs and NDCs, but these documents say little about options to address loss and damage and largely miss NELD.

Actions to address loss and damage include disaster risk management, assessment of losses and damages, capacity-building, early warning systems, insurance, compensation, social protection measures, support for rebuilding livelihoods and for communities to preserve their culture, humanitarian response and forecast-based finance, reflecting the grey zone that exists in practice between adaptation and loss and damage. While countries capture ELD relatively well, only a handful of NAPs address NELD. Developing a list of measures addressing ELD and NELD, both ahead of and during/after events, will be important in the context of setting up the institutional framework for addressing loss and damage within the UNFCCC and at national levels.

Given the complex, compounding, cascading and transboundary nature of climate risk, coordination across global frameworks besides the UNFCCC, such as the Sendai Framework for Disaster Risk Reduction, and the Sustainable Development Goals, will contribute towards strengthening loss and damage management approaches. There is also a need for more regional and subnational cooperation on loss and damage with transboundary characteristics to take advantage of opportunities of scale and to overcome barriers to implementation. Finally, all responses must respect country ownership and be equitable, inclusive, accessible and adequate.

Figure ES.6 Averting, minimizing and addressing losses and damages



Adapted from: Richards, J.A. (2022). https://www.lossanddamagecollaboration.org/stories-op/how-does-loss-and-damage-intersect-with-climate-change-adaptation-drr-and-humanitarian-assistance

Many uncertainties remain regarding the financial needs for addressing loss and damage, but innovative funding sources and governance structures must be found to reach the necessary scale.

A recent study estimated that damages in the 55 most climate-vulnerable economies alone exceeded US$500 billion over the past two decades. These costs will rise steeply in the coming decades, particularly in the absence of strong mitigation and adaptation, but more robust numbers are needed that underpin the urgency of addressing loss and damage. There is currently little evidence on the activities and associated costs of addressing loss and damage as it is a costly and time-consuming exercise requiring significant technical capacity, and most countries are yet to identify and assess their loss and damage risks and financial needs. Since the financial needs for addressing loss and damage are likely to grow significantly in the future, exploring innovative sources of finance (such as marine shipping levies, aviation levies, taxation, debt relief, debt swaps and special drawing rights) besides grants, insurance and concessional loans will be essential to reach the necessary scale. As well as assisting developing countries particularly vulnerable to climate risks in coping with loss and damage, the finance must also be used for capacity-building, institutional strengthening, data collection and analysis, disaster preparedness, and management of the consequences of NELD while respecting the principles of equity, justice, inclusiveness and ownership. Governance arrangements to help deliver loss and damage finance could be built around the dedicated loss and damage fund, the Santiago Network for Loss and Damage (SNLD) and the Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts (WIM) and could include existing institutions supporting humanitarian aid, disaster risk reduction, risk transfer, development finance and climate finance.

1

Chapter 1

The political and scientific context

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On 3 November 2022 in Jacobabad, Sindh province, Pakistan, Aneefa Bibi holds her 5-year-old daughter, Hood, who is experiencing fever and chest pain.

1.1 Introduction

The Adaptation Gap Report (AGR) series assesses recent literature and tracks primary sources of information to provide annual policy-relevant updates on global progress in climate adaptation, building on an increasingly clear scientific evidence base (box 1.1) and diversifying policy landscape. First, as global warming intensifies, climate impacts are becoming more severe and widespread, raising concerns about the severity of cascading and compounding risks and adaptation limits despite adaptation efforts. Second, the international policy arena is progressing towards establishing a framework for the global goal on adaptation, finalizing the first global stocktake,[1] discussing loss and damage funding arrangements,[2] strengthening adaptation transparency through the enhanced transparency framework and mainstreaming adaptation into the reform of the global finance system. And third, there is increasingly robust scientific knowledge on how to move adaptation efforts from incremental action to transformational processes, for example through further integrating social and gender equity into adaptation action (Birkmann *et al.* 2022; Prakash *et al.* 2022). What the available information does reveal, however, is whether countries, societies and communities are collectively on track to adapting to the global challenge of climate change.

To address this fundamental question, the AGR series investigates, on a yearly basis, how adaptation is planned, implemented and financed, to answer three linked questions, taking into account uncertainties and the limited data available:

- What has been done to adapt until today?
- To what extent are current adaptation actions reducing climate risks today?
- Are current adaptation efforts likely to reduce future climate risks?

Making progress on addressing these three questions is critical as science increasingly warns about the need to consider climate risks in a more complex way. In addition to this, and from an international policy perspective, the conclusion of the AGR 2022 that the adaptation gap is widening calls for an increased focus on several topics underlying effective and adequate adaptation. These include governance arrangements, transparency of policy processes, capacity-building, technology transfer, finance and equity (Birkmann *et al.* 2022; New *et al.* 2022), since women continue to be disproportionately affected by climate impacts. More than ever before, the AGR 2023 therefore pays specific attention to addressing the financial implications of adapting to climate change and dealing with its residual impacts by devoting in-depth chapters to adaptation finance and loss and damage.

1.2 Science exposes new challenges for adaptation

Previous editions of the AGR have already referenced various climate extremes (e.g. storms, droughts, floods) and slow onset events (e.g. sea level rise, changes in precipitation regimes) that affect countries, people and natural systems worldwide. Yet impacts are increasingly compounding and cascading, with examples including the successive cyclones that hit the Caribbean and south-east of the United States of America in 2017, and the devastating floods in Pakistan in 2022. Recent scientific studies therefore emphasize that greater consideration of the complexity of climate risks needs to be integrated into the ways that adaptation responses and strategies are planned, implemented and supported (New *et al.* 2022; Intergovernmental Panel on Climate Change [IPCC] 2023).

While there is still limited information on how to take into account such complexity, the scientific community agrees that current impact assessments are likely to be conservative due to insufficient consideration of the compounding, cascading and sometimes transboundary nature of climate risks (Anisimov and Magnan 2023).

These new challenges for adaptation call for further expanding and/or restructuring of the following key discussions under the UNFCCC:

- **Adequacy and effectiveness.** Adequacy and effectiveness are two cornerstone concepts used in climate negotiations to discuss whether policy instruments and support match the adaptation needs identified by countries and result in reducing climate risks (Gao and Christiansen 2023). To date, however, dedicated methods and knowledge for assessing adequacy and effectiveness remain in their infancy (United Nations Environment Programme [UNEP] 2022). This raises concerns about our ability to anticipate and manage increasingly complex climate risks.

1 The global stocktake is a policy process under the United Nations Framework Convention on Climate Change (UNFCCC) that assesses the extent to which the world is making progress towards meeting the long-term goals of the Paris Agreement, based on the principle of equity and the best available science. This is a Party-driven process conducted in a transparent manner and with the participation of non-Party stakeholders.

2 This mechanism has been established under the UNFCCC to further assist developing countries that are particularly vulnerable to the adverse effects of climate change, through enhancing knowledge on risks and risk management approaches, strengthening dialogue and coordinated action among relevant stakeholders and enhancing action and support (including finance, technology and capacity-building).

- **The loss and damage fund and funding arrangements.** Adaptation limits and residual risks raise concerns about further decreasing adaptive capacities, hence increasing the need for international cooperation to consider impacts occurring beyond a given system's adaptation potential. The loss and damage fund and funding arrangements agreed upon at the twenty-seventh session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 27) may therefore have to be additional to traditional adaptation finance.

- **The global stocktake and the global goal on adaptation.** The last two years of this UNFCCC-led process have been dedicated to the collection and assessment of data required to produce the first global stocktake. However, within the aforementioned scientific context, a new question arises: to what extent is complexity within climate risk being considered? And how might that impact discussions on the global goal on adaptation and progress towards it?

Box 1.1 What does the *IPCC Sixth Assessment Report* cycle tell us about the urgency to adapt?

Six major conclusions of the Intergovernmental Panel on Climate Change (IPCC) *Sixth Assessment Synthesis Report* (2023) help scope the adaptation challenge and underline the urgent need to accelerate knowledge in order to anticipate future changes (planning), undertake the right actions on the ground (implementation) and allocate necessary means of implementation (in particular, finance). The conclusions of the report are as follows:

- About 40 per cent of humankind are already living in highly climate-vulnerable areas (Birkmann *et al.* 2022).

- The world is on track to experience dangerous climate risk levels before the end of the twenty-first century, even under a warming scenario of 1.5°C or 2°C in global mean temperature (O'Neill *et al.* 2022), with the transition to globally-significant risks occurring at lower global warming levels in multiple IPCC reports (Zommers *et al.* 2020; O'Neill *et al.* 2022).

- Some socioecological systems are already experiencing adaptation limits (Thomas *et al.* 2021), which explains why residual risks will occur even under a warming scenario of 1.5 or 2°C, and will dramatically increase with further climate changes (Eisenberg 2021; Magnan *et al.* 2021).

- Not all adaptation options are long-term adaptation solutions (Schipper 2020; Eriksen *et al.* 2021; Reckien *et al.* 2023). Some options can provide immediate benefits but are maladaptive over time through insidiously increasing exposure and vulnerability in situ (e.g. coastal dykes stimulating urbanization in low-lying areas) or displacing threats to other connected places, sectors and population groups (Anisimov and Magnan 2023).

- There is increasing concern that the solution space (i.e. the range of options available for adaptation) is shrinking with warming (Haasnoot, Lawrence and Magnan 2021). Some options, such as coral reef restoration, could become obsolete in the coming decades due to accelerating ocean warming and acidification.

- Although notable adaptation progress has been made (Berrang-Ford *et al.* 2021; UNEP 2022), additional adaptation gaps remain when taking into account the full complexity of climate risks (cascading, compounding and accelerating) and challenges relating to adaptation limits, residual risks and the potential for maladaptation.

These findings demonstrate the need for urgent and forceful climate action in all three domains: mitigation to minimize global warming, adaptation to reduce existing and future climate risks and loss and damage to best address unavoidable climate risks and limits to adaptation (figure 1.1).

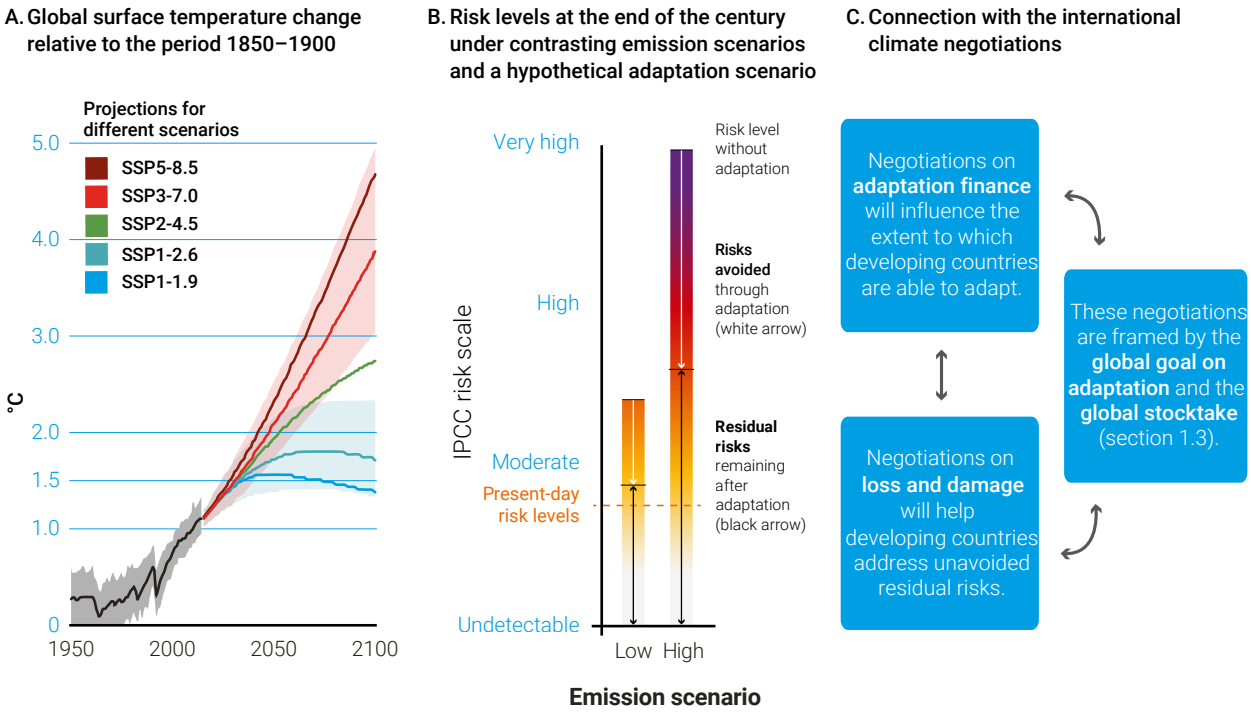
1.3 Ongoing developments in the global policy context

There has been some progress in international negotiations on adaptation and loss and damage in the UNFCCC. The decision to establish a new fund and funding arrangements for loss and damage, and the ongoing development of a framework for the global goal on adaptation represent examples of such progress. At the same time, the discussions are not moving at the pace necessary, resulting in limited progress in mitigation and adaptation (UNEP 2022). This section provides a cursory overview of ongoing developments related to adaptation and loss and damage within the global policy context, including the main challenges ahead of COP 28.

1.3.1 The development of a framework for the global goal on adaptation

Adopting a framework for the global goal on adaptation is anticipated to strengthen national, local and transboundary adaptation responses through improving planning and implementation processes, while also providing a means to assess collective progress on adaptation action and support that builds on existing communication and reporting tools. While all components of the framework are still under discussion, defining globally-relevant targets and metrics against which to assess progress on adaptation is the most urgent challenge, together with defining a clear road map for implementation towards the second global stocktake in 2028 (Adaptation Committee 2021; Leiter 2022; UNFCCC Secretariat 2022; Beauchamp and Józefiak 2023; United Nations Foundation 2023).

Figure 1.1 The conceptual landscape for the AGR series: connecting mitigation, adaptation and loss and damage with international climate negotiations



Source: Panel A inspired by IPCC (2022, 2023). Panels B and C: Authors' own elaboration.

Note: This figure illustrates the narrative going from greenhouse gas emission scenarios (panel A) to associated risk levels (under low and high emission scenarios; panel B), and then corresponding areas of negotiations under the UNFCCC (panel C). Panel B illustrates that – under each emission scenario – adaptation can reduce risks from maximum levels (occurring when no adaptation is deployed – top of each bar), to a hypothetical risk level which is determined by our ability to overcome soft adaptation limits (lower part of the white arrow). The residual risk space situated below this risk level represents risks that have not been avoided in this adaptation scenario (black arrow). Panel C shows that negotiations on adaptation finance can support the extent to which risks are avoided while negotiations on loss and damage can help address unavoidable risks. It also shows that the global goal on adaptation and the global stocktake serve as frameworks to accelerate action and support (especially for developing countries), and assess progress on adaptation globally.

1.3.2 The completion of the first global stocktake

The completion of the first global stocktake provides an opportunity to further strengthen the robustness and coherence of the adaptation agenda at the international level. However, the adaptation component of the global stocktake is facing challenges, such as the under-recognition of developing countries' adaptation efforts, as mentioned by some groups of parties. Similarly, as a recent report by the co-facilitators of the technical dialogue of the first global stocktake suggests (UNFCCC 2023), the work of constituted

bodies on the adequacy and effectiveness of adaptation and support is not yet advanced enough to benefit the completion of the first global stocktake. This work, however, will remain important to inform the implementation and revision of the global goal on adaptation framework and, ultimately, the second global stocktake. At the same time, progress made in the preparation of adaptation communications[3] is noteworthy, for example in terms of emphasizing national priorities and required support, but may not be adequately utilized by the first global stocktake. This is relevant because synthesizing such information is key for the global stocktake process to be able to assess whether global adaptation efforts are adequate and effective, a question the AGR has been seeking to answer for years and on which it could add value into the first global stocktake.

1.3.3 Increasing finance for adaptation and loss and damage

In addition to maintaining political momentum from COP 27 and catalysing the accelerated implementation of actions, the outcome of COP 28 and the first global stocktake will largely be assessed by their ability to mobilize resources and deliver on pledges, such as doubling finance for adaptation and making the loss and damage fund operational. All this needs to be achieved without losing sight of the fact that the funding arrangements seek to fill a gap in the provision of financial resources to address losses and damages associated with the adverse effects of climate change in developing countries.

Outside the UNFCCC arena, ongoing discussions are also relevant to gain an understanding of how finance, with respect to the mitigation–adaptation–loss and damage nexus (figure 1.1), fits into the conversation about reforming the international financial architecture. Although adaptation mainstreaming is gaining momentum, the role of international financial institutions in climate finance (especially multilateral development banks), the potential channelling of special drawing rights for adaptation projects and the diffusion of other innovative solutions, such as debt-for-adaptation swaps, is still unclear.

1.4 Framing of the AGR 2023

The AGR series is structured around regular updates on adaptation planning, implementation and finance, and also includes an in-depth chapter that focuses on varying topics. Compared with previous editions, the AGR 2023 delivers a detailed update of adaptation finance costs, needs and flows (chapter 4), which for the past three editions have been based on estimates derived from the *Adaptation Finance Gap Report* (UNEP 2016). In response to the progress made in Glasgow (COP 26) and Sharm El-Sheikh (COP 27), the in-depth chapter of the AGR 2023 is on loss and damage (chapter 5). New also to the AGR 2023 are global case studies, which illustrate global, regional and local impacts of climate change and adaptation responses. While not directly connected to the chapters, these case studies provide insight to the limits of adaptation and resulting losses and damages in various contexts and give a more detailed picture of local contexts needed to understand what is at stake for people and environments exposed to climate change.

Case Study: Cascading impacts and floods – Building adaptive capacity in Pakistan

Over the past three decades, the increasing frequency, scale and magnitude of climate extremes in Pakistan have caused significant loss of life, while triggering a reversal of development gains. The compounding impacts of the climate crisis mean that for each climate disaster which occurs, the window to build back is getting smaller and people are falling deeper in the poverty trap.

In Pakistan, the adverse and cascading impacts of disasters have eroded livelihoods and coping capacities. Flooding results in greater loss of life and damage to property than other natural hazards. The intensity and frequency of these events has increased since Pakistan was formed in 1947, with the most devastating floods to date occurring in 2022.

Responding to the cascading risks and impacts of the climate crisis requires a transdisciplinary, cross-scale and cross-sector approach. Understanding, identifying and attributing cascading effects to specific climate shocks and stressors is key to developing ways to build adaptive capacity and resilience. However, it is very likely that the costs of adaptation will be higher than anticipated.

Note: This case study is not connected to the chapter. The full case study is available online.

Authors: Jessica Troni, Alvin Chandra (UNEP)

3 An adaptation communication is a document established under the Paris Agreement that aims to raise the visibility and profile of adaptation and its balance with mitigation, strengthen action and support for developing countries, inform the global stocktake and enhance the learning and understanding of needs and actions (article 7.10 of the Paris Agreement and decision 9/CMA.1).


2

Chapter 2

Global progress on adaptation planning

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Contributing authors: Leona Harting (independent), Jheuel Carter-Guy (University of the West Indies), Ceri Cazabon (independent), Allyson Weekes (University of the West Indies), Myrico Morris (University of the West Indies), Peggy Arit Okey (University of the West Indies), Kwame Bradshaw (University of the West Indies), Mathias Hee Pedersen (independent)

Members of REFAN (Réseau des Femmes Agricultrices du Nord) in Senegal, 2021.

Key messages

- At present, 85 per cent of countries have at least one national-level adaptation planning instrument (e.g. a policy, strategy or plan) in place. As the world moves towards complete coverage by national adaptation planning instruments, a rapid shift towards implementation and continued, iterative planning is vital – which must be supported by, among other things, greater availability of and access to finance (chapter 4).
- Of the 15 per cent of countries that do not yet have a national planning instrument in place, just under half of these were found to be in the process of developing one. Reaching these remaining countries to help them finalize these processes will require additional support.
- Currently, 25 per cent of countries have in place legal instruments (e.g. laws and acts) that require national governments to prepare a national adaptation planning instrument. This percentage has risen slowly since the late-2000s. Given their importance in mandating and reinforcing adaptation planning, more countries should seek to prepare and adopt such instruments as a means of ensuring that adaptation planning is prioritized and that planning instruments are updated periodically.
- The assessment of the potential adequacy and effectiveness of national-level planning conducted in the 2021 Adaptation Gap Report (AGR) has been updated. It indicates that there has been a notable increase in the implementability of adaptation planning processes, with 69 per cent of countries putting a central administrative body in place to oversee adaptation action and 67 per cent allocating domestic finance towards implementing adaptation priorities.
- Less progress was observed on monitoring and evaluation (M&E), reflecting the difficulty of designing and implementing systems and processes for understanding the effectiveness of adaptation planning and action. M&E frameworks will become more important as legal instruments and more funding accelerate the implementation of adaptation, thereby increasing the pressure to demonstrate the impact of adaptation activities.
- While least developed countries (LDCs) and small island developing States (SIDS) are found to be in line with – or above – the global average for some of the criteria assessed, they appear to be lacking in certain areas recognized as contributing towards national adaptation planning being adequate and effective. This emphasizes the need for SIDS and LDCs to receive financial and technical support to advance their adaptation planning.

2.1 Introduction

In March 2023, the Intergovernmental Panel on Climate Change (IPCC) concluded its sixth assessment cycle with the publication of the Synthesis Report for the IPCC Working Group II *Sixth Assessment Report* (IPCC WGII AR6). This report states that "progress in adaptation planning and implementation has been observed across all sectors and regions, generating multiple benefits" (IPCC 2023, p. 55). Three months later, the technical dialogue process for the first global stocktake concluded at the Bonn Climate Change Conference, where adaptation planning was an important barometer of progress. The process found that "collectively, there is increasing ambition in plans and commitments for adaptation, but there also remains an implementation gap, in that plans are implemented inadequately, unevenly and incrementally" (United Nations Framework Convention on Climate Change [UNFCCC] 2023a, p. 17). The importance of adaptation planning is also reflected in discussions around the global goal on adaptation, where the proposed draft framework is structured around the dimensions of the iterative adaptation (policy) cycle – i.e. impact, risk and vulnerability assessment; planning; implementation; monitoring, evaluation and learning (Beauchamp and Józefiak 2023; UNFCCC 2022a). The global goal on adaptation framework will be negotiated at the twenty-eighth session of the Conference of the Parties to the UNFCCC (COP 28) in Dubai, and there is a high likelihood

that progress in national adaptation planning – possibly measured against a global target – will feature strongly, and therefore be part of the assessment of collective progress on adaptation through the global stocktake.

Recognizing the foundational importance of good planning in accelerating adaptation efforts around the world, and as with previous iterations of the AGR, this chapter aims to provide an assessment of global progress in adaptation planning by national governments. To do this, it first looks at the overall number of national adaptation plans, strategies, policies and laws that have been put in place by the 197 Parties to the UNFCCC (section 2.2).

Following this, it looks at the potential adequacy and effectiveness of adaptation planning in these countries, updating the analysis last produced in the AGR 2021 (section 2.3).[1] It is important to note that this analysis focuses more on the processes and outputs of national adaptation planning – such as planning documents and institutional mechanisms – rather than its outcomes, such as implementation of adaptation measures (chapter 3). The cut-off for data collection within this analysis was 5 August 2023. A detailed description of the methodology underlying the analysis presented in this chapter can be found in Annex 2.A.

2.2 Global status of national adaptation planning

2.2.1 Progress since the AGR 2022

By 5 August 2023, 85 per cent of countries had addressed adaptation at the national level through a plan, strategy or policy. In the previous 12 months, Parties to the UNFCCC had published 13 new national adaptation planning instruments. Of these, eight were national adaptation plans (NAPs) submitted by non-Annex I countries to the UNFCCC – with six coming from LDCs and/or SIDS – increasing the total number of published NAPs to 46. Only one of the 13 new planning instruments represents a country's first planning instrument. Of the 29 countries that do not presently have a plan, strategy or policy in place, 14 are in the process of developing one while a further five are in the process of applying for Green Climate Fund (GCF) readiness funding to support them with adaptation planning (GCF 2023).

2.2.2 Longer-term picture

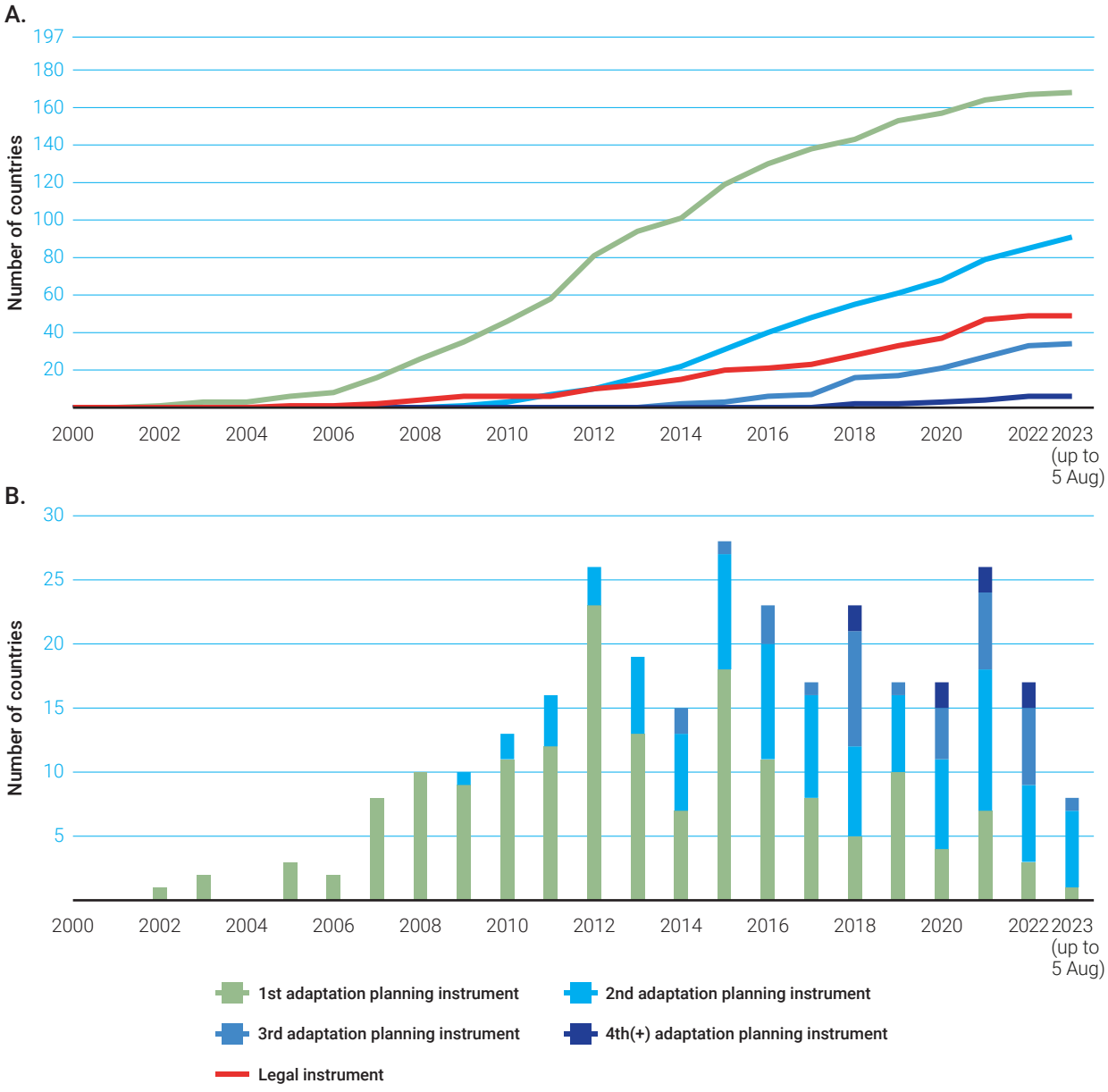
This analysis shows that since the early 2000s, the number of countries that have prepared at least one national planning instrument for adaptation has been increasing year-on-year, with the highest rate of increase occurring between 2010 and 2021 (figure 2.1, panel A). In the last two years however, with so much of the world already covered by national adaptation planning instruments, the rate of increase has slowed to just 2 per cent between 2021 and 5 August 2023 (four countries). As such, the pressure for scaled-up implementation is greater than ever, as lack of planning is becoming a smaller barrier to action. However, progress in reducing the number of countries without a national adaptation planning instrument may also be slowing, pointing to the need to focus resources and support, particularly in the Global South, to achieve 100 per cent global coverage.

Despite the slowdown in this metric, the analysis finds that the number of new adaptation planning instruments being published each year has been relatively constant since 2012 (figure 2.1, panel B). This indicates that many countries are engaging in iterative adaptation planning by putting in place new instruments that replace or update their initial one. In this regard, 46 per cent of countries have prepared a second planning instrument, while 17 per cent and 3 per cent have prepared a third and fourth, respectively. Further, of the 39 per cent of countries that presently have only one planning instrument in place, many are in the process of preparing a second. These trends are positive as adaptation planning is an iterative process, whereby countries can continually update and improve their strategies, plans and policies based on lessons, evolving national priorities and ever-changing climate risks (Woodruff 2016; Schinko *et al.* 2017; Begum *et al.* 2022).

This growing number of countries engaged in iterative adaptation planning is encouraging and may reflect an increased understanding of and commitment to adaptation among Parties to the UNFCCC, enabled by more technical and financial support – particularly to developing countries – in recent years. For example, in 2016 the GCF established an activity area dedicated to adaptation planning under its Readiness Programme. By 31 July 2023, 92 developing countries had received or were receiving funding, while a further 25 countries had proposals under review (GCF 2023).

1 The assessment of the adequacy and effectiveness of national adaptation planning was last conducted in the AGR 2021. The AGR 2022 focused on assessing the extent to which adaptation planning is implementable and inclusive.

Figure 2.1 Global progress in national adaptation planning since 2000. **Panel A:** Cumulative number of countries that have prepared a first, second, third or fourth national planning instrument or a legal instrument since 2000. **Panel B:** Number of national planning instruments published globally each year.



Finally, this year's analysis finds that 25 per cent of countries have put in place legal instruments (such as laws or acts) that require the national government to prepare national adaptation planning instruments. In addition, a number of countries that do not have a legal instrument currently in place for this purpose report that they are in the process of preparing one. While such instruments are not a prerequisite for adaptation planning, the presence of dedicated legislation can play an important role in supporting effective governance of adaptation and driving adaptation planning processes (Nachmany, Byrnes and Surminski 2019; IPCC 2022). As such, the steady increase in the presence of legislative instruments for adaptation represents a positive trend and indicates countries' increasing determination to address the risks posed by climate change.

2.3 Potential adequacy and effectiveness of adaptation planning

This section presents the results of the assessment of the potential adequacy and potential effectiveness of adaptation planning.

