Global progress on adaptation financing in developing countries

UN environment programme

Too Little, Too Slow

Climate adaptation failure puts world at risk

Adaptation Gap Report 2022

ISBN: 978-92-807-3982-4
Job Number: DEW/2480/NA

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Suggested citation
United Nations Environment Programme (2022). *Adaptation Gap Report 2022: Too Little, Too Slow – Climate adaptation failure puts world at risk*. Nairobi. https://www.unep.org/adaptation-gap-report-2022

Co-produced with:
UNEP Copenhagen Climate Centre and the World Adaptation Science Programme (WASP)

UN environment programme | copenhagen climate centre

WASP WORLD ADAPTATION SCIENCE PROGRAMME

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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, UNEP (cover)

THANKS ALSO TO:

UNEP: Angeline Djampou, Niklas Hagelberg, Polina Koroleva, Abdelmenam Mohamed, Jane Muriithi, Paz López-Rey, Lou Perpes, Pinya Sarasas, Nandita Surendran, Ying Wang.

Finally, UNEP would like to thank the Danish Ministry of Foreign Affairs, the Swedish International Development Cooperation Agency (SIDA), and the Belgian Federal Public Service Foreign Affairs, Foreign Trade and Development Cooperation for their support to the production of the 2022 edition of UNEP's Adaptation Gap Report.

A village in Pakistan is devastated by flooding. In 2022, much of the country was severely inundated.

Photo: © Shutterstock/Saigh Anees

Contents

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[3]).

Adaptation limits: The point at which an actor's objectives (or system needs) cannot be secured from intolerable risks through adaptive actions (IPCC 2022[1]).

- 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]).

Climate-resilient development: The process of implementing greenhouse gas mitigation and adaptation measures to support sustainable development for all (IPCC 2022[1]).

Co-benefits: A positive effect that a policy or measure aimed at one objective has on another objective, thereby increasing the total benefit to society or the environment (IPCC 2022[1]).

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]).

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 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]).

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[4] ; IPCC 2022[1]).

Trade-offs: A competition between different objectives within a decision situation, where pursuing one objective will diminish achievement of other objective(s). A trade-off exists when a policy or measure aimed at one objective (e.g. reducing greenhouse gas emissions) reduces outcomes for other objective(s) (e.g. climate resilience, biodiversity conservation, energy security) due to adverse side effects, thereby potentially reducing the net benefit to society or the environment (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 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://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-AnnexII_FINAL.pdf.

Photo: © Natalija Gormalova / Climate Visuals Countdown

Foreword

Climate change is landing blow after blow upon humanity, as we saw time and again throughout 2022: most viscerally in the catastrophic floods that put much of Pakistan under water. These are the kinds of climate impacts we are suffering at only 1.1°C above pre-industrial temperatures. We are heading for much higher temperatures: 2.8°C by the end of the century, based on current policies.

The international community must urgently reduce greenhouse gas emissions through a transformation of energy, industry, transport, food systems, financial systems and so much more. However, as the 2022 edition of UNEP's Adaptation Gap Report: Too Little, Too Slow finds, we must also urgently increase efforts to adapt to the impacts of climate change that are already here and to those that are to come.

The report finds that global efforts in adaptation planning, financing and implementation are increasing incrementally. However, they are not keeping pace with increasing climate risks. Yes, over 80 per cent of countries have at least one national adaptation planning instrument in place. But funding to turn planning into action isn't following.

International adaptation finance flows to developing countries reached USD 29 billion in 2020, an increase of 4 per cent from 2019. But up to USD 340 billion per year is needed by 2030, and far more beyond. The adaptation finance gap in developing countries is likely five to ten times greater than current international adaptation finance flows and will only widen if we do not ramp up investments. This financial shortfall is cascading down to the implementation level, which remains inadequate despite progress being made.

The message of this report is clear: strong political will is needed to increase adaptation investments and outcomes. Nations need to back the strong words in the Glasgow Climate Pact, adopted in 2021, with strong action, starting at COP27 in Sharm El-Sheikh, Egypt. We need pedal to the metal acceleration in scientific research, innovative planning, finance and implementation and deeper international cooperation.

If we don't want to spend the coming decades in emergency response mode, dealing with disaster after disaster, we need to get ahead of the game. We cannot use other global crises as excuses for inaction. Yes, the war in Ukraine, global supply shortages and the COVID-19 pandemic have

all