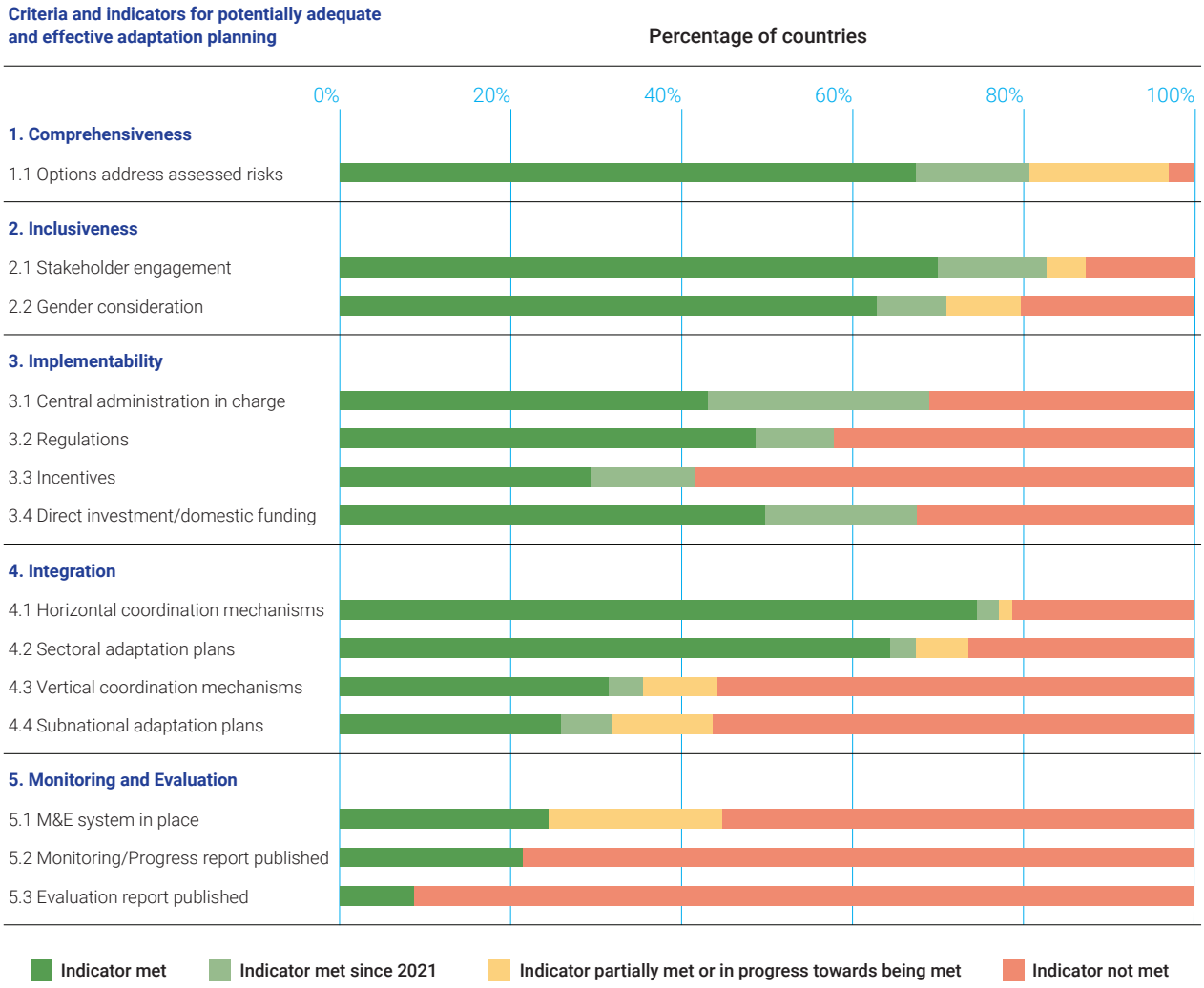
The assessment applies the same methodology used in the AGR 2021 (United Nations Environment Programme [UNEP] 2021). In this approach, five criteria are used to shed light on the extent to which the outputs of national adaptation planning can reasonably be assumed to be adequate (sufficient) and effective (successful) in achieving the stated objectives (reducing climate risks and enhancing resilience) and, where relevant, targets. The five criteria and the indicators used to assess these criteria are described in table 2.1 (see Annex 2.A for a description of the assessment's methodology).

The results of the assessment are discussed in the following sections. Figure 2.2 provides an overview of the results for all 197 Parties. Furthermore, given the acute vulnerability of LDCs and SIDS to the impacts of climate change, table 2.2 also disaggregates the results for these groups.

Table 2.1 Overview of criteria used to assess adaptation planning (including their underlying rationale) and associated indicators

Criteria and rationale	Indicators
1. Comprehensiveness	
Identifying climate risks and hazards and assessing vulnerability to existing and future climate hazards and impacts are foundational steps in the adaptation planning process. Countries can use this information to prioritize sectors for adaptation measures and develop a comprehensive adaptation plan by identifying adaptation options that align with these priorities and respond to the risks, hazards and vulnerabilities they face.	1.1 Adaptation options address assessed risks, impacts, hazards or vulnerabilities in priority sectors.
2. Inclusiveness	
For adaptation planning to adequately reflect existing and forthcoming risks and vulnerabilities and to effectively enhance the ownership of any implementation, it must emphasize the engagement of all relevant stakeholders and take gender into consideration.	Evidence that: 2.1 Stakeholders are being engaged in adaptation planning processes 2.2 Gender is considered in adaptation planning processes
3. Implementability	
Planning can be assumed to be effective if it leads to real implementation by public and private actors. As such, planning can benefit from a central administrative body that is officially in charge of adaptation policymaking and a variety of policy instruments, including investment, incentives and regulations that lead to the desired outcomes.	Evidence that countries have: 3.1 A central administrative body responsible for adaptation Evidence that countries are using the following instruments in adaptation planning: 3.2 Regulations 3.3 Incentives 3.4 Direct investment/domestic funding
4. Integration	
Integrating or mainstreaming adaptation planning and action horizontally (across sectors) and vertically (across levels of administration) is increasingly recognized as an important component of effective adaptation planning. This helps ensure that adaptation planning is comprehensive, avoids the duplication of effort or maladaptation, and enhances synergies.	Evidence that countries have: 4.1 Horizontal coordination mechanisms 4.2 Sectoral adaptation plans 4.3 Vertical coordination mechanisms 4.4 Subnational adaptation plans
5. Monitoring and evaluation (M&E)	
For planning to remain adequate and effective, it must be periodically monitored and evaluated.	Evidence that countries have: 5.1 M&E systems for adaptation 5.2 A published monitoring/progress report 5.3 A published evaluation report

Figure 2.2 Potential adequacy and effectiveness of adaptation planning in 2023



Note: As the criteria for allocating the "Indicator met" and "Indicator in progress towards being met" metrics were tightened for indicators 5.1–5.3, changes in the allocation of the "Increase in indicators being met" since 2021 metric cannot be displayed in this figure.

With the exception of M&E, for which a comparison against 2021 is not possible, there have been increases in all criteria used to assess potential adequacy and effectiveness of adaptation planning. The greatest progress is observed in the implementability of adaptation planning processes, while efforts to link national and subnational level(s) of adaptation planning are least evident.

2.3.1 Comprehensiveness

In terms of comprehensiveness, more countries are identifying adaptation options that cover a broad set of risks affecting their priority sectors. This year's review showed that 81 per cent of countries have adaptation options that respond to the assessed climate vulnerabilities and risks in priority sectors, such as agriculture, water and health. This represents a 13 per cent increase compared with the 2021 analysis. While this trend is undoubtedly positive, the indicator does not reflect the quality or robustness of the vulnerability and risk assessments that underpin the planning of adaptation options. Furthermore, it reveals that 19 per cent of countries are not addressing all of the vulnerabilities and risks that they themselves have identified as priorities.

2.3.2 Inclusiveness

The two metrics used to assess the inclusiveness of adaptation planning processes also point to progress. The number of countries that reported that stakeholders are systematically engaged in their adaptation planning has increased to 83 per cent. Meanwhile, 71 per cent of countries had evidence of integrating gender considerations into their adaptation planning efforts. The way countries report on gender considerations continues to vary considerably, from generally emphasizing the differential vulnerability of women and men, boys and girls to identifying gender equality as a principle or cross-cutting theme in adaptation action,

using gender as a platform to highlight other vulnerable populations, or developing adaptation options that explicitly address gender equality (Dazé and Hunter 2022).

Overall, this continued progress on the inclusiveness of adaptation planning is important, as it helps to ensure the credibility, relevance and legitimacy of adaptation action and, critically, avoid maladaptation, thereby leading to more effective and enduring outcomes (New *et al.* 2022).

Case study: Gender-responsive adaptation – Health insurance for women in Senegal

The climate crisis does not affect everyone equally. Adaptation action needs to consider how the climate crisis affects different genders.

Gender-responsive adaptation planning founded on understanding how the climate crisis affects people of different genders is key to addressing disparities.

For adaptation efforts to effectively manage climate risks while closing gender gaps and structural inequalities, policy processes must allow communities to lead the way in crafting gender policy design features in close collaboration with women's rights organizations.

An example of health insurance for women farmers in northern Senegal illustrates the need for recognizing gendered risks and policy action that address these risks. It shows how consulting with women's organizations paved the way for tailored solutions attuned to the needs of women and points to steps needed for gender mainstreaming in adaptation planning and implementation.

Note: This case study is not connected to the chapter. The full case study is available online.

Authors: Constanza Tabbush, Lorenzo Rovelli (UN-Women)

2.3.3 Implementability

The 2023 analysis also saw some important progress in the implementability of adaptation planning. The greatest progress made since the 2021 AGR analysis was around having a central administrative body in charge of adaptation policymaking. In August 2023, 69 per cent of countries had evidence to meet this criterion, which represents a 25 per cent increase since it was last assessed. A central administrative body can be important for effective policy coordination, which itself is critical to adaptation, as it is "a complex, long-term, knowledge intensive problem, which poses a significant cross-sector and multilevel decision-making challenge" (Russel *et al.* 2020, p. 2).

However, just as the existence of an adaptation plan does not automatically translate into more or better implementation of adaptation priorities, the existence of a central coordinating body does not necessarily mean it is operational or leading to positive policy coordination. The authority assigned to these bodies – often evidenced by legal mandates, technical and financial resources, and high-level political support – can be important in this regard (ibid.).

The other story of progress in the implementability of adaptation planning is around direct investment or funding, with 67 per cent of countries demonstrating that they are – or are planning to – set aside domestic financial resources for adaptation, including through direct budget allocations. This is up from 50 per cent of countries in the AGR 2021. The allocation of domestic funding is a central part of recognizing the adaptation efforts of developing countries within the context of the global stocktake and article 7 of the Paris Agreement. Yet, as noted in chapter 4 of this report, such finance is difficult to track and under-reported, while likely representing the largest source of funding for adaptation in many developing countries (UNEP 2021). These resources are being mobilized through activities such as the development of finance strategies and the establishment of dedicated domestic adaptation funds, and are typically channelled to adaptation priorities such as poverty alleviation, disease control, urban development and flood risk management (UNFCCC 2022b).

Progress was also observed in the use of regulations and incentives – 9 per cent and 12 per cent increases, respectively – to enhance the implementability of adaptation planning, albeit from a much lower starting position. Regulations such as building codes, land-use zoning and water restrictions were mentioned in the descriptions of adaptation planning efforts in 58 per cent of countries. Just over 40 per cent of countries mentioned incentives, such as taxes or subsidies, to encourage adaptation. The description of specific regulations or fiscal policy instruments may be too granular for the types of documents that were reviewed for this analysis. Further, jurisdictional considerations may mean that these types of policy levers for adaptation action are more often pursued at the subnational (e.g. municipal) level. Nonetheless, countries will require more support to ensure these important levers of policy action are integrated into adaptation planning processes.

2.3.4 Integration

As a complex multisectoral and multilevel governance process, national adaptation planning is a massive exercise in coordination. Horizontal coordination involves working with and across sectors, recognizing that a range of development priorities will be affected by climate impacts and that actions to address these impacts in one domain or sector may have implications for another. This cross-sectoral nature of adaptation is well established, as reflected by 77 per cent of countries having horizontal coordination mechanisms, such as interministerial committees, in place – a 5 per cent increase since 2021. About two thirds of countries (68 per cent) have developed at least one dedicated sectoral adaptation plan in sectors such as agriculture, water and health.

Vertical coordination across different levels of government is not as advanced. Only 36 per cent of countries show evidence of having vertical coordination mechanisms, such as councils or platforms, that help manage strategic linkages between national and subnational adaptation actors. The percentage of countries with subnational adaptation plans is even lower, at 32 per cent, although the full extent of planning efforts under way in different jurisdictions is unlikely to be captured in the national documents reviewed. Regardless, this points to a need for more investment in multilevel governance for adaptation so that local realities are reflected in national priorities while national priorities enable adaptation at the subnational level (Dazé, Price-Kelly and Rass 2016). Notably, these findings on integration only reflect evidence related to separate, stand-alone mechanisms and plans.

In many cases, countries are also reporting having integrated adaptation considerations into sectoral and subnational strategies or plans. While mainstreaming adaptation into development planning and decision-making is widely recognized as being central to strengthening and sustaining adaptation actions, as well as being one of the two objectives of the UNFCCC's NAP process, such efforts are not captured using the current AGR review methodology (IPCC 2022; UNFCCC 2011). As such, full global progress on these aspects of adequacy and effectiveness of adaptation planning is likely an under-representation.

Case study: Transboundary adaptation – Local and regional benefits in the Middle East

The climate crisis is making droughts more frequent and severe in the Eastern Mediterranean and Middle East, while at the same time changing rainfall patterns which are leading to more frequent and intense floods. When planning adaptation actions in this type of context, governments, finance providers and local stakeholders need to understand the transboundary dimensions of climate risk.

Ecosystem-based adaptation approaches can help to reverse negative feedback cycles such as sand and dust storms. The impacts of such cycles are far-reaching, spanning thousands of kilometres and extending across national borders. This means that new transboundary approaches to adaptation can help stakeholders to identify shared adaptation options.

Transboundary approaches are being tested in the region and show potential to deliver both local and regional environmental co-benefits, while helping to build trust among communities and across national boundaries.

Note: This case study is not connected to the chapter. The full case study is available online.

Authors: Elizabeth Sellwood (UNEP), Rosalind Cornforth, Celia Petty, Elena Saggioro, Anne Verhoef (University of Reading)

2.3.5 Monitoring and evaluation

In line with the findings of the first global stocktake (UNFCCC 2023c), this analysis demonstrates that countries are generally lacking the infrastructure to adequately monitor and evaluate their national adaptation processes. Only 24 per cent of countries were found to have an M&E system in place, while another 19 per cent were found to be in the process of developing one. The analysis also demonstrates that the majority of ongoing M&E is tailored towards monitoring, rather than evaluation. Of the 49 countries that have an M&E system in place, 43 have published a monitoring report, while only 16 have published an evaluation report.

These findings suggest that countries are generally not well positioned to effectively learn from and update their adaptation plans and strategies, thus highlighting the importance of continued and enhanced capacity-building support in this area.

2.4 Adaptation planning in LDCs and SIDS

IPCC WGII AR6 recognizes that LDCs and SIDS are particularly vulnerable to the adverse effects of climate change and have significant capacity constraints (IPCC 2022). As such, progress in adaptation planning is especially important for

these countries and the aforementioned analyses have been disaggregated for SIDS and LDCs.

Overall, LDCs and SIDS are found to be generally keeping pace with the global average in the development of adaptation planning instruments, with 89 per cent of SIDS and 85 per cent of LDCs having at least one national adaptation planning instrument in place. They are however, found to be less likely to have put in place legal instruments that require the national government to prepare national adaptation planning instruments, with 18 per cent of SIDS and 11 per cent of LDCs having done so compared with 24 per cent of all countries.

Table 2.2 Potential adequacy and effectiveness of adaptation planning globally and in LDCs and SIDS[2]

Criteria	Indicators	Percentage of all 197 Parties	Percentage of LDCs	Percentage of SIDS
1. Comprehensiveness	1.1 Adaptation options address assessed risks *(partially)*	● 81% *(13%)*	● 78% *(17%)*	● 84% *(16%)*
2. Inclusiveness	2.1 Stakeholder engagement *(in progress)*	● 83% *(5%)*	● 87% *(7%)*	● 89% *(8%)*
	2.2 Gender consideration *(in progress)*	● 71% *(9%)*	● 76% *(11%)*	74% *(11%)*
3. Implementability	3.1 Central administrative body in place	● 69%	● 65%	● 63%
	3.2 Regulations	● 58%	● 54%	● 58%
	3.3 Incentives	● 42%	● 30%	● 32%
	3.4 Direct investment/domestic funding	● 68%	● 59%	● 66%
4. Integration	4.1 Horizontal coordination mechanisms *(in progress)*	● 77% *(2%)*	● 83% *(2%)*	● 79% *(0%)*
	4.2 Sectoral adaptation plans *(in progress)*	● 68% *(6%)*	● 72% *(9%)*	● 68% *(8%)*
	4.3 Vertical coordination mechanisms *(in progress)*	● 36% *(9%)*	● 33% *(9%)*	● 18% *(5%)*
	4.4 Subnational adaptation plans *(in progress)*	● 32% *(12%)*	● 15% *(11%)*	● 5% *(16%)*
5. Monitoring and evaluation (M&E)	5.1 M&E framework in place *(in progress)*	● 24% *(20%)*	● 11% *(28%)*	● 8% *(18%)*
	5.2 Progress/Monitoring report published	● 22%	● 9%	● 8%
	5.3 Evaluation report published	● 8%	● 2%	● 0%

Note: The coloured circles in the LDCs and SIDS columns indicate how the values compare to the average value. ● indicates figures are 5–9 per cent higher than the average, ● indicates that figures are between 4 per cent higher and 4 per cent lower than the average, ● indicates that figures are 5–9 per cent lower than the average and ● indicates that figures are +10 per cent lower. The values in *parentheses* refer to the percentage of Parties that have either partially met, or are making progress towards meeting, the criteria for the relevant indicator.

2 Forty-six Parties are categorized as LDCs, while 38 are categorized as SIDS. It should be noted that the LDC and SIDS categories are not mutually exclusive, with some countries fitting into both groups.

The results are more mixed on potential adequacy and effectiveness of adaptation planning (table 2.2). While LDCs appear to be ahead of global averages on addressing gender considerations and horizontal coordination mechanisms in their adaptation planning, and SIDS are ahead on stakeholder engagement, they are significantly behind in several key areas. In particular, they are at least 10 per cent behind the global average when it comes to using incentives in adaptation, and performing at half of the global average on vertical integration and M&E.

Relatively poor performance by LDCs and SIDS in certain indicators may – to a certain extent – be a result of characteristics inherent to countries within these category groups. For example, in some cases, the poor performance of SIDS in indicators related to vertical integration could be explained by the fact that subnational plans and vertical coordination mechanisms are of slightly less importance to the adaptation planning processes in SIDS. Contrastingly, multi-island SIDS may have a strong need for vertical integration of national policies and are liable to face more pronounced cultural, institutional and logistical challenges associated with coordinating vertically than non-island states (Shah and Niles 2016; Ismail 2019; Lucas *et al.* 2018).

Overall, it is clear that SIDS and LDCs continue to require financial and technical support to advance their adaptation planning, with a particular focus on capacity-building in vertical integration and M&E. Moreover, macrolevel (i.e. supranational) transformative policies could significantly boost the capacity of SIDS and LDCs to access support and, in some cases, make more support available. In this regard, enhanced support for the reform of financial support to countries from the Global South that is aligned with the proposals for reform of global financial architecture, inclusive of the Bridgetown Initiative (see chapter 4), is likely to have positive impacts on developing countries' ability to fund and implement national adaptation planning instruments (Demekas and Grippa 2021). Reform of (for example) debt rules and increasing access to credit facilities may not only assist developing countries to increase the proportion of domestic funds from those earmarked for adaptation activities but also to boost their use of fiscal incentives and mechanisms as components of adaptation planning instruments. Reforms of the global financial system can also serve to reduce the cost of capital for countries seeking to implement national adaptation planning instruments (Donovan and Corbishley 2016; Buhr Bob *et al.* 2018; Persaud 2023).

Inle Lake is a freshwater lake located in the Nyaungshwe Township of Taunggyi District of Shan State, part of Shan Hills in Myanmar.

Photo: © ICIMOD / Alex Treadway

3

Chapter 3

Global progress on adaptation implementation

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Photo: © ICIMOD / Jitendra Raj Bajracharya

Key messages

- In 2022, new adaptation projects at a combined value of US$559 million in grants from the Adaptation Fund (AF), the Green Climate Fund (GCF) and the Global Environment Facility (the GEF via its Least Developed Countries Fund [LDCF] and Special Climate Change Fund [SCCF]) started implementation. This is 10 per cent higher than the average amount implemented over the preceding five years (2017–2021).
- The average number of new adaptation projects that started under these three multilateral funds plateaued at just under 40 projects per year during the decade 2013–2022. Due to GCF, the average size of grant-funded adaptation projects has increased. Since 2017, an average of 15 per cent of new adaptation projects have grant funding of over US$25 million.
- Over 1,100 implemented adaptation actions are listed by 35 countries in their adaptation communications. However, details are provided for just 670 actions (60 per cent). Of these, almost half were reported as completed and 37 per cent as ongoing. The implementation status of the remaining 17 per cent of actions was unclear based on the information reported.
- Information on the outcomes of implementation was reported for only 6 per cent of the 670 adaptation actions. This finding underscores the continued need for information on results beyond the outputs of adaptation actions, in order to determine their effectiveness.
- More than half (57 per cent) of stand-alone adaptation communications acknowledge that vulnerability differs across demographics, and a majority underscores the imperative of addressing gender inequality. However, only a third of actions indicated that they were targeting vulnerable groups. Of those that did, farmers were the most targeted vulnerable group (46 per cent of actions targeting vulnerable groups), while women, fisherfolk and Indigenous Peoples were targeted marginally.
- Just over half of the actions for which a funding source was reported were funded by domestic sources. For developing (non-Annex I) countries, this proportion was one third. Stand-alone adaptation communications therefore provide a new source of information on domestically funded adaptation implementation that can help recognize adaptation efforts by developing countries.
- Three quarters of the developing (non-Annex I) countries that submitted a stand-alone adaptation communication received support for its compilation, demonstrating the importance of providing adequate support for adaptation reporting, especially for least developed countries (LDCs) and small island developing States (SIDS). This finding is also highly relevant for the development of biennial transparency reports, which are due by the end of 2024.

3.1 Introduction

Since 2020, the implementation chapter of the Adaptation Gap Report (AGR) has been providing an overview of implemented adaptation actions worldwide. It complements the chapters on planning (chapter 2) and finance (chapter 4) by examining what is being implemented and where, which hazards and sectors are addressed, who is involved and what information on achieved results is available.[1] The findings of this chapter series are highly relevant for the first global stocktake that concludes at the twenty-eighth session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 28).

Tracking global progress in climate change adaptation faces several challenges that influence the scope and

1 For detailed analysis on hazards and sectors of multilateral and bilateral funding, please refer to the AGR 2022.

feasibility of what this implementation chapter can cover (United Nations Environment Programme [UNEP] 2017). For example, comprehensively tracking local or community-based adaptation at the global scale is currently not feasible due to an absence of databases of such actions with global coverage.[2] Reporting of adaptation is limited and often inconsistent across countries. In light of these challenges and gaps, this chapter uses multiple data sources to identify trends and better understand the implementation of adaptation action globally. Since 2020, the chapter has analysed four sources of data:

- adaptation projects implemented with funding from the three multilateral funds that serve the Paris Agreement (analysed since 2020)
- information on implemented adaptation documented in scientific literature (analysed in 2021)
- activity data from the Organisation for Economic Co-operation and Development (OECD) (analysed in 2021 and 2022)
- information submitted by countries to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat (analysed in 2023).

The analysis of each data source is not updated on an annual basis. However, analysing different data sources enables this chapter to triangulate findings from across multiple analyses and to cover data gaps or reporting biases inherent in single data sources. Combining multiple data sources in this manner is regarded by the Intergovernmental Panel on Climate Change (IPCC) as the most robust approach to assessing global adaptation progress (Garschagen *et al.* 2022).

This year, the chapter analyses two sources of data. Section 3.2 presents an updated analysis of the implementation of adaptation projects financed by the multilateral climate funds serving the Paris Agreement. This analysis updates previous annual analyses found in the implementation chapter (UNEP 2021a, 2021b, 2022a). Section 3.3 analyses adaptation communications that have been submitted to the UNFCCC Secretariat to explore what this relatively new source of data says about the implementation of adaptation action. Information about the methodology applied in these assessments can be found in Annex 3.B and Annex 3.C. Meanwhile, further information about analyses conducted in previous iterations of this chapter can be found in Annex 3.A.

3.2 Implemented adaptation actions funded by the Adaptation Fund, the Green Climate Fund and the Global Environment Facility

In 2022, new adaptation projects at a combined value of US$559 million in grants from the AF, GCF and the GEF through its LDCF and SCCF started implementation. This funding volume is 10 per cent higher than the annual average of the preceding five years (2017–2021) (see figure 3.1). An additional US$80 million in concessional loans and US$10 million in guarantees as well as funding for projects that address both mitigation and adaptation was provided by GCF (last year's implementation chapter of the AGR analysed these cross-cutting projects in detail; see UNEP 2022a). Climate finance through these three multilateral funds accounts for 6 per cent of total multilateral adaptation finance (see chapter 4).

It is too early to determine whether the financial increase in 2022 marks the beginning of an acceleration in implementation. While the number of new adaptation projects funded by the AF, GCF, and the GEF has been fluctuating in recent years, its average plateaued at just below 40 projects per year over the decade 2013–2022. However, due to GCF, the number of adaptation projects with grant funding above US$10 million and above US$25 million has increased substantially to 32 per cent and 15 per cent respectively over the period 2017-2022. Larger funding sizes can support a shift from piloting towards implementing at scale. In 2022, two new global projects with over US$100 million in grants started, both seeking to catalyse private-sector investments in adaptation technologies and in coral reef protection.

The majority of new projects were in the agriculture sector or aimed at flood and storm protection. On average, the combined grant value of new adaptation projects from the AF, GCF and the GEF has increased by around US$36 million per year (excluding co-financing), which represents a 25 per cent annual increase over the entire period 2007–2022 (figure 3.1). The drop in funding volume and number of new adaptation projects from 2018 to 2019 was largely due to the Trump administration significantly reducing the United States of America's international climate finance (see UNEP 2021b, p. 41). Further details about the scope, methodology and data sources are provided in Annex 3.C.

2 To date, such actions are only captured at the global level when they are self-reported by countries in their communications to the UNFCCC Secretariat, documented in journal articles or have been funded by OECD donor countries.

Case study: Closing weather and climate data gaps – Enabling effective adaptation in Bhutan

Early warning systems offer a cost-effective means of adapting to the climate crisis. However, warnings are only as good as the data they are built upon. Currently, gaps in basic weather and climate data undermine effective adaptation in many countries, due to a scarcity of technical and financial resources.

Closing this data gap will improve global weather models substantially, leading to better local forecasts and more effective early warnings – a key element of effective adaptation.

While the occurrence of flash floods and landslides cannot be prevented, the amount of loss and damage can be reduced significantly with timely early warning services.

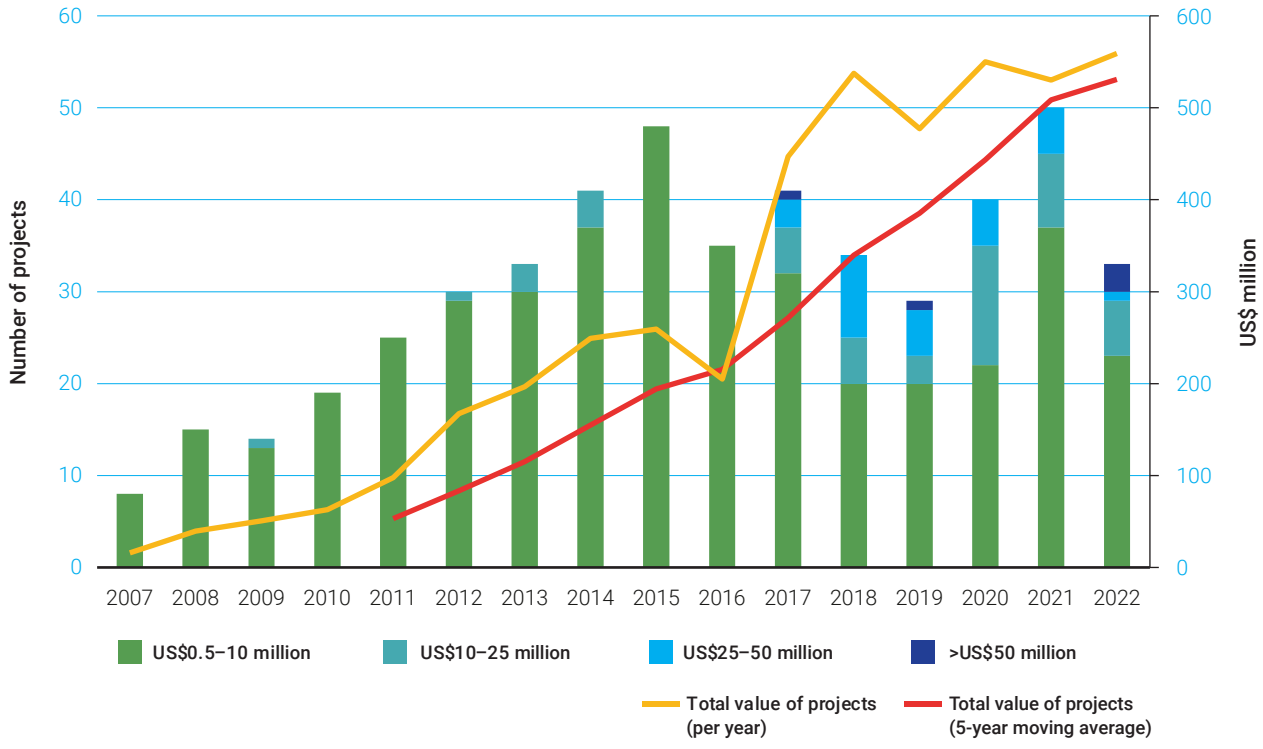
Advances in Bhutan show how the data gap can be narrowed by rehabilitating and restoring weather stations, in addition to building country knowledge and experience.

The enhanced data not only boost local early warning systems, but also enrich global data sets, amplifying their accuracy and depth.

Note: This case study is not connected to the chapter. The full case study is available online.

Authors: Markus Repnik (Systematic Observations Finance Facility), Karma Dupchu (National Centre of Hydrology and Meteorology – Bhutan), Jochem Zoetelief (UNEP), Harri Pietarila (Finnish Meteorological Institute)

Figure 3.1 Number of new adaptation projects per start year, size and combined annual funding value (grants only) under the AF, GCF and the LDCF and SCCF of the GEF, as at 31 August 2023



Note: The combined annual funding value is the sum of the project values that started in a particular year, excluding co-funding from other climate finance providers and host countries. Figure 3.1 is not based on actual disbursement data, which are not publicly available for every fund. The number of projects for the last two years has changed slightly compared with those reported in the AGR 2022 due to updates communicated by the funds' secretariats (see Annex 4.C [online] for the AGR 2022).

3.3 Actions reported in adaptation communications under the Paris Agreement

This section explores information on implementation contained in new stand-alone adaptation communications (box 3.1). As at 31 August 2023, a total of 59 countries and the European Union had submitted an adaptation communication to the UNFCCC Secretariat, including 43 developing countries. Twenty of the 43 submissions from non-Annex I countries are in the form of new stand-alone documents, while the other half consists mainly of nationally determined contributions (NDCs) that were retrospectively designated as adaptation communications. All bar one of the 16 adaptation communications from developed countries are new stand-alone adaptation communications. In total, there were 35 stand-alone adaptation communications from developed and developing countries (a list of countries and details about the methodology of analysis are provided in Annex 3.B).

Box 3.1 What are adaptation communications? And how do they provide information about the implementation of adaptation?

The Paris Agreement established adaptation communications as a new instrument for countries to voluntarily report their adaptation needs, policies and actions (Möhner, Leiter and Kato 2017). The first adaptation communications were submitted in the build-up to COP 26 in December 2021. An adaptation communication can be submitted either as a stand-alone document or as a section of either an NDC or a national communication, or as a national adaptation plan which can be designated as an adaptation communication. Adaptation communications are listed in an online registry of the UNFCCC Secretariat (https://unfccc.int/ACR).

Stand-alone adaptation communications potentially present a new data source on implemented adaptation and are therefore the focus of the analysis in this chapter. In contrast, if countries declared that a previously submitted document (e.g. an NDC) serves the function of an adaptation communication, no new information on implementation is expected. While most NDCs cover adaptation as a topic, the purpose of an NDC is mainly to pledge action rather than to report on implementation (UNFCCC 2022; Leiter 2023).

The 35 stand-alone adaptation communications mention 1,117 implemented adaptation actions. However, approximately 40 per cent of these lacked sufficiently detailed information to discern basic characteristics of the action. This primarily occurred when countries listed adaptation projects and programmes without elaborating on their content (e.g. simply listing them in a table). The absence of accompanying information meant that these actions could not be further analysed and do not feature further in the following results. For approximately 60 per cent of the actions identified (670 actions) however, some level of detail on implementation was available that enabled analysis. Of these 670 actions, almost half (46 per cent) had been reported as completed and 37 per cent as ongoing, while for the remaining 17 per cent the status of the implemented action was unclear based on the reported information. Approximately 50 per cent of the actions were preparatory[3] i.e. building the institutional and knowledge base for more substantive adaptation actions. Similarly, more than half of all adaptation actions documented in scientific articles published between 2013 and 2019 were in a planning or early implementation phase (UNEP 2021a, figure 5.1).

Sources of funding were provided for only 40 per cent of actions. Of these, 49 per cent were reported as being funded by international sources of finance, 45 per cent were reported as being funded by domestic sources, while 6 per cent were reported as being funded by both international and domestic sources of finance. One third of actions reported by developing (non-Annex I) countries in adaptation communications were domestically funded. Stand-alone adaptation communications therefore provide a new source of information that can help recognize adaptation efforts by developing countries.

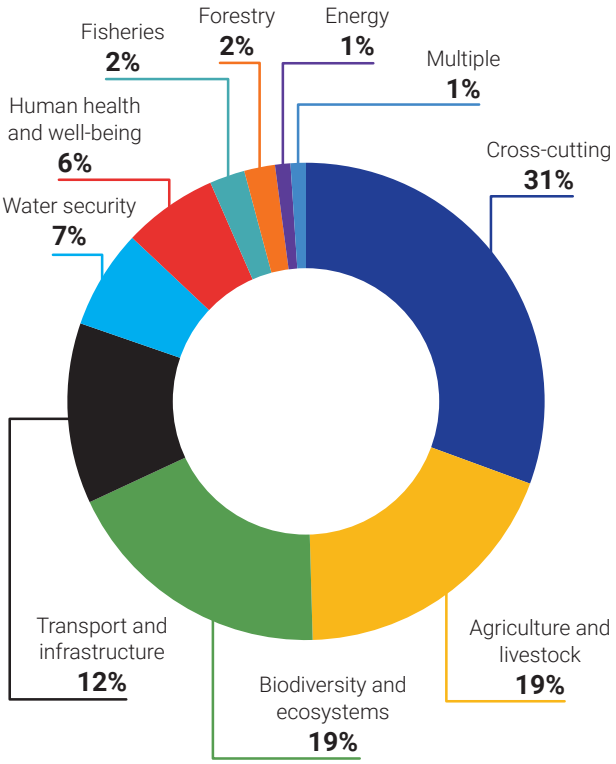
3.3.1 Sectoral focus

Almost one third of actions reported by countries in their adaptation communications refer to multiple or cross-cutting sectors (figure 3.2). Among those targeting one main sector, agriculture and livestock as well as biodiversity and ecosystems were most prevalent, each accounting for slightly more than 19 per cent of the reported actions. These findings differ somewhat from the sectoral composition of projects that started between 2015 and 2020 with funding from the AF, GCF and the GEF. While

3 Lesnikowski *et al.* (2015) distinguish between "preparatory" and "substantive" adaptation in their analysis of national communications.

agriculture was also the most frequently targeted sector among these projects (accounting for 27 per cent), followed by water (over 15 per cent), infrastructure accounted for a far lower proportion (less than 5 per cent) (UNEP 2021a, figure 5.3). Among the adaptation projects funded by bilateral finance providers, most common was a focus on multiple sectors, followed by agriculture and water (UNEP 2021b, figure 5.4).

Figure 3.2 Sectoral focus of adaptation actions reported in adaptation communications

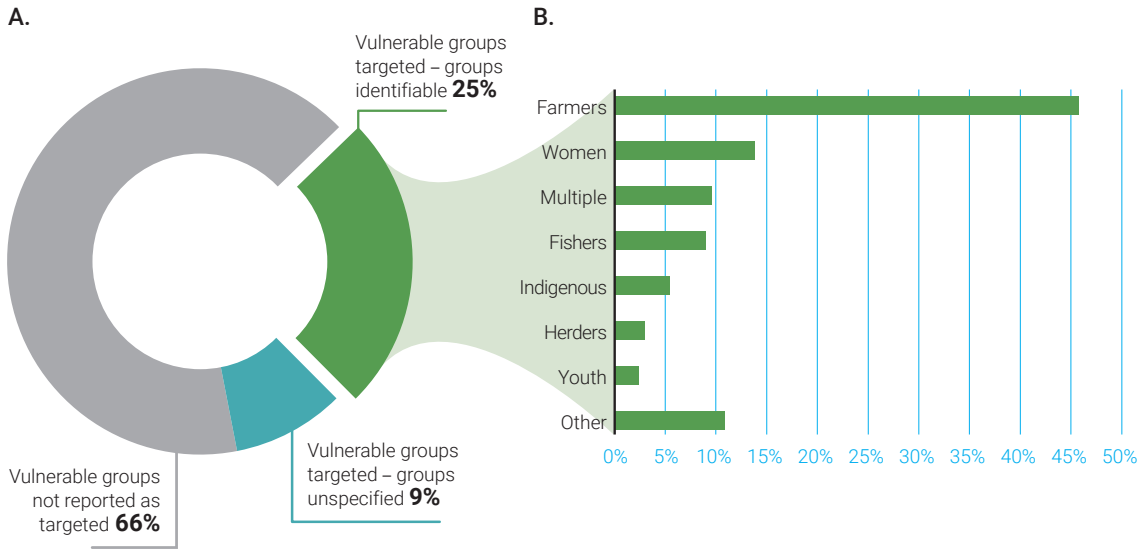


Note: "Multiple" indicates that an adaptation action specifically addresses multiple sectors. "Cross-cutting" indicates that an action provides broad implicit benefits but no sectors are addressed specifically.

3.3.2 Targeting of vulnerable groups and equity considerations

More than half (57 per cent) of stand-alone adaptation communications acknowledge that adaptive capacity and vulnerability differ across gender, age, abilities, racial and occupation lines. However, just one third of actions were explicitly reported to be specifically targeting vulnerable groups (figure 3.3, panel A). Those that did primarily focused on farmers (46 per cent), with the next most targeted groups being women and fisherfolk (14 per cent and 9 per cent, respectively – figure 3.3, panel B). The focus on farmers mirrored the prevailing focus on agriculture and food security as main vulnerabilities. Information about whether vulnerable groups actually benefited from adaptation actions is rarely reported.

Figure 3.3 Propensity of adaptation actions reported within adaptation communications to be targeting vulnerable groups. **Panel A** presents the proportion of actions that were reported to be specifically targeting vulnerable groups. **Panel B** presents the distribution of the different vulnerable groups targeted by these actions.

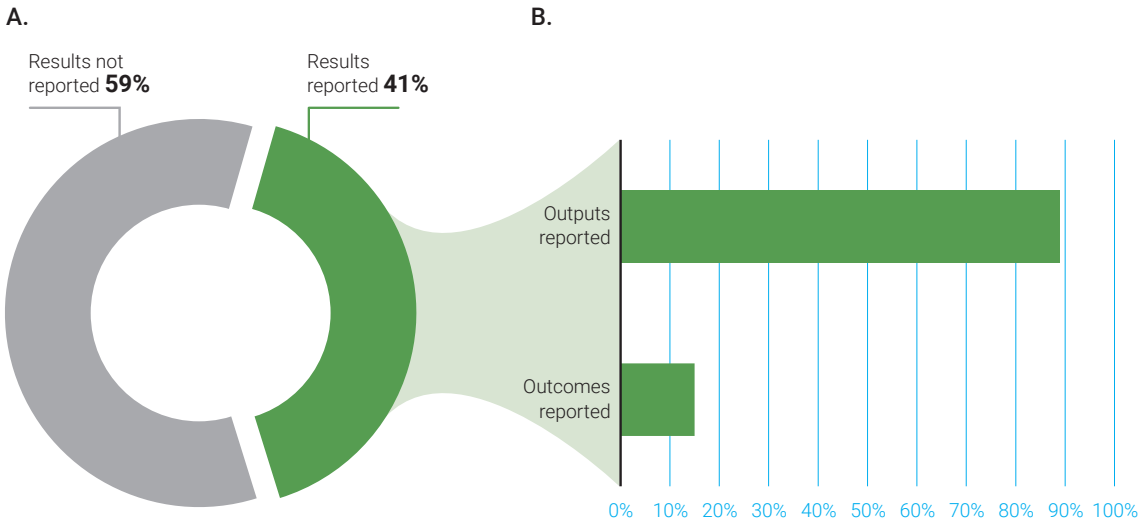


Among the adaptation communications that generally mention equity considerations, a majority underscored the imperative of addressing gender inequality in adaptation and some also called for gender mainstreaming efforts to be expanded in adaptation plans and implementation. Furthermore, countries reported efforts to incorporate Indigenous and local knowledge within adaptation planning and implementation. This ranged from generic mentions of how Indigenous and local knowledge is incorporated to descriptions of how traditional knowledge and practices are included in specific actions.

3.3.3 Results of implemented actions

Information related to the results of adaptation was only provided for 40 per cent of actions (figure 3.4, panel A). When such information was provided, it was mainly limited to describing the outputs of implemented projects and programmes (in 89 per cent of cases), with information about outcomes being available in only 15 per cent of cases (figure 3.4, panel B). In total, only 6 per cent of the 670 actions analysed included information about outcomes – despite almost half of these actions having already been completed. This lack of information on adaptation outcomes is consistent with findings of systematic reviews conducted on other sources of data (for example, Berrang-Ford *et al.* 2021). In many cases, the absence of this information in national reports is likely linked to a sole or primary focus on outputs by most national adaptation monitoring and evaluation (M&E) systems (Leiter 2021). Moreover, only 24 per cent of countries have an adaptation M&E system in place (chapter 2). Enhanced efforts and support are therefore needed to develop and operate adaptation M&E systems that inform planning and policymaking and to assess adaptation actions beyond outputs (UNFCCC Adaptation Committee 2023; see also UNEP 2022a, chapter 5).

Figure 3.4 Propensity of adaptation actions reported in adaptation communications to include information about results. **Panel A** presents the proportion of actions that were accompanied by information about their results. **Panel B** presents the extent to which different types of information about results were provided.



3.3.4 Barriers to adaptation implementation

Besides reporting on the implementation of adaptation, adaptation communications also provide information related to the barriers to implementing adaptation. These barriers overwhelmingly relate to informational gaps, including low awareness of climate change, limited access to data and information to support adaptation planning, and lack of appropriate data and tools to monitor and evaluate adaptation. There are also institutional barriers such as lack of coordination and inclusion of adaptation priorities into plans and policies. Countries also point to the inadequacy of financial resources, limited understanding of and access to available financing mechanisms, and unavailability of public funds. These findings align with earlier studies, including from the UNFCCC Adaptation Committee (2021).

3.3.5 Lessons for further development of adaptation communications

Adaptation communications submitted under the Paris Agreement do to some extent represent a new source of data on implemented adaptation, particularly for actions that are domestically funded. However, the level of information accompanying individual actions reported to date significantly limits a detailed understanding of progress in adaptation implementation. In particular, the scarcity of information on the outcomes and effectiveness of adaptation actions significantly hinders the ability to understand whether current adaptation is adequate in the face of present and future climate risks.

Countries can improve clarity by providing information on the implementation status and results of actions (where available), and on the targeting and inclusion of, and benefits for, vulnerable groups. Adaptation communications could also provide more information on co-benefits (e.g. for mitigation or sustainable development) (Berrang-Ford *et al.* 2022) and steps taken to avoid maladaptation (Schipper 2020). The voluntary guidance for adaptation communications published by the UNFCCC Adaptation Committee (2022) may assist countries in this regard. Most importantly, the inclusion of information on the outcomes associated with implemented actions is necessary for understanding adaptation effectiveness, scale and adequacy. These lessons are also relevant when countries prepare their first biennial transparency reports that are due by the end of 2024, even though adaptation is a voluntary component and LDCs and SIDS have discretion over whether to publish a biennial transparency report.

Finally, it is worth noting that 75 per cent of developing countries that submitted a stand-alone adaptation communication indicated that they received technical and/or financial support for adaptation reporting from various sources, most frequently from bilateral finance providers through the NAP Global Network and in fewer cases through national adaptation plan readiness funds from GCF. This finding underscores the importance of support in enabling developing countries, especially those with the lowest resources and capacities, to report on adaptation.

Case study: Ecosystem-based adaptation – Rice farming in Cambodia and Madagascar

Shifting rainfall patterns, unpredictable temperatures and extreme events are putting rice production and rain-fed agriculture under immense pressure. More resilience to erratic rainfall, drought, higher temperatures and other climate hazards is needed urgently.

In Cambodia and Madagascar, two countries which are heavily reliant on rice cultivation for food security and economic stability, recent advances have shown the potential of ecosystem-based adaptation approaches for climate-resilient food systems.

Taking a holistic strategy to implementing integrated adaptation measures, which combines climate risk assessments with the agricultural, environmental, economic and institutional factors of climate resilience, in addition to community engagement and value restoration of agroecosystems, can strengthen the resilience of both the rice subsector and vulnerable farmers.

The advances that have helped farmers adapt to the impacts of the climate crisis include climate-resilient rice varieties, improved water management practices, water storage and irrigation infrastructure, soil management, reforestation and the promotion of sustainable farming practices. Moreover, these measures can be transferred to many other rice-producing regions in Africa and Asia.

Note: This case study is not connected to the chapter. The full case study is available online.

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4

Chapter 4

Adaptation finance gap

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Inle Lake is a freshwater lake located in the Nyaungshwe Township of Taunggyi District of Shan State, part of Shan Hills in Myanmar.

Key messages

- This year's Adaptation Gap Report (AGR) includes a comprehensive assessment of the literature and has commissioned new studies to provide updated estimates of the cost of adaptation and current adaptation finance flows, and thus the adaptation finance gap for developing countries.

- The costs of adaptation from this new assessment are estimated to be in a plausible central range of US$215–387 billion/year for developing countries this decade. This is a significant increase from the previous AGR estimate. This is based on two evidence lines:

    - A modelling analysis estimates that the costs of adaptation could be US$215 billion/year this decade, with a range of US$130–415 billion/year. These costs are projected to rise over future decades towards 2050.

    - An analysis of the needs communicated in nationally determined contributions (NDCs) and national adaptation plans (NAPs), with extrapolation to all developing countries, estimates adaptation finance needs at US$387 billion/year for 2021 to 2030, with a range of US$101 billion to US$975 billion/year.

- An analysis of international public adaptation finance flows to developing countries estimates these at US$21 billion in 2021 – a 15 per cent decrease compared to 2020.

- Of the total bilateral finance commitments to developing countries over the period 2017–2021, only 66 per cent was disbursed compared with 98 per cent for all bilateral development finance. This indicates that there are specific barriers to adaptation that impede implementation.

- Based on this new assessment of costs and flows, the adaptation finance gap has grown significantly since previous assessments. The estimated costs/needs of adaptation are now approximately 10–18 times as much as international public adaptation finance flows. A widening gap indicates a deepening climate crisis and will mean increased loss and damage.

- This indicates that a significant increase in international public adaptation finance is needed, which should be anchored in the new collective quantified goal. However, any such increase is unlikely to bridge the adaptation finance gap on its own. For example, reaching the goal of the twenty-sixth session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 26) of doubling international public adaptation finance by 2025 would require an increase of 16 per cent per year (on average), but this would only close the adaptation finance gap by approximately 5–10 per cent.

- Domestic expenditure and private finance could be vitally important sources of adaptation finance, but quantitative estimates are not yet available. However, neither domestic expenditures nor private finance flows are likely to bridge the adaptation finance gap alone, especially in low-income countries (including the least developed countries [LDCs] and small island developing States [SIDS]) and there are important equity issues in using these flows to fill the gap in these countries.

- For the first time in the gap report, an analysis of gender equality and social inclusion has been made. This indicates that gender is only weakly included in adaptation finance. Of the international public finance for adaptation that is also tagged with gender equality as a principal marker, only 2 per cent is assessed as gender-responsive, with a further 25 per cent as gender-specific or gender integrative. Analysis of costed NDCs and NAPs finds that 20 per cent of these now include dedicated costs for gender aspects, and the budget allocated to these interventions is generally low, at 2 per cent on average. Only one country's document is considered gender-responsive, with the rest gender-specific or -integrative. Among both finance flows and finance needs, other aspects of social inclusion (e.g. Indigeneity, ethnicity, disability, age or migration status) receive little attention.

► Bridging the adaptation finance gap requires more ambitious mitigation and effective adaptation. In addition to increased international public adaptation finance, private-sector finance and domestic expenditure, several approaches can help bridge the gap. These include remittances, increased finance for small and medium-sized enterprises (SMEs), reform of the international financial system and the implementation of article 2.1(c) of the Paris Agreement. The latter offers significant potential, including for developing countries, but it also brings the risk that vulnerable developing countries become less attractive to invest in if article 2.1(c) is driven solely by financial materiality.

4.1 Introduction and context

The adaptation finance gap is defined as the difference between the estimated costs of meeting a given adaptation target and the amount of finance available for adaptation (United Nations Environment Programme [UNEP] 2014). The AGR 2023[1] has undertaken a new and comprehensive analysis to estimate the adaptation finance gap for developing countries (the non-Annex I countries under the United Nations Framework Convention on Climate Change [UNFCCC]).[2]

In practice, estimating the gap is challenging, both conceptually and quantitatively (UNEP 2016a). Furthermore, while a monetary metric helps communicate the scale and urgency of the gap, finance is a means rather than an end, as the availability of funds does not guarantee that they will be used efficiently and effectively (see chapter 3). There may also be 'soft' and 'hard limits' to adaptation (see glossary). Nevertheless, a widening finance gap indicates a deepening climate crisis and will mean higher losses and damages (see chapter 5), whereas a narrowing gap indicates progress. The finance gap estimate is based on three evidence lines:

- An updated analysis and estimate of the costs of adaptation based on global sectoral models
- An updated analysis and extrapolation of adaptation finance needs reported in NDCs and NAPs
- An updated analysis of global adaptation finance flows (where possible) at the country level

Based on this analysis, the chapter compares the adaptation costs and finance needs against the current adaptation finance flows to estimate the size of the adaptation finance gap. It has also considered the gender equality and social inclusion dimensions of adaptation costs, needs and finance. Finally, the chapter discusses ways to potentially bridge the gap. Additional information on the analysis is provided in the supporting Adaptation Finance Gap Update 2023 (AFG Update 2023).

This new adaptation finance gap estimate is relevant to the discussion of the nature and size of the new collective quantified goal on climate finance, which is to be set prior to 2025 by the Parties to the UNFCCC and which will be fundamental to helping close the adaptation finance gap, in particular for more vulnerable countries such as the LDCs and SIDS. It is also relevant to the decision taken at COP 26 in Glasgow to urge developed countries to at least double their collective provision of finance for adaptation to developing countries from 2019 levels by 2025 (decision CMA.3).

4.2 The costs of adaptation in developing countries

4.2.1 Introduction, approaches, challenges, methods and evidence lines

The costs of adaptation can be defined as the costs of planning, preparing for, facilitating and implementing adaptation measures to moderate harm or exploit beneficial opportunities arising from climate change. In simple terms, the costs of adaptation can be assessed by estimating the current and future impacts of climate change, then

1 This chapter was co-financed by the ECONOGENESIS project funded under the Climate Adaptation and Resilience (CLARE) programme, a partnership between the UK Foreign, Commonwealth and Development Office (FCDO) and the International Development Research Centre (IDRC), Canada. The views expressed herein do not necessarily represent those of the UK government, IDRC or its Board of Governors. This chapter also was co-financed by the Assessing Climate Change Risk in Europe project (ACCREU) funded by the European Union through the HORIZON Europe RIA (Research and Innovation Action) under grant agreement 101081358 and from UKRI under the UK Government's Horizon Europe Guarantee, Reference Number: 10073932. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible for them. The update on fisheries and aquaculture was funded by Food and Agriculture Organization of the United Nations under the NORAD-funded Project on Assisting partner countries and key stakeholders to adapt to climate change effectively (GCP/GLO/352/Nor, component 2). The views expressed in this information product are those of the author(s) and do not necessarily reflect the views or policies of FAO.

2 See www.unfccc.int/process/parties-non-party-stakeholders/parties-convention-and-observer-states.

assessing the reduction in these impacts (the benefit of adaptation) and its associated cost (UNEP 2016b). However, there is a trade-off involved over how much adaptation to do, and on the level of residual damage costs after adaptation (noting these include both market and non-market damages). This reflects the fact that adaptation is rarely 100 per cent effective and that it usually becomes more costly (and less cost-effective) to reduce impacts towards zero. This residual damage after adaptation closely relates to the concept of loss and damage (see chapter 5), including economic and non-economic impacts). It is highlighted that the trade-off between adaptation costs and residual damage involves ethical as well as technical considerations, and that different actors may have different views on these issues.

In practice, estimating the costs of adaptation is extremely difficult (UNEP 2016a, 2021a) and there is no single definitive estimate, because costs depend on the objectives chosen, as well as on the definitions and methods used (UNFCCC 2022a). Further discussion of why estimates of the adaptation costs can vary is summarized in box 4.1, with a fully referenced discussion in the AFG Update 2023.

Box 4.1 Why do the estimated costs of adaptation vary?

Framing issues

- Objectives. There is no single agreed quantitative goal for adaptation. The costs of adaptation vary with the objective and whether this is based on economic efficiency, acceptable risk levels or reducing impacts to current levels. This also determines residual damages, which are relevant for losses and damages.
- Uncertainty. There is high uncertainty around the future risks of climate change and thus the amount and cost of adaptation needed. This arises from alternative future emission and socioeconomic scenarios, alternative climate models as well as from uncertainty around the level of (physical) climate impacts.
- Coverage and boundaries. Adaptation costs vary with the coverage of sectors and the risks as well as the boundaries e.g. whether to include costs to address existing natural climate variability and extremes, and whether general development is included (e.g. activities to increase household incomes).

To help address these framing issues, the AGR uses different evidence lines and undertakes sensitivity analysis where possible, for example to capture the effects of uncertainty.

Methodological issues and assumptions

- Estimating adaptation costs is challenging because of the site- and context-specific nature of risks (hazard, vulnerability and exposure), which change over time non-linearly and have high uncertainty (as above).
- Adaptation costs vary with the method used, the assumptions within the modelling or analysis framework, and with the assumed effectiveness of adaptation (in reducing climate risks).
- The incremental level of climate impacts and the level of adaptation and costs both depend on the historical reference period chosen. More recent baselines reduce the level of impact and thus adaptation costs.
- Adaptation costs vary depending on whether autonomous adaptation is included in the analysis of impacts (e.g. from natural acclimatization to heat or from changes in prices in markets).
- Adaptation costs are higher if real world implementation is considered, and if associated opportunity and transaction costs as well as design, management, implementation and monitoring costs are taken into account.
- Adaptation costs are lower if learning and innovation are included, and if soft options are considered (e.g. early warning), as these can have lower costs than engineered options.
- Adaptation costs expressed in US$ can vary. Different studies have different price years and some estimates are presented as purchasing power parity values.
- Adaptation is often described as a process. An adaptive management approach frames risks iteratively over time, then uses decision-making under uncertainty, and so identifies different adaptation options and costs, compared with a linear static analysis.

These issues are acknowledged in the AGR, and analysis is made of their influence on reported values.

Additional factors and key gaps

While there has been significant progress in estimating adaptation costs, there remain areas that are still not well captured in the literature, which are priorities for future updates.

- Most adaptation costing has focused on incremental adaptation, but the need for transformative and transformational adaptation will involve very different costs (and is a priority for further analysis).
- Adaptation costs will vary with soft and hard limits to adaptation, which also determine residual damages, but these limits have rarely been considered in analysis.
- Most studies have focused on direct climate change impacts, but there is increasing awareness of the need to adapt to cascading and compounding risks and address interdependencies.
- Adaptation that considers gender equity and social inclusion, or distributional analysis, will give different weight to different groups, which can affect costs.
- Mitigation and adaptation can involve positive synergies and potential trade-offs. Considering these can change adaptation options and costs.
- Adaptation is often delivered by integrating in existing policies and programmes, rather than as a stand-alone policy, and there can be synergies (or trade-offs) with other policy objectives, which affect costs.

Noting these challenges, the AGR has identified indicative ranges of adaptation costs using two alternative evidence lines and metrics: first, estimates of the costs of adaptation from modelling studies (4.2.2) and second, adaptation finance needs as estimated and communicated by national governments in UNFCCC submissions (4.2.3).[3]

4.2.2 The modelled costs of adaptation

A comprehensive review and assessment of the literature, and commissioned studies, have been used to update the modelled costs of adaptation. Full details are presented in chapter 2 of the supporting the AFG Update 2023.

Global model assessments. Since the AGR 2016, there have been a significant number of new modelling studies on the global economic costs of climate change, as reported in the Intergovernmental Panel on Climate Change Working Group II *Sixth Assessment Report* (IPCC WGII AR6) (O'Neill, van Aalst and Ibrahim 2022). This includes the use of global integrated assessment models, structural models (including computable general equilibrium models) and econometric (statistical) analysis to assess the economy-wide effects of climate change. However, there has been much less progress in producing new estimates of global adaptation costs. Indeed, adaptation remains poorly represented in current global modelling frameworks and models (van Maanen *et al.* 2023). The IPCC WGII AR6 (New *et al.* 2022) reviewed the global costs of adaptation for developing countries. A review for the AGR 2023 has identified only a limited number of additional adaptation studies since the IPCC report (de Bruin and Ayuba 2020; van der Wijst *et al.* forthcoming).

Sector modelling assessments. Because of the challenges in integrating adaptation into the global economic models above, and thus the low number of published studies, an alternative approach is to aggregate adaptation costs produced at the sector level. This includes the use of sector-integrated assessment models, sector economic models and sectoral assessments. This approach allows an improved representation of adaptation, though it does not capture the wider economic and cross-sectoral linkages that are possible with the above-mentioned global economic frameworks. Ideally these sector studies are run using consistent scenarios and assumptions to facilitate aggregation which can then be input into integrated global economic models.

This report has used a sectoral approach to produce new estimates of the costs of adaptation. It has derived adaptation cost estimates from established sector models and recently published studies, working with modelling teams to extract adaptation cost information and updating to current prices (presenting values as annual undiscounted adaptation costs). The analysis is summarized in table 4.1. This includes updates to previous sectoral assessments but also the extension to additional sectors and risks. The

3 All values in this chapter are reported in constant 2021 prices (to year end 2021), in alignment with the method used in the Organisation for Economic Co-operation and Development (OECD) Development Assistance Committee (DAC) database, without purchasing power parity adjustment. The price level adjustment was also applied to previous AGR estimates and estimates of adaptation finance needs.

resulting estimates have been aggregated to provide a new indicative cost of adaptation for developing countries. This approach has allowed a comprehensive update of the costs of adaptation, although it was not undertaken as a fully integrated analysis.[4]

Table 4.1 Approach and results for the sectoral modelled costs of adaptation for developing countries

Sector or theme	Approach	Estimated adaptation costs (central) for developing countries
Coastal zones	DIVA model (Hinkel *et al.* 2013; Hinkel *et al.* 2014) and model runs (Lincke *et al.* 2018)	Cost of coastal protection and beach nourishment estimated at US$56billion/year for 2020–2030 (adaptation cost only, excluding residual damage, RCP4.5–SSP2). Costs increase by 2050s, especially for higher emission scenarios, and increase rapidly thereafter. High residual costs remain after adaptation, though levels vary with protection levels.
River floods	GLOFRIS model (Ward *et al.* 2017) and model runs (Lincke *et al.* 2018)	Costs of river flood protection estimated at US$54 billion/year for the period 2010–2050 (RCP4.5–SSP2, average of five climate models, relative risk constant scenario). High residual costs remain after adaptation, though vary with protection level. Excludes pluvial flooding and water management for public water supply.
Infrastructure	World Bank Studies (Hallegatte, Rentschler and Rozenberg 2019; Hallegatte *et al.* 2019), extended to 2050 (AFG Update 2023)	Costs of making infrastructure resilient in the energy and transport subsectors estimated at US$56 billion/year. Adaptation reduces the risks of damage by a factor of two to three, though residual impacts remain. Costs increase significantly towards 2050. Does not include adaptation costs for other infrastructure (including urban).
Agriculture	IFPRI modelling suite and model runs (Sulser *et al.* 2021)	Annual adaptation investment needs to address the impact of climate change on chronic hunger estimated at US$16 billion/year over the period 2015–2050, based on costs of agricultural research and development, water management and infrastructure.
Fisheries, aquaculture and marine ecosystems	AFG Update 2023 using fisheries impact data from the Food and Agriculture Organization of the United Nations (2018)	Costs of adaptation to address changes in fish catch potential estimated at US$5 billion in the 2020s, rising towards 2050s. Includes costs for adaptation for marine and coastal ecosystems (marine protected areas) and safety at sea, but not ocean acidification.
Health	AFG Update 2023 using health impact data from the World Health Organization (2014)	Costs of disease control to address increases in malaria, dengue and diarrhoeal diseases (RCP4.5) and to address increased heat-related mortality, plus indicative costs of increased disease surveillance and making Water Sanitation and Hygiene for All and health infrastructure resilient. Total estimated at US$11 billion/year.
Early warning and social protection	AFG Update 2023	Costs of weather and climate services (including early warning systems [EWS]) from the Early Warning for All Assessment (World Meteorological Organization 2022) and a review of 31 national studies. Costs of adaptive social protection based on costs of additional funding for shock response programmes from 11 national studies. Total US$16 billion/year.

4 While the analysis has aimed to harmonize as much as possible, this means there are some differences in the exact reference periods, in the representative concentration pathways (RCPs) and shared socioeconomic pathways (SSPs) considered, and for the specific climate model/s used for each RCP.

Terrestrial biodiversity and ecosystem services	AFG Update 2023 based on data and approach of Protected Planet (2023), Waldron *et al.* (2020) and UNEP (2022). Noted as underestimate	Indicative analysis of the costs of adaptation for protected areas only estimated at US$1.5 billion/year, with climate change attribution based on the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (2019). Costs rise significantly in 2050 to address changes in species abundance. Estimate is an underestimate as does not capture adaptation to address non-protected areas or wider impacts on ecosystem services.
Cooling demand and labour productivity	Qualitative review (quantified analysis planned for next AGR)	Review of adaptation costs for heat-related impacts for built environment and energy demand for cooling as well as impacts on labour productivity. While impacts are autonomous or fall to the private sector/households, they do involve costs for developing countries.
Business and industry	Qualitative review (due to low evidence base)	Review of adaptation costs for business and industry, including tourism and for supply chains.
Capacity-building and governance	Qualitative review (due to low evidence base)	Review of potential adaptation costs associated with capacity-building and governance.
Socially contingent effects	Qualitative review (no quantified estimates available)	Review of potential adaptation costs for social sectors (e.g. education) and socially contingent effects such as migration or conflict.

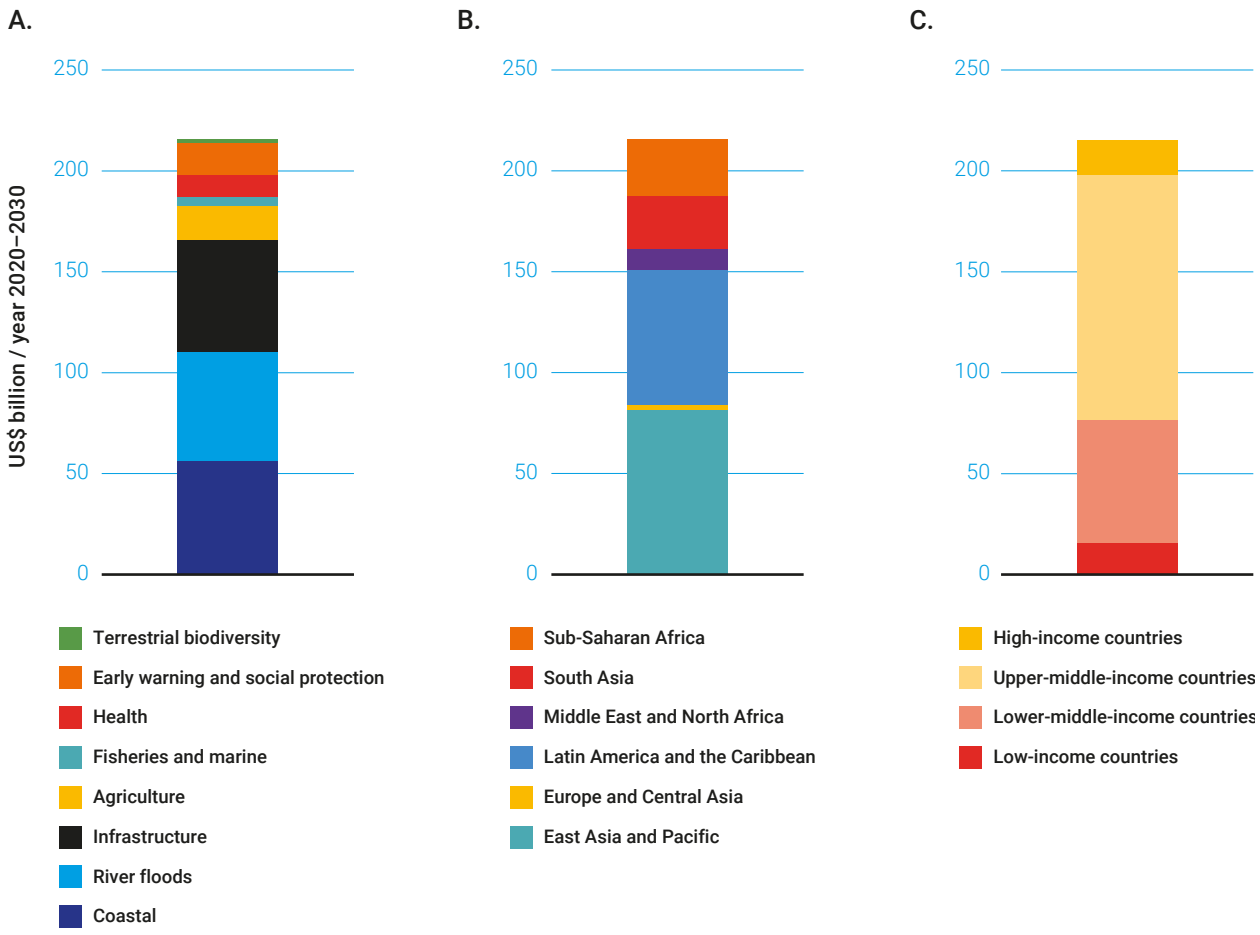
Note: Coverage of sectors and risks is partial and in some cases only qualitative. All values are presented in constant 2021 prices, and thus values differ from original published studies. Further discussion and the ranges around the central values are presented in chapter 2 of the AFG Update 2023.

The results of this updated analysis are presented in figure 4.1. This shows the aggregated costs of adaptation (undiscounted annual cost in the period of the 2020s i.e. for the period up to 2030) for developing countries by sector, region and by income level group. The indicative total cost of adaptation (central estimate) is estimated at US$215 billion/year for all developing countries, though there is a large range around this value. This central estimate is equivalent to 0.56 per cent of gross domestic product (GDP) (2021) for all developing countries (or approximately US$33 per capita/per year). The highest adaptation costs are for river flood protection, infrastructure, coastal protection and for the regions of East Asia and the Pacific as well as Latin America and the Caribbean. The highest absolute costs are for the upper and lower middle-income countries, but when expressed as a percentage of GDP, adaptation costs are much higher for low-income countries (3.5 per cent) than for lower-middle (0.7 per cent) or upper-middle (0.5 per cent).

The modelled costs for the LDCs and SIDS have been considered separately. The indicative central values are estimated at US$4.7 billion/year for SIDS (0.7 per cent of GDP), and US$25 billion/year (2 per cent of GDP) for LDCs, totalling US$29 billion/year (noting that some SIDS are also LDCs). The costs of adaptation for LDCs and SIDS are 12 per cent of the modelled adaptation costs for all developing countries.

There are several issues to highlight with these global adaptation costs, which link to the issues raised in box 4.1. First, while the coverage is wider than earlier studies, it remains partial. For example, it does not include adaptation costs related to the built environment or labour productivity, and values for biodiversity and ecosystem services only cover protected areas. Second, these figures only include the costs of adaptation, and there are additional residual costs (which are especially relevant for loss and damage). Finally, there is a significant range around these central values. Sensitivity testing has been undertaken to explore the influence of these factors. Based on the information available, the range around the indicative central value – for alternative representative concentration pathways (RCPs) and climate models – is US$130 billion/year to US$415 billion/year. However, a much wider range emerges when other factors are considered. As an example, the use of different objectives (e.g. for river floods) alters the adaptation costs by a factor of two or more, as well as the level of residual damage, with more ambitious adaptation reducing residual levels. Different functions or models for the same sector, and different assumptions on adaptation effectiveness and costs, also significantly affect the values. Further details are provided in the AFG Update 2023.

Figure 4.1 Estimated costs of adaptation for developing countries by sector (panel A), region (panel B), and income group (panel C) for 2030 (indicative central value).



Note: For details, see table 4.1 and the AFG Update 2023.

These updated values can be compared with previous estimates. A similar sectoral modelling approach was used in the earlier World Bank Economics of Adaptation to Climate Change study (World Bank 2010; Narain, Margulis and Essam 2011). This estimated the costs of adaptation for developing countries at approximately US$70 to US$100 billion/year for the period 2010–2050 for a 2˚C scenario (by 2050) (2005 prices), which is equivalent to US$125 to US$171 billion/year in current prices (2021). The modelled costs in this update are therefore considerably higher, even when the same models have been used for sectoral analysis (as in coastal, river floods and agriculture). This reflects the more negative impacts of climate change reported in the literature (IPCC 2022), as well as updates to the level of adaptation costs, but it also reflects the addition of new risks and sectors.

The modelled costs of adaptation are estimated to increase significantly by 2050 for most sectors and risks, especially for high warming scenarios (see AFG Update 2023). For example, the annual costs of adaptation for coastal protection rise with increasing sea level rise by 2050, especially under the RCP6.0 and RCP8.5 scenarios. Similarly, for new infrastructure there are rising annual costs of adaptation because of rising risks, but also the growing stock of new infrastructure assets to protect. However, some adaptation cost estimates decrease with time. For example, additional cases of diarrhoeal disease owing to climate change are estimated to be lower in 2050 than 2030 (World Health Organization 2014) due to reductions in baseline levels from socioeconomic change. The sector studies show that adaptation costs will be significantly lower in a world where the Paris Agreement goals are met, especially towards mid-century and beyond. This highlights the need for mitigation in reducing future impacts as well as the future costs of adaptation.

Case study: Navigating climate risks – The path of San Pedro Sula to a resilient future

The climate crisis is exacerbating existing risks and creating new challenges for cities worldwide. Across the globe, communities grapple with the same pressing questions, such as, "How can we adapt to changing rainfall patterns, floods and storms made worse by the climate crisis?" These challenges are often combined with limited access to information.

To understand and project evolving climate risks, cities need to bridge these knowledge gaps to enable measures that offer the best cost-to-benefit ratio and protect the most people.

In San Pedro Sula, Honduras, 20 adaptation measures were assessed in a framework that gave the municipality concrete information to take a proactive approach to confronting climate risks, significantly improving its ability to reduce these threats. This example offers a model for municipalities across the world on the benefits of bridging knowledge gaps. In turn, this enables local governments to tackle complex climate risks, while highlighting the importance of further investment into climate risk-related data, enhancing weather-monitoring networks and strengthening early warning systems.

Note: This case study is not connected to the chapter. The full case study is available online.

Authors: Alvaro Rojas (Munich Climate Insurance Initiative), Jorge Cálix Tejeda (Municipality of San Pedro Sula Honduras), David Daou (United Nations University and Munich Climate Insurance Initiative), Maxime Souvignet (United Nations University)

4.2.3 Adaptation finance needs

A comprehensive assessment and new analysis have been made of adaptation finance needs for domestic adaptation priorities, as submitted to UNFCCC in NDCs and NAPs by countries. Among 155 developing (non-Annex I) countries, all except Libya and Yemen, have submitted at least one NDC, and 46 countries have also submitted their NAPs as at 31 July 2023 (UNFCCC 2023a; UNFCCC 2023b).

The country-driven, bottom-up and dynamic nature of the information in NDCs and NAPs makes these documents an important source of evidence for estimating the adaptation finance needs of developing countries. However, the information provided in these documents is highly heterogeneous: the plans differ in terms of their adaptation ambition, consideration of future climate and socioeconomic scenarios, methods employed to identify and prioritize adaptation options, costing methodologies, sectoral coverage and implementation time frame (box 4.1). Therefore the adaptation finance needs reported should be interpreted with their inherent limitations. The data collection, processing and analysis methodology and detailed results are further explained in chapter 3 of the AFG Update 2023.

Box 4.2 Modelled costs versus adaptation finance needs

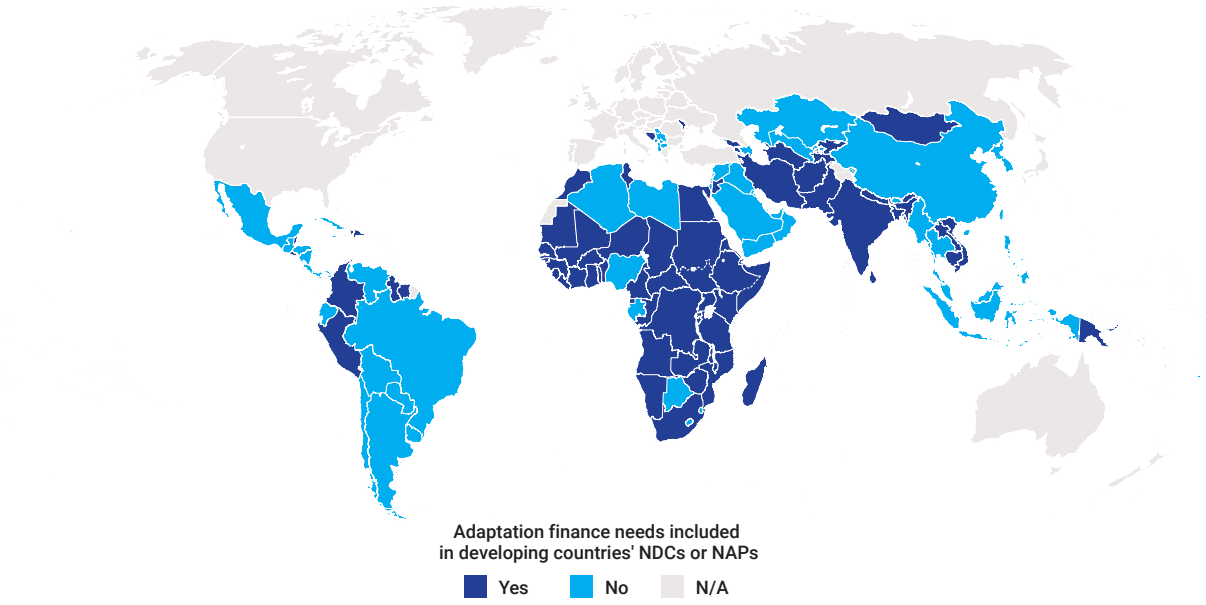
The modelled costs of adaptation (4.2.2) are typically based on an analysis of the adaptation needed to reduce incremental climate risks, relative to a reference period, without consideration of how this is financed. The country adaptation finance needs (4.2.3) involve similar metrics (US$) but refer to the financial resources required by countries from international and domestic sources to implement their domestic adaptation plans. These are influenced by existing adaptation ambition and socioeconomic circumstances. The two approaches also tend to use different methods. Adaptation finance needs tend to be based on programme and project level costing, and often include different definitions to modelled studies of adaptation costs. There can also be differences in the sectors and risks included, and the objectives set for adaptation. All of this means that there are often differences between needs and modelled costs for the same country.

Status of adaptation finance needs information in the countries' domestic adaptation plans

Of the submitted NDCs and NAPs, 85 developing countries have specified their adaptation finance needs for the period 2021–2030 in at least one of their submissions. The proportion of countries specifying adaptation finance needs rises with income. Among low-income countries, 89 per cent have stated their finance needs, compared with 68 per cent of lower-middle-income countries, 42 per cent of upper-middle-income countries and just 16 per cent

of high-income countries. This suggests low-income countries have a greater need for international climate finance assistance and are more proactive in expressing their finance needs. These needs are mostly based on sector- and project-based estimates. Some countries also reference previous studies that have utilized economic and integrated assessment models to indicate their adaptation finance needs.

Figure 4.2 Status of adaptation finance needs information in developing countries' NDCs and NAPs



Note: "N/A" refers to Annex I countries.

The cost of implementing adaptation priorities and plans for these 85 developing countries totals US$105 billion per year on average for the period 2021–2030. This amount equates to 1.5 per cent of their GDP on average. A total of 31 countries have also indicated their conditional and unconditional adaptation finance needs. Among those, around 85 per cent of the adaptation finance needs submitted by countries are conditional, relying on international climate finance support. The remaining 15 per cent is unconditional and they are expected to be financed domestically.

It is important to recognize that not all NDCs and NAPs, as well as the identified adaptation needs in these plans, have been fully costed. Many countries have highlighted methodological challenges and capacity gaps in quantifying adaptation finance needs (UNFCCC 2021a). Therefore, even for those countries that have submitted costed estimates, actual adaptation needs may potentially be larger. At the same time, the lack of rigorous assessments and countries' interest in attracting international finance means there is a possibility that adaptation finance needs are overestimated.

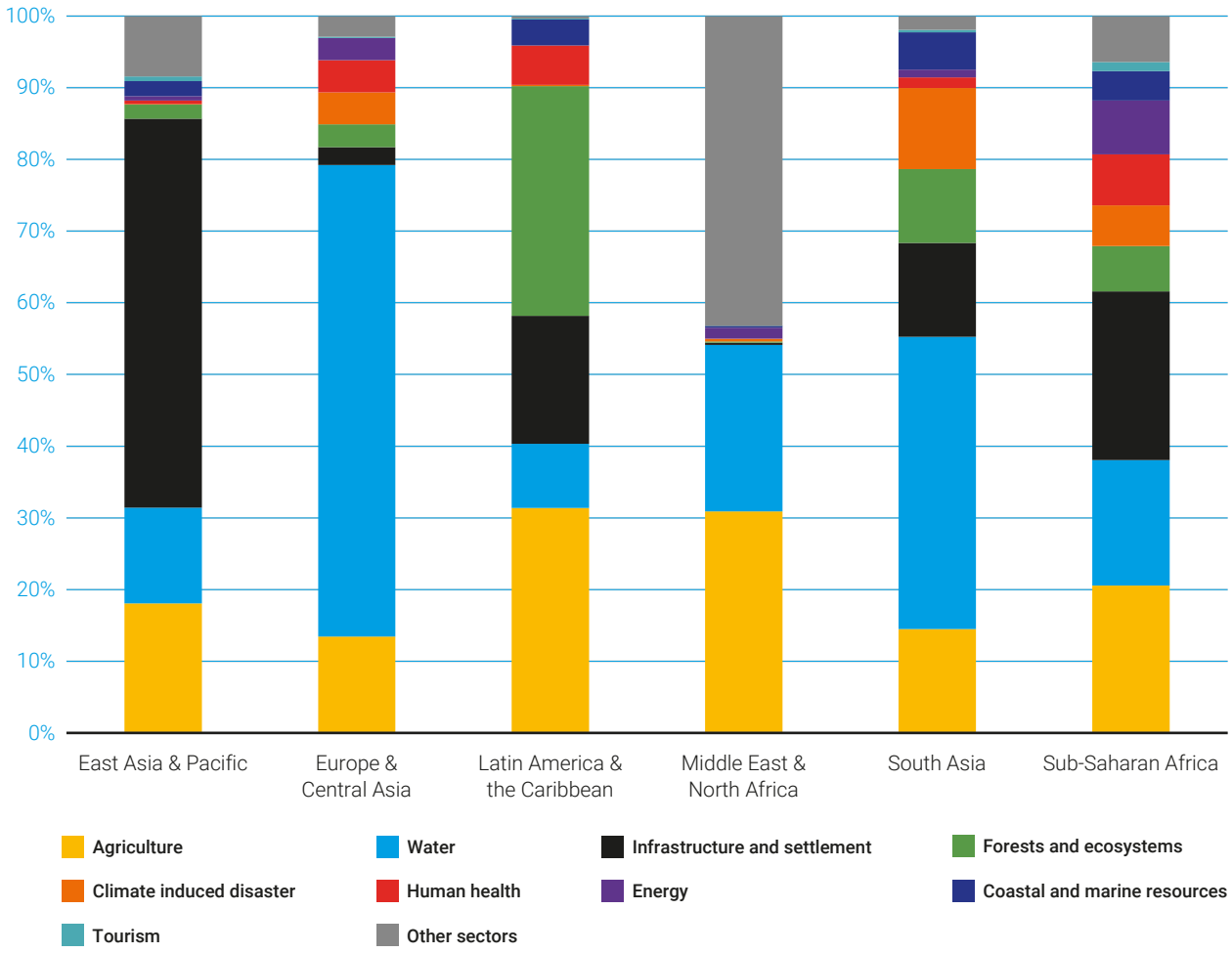
Sectoral distribution of adaptation finance needs

A total of 52 countries have provided a breakdown of adaptation finance needs by sector (for at least three sectors). Water, agriculture and infrastructure are the priority sectors identified in adaptation finance needs across regions, though the priorities vary as shown in figure 4.3. Further details are in the AFG Update 2023.

Global adaptation finance needs

The analysis of the adaptation finance needs submitted in NDCs and NAPs shows that per capita needs tend to increase with the income level, with high-income countries having higher average per capita needs in their submissions (figure 4.4, panel A). The average per capita adaptation finance needs in low-income countries is only US$22 with an interquartile range (IQ) of US$9 to US$36. In lower-middle-income countries, the average per capita adaptation finance needs increase to US$51 (IQ range US$22–109). The average per capita adaptation finance needs are US$81 (IQ range US$9–238) in upper-middle-income countries and high-income countries. The average per capita adaptation finance needs in the LDCs is US$25 (IQ range US$13–$46), and in SIDS is US$153 (IQ range US$65–258).

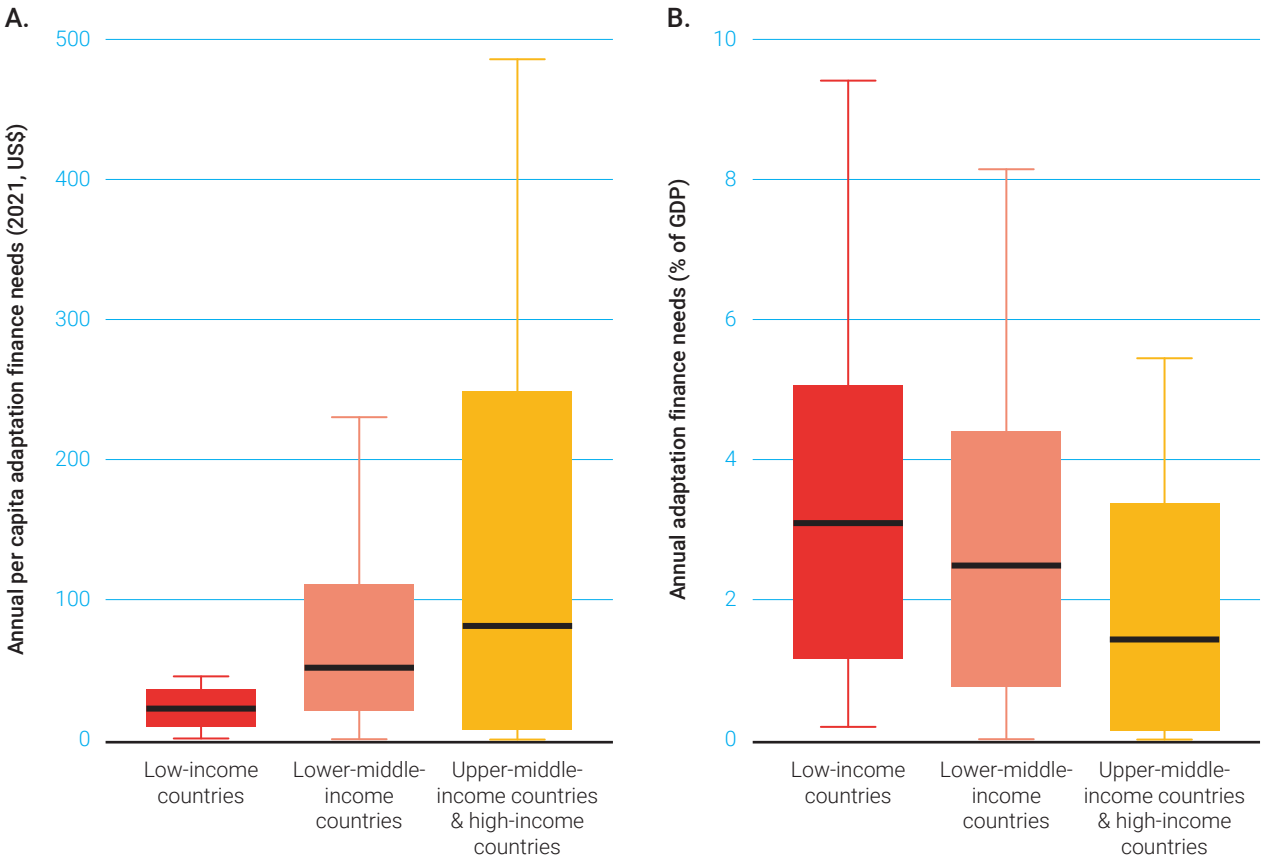
Figure 4.3 Sectoral distribution of adaptation finance needs by world regions, presented as a percentage of total finance needs for the respective region



However, a different trend emerges when finance needs from country submissions are expressed as an equivalent percentage of GDP. In this case, the needs are higher in low-income countries (figure 4.4, panel B). The average adaptation finance needs in low-income countries is 3.09 per cent of GDP (IQ range 1.18–4.96 per cent), whereas the adaptation finance needs are 2.5 per cent of GDP (IQ range of 0.77–4.41 per cent) in lower-middle-income countries, and 1.43 per cent of GDP (IQ range of 0.14–3.20 per cent) in upper-middle-income countries and high-income countries. In the case of LDCs and SIDS, the adaptation finance needs are 2.67 per cent of GDP (IQ range 1.14–4.74 per cent) and 3.39 per cent of GDP (IQ range 1.28–4.62 per cent), respectively.

These results may indicate that wealthier countries, which typically have more assets and infrastructure to adapt to climate change, tend to estimate higher needs in terms of absolute dollar values, and/or that they have a higher value at risk. These countries may have higher adaptive capacities and can afford to invest more in adaptation. In case of the SIDS, the high per capita adaptation finance need partly results from their small population size and partly from the level of adaptation necessary given their high vulnerability. On the other hand, adaptation finance needs for low-income countries constitute a larger relative proportion of their economies (i.e. of GDP). The existing low development baseline in the low-income countries – and their limited technical and financial capacity to conduct robust needs assessments – might have also contributed to lower adaptation finance needs, even though these countries are more likely to require increased international climate finance because of domestic budget constraints.

Figure 4.4 Annual adaptation finance needs in per capita (panel A) and as a percentage of GDP (panel B) by income level, from submitted NDCs and NAPs. Figure shows the median, IQ and full range.



Global and regional adaptation finance needs

To estimate the total regional and global adaptation finance needs of developing countries, the analysis uses the annual per capita adaptation finance needs from submitted NDCs and NAPs (median and IQ range) (figure 4.4, panel A and table 4.2) by income group as an extrapolation factor. The average annual adaptation finance needs in developing countries for the period 2021–2030 from this extrapolation are estimated at US$387 billion, with a range of US$101–975 billion. The wide uncertainty range highlights the challenges in determining global adaptation finance needs. These values can be expressed as a percentage of GDP percentage. The average adaptation finance needs in developing countries equate to 1 per cent of GDP (with a range of 0.25–2.50 per cent). The annual adaptation finance needs in LDCs and SIDS are US$41 billion with a range of US$16–83 billion: while this amount is small in absolute dollar value, the amount is equivalent to 2 per cent of their GDP (with a range of 0.80–4 per cent). The analysis has also considered the income level specific annual adaptation finance needs in per cent of GDP as an alternate extrapolation factor (figure 4.4, panel B). These values are presented in the AFG Update 2023.

4.3 International adaptation finance flows

A revised assessment of current adaptation financial flows to developing countries has been undertaken, as these flows will allow implementation of the adaptation costs or financing needs outlined in previous sections. This analysis focuses on the finance flows from developed to developing countries, compared with existing reports focusing on global financial flows including for developed and developing countries (Global Center on Adaptation [GCA] and Climate Policy Initiative [CPI] 2021; UNFCCC 2022).

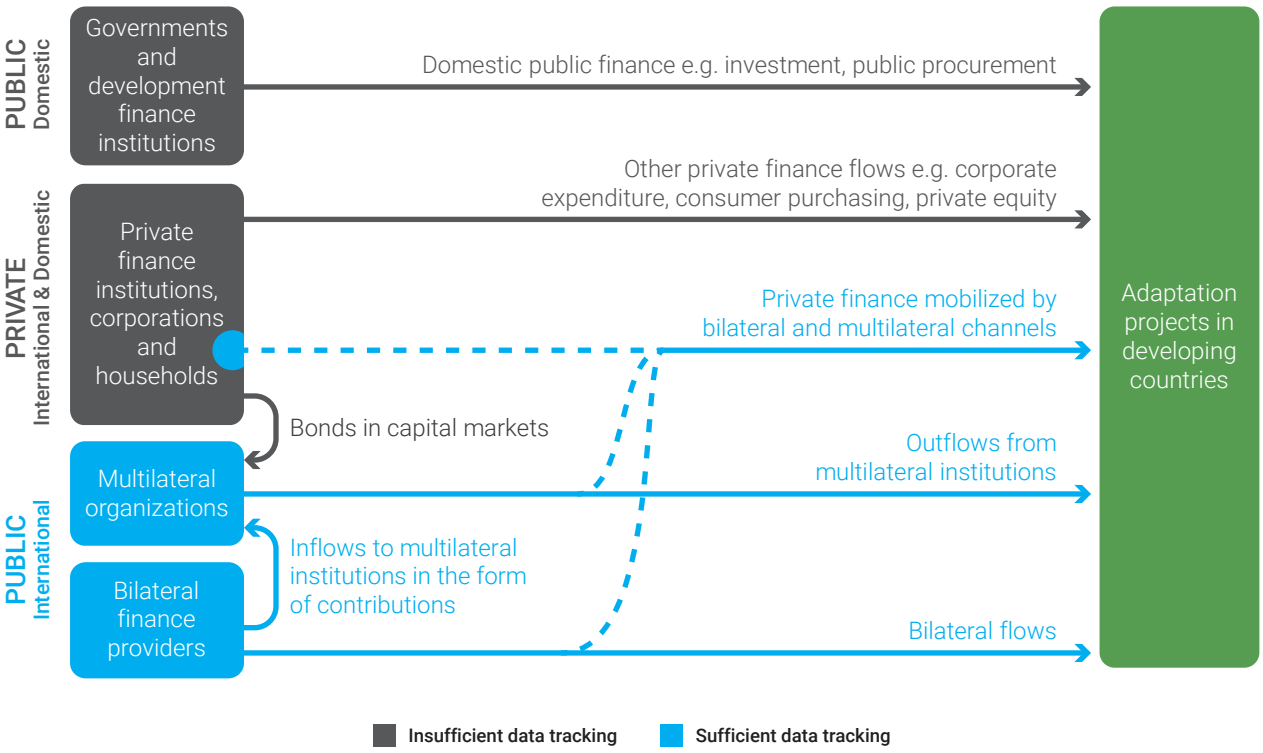
Adaptation projects in developing countries are financed by both public and private sources. Each of these includes both international finance flows as well as domestic expenditures. Existing data sources allow for analysis of international public finance only. Data also exist for private finance mobilized by public bilateral and multilateral channels. However, the data quality of other private flows, as well as domestic expenditures (public and private) is not sufficient to allow inclusion (figure 4.5).

Table 4.2 Estimated developing countries' adaptation finance needs by region for the 2021–2030 period

Region	Annual adaptation finance needs in US$ billion (2021 value)		Annual adaptation finance needs as a percentage of GDP	
	Median	Min – Max	Median	Min – Max
East Asia & the Pacific	158	27–439	0.7	0.1–1.9
South Asia	97	40–205	2.4	1.0–5.1
Latin America & the Caribbean	51	6–149	0.9	0.1–2.7
Sub-Saharan Africa	46	17–96	2.4	0.9–5.0
Middle East & North Africa	27	8–66	0.7	0.2–1.8
Europe & Central Asia	8	2–20	1.4	0.3–3.6
Global	**387**	**101–975**	**1.0**	**0.3–2.5**

Note: Values are based on extrapolation of median and IQ range of annual per capita adaptation finance needs for each income class from figure 4.4 (panel A) to all developing countries (including those that have submitted finance needs).

Figure 4.5 Finance types for adaptation projects in developing countries



Source: Authors, based on OECD (2022a).

Note: Figure provides an overview of main actors and flows in the climate finance for developing countries.

In November 2021 a decision was taken at COP 26 to urge developed countries to at least double their collective provision of finance for adaptation to developing countries from 2019 levels by 2025 (decision CMA.3). The data included in this analysis (to the end of 2021) provides an overview of adaptation finance between 2017 and 2021 and an estimate on the progress towards this target.

4.3.1 Data sources and methodological approach

A comprehensive assessment and analysis have been made of the self-reported public international adaptation finance flows from bilateral and multilateral finance providers to developing countries. Full details are provided in chapter 4 of the AFG Update 2023.

Such analysis is constrained by data availability and limitations (Canales *et al.* 2023; Roberts and Weikmans 2022), including around definitions, methodological differences among finance providers, accounting issues, confidentiality restrictions and a lack of universally accepted definitions (for an overview see AFG Update 2023). Several studies claim that the self-reporting by climate finance providers and the lack of independent quality control result in low data reliability and sometimes substantial overestimations of finance flows (Weikmans *et al.* 2017; UNEP 2021b; Toetzke, Stünzi and Egli 2022). This reduces the accountability and transparency of climate finance, which is fundamental for building trust in climate negotiations (Pauw *et al.* 2022b). This highlights the benefits of having a more standardized tracking system based on the principles of accountability and transparency. Despite the data limitations, analysing international public finance flows for adaptation provides valuable insights. Table 4.3 presents the approach used.

Table 4.3 Data sources and main methodological choices for the analysis of international public adaptation finance flows

Technical factor	Methodological choice
Data source	OECD DAC
Finance type	International public finance
Period covered	2017–2021
Geographic classification	Annex II Parties to non-Annex I Parties
Sources of finance	• Bilateral flows. • Multilateral outflows (from multilateral development banks (MDBs), climate funds and other multilateral institutions) attributed to developed countries.
Financial instruments	• Grants and loans (concessional and non-concessional). • Other (equity and shares in collective investment vehicles, mezzanine finance instrument).
Point of measurement	Commitments and disbursements
Methodological decisions	• Activities marked as "significant" and "principal" under the Rio marker methodology were discounted based on coefficients to estimate climate-specific amounts. • For multilateral finance providers outflows, coefficients to identify amounts attributable to developed countries were applied. • Exclusion of: export credits, coal-related projects, administrative costs of finance providers.

4.3.2 Total international public climate finance for developing countries

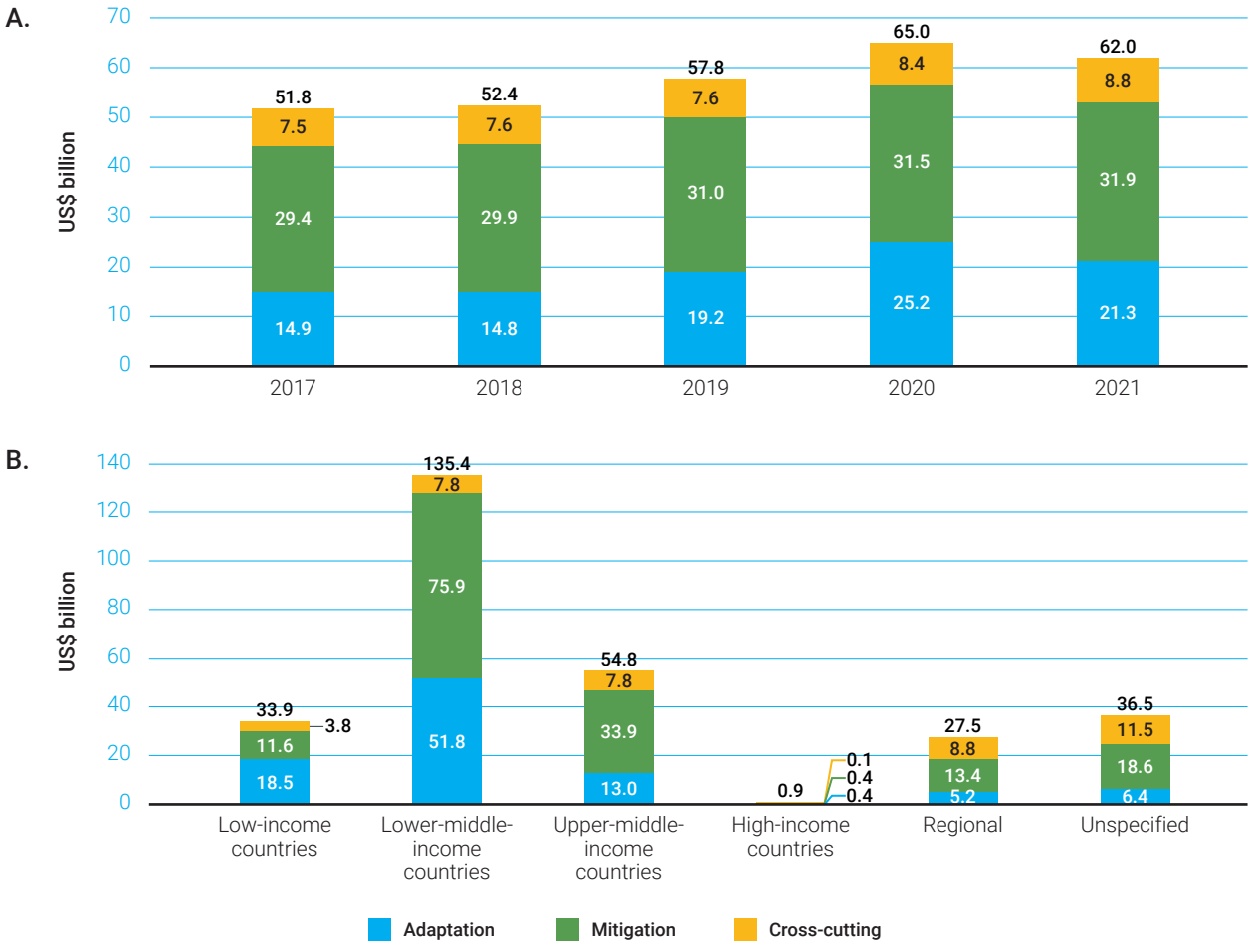
Between 2017 and 2021 (the five years following the year Paris Agreement entered into force and the latest five years for which comparable data for bilateral and multilateral sources is available), total climate-specific international public finance commitments towards developing countries from bilateral and multilateral finance providers remained well below US$70 billion per year (figure 4.6, panel A). At US$65 billion, 2020 was the year with the highest amount. Notably, the increasing trend between 2017 and 2020 is followed by a decrease in finance commitment in 2021 (figure 4.6, panel A). This decrease is driven by the lower financial commitments for adaptation, which dropped by 15 per cent. Often year-on-year variations in climate finance can be influenced by both large individual projects (such as infrastructure) as well as changes in methodologies used by each financial provider for reporting its climate finance. However, our analysis shows that the 2021 decline is not attributed to a single or a handful of sectors or finance providers. This implies a more general trend of decline for adaptation finance. On the other hand, both mitigation and cross-cutting commitments indicate slight increases on the order of 1.4 per cent and 5 per cent, respectively.

Total adaptation-specific international public finance towards developing countries remained well below US$30 billion per year between 2017 and 2021 (figure 4.6, panel A). In 2019, the baseline year for the doubling of adaptation finance by 2025, the estimates point to total

financial commitments for adaptation of US$19.2 billion, implying that US$38.4 billion would be needed by 2025 to achieve the doubling. In 2020, finance increased by 31 per cent, reaching US$25.2 billion. However, the decrease of adaptation-specific finance between 2020 and 2021 implies that, to reach a doubling by 2025, a 16 per cent annual compound growth rate is needed between 2021 and 2025.

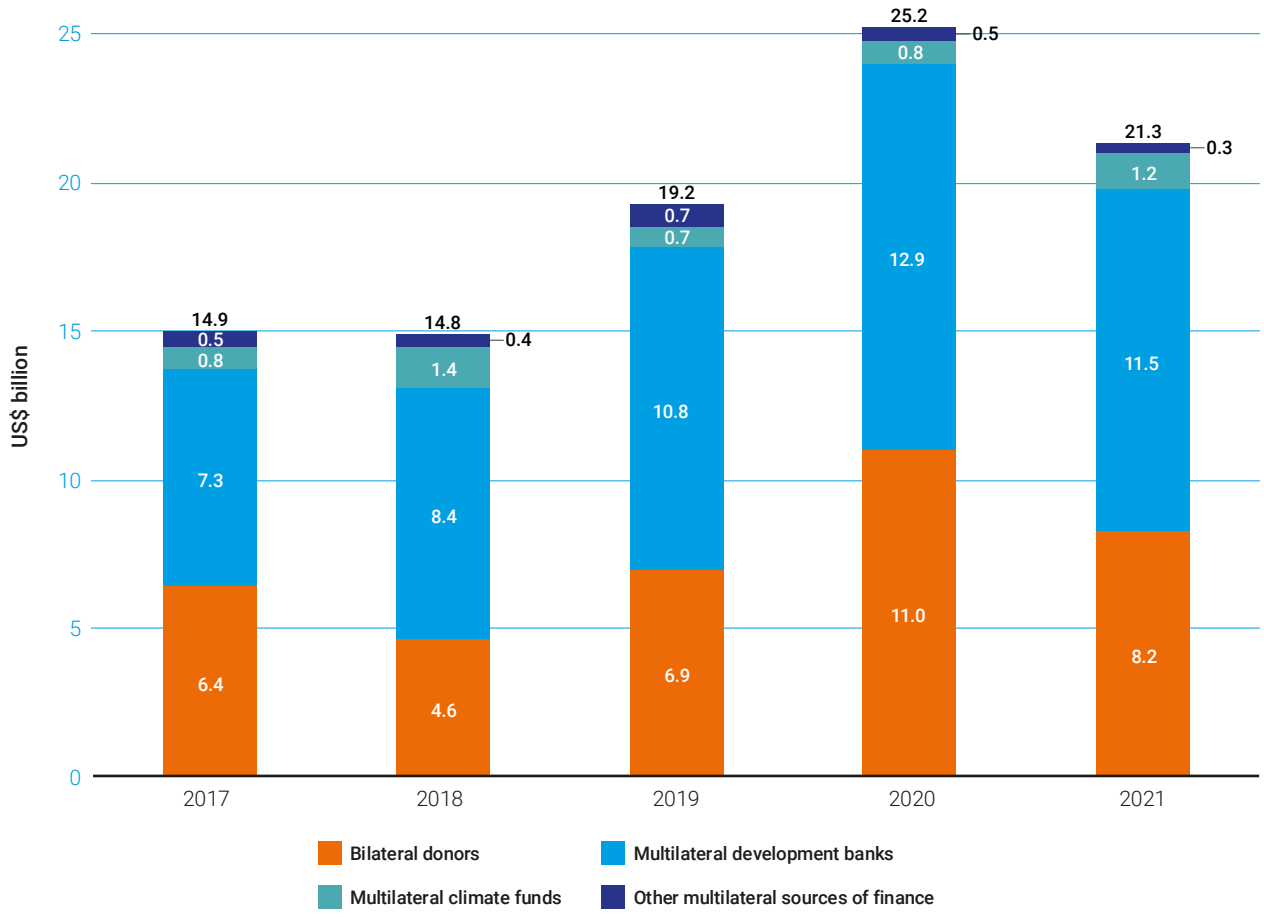
In line with article 9, paragraph 4 of the Paris Agreement, climate finance is meant to be balanced between adaptation and mitigation. Total international public climate-specific finance for the period 2017–2021 towards developing countries was US$289 billion (figure 4.6, panel A). Of this total, around US$95 billion (33 per cent) went to supporting adaptation activities, and an additional US$40 billion (14 per cent) was earmarked for initiatives addressing both adaptation and mitigation, also known as cross-cutting. In terms of income groups (figure 4.6, panel B), low-income and lower-middle-income country groups received higher commitments for adaptation than for mitigation compared with upper-middle- and high-income country groups. The highest amount of climate finance and adaptation finance is concentrated in lower-middle-income countries, which is also the group with the highest number of countries (53 countries) in the analysis. The share of adaptation in total climate-specific finance is the highest in low-income countries (at 55 per cent), followed by lower-middle-income and upper-middle-income countries (with 38 per cent and 24 per cent, respectively). LDCs and SIDS also receive higher commitments for adaptation (51 and 52 per cent) than for mitigation (39 and 30 per cent). Regional allocations that represent multi-country finance for regional cooperation for adaptation receive a substantial amount (roughly 10 per cent of total commitments in the period 2017–2021).

Figure 4.6 Climate-specific finance commitments from developed to developing countries per year (panel A) and per income group (panel B) for the period 2017–2021 (US$ billions, constant prices)



Note: Amounts are presented at face value. Regional allocations include financial commitments that were reported separately from allocations to individual countries and unspecified allocations are allocations without any recipient country or region information. For more on the data and methodology see AFG Update 2023.

Figure 4.7 Adaptation-specific finance commitments to developing countries per finance provider type over time (US$ billions, constant prices)



Note: The amounts include financial commitments for adaptation and exclude financial commitments for initiatives that target both adaptation and mitigation simultaneously (cross-cutting). Amounts are presented at face value. For more on the data and methodology see the AFG Update 2023.

Adaptation finance commitments over time and per finance provider

Looking at adaptation-specific finance, which includes finance across financial instruments (mainly loans and grants), per finance provider type, MDBs are the largest provider type throughout the period (figure 4.7). Their financial commitments follow a continuous increase from 2017 to 2020 which is, however, followed by a decrease (11 per cent) in 2021. For bilateral providers, the second largest finance provider type, there has been a steeper increase between 2018 and 2020 (roughly 51 per cent from 2018 to 2019 and 58 per cent 2019–2020), which was also followed by a decrease of 25 per cent in 2021. Multilateral climate funds comprise the only finance provider type that increased its commitments between 2020 and 2021. A breakdown of finance per financial instrument is provided in the following section.

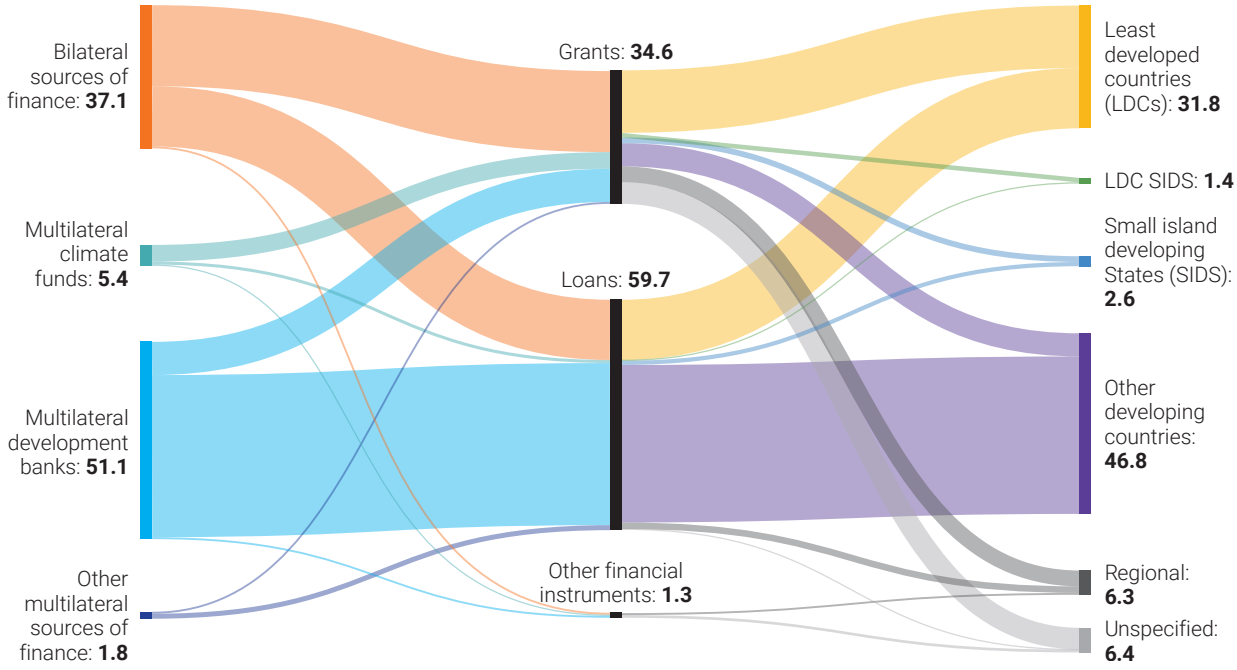
Adaptation finance commitments per instrument

In addition to the total volume of finance, it is important to consider whether the financial support provided by developed nations is deemed fair by those countries that have contributed least to climate change but are most impacted by it, such as the LDCs and SIDS. Selecting the most suitable financial instrument for establishing just and equitable climate finance is context specific. For instance, debt instruments are not necessarily a negative option when they are employed to fund a project with a high likelihood of yielding returns, and/or when the borrower has the capacity and institutions to ensure the debt is sustainable and used productively (Mustapha 2022). However, considering the prevalent debt vulnerabilities and limited fiscal capacity in many developing countries, it is improbable that delivering most of the climate finance via traditional debt instruments would be equitable (Mustapha 2022).

The analysis finds that 63 per cent of all adaptation-specific finance between 2017 and 2021 was provided as debt instruments (loans) and 36 per cent as grants (figure 4.8). Of the total adaptation finance offered as debt instruments, 70 per cent came from MDBs, 26 per cent from bilateral providers, 1 per cent by multilateral climate funds (primarily from the Green Climate Fund) and the remaining 2 per cent by other multilateral funds. Grant-based finance, on the other hand, came predominantly from bilateral sources (61 per cent), followed by MDBs (25 per cent), multilateral climate funds (13 per cent) and other multilateral funds (1 per cent).

Focusing on the share of grants and loans per finance provider type, the majority of MDB adaptation finance (67 per cent) is loans. In contrast, the majority of finance from multilateral climate funds is delivered as grant-funding. For bilateral providers, 57 per cent of total adaptation finance is provided as grants and 42 per cent as loans. On the recipient side, the share of grants in finance for LDCs (52 per cent) is substantially higher than that of non-LDCs (26 per cent) indicating that financial providers prioritize grant-based financing for LDCs. SIDS have an even higher share of grants in their total commitments (67 per cent).

Figure 4.8 Total adaptation-specific finance commitments by finance provider type, financial instruments and LDC/SIDS status of recipient countries, 2017–2021 (US$ billions, constant prices)



Note: The amounts include commitments for adaptation and exclude commitments for initiatives that target both adaptation and mitigation (cross-cutting). Amounts are presented at face value. For more details, see the AFG Update 2023.

Finance flows per capita

Looking at per capita amounts, except for various SIDS and Djibouti, no country was allocated more than US$25 per person per year for adaptation. Of the 132 recipient countries included in the analysis, only 31 were allocated more than US$15 per person per year and 52 countries were allocated less than US$5 per person per year – far below the per capita needs. This is compared with modelled costs and finance needs in the later gap section.

Adaptation finance to the local level

There is growing recognition that local organizations, people and communities need to lead or be meaningfully involved in the response to climate change. Being on the frontlines of climate change impacts, they are often the most engaged and innovative in developing transformative adaptation solutions (GCA and CPI 2021; Castro and Sen 2022). However, they often face a shortage of resources, and the agency required to effectively implement these solutions (GCA and CPI 2021). To guide the promotion of locally led adaptation (LLA), the Global Commission on Adaptation developed the eight LLA Principles.[5]

The knowledge of the flows and quality of adaptation finance remains limited. Previous analysis of international climate funds' financial commitments for climate shows that less than 10 per cent of their commitments to developing countries for climate change was directed at the local level

5 See https://gca.org/programs/locally-led-adaptation/.

(Soanes *et al.* 2017). In our analysis, we investigate bilateral and multilateral climate finance providers' reporting to OECD following the methodology by Soanes *et al.* (2017). There is a lack of data coverage for finance at the local level, in NDCs and NAPs, as well as from developed countries on tracking and reporting. Our analysis uses key search words[6] in the project description of the OECD database and is contingent on the comprehensiveness of the detail provided in each entry.

Based on our estimation, out of the total adaptation finance of about US$95 billion allocated between 2017 and 2021, less than 17 per cent (US$16.5 billion) was reported to climate change adaptation projects with a specific focus on local communities. The global goal on adaptation could present important opportunities to better define LLA efforts, ensuring that social inequalities among local actors and between local and non-local actors are addressed, and ultimately improving the tracking of LLA activities for assessing adaptation progress.

Adaptation finance disbursement ratios

The analysis above is based on commitment data. However, while commitments showcase ambition, projects can have an impact only when they get disbursed and implemented. Therefore, investigating the disbursement gap is important (Savvidou *et al.* 2021, SEforALL 2020; Jain and Bardhan 2023). Assessing the ratio of disbursements to commitments over a specific time frame provides insights into whether approved projects are being implemented as intended or if they are facing challenges during implementation (Savvidou *et al.* 2021).

Disbursement information with high confidence is reported regularly by bilateral donors since 2007 (OECD, undated). However, most MDBs and some climate funds only report on commitments. In this section, we analyse disbursements focusing on bilateral providers. According to our estimations, disbursements from bilateral providers to developing countries for adaptation are substantially lower than the amounts committed during the period under analysis. 66 per cent of the committed amounts are disbursed during the period. This estimated disbursement ratio for adaptation finance (66 per cent) is much lower than the disbursement ratio for all development finance (98 per cent) (Atteridge *et al.* 2019) which indicates challenges in disbursing adaptation-specific projects. For more on the disbursement ratio per region and an assessment of barriers associated with low disbursement ratios refer to AFG Update 2023.

4.3.3 Assessment of private finance flows related to adaptation

The private sector's investments in adaptation are limited by barriers and constraints. These include a lack of country-level climate risk and vulnerability data and information services that can be used to guide investment decision-making; market failures (including positive externalities that reduce the return on investment of adaptation activities, but that could have public good benefits); financial challenges, policy and governance barriers and behavioural barriers (Bisaro and Hinkel 2018; Tall *et al.* 2021; Frontier Economics and Paul Watkiss Associates 2022; Lu 2022; Pauw *et al.* 2022a; UNFCCC 2022a). Nevertheless, there is fragmented evidence of private-sector adaptation interventions all over the world, including priority sectors such as water and agriculture. However, the reporting of such interventions in adaptation in academic literature continues to be low, in particular when it comes to small business adaptation and developing countries (Berrang-Ford *et al.* 2021; Harries 2021; Caré and Weber 2023). While companies are increasingly reporting on climate-related issues, the comparability, consistency, comprehensiveness and coherence across the different data sets, as well as the limited information on adaptation actions taken, inhibit meaningful aggregation (Dale *et al.* 2021). Private adaptation finance that is mobilized through international public climate finance continues to be limited and far below mitigation. For the period 2016–2020, OECD (2022b) reports around US$1.9 billion/year on average. Philanthropy provided an additional US$0.09 billion/year in this period (Savvidou, Dzebo and Atteridge 2019). So while evidence hints at increasing private-sector engagement in adaptation, the related investments – and contribution to closing the adaptation finance gap – remains unclear.

Private-sector financing for adaptation includes 'internal' adaptation investments by large corporations: e.g. an analysis of voluntary public disclosures on physical climate change risks by 1959 companies (representing 69 per cent of global market capitalization) demonstrated that 68 per cent reports on implementation of adaptation actions (Goldstein *et al.* 2019). However, reporting on the related costs are sporadic and inconsistent (ibid.). While small businesses are less likely to plan and finance measures to reduce their vulnerability than larger businesses (Daddi and Iraldo 2016; Harries 2021), empirical research in developing countries demonstrates that SMEs also innovate in response to climate change impacts (Alam *et al.* 2022). However, adaptation is often done unconsciously (see Hess 2020 on SMEs in tourism in Thailand) and related investments are often unknown.

6 The key words used for tracking finance flows to the local level are: civic, Indigenous, smallholders, community, local, SMEs, cooperative, municipal, subnational, decentralized, province, town, home, rural, village, household, slums. See Annex 4.C for more on the methodology.

Case study: Adaptation finance – Mobilizing the private sector

Current climate finance flows for adaptation fall short of what is required to meet the Paris Agreement's targets.

However, efficient use of public funds can help facilitate the much-needed private sector investment in adaptation by addressing market imperfections.

A new approach brought together companies and impact investors with a shared interest in investing in climate adaptation and raised US$2 million while developing practical experience in identifying, developing and financing adaptation projects.

The approach allowed an analysis of the investment requirements and risk characteristics of adaptation-related projects through engagement with private actors and finance providers.

The process demonstrated that adaptation investments do not always require grant financing or compensation to be economically and financially viable. Barriers can be overcome by providing expertise and mentorship to facilitate private adaptation investments.

Note: This case study is not connected to the chapter. The full case study is available online.

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Apart from such internal adaptation investments, the private-sector contribution to adaptation is also driven by financial institutions' provision of finance for adaptation activities that contribute to adaptation and through companies' provision of solutions through technology, services and products (Lu 2022; Stout 2022). Examples of the former include loans for sustainable agriculture and property retrofits. However, data on such private adaptation finance are still largely missing, because of challenges associated with context dependency, confidentiality restrictions, uncertain causality and a lack of agreed-on impact metrics (Buchner *et al.* 2021). At the same time, financial institutions—including commercial banks, insurance companies and bond-rating agencies—understand the shifting landscapes of market risk and are engaged in an "intelligence arms race" to measure climate impacts on investments and steer them to new speculative sites and cities (Shi and Moser 2021).

Public sector actors continue stimulating or mobilizing more private-sector investments in adaptation, including through blending public and private finance. Examples include "monetizing resilience benefits" (International Fund for Agricultural Development); the G20's Global Partnership for Financial Inclusion's supporting SMEs to respond to climate change as well as incorporate climate risks into their operations (Csaky 2017); and the Global Environment Facility-funded Adaptation SME Accelerator Project led by Lightsmith and supported by Conservation International and the Inter-American Development Bank (Botero, Brinks and Gonzalez-Ocantos eds. 2022).

It is important to point at the potential of non-finance related private-sector initiatives to reduce vulnerability over time. Standard-setting organizations that oversee, for instance, engineering, design, insurance and lending practices, are moving towards incorporating climate science into their benchmarks, requirements and guidelines (Shi and Moser 2021). For example, in the absence of federal leadership on risk disclosure in the United States of America, private consulting firms (and some NGOs) are growing in-house technical expertise to map future flood risks. This not only directly helps to inform individual homeowner purchasing decisions, but it also indirectly helps via integrating climate risks into the real estate market (Shi and Moser 2021). In another example, also from the United States of America, insurance companies stop selling new policies in areas affected by catastrophic wildfires (California), hurricanes (Louisiana) and storms (Florida) (Joselow 2023). Such private-sector initiatives do not necessarily bring along private investments that help reduce the adaptation finance gap, and in the short term they have a negative effect on, for instance, homeowners that cannot insure their property. In the longer term, however, they will reduce overall vulnerability.

Finally, private-sector finance for adaptation is not a panacea. Investments will gravitate to opportunities with low risk-return ratios and where private interests often outweigh public interests. The most vulnerable people in LDCs or non-market sectors are therefore less likely to be targeted (Pauw 2015; UNEP 2021b). Furthermore, knowledge on the effectiveness of private investments in adaptation is low. Effectiveness could be constrained for example through adaptation being done unconsciously (Pauw 2015; Hess 2020) or with a narrow view of climate change risks (e.g. underestimating supply chain and broader societal impacts, see Goldstein *et al.* 2019), and/or because adaptation only shifts vulnerability to others (Pauw 2021). Finally, it is important to realize that significant amounts of private finance do not take climate change into account at all (UNEP 2022a, 2022b), potentially leading to increased vulnerability in the longer term. For example, property developers can make short-term financial gains

from developing on vulnerable coasts, creating long-term risks for others (Siders 2019). Two important developments are therefore that investors are starting to ask companies to disclose climate change risks (Dale *et al.* 2021) and that governments are starting to develop policies for sustainable financial systems (Task Force on Climate-related Financial Disclosures 2017; UNEP 2021a).

4.3.4 Assessment of domestic expenditures on adaptation

Domestic expenditure continues to be an underexamined but potentially vitally important and often sustainable source of finance for adaptation (UNFCCC 2022b). Domestic budgets are likely to be the largest source of funds for adaptation in many developing countries (Allan *et al.* 2019; United Nations Development Programme [UNDP] forthcoming). Domestic expenditure offers a number of comparative advantages that make it particularly well suited for financing adaptation. These include the mainstreaming of adaptation in development activities, such as through climate-proofing routine investments (Allen *et al.* 2019); addressing domestic adaptation priorities (Kirchhofer and Fozzard 2021); higher predictability compared with international adaptation finance and potentially better suitability for financing long-term and recurring adaptation investments (Allan *et al.* 2019); and leveraging existing institutional structures, potentially improving impact and value for money (Africa Adaptation Initiative 2018). Over longer time periods, tracking climate-related expenditure can also help identify whether countries are shifting public financial flows towards climate-resilient development pathways, thereby implementing article 2.1(c) of the Paris Agreement (see section 6).

Domestic expenditure on adaptation can be measured for example through climate change budget tagging and (regular) tracking. Tagging is the process of defining and applying a tag, while tracking is the process of using the tag to quantify and monitor climate-relevant activities and expenditure (Choi *et al.* 2023). At present there are no internationally agreed-on tagging methodologies to identify climate-related expenditures in public sector budgets. There are, however, some recognized approaches, such as the OECD Rio marker methodology, the European Union climate action taxonomy, and the Climate Public Expenditures and Institutional Review approach developed by UNDP (Pizarro *et al.* 2021). Some countries have developed their own criteria (UNDP 2019).

The amount of information on domestic expenditure on adaptation has increased in recent years. A recent review found that 24 national studies had assessed domestic climate expenditures, 14 of which report on adaptation-only expenditure (UNFCCC 2022a). The inconsistency in methods makes direct comparison between country studies difficult, though reported government budgets spent on adaptation ranged from 0.2 per cent to over 5 per cent. These equate to a large range of total GDP (from 0.1 per cent to >3 per cent). Another study shows African countries on average spent 0.95 per cent of their government budget on adaptation in 2019 (with Botswana and Seychelles spending over 4 per cent) (UNDP 2023). This makes government expenditure on adaptation in Africa 10 times larger than international support for adaptation (indicated to be 0.09 per cent of GDP) and also larger than the indicative 0.22 per cent from private adaptation (ibid.).

The main reported benefits of climate budget tagging and tracking are awareness-raising and improvements in transparency and accountability (Kirchhofer and Fozzard 2021). However, related expenditure estimates cannot be directly used in the finance gap estimates of the UNEP Adaptation Gap Reports. Data is unreliable and non-comparable because of the diversity of methods and approaches and the inherent subjective analysis and judgment on adaptation-relevance of expenditure (UNFCCC 2022a; Choi *et al.* 2023). Furthermore, budget tagging is often not systematically applied to subnational government expenditures and mobilized private finance, and 'negative expenditure' such as harmful initiatives that may increase vulnerability are typically excluded (Choi *et al.* 2023). Finally, across different regions, there was limited evidence of formal quality assurance and verification mechanisms (Choi *et al.* 2023). This carries implications for the knowledge on the effectiveness of adaptation-related expenditure, which often remains limited.

Ethical considerations are also important when analysing to what extent domestic expenditure can help close the adaptation finance gap and in comparison with international support for adaptation (UNFCCC 2022a). This is especially the case in relation to particularly vulnerable countries that have contributed little to global historical greenhouse gas emissions, such as LDCs (Grasso 2010). The potential for domestic expenditure on adaptation also needs to be seen in the context of other challenges facing developing countries, such as the high indebtedness and limited fiscal space (Kozul-Wright 2022).

The challenges faced in aggregating domestic expenditure on adaptation are also reflected in the broader efforts to develop a global goal on adaptation. Some of these challenges include the lack of systematic tracking frameworks and methodological tools (Berrang-Ford *et al.* 2019), inconsistent metrics (Craft and Fisher 2018) and limited legitimacy of existing global governance initiatives (Persson 2019). The global stocktake process under the Paris Agreement and the global goal on adaptation could present important opportunities to advance efforts and initiatives to measure and track domestic adaptation efforts.

4.4 The adaptation finance gap

The evidence lines above are brought together to provide a revised estimate of the adaptation finance gap. Based on modelled costs of adaptation (section 4.2.2) and adaptation

finance needs (section 4.2.3), a plausible central range for the adaptation costs/financing needs is **US$215 billion/year to US$387 billion/year for developing countries this decade.** This equates to 0.6 per cent to 1.0 per cent of GDP (for all developing countries, 2021). The corresponding values for LDCs and SIDS (together) are US$29 billion/year (modelled) and US$41 billion/year (needs-based extrapolation). These new values can be compared with the earlier AGR values.[7] This updated central range is significantly higher than the previous estimate (UNEP 2016b), which was US$170 billion to US$340 billion/year in current prices for the same period.

While the total estimated finance needs (extrapolated from submitted communications) are higher than total modelled costs at the global level, this is not always the case at the individual country level. A direct comparison of the 85 submitted adaptation needs in costed NDCs and NAPs against the modelled costs for the same countries finds that, in many cases, submitted costs are lower than modelled. Further details of the country and sector results are provided in the AFG Update 2023.

The new 2030 values for adaptation costs/financing needs can be compared with the updated estimates of global public finance flows to adaptation (section 4.3.2), **which were US$21 billion/year in 2021.** This indicates that the adaptation finance gap – the difference between needs/costs and flows – is very large (see table 4.4). The modelled costs/finance needs are 10–18 times as much as current international public finance flows, though this gap will be narrowed by current domestic finance (including unconditional commitments in NDCs) and private-sector adaptation flows, which are not included here.

Table 4.4 Summary of the adaptation finance gap in developing countries, based on AGR evidence

Modelled cost of adaptation	Adaptation finance needs	Adaptation finance flows	Adaptation finance gap
US$215 billion/year this decade (central estimate), with a range of US$130–415 billion/year	US$387 billion/year (median), with a range of US$101–975 billion/year (up to 2030)	US$21.3 billion (2021)	The adaptation finance gap is estimated at US$194–366 billion per year (currently) Adaptation costs/finance needs are 10–18 times as much as current flows
Central range of US$215–387 billion/year for developing countries this decade			

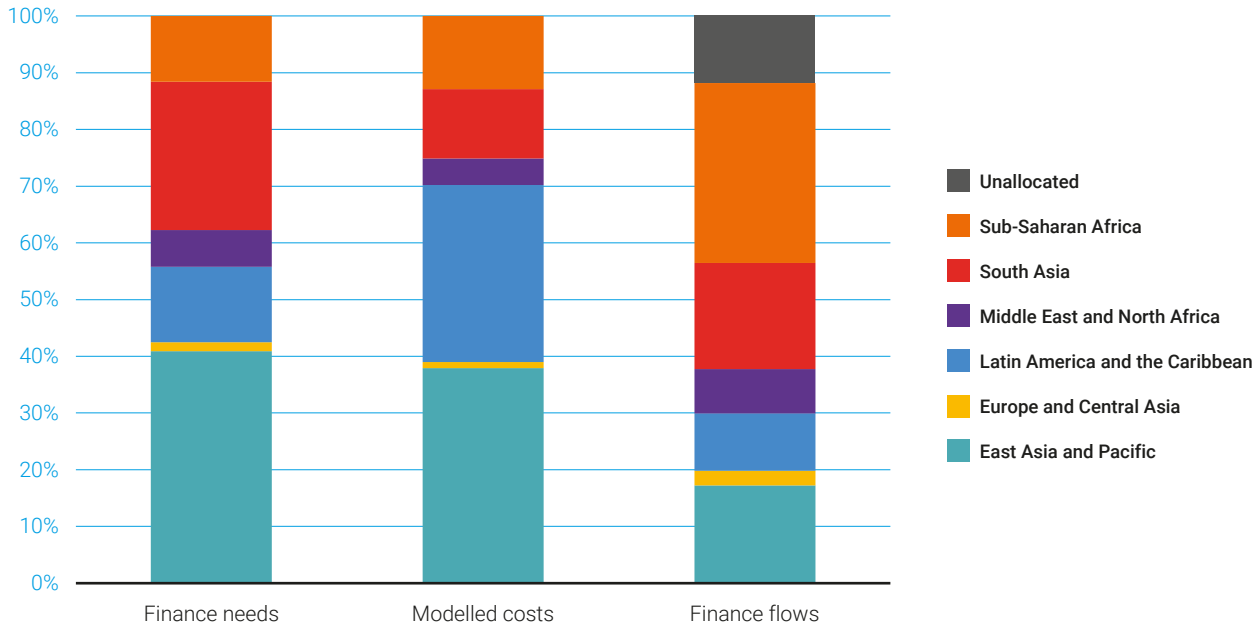
When compared to the previous AGR assessments (UNEP 2016b, 2022b), the updated adaptation finance gap is more than 50 per cent greater. There are several reasons for this increase. As highlighted earlier, there are higher modelled costs of adaptation, which reflects the more negative impacts of climate change reported in the literature (see IPCC 2022). There are also more comprehensive studies in submitted NDCs and NAPs, which include more detailed estimates and greater coverage, and thus higher reported adaptation finance needs. This compares with the trends in public international adaptation finance flows, which increased from 2017 to 2020, but declined in 2021.

It is also noted that given the size of the gap, if the 2021 Glasgow Climate Pact is met (which urges developed country Parties to at least double their collective provision of climate finance for adaptation from 2019 levels by 2025), international adaptation finance flows would reach an estimated US$38 billion per year, but this would only cover only a small share (5–10 per cent) of the current gap.

The comparison of the modelled costs, finance needs and finance flows reveals additional insights. The first comparison is shown by region in figure 4.9. The highest adaptation finance needs (extrapolated) are for East Asia and the Pacific, and for South Asia, while the highest modelled costs are for East Asia and the Pacific, and for Latin America and the Caribbean. In contrast, the highest financial flows, in percentage terms, are to sub-Saharan Africa (though they are far below estimated adaptation finance needs or costs).

7 AGR 2016 estimated the costs of adaptation were in a likely range from US$140–300 billion per year by 2030, rising to US$280 billion to US$490 billion per year by 2050. In current prices (2021), these are equivalent to approximately US$170 billion to US$360 billion per year by 2030, rising to US$340 to US$600 billion per year by 2050.

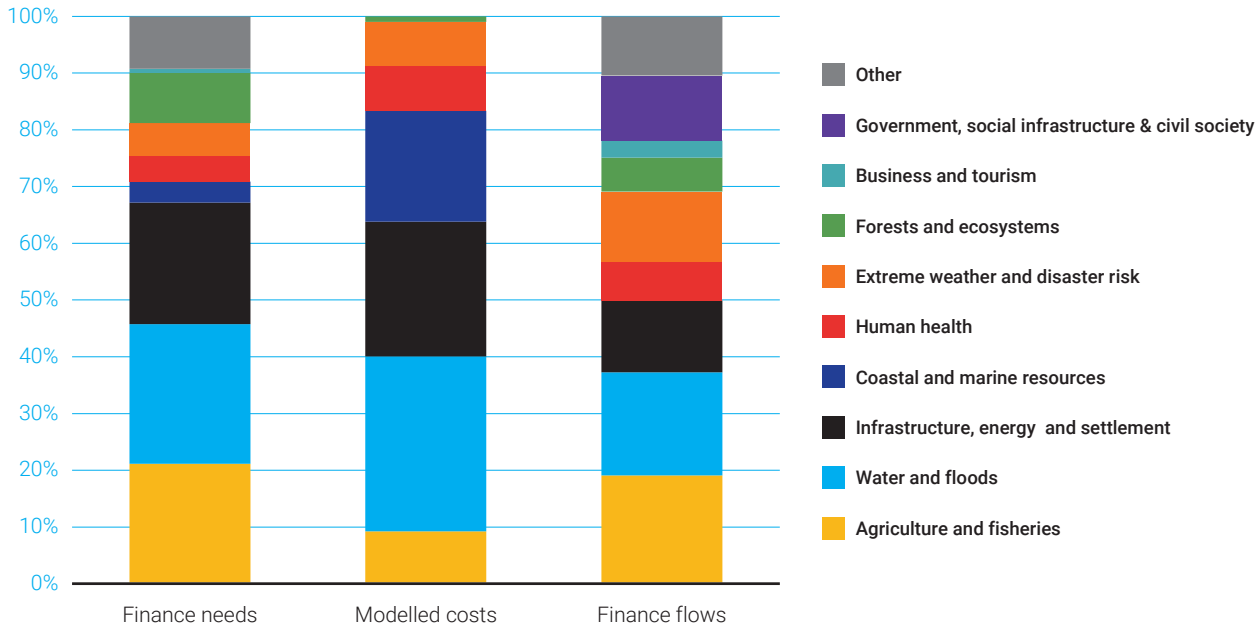
Figure 4.9 Comparison of adaptation finance needs (extrapolated) versus modelled costs of adaptation versus adaptation finance flows (international public) by region



It is also possible to compare the data by sector, though some caveats are needed. For example, several categories in the finance flows are not yet modelled (business, government, capacity-building). Further, there is not always a direct equivalence in sector categorization e.g. many cross-cutting disaster risk reduction measures are reported differently across the three evidence lines. There are also a relatively small number of costed NDCs and NAPs that include a sectoral breakdown (only 58 countries) and the average of these countries may not represent the global value. Nonetheless, some trends do appear. The highest financial needs are for agriculture, water and infrastructure. These are also three of the largest areas of adaptation finance flows (though flows are much less than needs). The modelled costs also identify water and infrastructure but have a lower proportion for agriculture. This is potentially because of the addition of trade in the modelling studies, which lowers costs. In contrast, national studies prioritize domestic adaptation (not imports) to address productivity losses. Coastal protection is also a higher share of the modelled costs. It is more difficult to compare other sectors, but it is noted that forests and ecosystems are an important share of finance needs, health is an important proportion of modelled costs, and government, social sectors and capacity-building (including local adaptation) are an important share of financial flows.

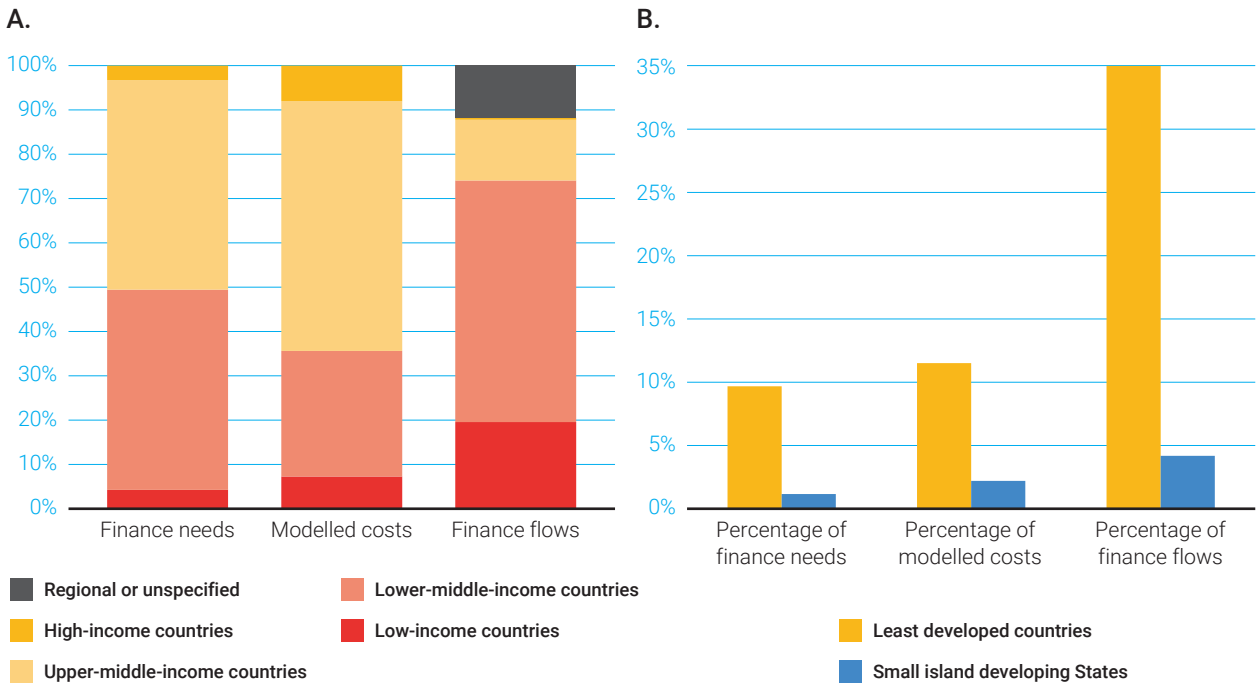
The final comparison is based on income level, including a focus on LDCs and SIDS as the most vulnerable countries. The analysis of LDCs and SIDS estimates their costs/needs in a central range of USD$29-41 billion/year (reflecting the modelled costs and financing needs, respectively). The comparison of these adaptation costs with finance flows can be seen in figure 4.11, which shows that a higher relative proportion of finance is flowing to the low-income and lower-middle-income countries, and to LDCs and SIDS, as compared with the estimated finance needs and modelled costs. This provides some indication that while the total finance flows are insufficient to meet finance needs or modelled costs, the relative share of total finance flows is higher, and that finance is somewhat prioritized to these more vulnerable countries.

Figure 4.10 Comparison of adaptation financial needs (from submitted NDCs and NAPs) versus modelled costs of adaptation finance flows (international public) by sector



Note: Some care is needed in comparing sectors because of differences in classification and omissions of some sectors.

Figure 4.11 Comparison of adaptation finance needs (extrapolated), modelled costs of adaptation, and international public adaptation finance flows for developing countries by country income level (panel A). LDCs' and SIDS' share of adaptation finance needs (extrapolated), modelled costs of adaptation, and international public adaptation finance flows (panel B).



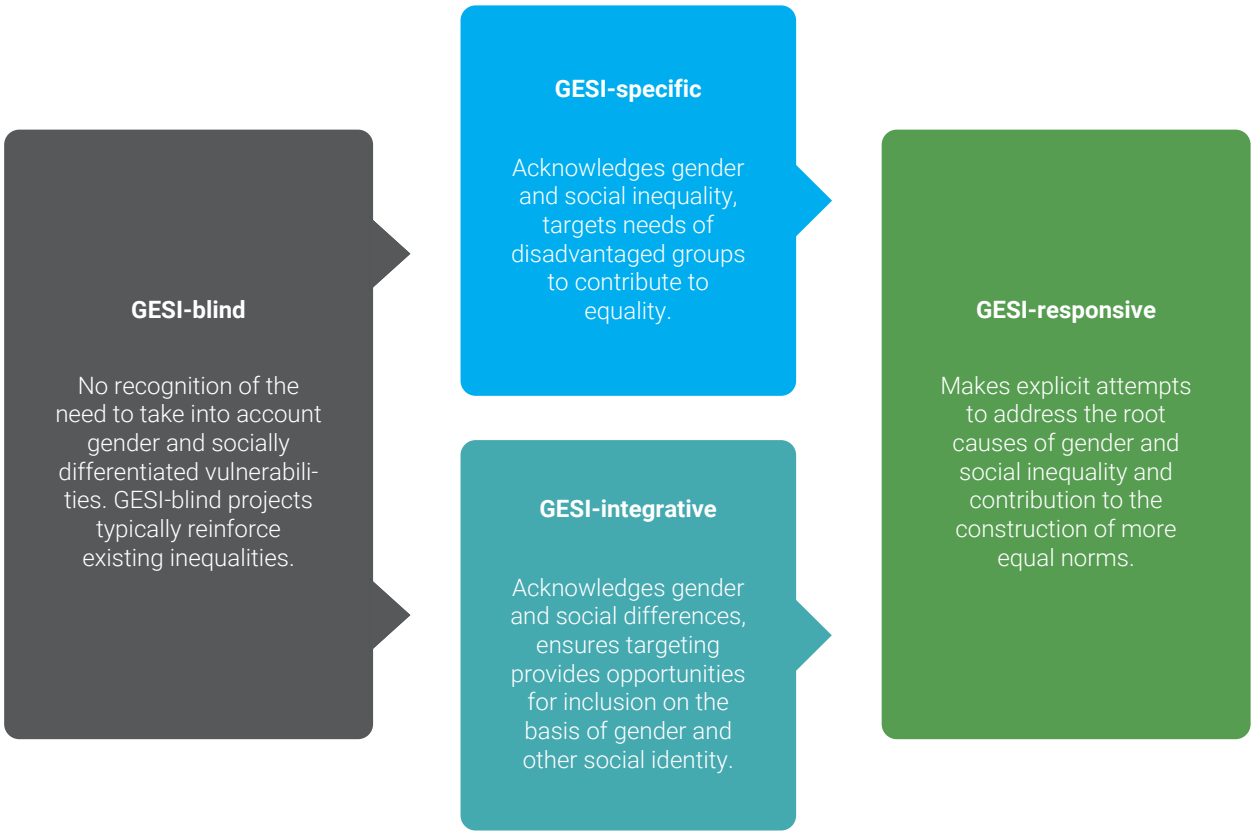
Note: Finance flows are the average for the period 2017–2021.

Finally, it is stressed that closing the adaptation gap (by increasing adaptation finance flows) will deliver large benefits, as it will reduce climate impacts (and residual damage). As examples, for the coastal sector, an additional US$1 billion of adaptation investment is estimated to generate a US$14 billion benefit, from the reduction in the economic costs of coastal flooding, while for agriculture, an additional US$16 billion/year in adaptation would prevent approximately 78 million people from chronic hunger due to climate change (Sulser *et al.* 2021).

4.5 Gender equality and social inclusion

There is recognition that climate change can exacerbate inequality across multiple dimensions of social identity, including gender. Reflecting commitments in the UNFCCC Gender Action Plan and Paris Agreement (among others), the extent to which gender (and social inclusion) is included in the costs of adaptation and in financial flows has been investigated. To do this, the analysis assessed financing needs and international public adaptation finance flows using a modification of the common gender equality and social inclusion (GESI) continuum used widely in the development literature (see figure 4.12). The continuum rates adaptation responses from GESI-blind (where no reference or consideration is made), to GESI-specific (which specifically targets marginalized groups) and GESI-integrative (where opportunities are provided for participation and benefit on the basis of gender and social group), to GESI-responsive (which aims to change policy and structures to address inequality)

Figure 4.12 The modified gender continuum used for the analysis



The analysis of adaptation cost modelling studies (section 4.2.2) found very few studies of relevance, and none of the modelled cost estimates include consideration of gender or social inclusion aspects. This is therefore a priority for future analysis.

The analysis of adaptation finance needs (section 4.2.3) reviewed the 97 submitted NDCs and NAPs, (from 85 countries) which include adaptation costs. The analysis found that the approach used to consider GESI varies, but 20 per cent of NDC and NAP plans had costed dedicated GESI activities (though it is 33 per cent of the 58 countries that included a sectoral breakdown of costs). The budget share of the total adaptation costs allocated to these GESI activities is generally low at an average of 2.4 per cent (with a range from 0.01 to 12 per cent). Most activities were classified as GESI-specific or -integrative, with only one country having commitments that can be classed as GESI-responsive. The analysis also found that costed adaptation activities in NDCs and NAPs focused almost exclusively on gender, and they did not allocate budgets to other aspects of social inclusion, such as Indigeneity, age, ethnicity, migrant status or disability.

The analysis found that some countries mainstream gender budget statements as part of their medium-term expenditure planning and budget cycles. These offer an alternative to dedicated or ring-fenced budgets. Further discussion is included on these issues in chapter 6 of the AFG Update 2023.

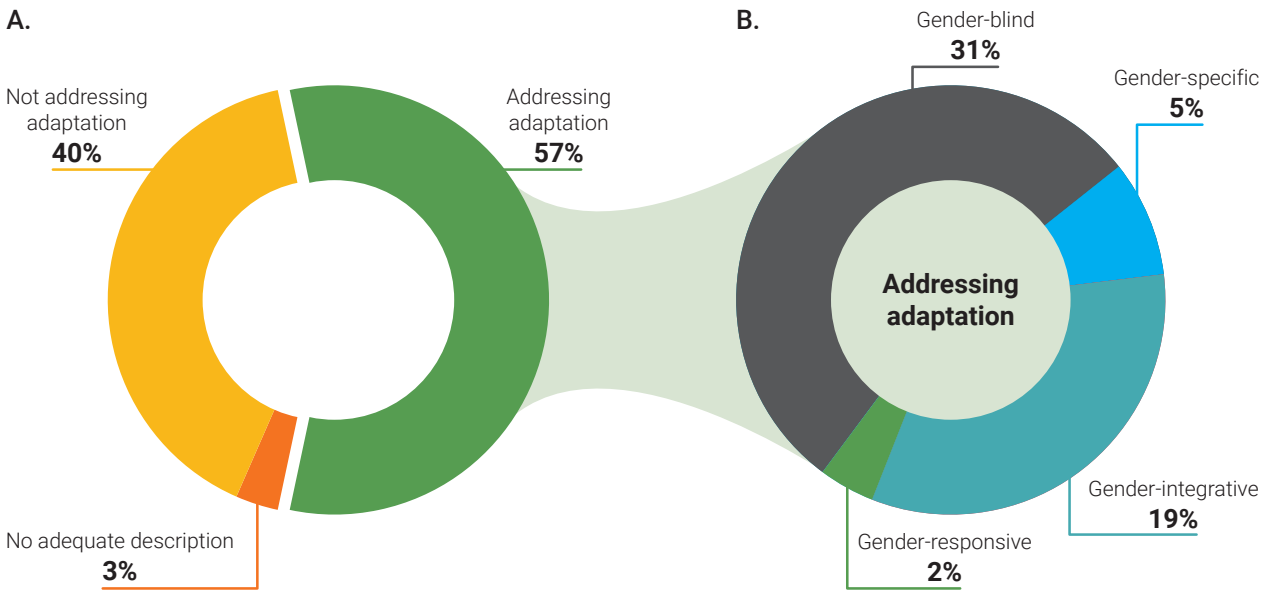
Activities considering the unique needs and contributions of women and men have been linked with higher effectiveness in reaching their adaptation objectives (UNDP 2018; Roy, Tandukar and Bhattarai 2022). Therefore, this report has also analysed the level of gender integration in adaptation finance flows to see what gender-targeted activities are funded. At COP 23, UNFCCC approved a gender action plan, which includes the use of gender-responsive finance as a core tool for implementation (UNFCCC 2017). In 2016, the OECD DAC database introduced a gender equality policy marker, allowing finance providers to tag their commitments on whether transactions support the policy objective of gender equality (though not all finance providers use this marker). Between 2017 and 2021, around 38 per cent of adaptation finance was marked as targeting gender equality, of which 94 per cent was tagged as having a "significant" objective and only 6 per cent as having gender equality as a "principal" objective.

The analysis conducted a further, more in-depth analysis of international public finance tagged as adaptation-related and with the principal objective for the gender marker, again using the gender continuum above. Of the finance tagged as principally targeting gender equality (approximately US$1.7 billion) (figure 4.13, panel A), 3 per cent did not provide adequate project description to allow for an analysis. A further 40 per cent had a project description which did not appear to address climate adaptation. This reinforces the findings of previous AGRs that over one third of activities marked as having adaptation as a principal objective did not meet the respective OECD criteria (UNEP 2022), suggesting a need for more consistency in the reporting of adaptation activities. Of the remaining finance volumes focusing on adaptation (57 per cent) and marked as gender principal, a review of project description (summaries) found that nearly 31 per cent (one third) are gender-blind, 5 per cent gender-specific, 19 per cent gender-integrative, and only 2 per cent gender-responsive.

Of the finance tagged as gender-specific, -integrative or -responsive (US$450 million) (figure 4.13, panel B), 16 per cent addressed intersections of gender with other dimensions of social inclusion: age (8.3 per cent), race (0.3 per cent) and a combination of social identities (7.4 per cent). However, the sample of data analysed is based on the marker of gender equality. Since there is no explicit social inclusion marker, for a complete analysis of social inclusion aspects, an analysis of the entire data set would be required.

Based on the analysis, to align with the UNFCCC Gender Action Plan, as well as commitments in the Paris Agreement, there is a need for greater transparency and consistency in the reporting of gender equality markers. Climate finance providers could also increase their funding of gender- and social inclusion-responsive adaptation projects to support equitable and effective adaptation, as this also contributes to equality by considering the unique needs and capacities on the basis of gender and social identity.

Figure 4.13 International public adaptation-specific finance marked with a principal objective for gender equality marker (panel A) along the gender continuum (panel B).



4.6 Bridging the gap

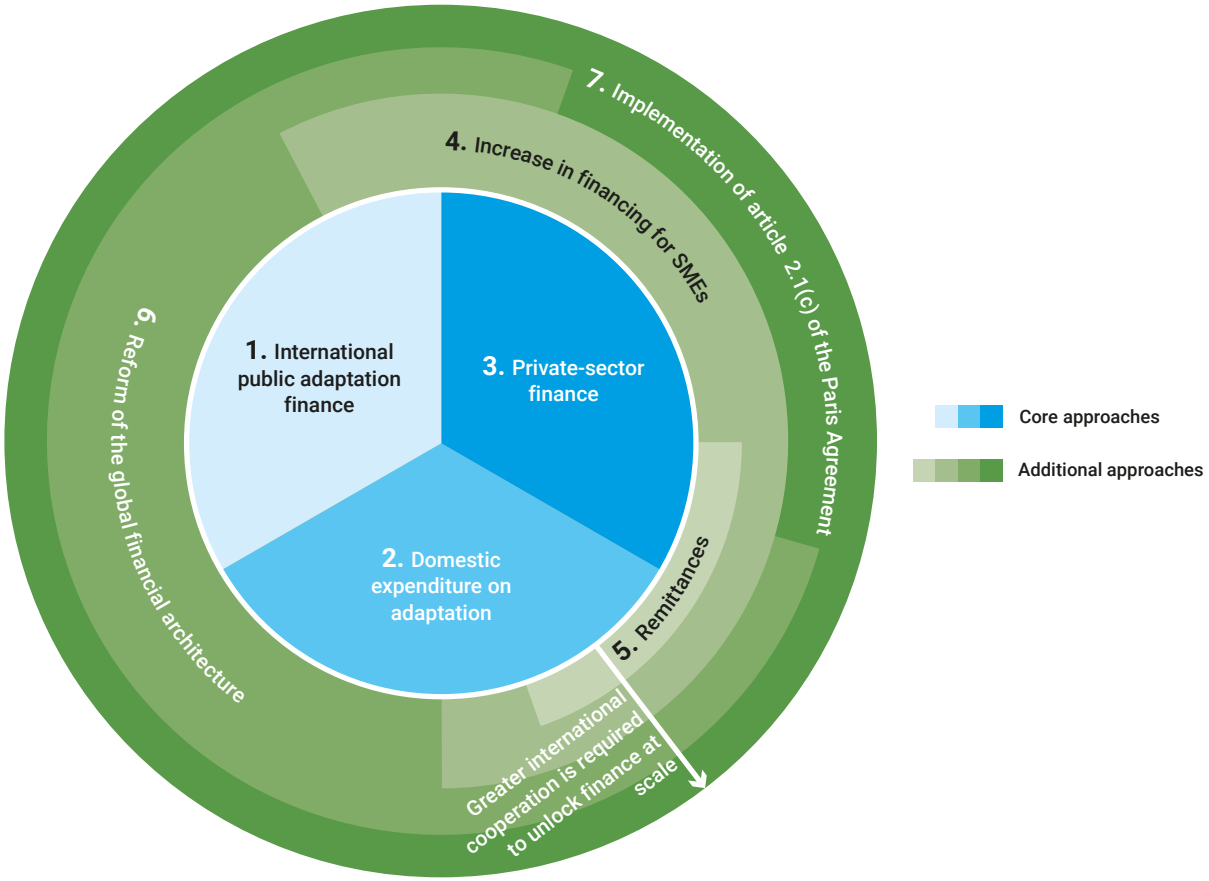
Ambitious mitigation will mean that fewer hard and soft adaptation limits are hit, therefore making it essential to limit the costs of future adaptation and measures addressing losses and damages. Any further delay in anticipatory global action on mitigation and adaptation "will miss a brief and rapidly closing window of opportunity to secure a liveable and sustainable future for all" (IPCC 2022).

This report identifies seven approaches to bridging the adaptation financing gap (see figure 4.14). The core approaches will continue to be dominated by increasing existing sources of adaptation finance, namely: international adaptation finance, domestic expenditure on adaptation and private-sector finance for adaptation, even though the relative contributions to closing the adaptation finance gap remain uncertain (see sections 4.3.1–4.3.4). Around this core, four additional approaches for unlocking adaptation finance are identified. The further away from the core, the more international cooperation is required to unlock finance at scale. The outer ring is the implementation of article 2.1(c) of the Paris Agreement on shifting finance flows towards low-carbon and climate-resilient development pathways, which encompasses all financial flows in all countries (Zamarioli *et al.* 2021). It is important to note that these seven approaches offer different opportunities and face different constraints across countries. Section 4.3.1–4.3.3 demonstrated, for example, that LDCs rely heavily on international support, in particular grants. Bridging the adaptation finance gap requires attention to both quantitative and qualitative aspects, such as access to finance and equity (Khan *et al.* 2020). Further, as the number of institutions and initiatives on adaptation financing as well as the number of actors involved are increasing, enhancing institutional and technical capacity is also key to bridging the adaptation finance gap.

4.6.1 Core approaches

1. **Increase international adaptation finance.** The 2021 Glasgow Climate Pact urges developed country Parties to at least double their collective provision of climate finance for adaptation from 2019 levels by 2025 (UNFCCC 2021b, para. 18). Furthermore, Parties are negotiating a new collective quantified goal for the post-2025 period. This could safeguard an increase in adaptation finance. First, the goal could increase significantly. While the technical expert dialogue is still discussing the elements required to make informed discussions on the quantum of the goal (UNFCCC 2023c), a correction for inflation would already increase the target from US$100 billion per year to US$139 billion per year (Pauw *et al.* 2022b). Second, the new collective quantified goal on climate finance should "take into account" the needs and priorities of developing countries (UNFCCC 2016, decision 1/CP.21, para. 53), which could be translated into a larger share of the finance going towards adaptation or a subgoal on adaptation (Pauw *et al.* 2022b). While an increase in international public adaptation finance will be instrumental in helping to close the adaptation finance gap, especially in the short term, it is unlikely that any such increase will close the gap by itself.

Figure 4.14 Seven complementary approaches to bridging the adaptation finance gap



2. **Effective domestic expenditure: Increase and improve budget tagging and tracking.** At the moment, budget tagging and tracking cannot be used to estimate how much domestic expenditure helps to close the adaptation finance gap (see section 4.3), or whether such expenditure is increasing (UNFCCC 2022a). Tagging and tracking increases awareness among policymakers in different ministries for integrating adaptation into budget planning e.g. for long-term adaptation investments, or in recurring expenditures, and to reduce potential negative expenditure (Choi *et al.* 2023). Increased and improved tagging and tracking can therefore help to spend government funds more consciously and to integrate climate risks more effectively. This helps to make the most of domestic financing and potentially increase domestic expenditure on adaptation, especially when a country also has systems in place to assess how effective those expenditures are. When coupled with other initiatives such as the recommendations by the Task Force on Climate-Related Financial Disclosures (2017), tagging and tracking should also help countries to implement article 2.1(c) of the Paris Agreement to make all finance flows consistent with climate-resilient development pathways.

3. **Mobilize private investments.** From an economic point of view, it should not be the role of the public sector to cover the full costs of adaptation – which would also typically exceed government's fiscal space (Pauw *et al.* 2021). Rather, the public sector should set the right conditions for private investments in adaptation, while keeping in mind the overall welfare of society (ibid.). For that purpose, three market imperfections need addressing: positive externalities, imperfect financial markets and incomplete or asymmetric information (Druce *et al.* 2016; Pauw *et al.* 2021). These market imperfections may be addressed either by modifying the market environment e.g. by reflecting positive externalities in financing models or by addressing the consequences of the imperfection through market mechanisms. This can be done through the public provision of improved climate risk information (to address asymmetric information) or through government-based financing support or risk sharing (Gardiner *et al.* 2015; Bisaro and Hinkel 2018; Woodruff, Mullin and Roy 2020; Pauw *et al.*

2022a). For example, the Government of Malaysia developed a mixed-use tunnel allowing for traffic flow under normal circumstances while providing for storm water diversion during heavy rains. Private investments were secured by compensating the positive externality (public benefits of stormwater diversion) by allowing the private investor to toll a portion of the tunnel for traffic (see Gardiner *et al.* 2015). Various instruments can be used to address market imperfections (Pauw *et al.* 2022a) and they typically involve blended finance arrangements that bring together concessional public capital and private capital (Gouett, Murphy and Parry 2023). For example, guarantees and insurance can provide protection to private investors. Concessional finance can help encourage or de-risk private-sector investment and to reduce the cost of capital, with the potential to also include technical assistance funds (grants) to help strengthen financial viability or provide support on key issues (UNFCCC 2022a). Other instruments include resilience bonds (Bascunan, Molloy and Sauer 2020) and public-private partnerships in infrastructure or service provision (UNFCCC 2022a).

4.6.2 Additional approaches to bridging the adaptation finance gap

4. **Remittances.** These are a potential supplementary source of finance for bridging the adaptation gap at the local level, although more discussion is needed on fairness aspects as well as the limitations of nudging recipients to use remittances for adaptation. Remittances – money sent to families and friends in the origin countries by migrants – have potential for three reasons (Bendandi and Pauw 2016). First, the recorded volume of these flows to developing countries has been rising rapidly to US$791 billion in 2021 (Ratha *et al.* 2023). While the largest flows are to middle-income countries, they are more important in relative terms for LDCs (e.g. at 29 per cent of GDP in the Gambia and 23 per cent in Nepal [ibid.]). Second, remittances directly address the household level that is often hard to reach through public interventions. Third, in contrast to private finance, the motivation to remit is not only based on financial returns but also on personal bonds, which allows for investments where adaptation needs might be high but not have a return on investment. For example, Musah-Surugu *et al.* (2018) demonstrate that remittances in Ghana allow households to invest in climate resilience over time, can reduce households' vulnerability by closing their financial exclusion gap, and absorb part of the economic losses owing to climate-related natural disasters, thereby lessening relief service required from local and central government. In Moldova, remittances increase the likelihood of utilization of water-efficient irrigation facilities in dry areas (Pilarova, Kandakov and Bavorova 2021). Governments could help to increase autonomous household adaptation through remittances. Maduekwe and Adesina (2022) find limited differences in exposure and adaptation action taken by Nigerian households that receive remittances compared with those who do not receive remittances but argue that government action to increase climate change literacy could change this. More research is required on the extent to which governments can encourage remittances to support adaptation and on climate justice concerns regarding such government action and the fact that recipients of remittances would use their money to adapt to a problem they might not have contributed to.

5. **Increase financing for SMEs.** SMEs hold considerable potential in unlocking climate adaptation solutions and engaging the private sector (see also GCA and CPI 2021). Since SMEs constitute the bulk of the economy for many developing (and developed) countries, financing mechanisms should be tailored to meet their particular needs and stimulate their potential to offer adaptation-relevant products and services. Initiatives at the global level, such as the G20's Global Partnership for Financial Inclusion, can help mobilize and scale adaptation finance for SMEs. Support through the G20 can be enhanced, for example, by working with the regional development banks in developing countries to channel funds through well-established mechanisms. Regional initiatives such as those in Latin America (Botero, Brinks and Gonzalez-Ocantos eds. 2022), Asia (Papadavid 2021), or Africa (African Development Bank 2019) are salient examples. Moreover, financial de-risking mechanisms can be adapted to include the needs of SMEs, such as in financing small-scale energy projects. Although financial de-risking is occurring in various parts of the world, smaller countries with limited financial markets do not have adequate access to financial de-risking instruments (World Bank 2016). Targeted investments in SMEs can also enable them to address priority areas identified in countries' NDCs, with evidence showing that some SMEs already invest in adaptation in, for example, tourism (Rasul *et al.* 2020; Hess 2020) and agriculture (Gannon *et al.* 2021). Local banks are the natural structuring agents and sources of project development funding. By connecting projects to local institutional investors, currency risks can also be mitigated.

6. **Reform of the global financial architecture (incl. Bretton-Woods institutions).** The Bretton-Woods architecture, which includes the International Monetary Fund (IMF), World Bank and World Trade Organization, was originally designed for the post-World War II era. After the global financial crisis of 2009 and the COVID-19 pandemic, it has

become evident that this system is no longer fit to address today's global challenges (Chhibber 2022). This architecture, together with other financing institutions such as MDBs, holds a large and unused potential for helping developing countries to tackle twenty-first century problems, including adaptation (Georgieva and Verkooijen 2021). The Bridgetown Initiative (Barbados 2022) highlighted:

a. Return access by low-income countries to IMF's rapid credit financing facilities at levels from the COVID-19 crisis period. These financing windows are unconditional, have zero interest rates and can be used particularly after large natural disasters.

b. Debt service suspension clauses, which give temporary relief through the suspension of debt repayment for countries in distress. That way, countries can focus on addressing specific crises or on reconstruction efforts after a climate catastrophe. Debt suspension has already been used to some extent by the G20 members (World Bank 2022), Inter-American Development Bank (2023) and in bilateral cooperation by the United Kingdom Export Finance (2022), and can be coupled with adaptation-related requirements, as in the case of debt-for-climate or debt-for-adaptation swaps (Fuller *et al.* 2018; Hebbale and Urpelainen 2023).

c. Rechannelling unused special drawing rights (SDR). SDR are unconditional support by the IMF to countries' foreign reserves, which do not add to the national debt and have significant potential when redesigned for bolstering climate resilience. They can give fiscal space to governments against economic challenges or be exchanged for hard currency, also working to reduce exchange rate risks and borrowing costs (Andrés Arauz, Cashman and Merling 2022).

d. Other proposals include: (i) the operationalization of the IMF's Resilience and Sustainability Fund, aimed at providing long-term financing; (ii) the expansion of lending by MDBs by US$1 trillion, with a focus on building climate resilience in climate-vulnerable countries through increased risk appetite, guarantees and holding of SDR to expand lending to governments; (iii) a global mechanism for raising reconstruction grants for any country facing climate disasters; and (iv) a multilateral agency that accelerates private investments in the low-carbon transition. Outside the Bridgetown Initiative, a more adaptation-conscious South-South cooperation may also help bridge the gap, such as with the creation and expansion of new multilateral institutions e.g. as the BRICS' New Development Bank.

7. **Implementation of article 2.1(c) of the Paris Agreement.** Making finance flows consistent with a pathway towards low-carbon and climate-resilient development (UNFCCC 2016). Although a global goal, its implementation offers developing countries the potential to help to close the adaptation gap (a–c below), though it also brings risks (d) that need addressing by UNFCCC while further developing guidance on how to scale up climate resilience through the financial system:

a. Standardized reporting on article 2.1(c), such as with the Global Resilience Index Initiative and the Risk Information Exchange by the United Nations Office for Disaster Risk Reduction (UNDRR) (UNDRR and CGFI 2022) could create a proxy for monitoring the extent to which climate resilience is integrated in investment decisions in both public and private sectors. While reducing risks in the medium to long term, thus helping to limit the adaptation gap, the alignment of finance flows with climate-resilient development should also uncover private opportunities for climate adaptation, at the company and project levels, and could lead to more investments in adaptation.

b. As jointly agreed in 2021, MDBs are applying Paris alignment methodologies to all their operations and providing useful lessons learned. The aim is to ensure that projects do not contradict countries' climate strategies, including NAPs. Under the adaptation methodology ("building block BB2"), the focus is to identify and address climate risks. This can both lower material risks for the MDBs by improving the viability of a project over time and seek to improve final beneficiaries' resilience. The methodology applies to direct operations and policy-lending finance, while guiding MDBs' work with financial intermediaries and companies. This can cascade down to MDB partners such as public banks, private financial institutions, investment funds and companies. The experiences of MDBs also offer an important lens for understanding the difference and synergies between resilience-building under article 2.1(c) and international adaptation finance. While following similar steps, the latter only accounts for the shares of project costs specifically addressing adaptation (European Investment Bank 2022), while the goal of article 2.1(c), is ultimately to have 100 per cent of operations aligned with the Paris Agreement.

c. Incorporating climate risks into the financial industry's decision-making strengthens the signal to companies that they need to build and demonstrate climate preparedness, which in turn could lead to investments in adaptation. Whether for managing creditworthiness, accessing mortgages, holding reasonably priced insurance and so forth, addressing risks related to climate impacts is progressively

attached to the ability of companies to manage their financial health (Choi *et al.* 2023), as reflected by different credit rating agencies' evaluations of companies, as well as national governments and municipalities (Moody's Investors Service 2017a).

d. The identification and disclosure of climate-related risks should contribute to adaptation, but in the shorter term it could negatively impact on the economies of developing countries. Broadly speaking, the identification of climate-related risks in investment or finance decisions could lead to three scenarios. In the best scenario, measures are taken to address these climate-related risks at low cost or at no cost in design. In the second-best scenario, addressing risks comes at a higher price e.g. through insurance, guarantees or other de-risking instruments. In the worst scenario, the identification of climate-related risks deems investments prohibitively expensive or unprofitable. Because of the latter, advancing article 2.1(c) solely driven by financial materiality might lead to the increase of perceived risks and negative biases against the most vulnerable populations, such as the ones located in islands and LDCs (Moody's Investors Service 2017b; Fitch Ratings 2021), or the most exposed sectors such as agriculture, natural capital and infrastructure. This is an issue of fairness that UNFCCC need to address.

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5

Chapter 5

Loss and damage

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Key messages

- In the United Nations Framework Convention on Climate Change (UNFCCC), loss and damage has emerged as a third key pillar of climate policy, alongside mitigation and adaptation, to address ever-increasing climate impacts in developing countries that are particularly vulnerable to the adverse effect of climate change.
- Losses and damages arise when efforts to avoid or minimize climate impacts through mitigation and adaptation fail. Given the slow progress of mitigating greenhouse gas (GHG) emissions and of adapting to climate risks, some losses and damages are occurring, and further loss and damage is unavoidable.
- There is a broad typology of responses available for both economic and non-economic losses and damages that must all respect country ownership and be equitable, inclusive, accessible and adequate, but the lack of conceptual clarity is a clear barrier to making progress on loss and damage.
- Many uncertainties remain regarding the financial needs to address loss and damage, but innovative funding sources and governance structures must be found to reach the necessary scale.

5.1 Introduction

5.1.1 What is loss and damage?

While there is no commonly agreed definition, loss and damage is most commonly understood as the adverse effects of climate change that are not or cannot be avoided by mitigation and adaptation efforts (van der Geest and Warner 2020). This definition implies that there are two types of loss and damage: those that exceed adaptation limits and those that can be minimized by ramping up adaptation efforts and finance. The limits to adaptation are the points at which adaptation fails to avert intolerable climate impacts. They are typically classified as being either hard or soft.

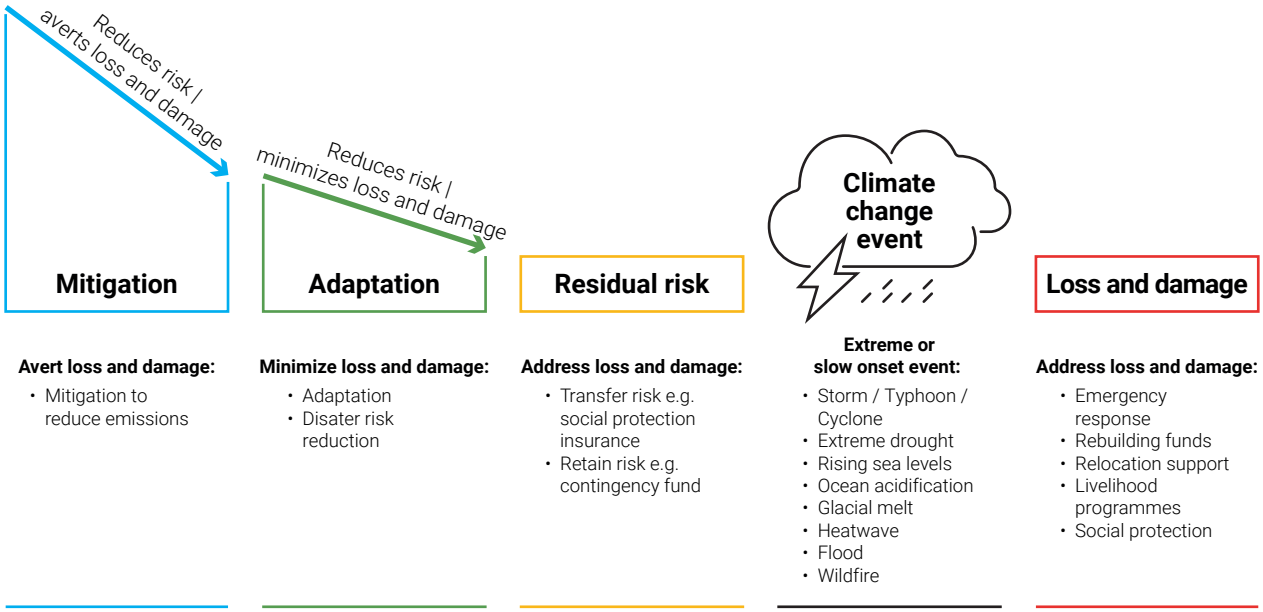
- Hard limits are typically those associated with physiological responses to changing climates, and other than reducing GHG emissions, there are few options available to humans to avoid the points at which climate-sensitive systems are fundamentally damaged.
- Soft limits are those that arise from failures to implement adaptation actions that could effectively reduce vulnerability. This failure can be for cultural, economic and/or political reasons.

As the previous chapters of this report have shown, there are significant gaps and challenges in the policies and actions that national governments and other actors implement to adapt to climate change. The wider these gaps and the longer it takes to overcome the challenges, the more severe the losses and damages will be, particularly in vulnerable countries. An important way to reduce losses and damages is to tackle adaptation constraints and boost national capacities to implement effective adaptation efforts.

Opportunities for averting, minimizing and addressing loss and damage can be found across a spectrum ranging from reducing GHG emissions to disaster risk management, climate change adaptation, and addressing residual loss and damage (figure 5.1). Reducing global warming can help to avert losses and damages while disaster risk management and climate change adaptation actions can help minimize them. Policies to address loss and damage are still scarce, but some are emerging (see section 5.4 for an overview).

It is important to recognize that options to avert, minimize or address loss and damage may work at various timescales. Reducing GHG emissions, for example, may avert loss and damage in the timescales of decades to centuries, while both disaster risk reduction and climate change adaptation actions can minimize loss and damage in the short to medium term.

Figure 5.1 Policy interventions to avert, minimize and address loss and damage



Source: Richards (2022)

5.1.2 Evolution of loss and damage in the climate negotiations

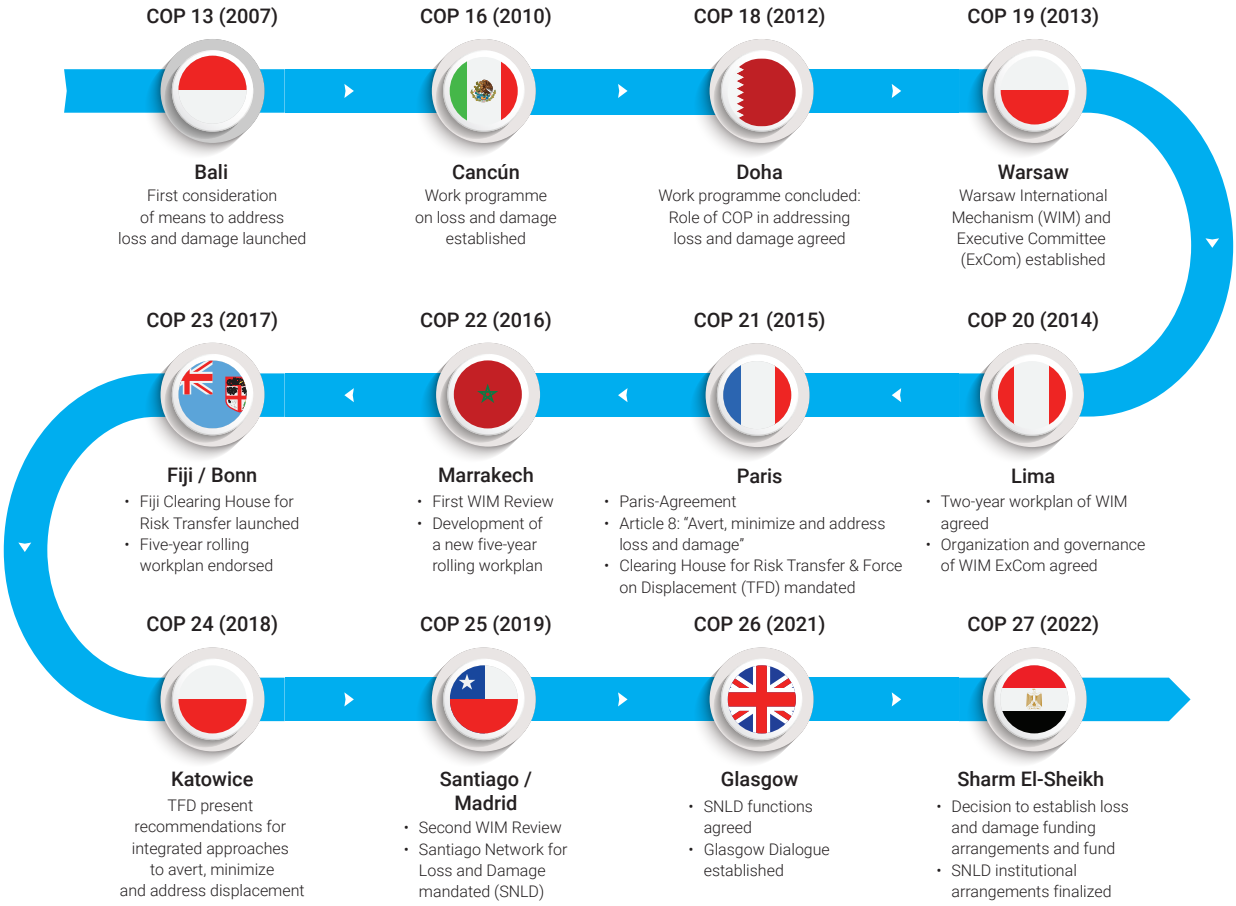
The issue of loss and damage has evolved over time, leading to the decisions achieved at the twenty-seventh session of the Conference of the Parties to the UNFCCC (COP 27) in Sharm El-Sheikh to establish a fund and funding arrangements for loss and damage (figure 5.2).

Loss and damage was first raised as an issue in climate change negotiations in 1991, four years before COP 1 took place. That year, Vanuatu, on behalf of the Alliance of Small Island States, submitted a proposal for an international insurance pool to address loss and damage from sea level rise in small island developing States. The attempt was unsuccessful, and it took almost two decades for the issue to reappear in the climate negotiations. In 2010, a work programme on loss and damage was created, which eventually led to the establishment of the Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts (WIM) in 2013. WIM was mandated to 1) enhance knowledge and understanding on loss and damage; 2) strengthen dialogue, coordination, coherence and synergies among relevant stakeholders; and 3) enhance action and support, including finance, technology and capacity-building.

Despite slow progress since the establishment of WIM, particularly on enhancing action and support (Johansson *et al.* 2022), several milestones have since been achieved. In 2015 the Paris Agreement dedicated article 8 to loss and damage, emphasizing the importance of averting, minimizing and addressing loss and damage, including the irreversible impacts that have already occurred and those that are expected to happen in the future. Article 8 acknowledges the reality that some climate impacts are beyond adaptation efforts and may result in loss and damage to vulnerable countries and communities. The decision text notes that article 8 does not provide a basis for liability and compensation. Proponents of this text say that this is necessary to make progress on addressing loss and damage politically feasible, while critics say it weakens the treaty and removes the pressure on polluters to ramp up action to avert climate change, and on developed countries to intensify their support for adaptation.[1]

1 For a careful interpretation of liability and compensation under article 8, see Mace and Verheyen (2016).

Figure 5.2 The emergence of loss and damage in the climate negotiations



Source: Adapted from Mirwald (2023).

Between 2016 and 2021, there was a gradual move towards more concrete plans for action on loss and damage. Noteworthy is the establishment of the Santiago Network for Loss and Damage in 2019. The objective of the network is to catalyse technical assistance for approaches to avert, minimize and address loss and damage at the local, national and regional level. The technical assistance is particularly geared towards climate vulnerable countries.

At COP 27 in 2022, an important new milestone was achieved with the agreement to establish financial arrangements, including a fund, for addressing loss and damage in developing countries particularly vulnerable to the adverse effects of climate change (UNFCCC 2022a). The COP decision calls for the mobilization of new and additional resources to address loss and damage. While previous decisions since 2015 used the phrasing "avert, minimize and address", the 2022 text emphasizes that the new fund's mandate should focus on *addressing* loss and damage. The idea behind this is that action to avert and minimize loss and damage is already covered by finance for mitigation and adaptation.

Critics note that the international response on loss and damage in the UNFCCC has insufficiently taken human rights into account. They have pursued the integration of loss and damage in relevant human rights bodies including the United Nations Human Rights Council and the Office of the High Commissioner for Human Rights. Further, the United Nations General Assembly has asked for an advisory opinion on climate change from the International Court of Justice at the behest of Vanuatu.

5.1.3 Outline of chapter

Section 5.2 of this chapter examines soft and hard limits to adaptation in natural and social systems, and their relevance for our thinking about ways to avoid and minimize loss and damage. Section 5.3 discusses different conceptualizations and perspectives on loss and damage, including a climate justice lens. Section 5.4 looks at the different policy options for addressing economic and non-economic losses and damages, and section 5.5 assesses the magnitude, sources and mechanisms for financing action to address loss and damage.

5.2 Adaptation limits and loss and damage

Loss and damage from climate change arises when efforts to avert or minimize climate impacts through mitigation and adaptation fail. The points at which adaptation fails to avert climate impacts are called the 'limits' to adaptation. Research on adaptation limits commonly refers to hard and soft limits. Hard limits are those that arise in physical systems, and which cannot be averted through adaptation action but rather only through mitigation of GHGs. Soft limits are those that can be avoided or minimized through more concerted adaptation efforts. Thus, the more the adaptation gap is reduced, the fewer soft limits will be crossed and the less loss and damage there will be.

5.2.1 Hard limits to adaptation

Even if the temperature goal of the Paris Agreement is achieved, there will still be between 1.5°C and 2°C of warming above pre-industrial levels (Meinshausen *et al.* 2022). At 1.5°C of warming, widespread changes in highly climate-sensitive ecosystems such as coral reefs and tropical glaciers are likely (Hughes *et al.* 2018; Stuart-Smith *et al.* 2021; McKay *et al.* 2022). It is in natural systems such as these where the limits to adaptation seem *hard* in the sense that there are few options available to humans to avoid the points at which they are fundamentally damaged and some or all their unique and valued characteristics are lost (Marshall *et al.* 2019; Stensrud 2020; Intergovernmental Panel on Climate Change [IPCC] 2022).

Case study: Mountains in silent thaw – Losses and damages from the disappearing "frozen heartbeat" of Earth

The mountain cryosphere – ice, snow and permafrost – is melting due to climate change, affecting billions of people worldwide with significant economic and social consequences.

As natural water storage continues to shrink, the timing and availability of fresh water change. This means increased flooding and erosion during melting periods and water scarcity during dry seasons, damaging infrastructure and disrupting water supplies for agriculture, drinking and energy generation.

Addressing loss and damage from a diminishing mountain cryosphere requires a comprehensive and urgent response. More adaptation action is needed for resilient infrastructure, early warning systems and adaptive water management and agricultural practices.

While it is a global responsibility to safeguard the crucial ecosystem services mountains provide, success hinges on engaging and empowering local communities, particularly Indigenous Peoples, in collaborative adaptation action. Local and traditional knowledge is critical for tailored solutions, promoting resilience, equity and sustainability in the face of changing cryosphere conditions.

Note: This case study is not connected to the chapter. The full case study is available online.

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Many studies indicate the risks of changes in ecosystems resulting from climate change (Zommers *et al.* 2016; van der Geest *et al.* 2018). For example, the coral reefs of the Indian Ocean are threatened with collapse due to marine heating (Obura *et al.* 2022); beaches and wetlands in California may be lost due to rising sea levels (Barnard *et al.* 2021); the West Antarctic ice sheet may progressively melt due to warming (Pattyn and Morlighem 2020); many mountain glaciers may tip into irreversible melting beyond 2°C of warming (see box on the mountain cryosphere; Hock *et al.* 2019); parts of the Amazon rainforest are at risk of turning into savannahs because of drying, heat and fire; and changes in the West African monsoon may lead to shifts in vegetation cover in the Sahel (McKay *et al.* 2022).

Climate-sensitive ecosystems facing hard limits have both intrinsic and extrinsic value to people. Extrinsic (or instrumental) values are those that arise from the goods and services provided by ecosystems to peoples whose livelihoods depend on them. The loss of the goods and services provided by ecosystems that exceed their limits to adaptation often flows on to loss and damage in social systems. For example, migration and mobility in response to water insecurity can enhance conflict and disrupt the cohesion of families and communities (see box on transboundary water management in chapter 2; Heslin *et al.* 2019); the loss of reefs undermines the livelihoods of fishers, human health, and in extreme cases the sovereignty of whole countries (Martyr-Koller *et al.* 2021); and changes in vegetation cover can increase hunger and malnutrition (Kogo, Kumar and Koech 2021).

Climate-sensitive ecosystems that face hard limits also have intrinsic value in that people value them for their existence. Intrinsic values are revealed, for example, in World Heritage listings, and people's attachments to places and landscapes (Adger *et al.* 2013; Barnett *et al.* 2016). There are no commensurable substitutes for the loss or damage of things that are intrinsically valued, and so these can be catastrophic to people's identity and well-being (Adger *et al.* 2022). Hard limits can only be avoided by deep cuts in GHG emissions that allow ecosystems to slowly adapt in ways that retain their instrumental and intrinsic values (IPCC 2022).

5.2.2 Soft limits to adaptation

In some cases, loss and damage to climate-sensitive ecosystems can be avoided or at least greatly delayed through reductions in non-climate stressors. For example, human diversions of water are often a larger driver of change in wetlands than climate; poorly sited and designed structures can have a bigger impact on coastal erosion than sea level rise; and logging and habitat fragmentation can have a bigger impact on biodiversity losses in forests than climate drivers. In these cases, there are actions that humans can take to avert and minimize loss and damage, and so the limits to adaptation may be called *soft* in the sense that known practices and technologies can be effective, even if they are not immediately available and their application seems unlikely (Barnett *et al.* 2015; Klein *et al.* 2015; Mechler *et al.* 2020; IPCC 2022).

The soft limits to adaptation arise from development processes that expose some groups to climate change risks, constrain their adaptive capacities or impede adaptation responses. A range of adaptations exist that can be made to avert and minimize loss and damage to resource dependent livelihoods, most often through a combination of technologies, ecosystem management, changes in livelihoods and improvements in social and economic opportunities (see Valdivia *et al.* 2012; Cinner *et al.* 2018; Janzen *et al.* 2021; United Nations Environment Programme 2022). These include practices that reduce people's dependence on climate-sensitive resources or enhance their freedoms to adapt, such as social protections and income guarantees in times of crisis, industrial restructuring programmes, improvements in infrastructure and improvements in social opportunities. They also include technologies and practices that reduce vulnerability and exposure to climate hazards, such as coastal defences, irrigation, risk-sensitive land-use management, and improved designs for infrastructure. While these adaptations are theoretically possible, some carry the risk of maladaptation, all entail trade-offs among competing values, and most face barriers due to costs, governance systems or social norms (Boyd *et al.* 2021; Henrique *et al.* 2022; Thomas *et al.* 2021; IPCC 2022).

Therefore, identifying the limits of adaptation is important to help avert, minimize and address loss and damage (Barnett and Sinha Roy forthcoming). People's sense of 'intolerable losses' can be ascertained using diverse social science methods, including those associated with the elicitation of values (Barnett *et al.* 2016). Doing so in the context of climate risks brings to the fore benchmarks of loss whose avoidance and minimization can serve as the goals of adaptation. Careful and committed co-production of knowledge and strategies to identify, avert, minimize and, if necessary, address loss and damage can remove feelings of powerlessness and injustice, build relationships of care and responsibility, help affected populations come to terms with loss, stimulate collective action and responsibility, and change expectations of the future in ways that transform perceived losses to something less existentially troubling over time (Barnett *et al.* 2016). Averting, minimizing and addressing loss and damage therefore involves foresight to identify adaptation limits and their consequences.

Case study: Health-related loss and damage – Lessons from the Caribbean

Climate-related health risks are escalating rapidly worldwide. Without effective adaptation, health-care infrastructure will continue to be overwhelmed by demand and damaged during climate disasters such as heatwaves, floods and wildfires.

Adaptation solutions to avert, minimize and address loss and damage in health require scaled-up efforts on all levels. Governments must also address the lack of clear definitions and quantifiable data on the economic and non-economic impacts of loss and damage on health.

A regional approach in the Caribbean has strengthened climate resilience through national food and water safety plans, climate-related health bulletins and the development of climate-integrated early warning systems for health.

The approach combines capacity-building and risk awareness, targeted investments, combined political intent, scientific know-how and local participation, underscoring the importance of coordinated adaptation planning.

Note: This case study is not connected to the chapter. The full case study is available online.

Authors: Kathryn Bowen (Melbourne Climate Futures and University of Melbourne), Janine Felson, Elise Moo (University of Melbourne), Chandni Singh (Indian Institute for Human Settlements), Joy St John (Caribbean Public Health Agency)

This can be done at any sectoral or spatial scale using established methods for investigating future conditions (Cook *et al.* 2014).

The risk that adaptation fails increases with GHG emissions. The more warming there is, the less time there will be for adaptation to take effect. Slowing the rate of warming allows more time for soft limits to adaptation to be overcome. Given enough time, adaptation action may indeed overcome some soft adaptation limits in ways that avoid and minimize some loss and damage. Nevertheless, climate extremes are already causing significant loss and damage, and this trend will continue despite even the most effective adaptation and well before anticipated limits to adaptation have been reached.

5.3 Conceptualizing loss and damage

There are a myriad of conceptualizations of loss and damage and no universally agreed definition exists in either policy, practitioner or research arenas. The lack of conceptual clarity on a definition of loss and damage has challenged both theoretical advancements in loss and damage research while also making it difficult to develop comprehensive action to address it in practice (Boda *et al.* 2021; Jackson *et al.* 2023). The lack of clarity of what constitutes loss and damage also poses challenges for how to address it. Still, the vague understanding of loss and damage in the UNFCCC has also been identified as beneficial to allow progress in political negotiations, despite different perspectives of stakeholders (Vanhala and Hestbaek 2016; Calliari, Serdeczny and Vanhala 2020).

Research on the varying conceptualizations of loss and damage shows that perspectives range from:

- considering all anthropogenic climate change impacts as loss and damage, to
- understanding loss and damage as impacts that occur after limits to adaptation have been reached, to
- defining loss and damage as irreversible and inevitable harms from climate change (Boyd *et al.* 2017; Mechler *et al.* 2020).

The relationships between mitigation, adaptation and loss and damage have been conceptualized differently and have led to several theoretical strands of research and varying approaches on suitable responses to loss and damage (New *et al.* 2022), as detailed in section 5.4.

Despite different conceptualizations, justice is a major theme underpinning many understandings of loss and damage, and has been a key component of discussions of the issue in the UNFCCC (Roberts and Pelling 2020; Boyd *et al.* 2021; Jackson *et al.* 2023). Distributional, procedural and recognition (in)justice as they relate to loss and damage are experienced at multiple scales, from the global level where historically low-emitting countries face disproportionate impacts of climate change, to the local level where more vulnerable members of society are frequently most affected by impacts (Thomas and Benjamin 2022). A justice lens underscores that loss and damage is not the product of climate hazards alone but is influenced by differential vulnerabilities to climate change, which are often driven by a range of sociopolitical processes, including racism and histories of colonialism and exploitation (Falzon and Batur 2018; Abimbola *et al.* 2021; Kashwan and Ribot 2021).

5.3.1 Categorizing loss and damage

Although many conceptualizations of loss and damage exist, there is general agreement that it can be categorized as being economic or non-economic, an understanding which is also shared by the UNFCCC's overview of the issue (Boyd *et al.* 2017; UNFCCC undated).

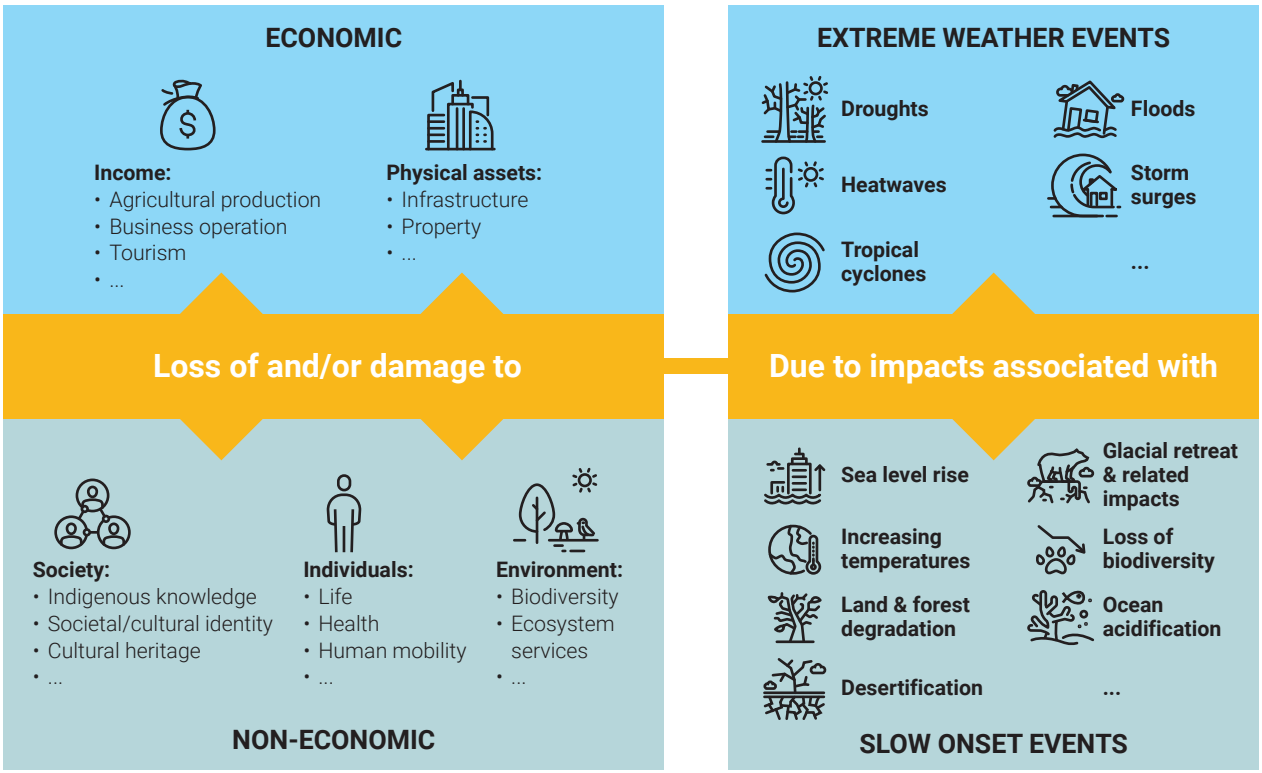
Economic loss and damage includes impacts that can be assigned a monetary value, such as damage to infrastructure or loss of earnings or productivity. Non-economic loss and damage encompasses a spectrum of outcomes that are not easily assigned a monetary value and are not typically subject to market transactions. They include the loss of life, health, rights, territory, cultural heritage, Indigenous or local knowledge, biodiversity loss and loss of ecosystem services (see figure 5.3).

While there are methodologies that attempt to quantify economic loss and damage, non-economic losses and damages are more difficult to assess and thus are often disregarded or undervalued (Boyd *et al.* 2021). However, failure to consider non-economic losses and damages means that quantitative estimates of loss and damage underestimate the extent of climate impacts, particularly for low-income regions where there is a lack of systematic monitoring or reporting of non-economic losses and damages (Thomas and Benjamin 2020; Chandra *et al.* 2023).

Another approach is to categorize loss and damage as avoidable or unavoidable – a way of differentiating between loss and damage that may or may not be prevented by adaptation and mitigation (Verheyen 2012; van der Geest and Warner 2015). Avoidable loss and damage can theoretically be prevented through implementing mitigation and/or adaptation measures and can be further categorized as unavoided if such measures were not implemented. Unavoidable loss and damage refers to impacts that occur despite mitigation and adaptation, such as loss and damage resulting from extreme events where no adaptation efforts would have been able to prevent impacts. Unavoidable loss and damage is closely linked to understandings of adaptation limits and thresholds, as detailed in section 5.2. Categorizing loss and damage as avoidable or unavoidable allows for identifying different approaches to respond to

loss and damage, including the need for transformative approaches to address the inevitable impacts of climate change, such as loss of territory due to long-term sea level rise (Mechler and Schinko 2016; Heslin 2019; Mechler and Deubelli 2021).

Figure 5.3 Examples of economic and non-economic loss and damage from extreme and slow onset events



Source: UNFCCC (2019).

5.3.2 Relating loss and damage to cascading and compound risks

While most conceptualizations of loss and damage posit that loss and damage is a result of both slow onset and extreme events, recent findings by the IPCC highlight that these events do not happen in isolation. Rather, multiple climate hazards (both slow onset and extreme events) may coincide and interact with non-climatic risks, resulting in higher overall levels of risk that affect multiple sectors and regions (IPCC 2022). The devastating 2022 floods in Pakistan 2022 (Nanditha *et al.* 2023) (see box on Pakistan) brought complex, compound and cascading risks that made it difficult to attribute loss and damage solely to a particular event, highlighting that loss and damage encompasses more than direct negative impacts in a particular place and may cascade across sectors and regions.

5.3.3 Assessing loss and damage

The absence of an agreed definition of loss and damage hinders its assessment. Given that it is common to measure the costs of disasters in economic terms, economic assessments of damage tend to dominate, whereas estimates and measures of non-economic losses rarely consider metrics other than the loss of life (Scown *et al.* 2022). Moreover, the social values underpinning non-economic loss and damage are rarely universal, so as well as being difficult to quantify there can also be disagreement about which to prioritize and how to address them. Nevertheless, the number of studies explicitly focusing on non-economic loss and damage is growing, including proposals for a loss and damage assessment methodology based on locally identified values (van Schie *et al.* 2023). For example, when ancestral knowledge about travel routes and weather conditions is lost there is a risk of impairing the ability of Inuit communities to travel, hunt and fish, thus threatening their traditional ways of life (Cunsolo and Ellis 2018).

Assessments of loss and damage therefore need to consider a spectrum of outcomes, including all those that do not have market values. Assessments of the risk of loss and damage also need to consider which can be averted, minimized and addressed, and likely residual risks after implementing all known and feasible adaptation solutions, while recognizing the potential for maladaptation and adaptation failure. Understanding and operationalizing concepts such as adaptation limits (see section 5.2) is also important in order to assess loss and damage, but is still in

Case study: Transformative adaptation and human mobility – Planned relocation in Fiji

The climate crisis and the resulting rising sea levels and extreme weather events is threatening the existence of many coastal communities. The result is unavoidable loss and damage to way of life, culture, biodiversity, land, livelihoods, agency, assets and social cohesion.

In Fiji, Planned Relocation Guidelines provide a detailed blueprint to guide the implementation of relocations, which is grounded in analysis and community consent. These guidelines unlock the potential for continuing a traditional way of life, economic growth, infrastructure development and enhanced resilience.

The accompanying Climate Relocation of Communities Trust Fund Act provides an example of possible adaptation funding arrangements at the national level, to address relocation due to the climate crisis.

The lessons from Fiji underscore the importance of proactive, community-centred, culturally-relevant and holistic approaches to ensure the resilience and well-being of affected populations in the face of the increasingly unavoidable impacts of the climate crisis.

Note: This case study is not connected to the chapter. The full case study is available online.

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the nascent stages (Qi, Dazé and Hammill 2023). The lack of methodologies means it is difficult to assess adaptation limits and associated losses and damages resulting from those limits. However, there is emerging evidence on residual risks and soft and hard adaptation limits that is relevant for practitioners and policymakers (Mechler *et al.* 2020; Thomas *et al.* 2021; Berkhout and Dow 2022).

Yet at present there is often strong emphasis on the hazard aspect of the risk and less emphasis on the socioeconomic drivers of vulnerability. Because of this gap, the currently developed adaptation plans may largely be insufficient as they are based on an underestimation of risks without considering all possible non-economic losses and damages.

5.4 Addressing loss and damage

5.4.1 Actions to address loss and damage

There are a growing number of actions to address loss and damage. Actions commonly identified in national adaptation plans (NAPs) include disaster risk management, research, risk assessment, information and data collection, capacity-building, knowledge management, early warning systems (EWS), insurance, social protection measures, humanitarian response and forecast-based finance (Bharadwaj *et al.* 2022).

In practice, a grey zone exists between adaptation and loss and damage actions. There is a typology of instruments for addressing economic loss and damage, including support for rebuilding livelihoods, risk insurance, EWS, social and financial protection, compensation, and humanitarian assistance. Measures for addressing non-economic loss and damage include support for communities to preserve their culture, recognition of loss and repair of damage, official apologies, active remembrance, counselling, and the conservation and restoration of ecosystems (see table 5.1 and Annex 5.A for further details).

There is no global inventory of non-economic assets (e.g. built cultural heritage) at risk from climate change. When it comes to natural heritage, especially immaterial heritage, awareness among policymakers – let alone the preparation of inventories or the implementation of response measures – ranges from rare to nil (Barnett *et al.* 2016). However, there are significant data on non-economic loss and damage that can be synthesized.

Proposals to facilitate mobility and migration to avoid loss and damage are controversial, and not universally supported by people, communities and governments. Migration almost always has costs, and these rise the more migration is forced and rapid (see Wiegel *et al.* 2021; Yee *et al.* 2022; Mombauer, Link and van der Geest 2023).

Table 5.1 A selection of actions associated with economic and non-economic loss and damage

	Extreme events	Slow onset processes
Economic loss and damage		
Ahead of event impact	Social protection measures, including pre-disaster financial support Risk layering, risk retention, risk transfer (e.g. climate insurance) Early warning and impact-based forecasting Loss and damage databases to support decision-making and risk assessments	Livelihood diversification with reskilling and support for alternative livelihoods Planned relocation/ assisted migration Social protection measures (e.g. social assistance and safety net programmes)
During/following event	Humanitarian assistance Short- and long-term recovery and rehabilitation Support for rebuilding livelihoods Rebuilding damaged infrastructure Compensation	Support for rebuilding livelihood Rebuilding damaged infrastructure Compensation
Non-economic loss and damage		
Ahead of event impact	Early warning and impact-based forecasting (e.g. to enable timely evacuation) Through assisted migration, support to people in areas at high risk of extreme events to relocate to safer areas and avoid disaster displacement	Investment to safeguard cultural heritage (e.g. restoring or rehousing artefacts); support for intangible cultural heritage (e.g. documentation) Developing culturally sensitive and people-centred planned relocation guidelines and processes
During/following event	Reparations to help ensure future well-being following loss Recognition of loss and repair of damage; official apologies Active remembrance (e.g. through museum exhibitions, school curricula) Counselling Support for communities to preserve their unique culture and social ties outside their traditional/former place of residence (particularly for displaced/relocated populations) Enabling access/safe visits to abandoned sites Conservation and restoration of ecosystems and biodiversity	Recognition of loss and repair of damage; official apologies Active remembrance (e.g. through memorial sites, monuments and museum exhibitions, ongoing awareness and education programmes, school curricula) Counselling Support for communities to preserve their unique culture and social ties outside their traditional/former place of residence (particularly for displaced/relocated populations) Enabling access / safe visits to abandoned sites Conservation and restoration of ecosystems and biodiversity

Source: Adapted from Shawoo *et al.* (2021) and Richards *et al.* (2023).

5.4.2 Coordinating actions for loss and damage

The compounding and transboundary nature of climate risk requires implementing solutions in coordination across scales from the global to the local. Global frameworks such as the Sendai Framework for Disaster Risk Reduction, Paris Agreement, Convention on Biological Diversity and the Sustainable Development Goals contribute to strengthening risk management. Loss and damage has brought about new actor constellations under the UNFCCC with different roles, capacities and knowledges and includes:

- The **Warsaw International Mechanism for Loss and Damage**, which focuses on research and dialogue and enhancing action and support, including finance (established at COP 19 in November 2013).
- The **Santiago Network for Loss and Damage**, which was established at COP 25 (December 2019) to provide technical assistance in averting, minimizing and addressing loss and damage. The Santiago Network's aim is to catalyse the technical assistance of organizations, bodies, networks and experts for the implementation of actions at the local, national and regional levels in developing countries particularly vulnerable to the adverse effects of climate change.
- The **Expert Group on Non-Economic Losses**, which prepares guidelines on "averting, minimizing and addressing non-economic losses in the context of human mobility". Two of the guidelines focus on "addressing losses associated with the loss of territory–ecosystem services–cultural heritage nexus", and the impact that climate change-driven mobility has on "Indigenous or local knowledge, societal identity and cultural heritage" (UNFCCC 2021).
- The **Transitional Committee**, whose objective is to operationalize the new funding arrangements and loss and damage fund (established at COP 27 in November 2022).

There are gaps in understanding how to most effectively govern and coordinate action to address losses and damages already occurring and at what scale (Jackson *et al.* 2022).

Case study: The Pacific heat dome – Heatwave lessons from the United States of America

With climate change comes increasing exposure to extreme heat for people all over the planet. This has significant impacts on morbidity and mortality. However, deaths related to extreme heatwaves are all potentially preventable. Adaptation is needed urgently to protect human health and well-being.

In 2021, an extreme heatwave in Seattle, in the United States of America, caught the city off guard, leading to severe health consequences. The region had never experienced a heatwave of this magnitude and was unprepared, even though almost everything experienced during the event, from patterns of morbidity and mortality to stress on front-line health-care providers, was highly predictable.

Understanding projected increases in the frequency, intensity and duration of heat events must be translated into actions that protect vulnerable populations, with adaptation occurring at the individual, community, building and urban levels to protect human health and well-being in future heatwaves.

Note: This case study is not connected to the chapter. The full case study is available online.

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Regional, national and subnational level

At the national level, national policies and programmes provide the enabling environment for the proliferation of options for averting, minimizing and addressing loss and damage. With growing concern for cascading, compounding and transboundary climate risks, there is more need for regional cooperation in implementing regional-level measures for addressing loss and damages. To date, only regional catastrophic insurance mechanisms are clearly visible options available and there is a need to explore more regional cooperation measures that have the synergistic impact of addressing losses and damages at the regional to local level. Such measures should take into consideration the ecosystems, sharing regional early warnings, trade and supply chains and financial markets.

An analysis of NAPs provides deeper insights into the extent to which loss and damage policy and related interventions received attention as well as their progress. Of the 41 NAPs submitted to the UNFCCC as at 1 March 2023, 49 per cent of them have direct references to loss and damage (Qi, Dazé and Hammill 2023). Some countries have dedicated sections for observed loss and damage, including Saint Lucia. However, the NAPs do not provide the details on how much future loss and damage is anticipated in certain climate change scenarios, and what kinds of loss and damage are expected at the national, regional and local levels. Further research is needed on how institutions deal with loss and damage policy and decision-making at the national, regional and subnational levels (Nand, Bardsley and Suh 2023).

5.5 Finance to address loss and damage

The decision to establish a dedicated fund to assist developing countries in responding to economic and non-economic loss and damage associated with climate change was a historic move agreed at COP 27 in 2022. The decision acknowledged "the urgent and immediate need for new, additional, predictable and adequate financial resources to assist developing countries that are particularly vulnerable to the adverse effects of climate change in responding to economic and non-economic loss and damage associated with the adverse effects of climate change, including extreme weather events and slow onset events." (UNFCCC 2022b).

At COP 27, a Transitional Committee agreed it was responsible for operationalizing both the new funding arrangements and the fund for consideration and adoption at COP 28 in Dubai; a process that is ongoing. Key considerations raised during the discussions include questions related to the sources of funding, access to funding, the types of activities and options to be funded and the structure and governance of the fund and the funding arrangements. Another key question is how to prioritize countries that are highly vulnerable and have low capacity to finance climate action. Different understandings of vulnerability and interpretations in climate negotiations mean these discussions are complex (Chhetri, Schaefer and Watson 2021).

The loss and damage fund is at the forefront of this chapter but consideration of the implications of other funding arrangements for addressing loss and damage is also critical as there will be overlaps with the activities and roles of the broader risk management, development and humanitarian communities. Providers of bilateral and multilateral development finance increasingly realize the importance of explicitly taking the risk of loss and damage into account in their strategic and programming approaches (Organisation for Economic Co-operation and Development 2021).

The funding for loss and damage will be wide-ranging and the needs of countries, as informed by national assessments, will vary across space and over time. Countries will experience different conditions for similar climatic events, non-economic and economic needs will also differ, and there will be varying financial requirements for addressing loss and damage from extreme weather events and slow onset events. Adequate climate information services and needs assessments are crucial for informed planning and addressing loss and damage. Similarly, support to develop appropriate financial tools, including social protection, insurance and measures to assist those displaced by loss and damage, is crucial.

5.5.1 Identifying climate finance needs for loss and damage

Varying studies have identified different broad-scale financial estimates based on different models, methods and scientific contexts. The focus to date has been on economic dimensions. The approximated cost of addressing loss and damage, incorporating both economic and non-economic dimensions, will be enormous given the current temperature path the world is heading for. The actions taken on mitigation and adaptation will significantly determine the future cost of loss and damage. Table 5.2 summarizes the key findings of some of the economic studies.

Table 5.2 Studies identifying climate finance needs for loss and damage

Source	Methodology	Findings
Fanning and Hickel (2023)	The authors develop a procedure to quantify the level of compensation owed in a net-zero scenario where all countries decarbonize by 2050, using carbon prices from IPCC scenarios that limit global warming to 1.5°C and tracking cumulative emissions from 1960 across 168 countries.	US$192 trillion would be owed to the undershooting countries of the Global South for the appropriation of their atmospheric fair shares by 2050.
Baarsh, Schaeffer and Awal (2022)	This analysis provides the first ever estimate of the economic losses attributable to anthropogenic climate change only. The study leverages a data set that provides a counterfactual climate for observations over the last 40 years. Building on a macroeconometric model, the analysis then compares the effect on gross domestic product (GDP) per capita growth in real climate observations against the effect in the counterfactual climate estimates.	It is estimated that US$525 billion have been lost because of climate change in the last two decades and economic losses cut GDP growth by one full percentage each year on an average in the most vulnerable countries.
Markandya and González-Eguino (2019)	Economic integrated assessment models.	Total residual damages for the following regions, where the countries belong mainly to the non-Annex I group (Middle East and North Africa, sub-Saharan Africa, South Asia, China, East Asia and Latin America and the Caribbean): From US$116–435 billion in 2020, rising to US$290–580 billion in 2030, US$551–1,016 billion in 2040 and US$1,132–1,741 billion in 2050.
Baarsch *et al.* (2015)	Based on the methodology of the IPCC *Fifth Assessment Report*.	Suggest loss and damage costs (not needs) for developing countries of around US$400 billion in 2030, rising to US$1–2 trillion by 2050.
DARA and the Climate Vulnerable Forum (2012)	A conceptual framework that assessed vulnerability at the national level through desk research fieldwork; national-level workshops and peer review.	Estimates loss and damage costs to be US$4 trillion in 2030.

Further research on the methodologies and processes for estimating loss and damage and associated finance needs, as well as non-economic loss, is needed. Key issues include (i) the relationship between adaptation expenditures and loss and damage, (ii) the time-horizon under consideration and iii) associated uncertainties (Markandya and González-Eguino 2019).

5.5.2 Building an evidence base

Unlike in the areas of mitigation and adaptation, where countries have identified and communicated to the UNFCCC about their national commitments, proposed actions and costs through nationally determined contributions (NDCs) and NAPs, most developing countries are yet to identify and assess their loss and damage risks and financial needs.

Currently, limited processes exist for collecting, recording and reporting information on the activities and associated costs of addressing loss and damage. This is a significant undertaking for many countries as it is a technical, costly and time-consuming process. Countries will have to assess both the economic and non-economic costs of the different options for addressing loss and damage based on their population, economy, sociocultural context and natural capital.

5.5.3 Sources and utilization of finance

A broad range of funding options exists for financing loss and damage internationally and domestically. These include public, private and innovative sources of finances with a wide variety of instruments – grants, concessional financing, insurance and more. Since the financial need for addressing loss and damage could escalate in the future, exploring sustainable innovative sources through, among others, maritime shipping levies, aviation levies, taxation, debt relief, debt swaps and special drawing rights will be essential. International public finance will play a key role in addressing loss and damage to assist developing countries particularly vulnerable to climate change's adverse effects. Understanding the roles of different sources of finance and how they may interact is crucial.

The provision of finance will need to be allocated based on needs and the ability to effectively deploy the funding. Funding will also be critical for capacity-building, institutional strengthening, promoting Indigenous knowledge and technology, data collection and analysis.

The conventional project-based model currently employed in much of climate finance is likely unsuitable for a significant portion of loss and damage finance provision. It is unsuitable for extreme weather events given the unpredictability of these types of events and unsuitable for slow onset hazards given their incremental nature (the lack of start and end dates) and given the cascading and compounding nature of climate risks. Alternative models of finance disbursement should be developed that ensure finance reaches affected communities with urgency and purpose, with its utilization being locally driven, people-centred and gender-responsive.

Loss and damage finance must be just, gender equitable, accessible and adequate for vulnerable communities and countries. Country ownership, inclusiveness and incorporation of gender equality considerations must be respected.

5.5.4 Mechanisms for financing loss and damage

Diverse international institutions exist inside and outside the UNFCCC's finance mechanism that could support the financing for addressing loss and damage. This includes parts of the humanitarian financing system, disaster risk reduction and management financing, development finance and climate finance (Richard and Schalatek 2017).

These sets of international institutions are already playing an important role but not all are equipped with the needed mechanisms, expertise and ability to meet the needs of the developing countries.

The loss and damage fund, the design of which is being discussed by the Transitional Committee under the UNFCCC, can be one of the principal vehicles. It could also act as a catalyst in ensuring coherence, and complementarity and can identify and realize collaboration among the existing institutions, platforms and mechanisms to better coordinate and provide necessary support to strengthen financing for loss and damage in the developing countries. The Santiago Network for Loss and Damage could provide technical support while the fund helps developing countries take concrete actions, hence working in tandem is necessary.

To better serve the communities' needs, the international mechanism must be linked with the national system and institutions. Expertise may be drawn from various organizations and experiences to support capacity-building of the subnational and national institutions. Therefore, mapping the overlaps and identifying gaps in existing domestic and international architectures form a critical next step in the mosaic of loss and damage financing.

Underwood, WA USA - July 2, 2023: Tunnel 5 Fire in Columbia River Gorge.

Photo: © Christian Roberts-Olsen / Shutterstock

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Chapter 2

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Chapter 5

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In the Dolakha region of Nepal, specially built ponds allow farmers to grow food in the dry seasons.

More information at: https://www.unep.org/news-and-stories/story/nepals-slopes-villages-brace-worsening-monsoon

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This publication is supported by the Environment Fund - UNEP's core financial fund. The Fund is used to provide scientific evidence on the state of the global environment, identify emerging environmental issues and innovative solutions, raise awareness and advocacy, bring together stakeholders to agree on action, and for building capacity of partners. Core funding gives UNEP the strength and flexibility to implement the programme of work (in support of the 2030 Agenda) as approved by its Member States, and to strategically respond to emerging challenges. UNEP is grateful to all the Member States that contribute to the Environment Fund.

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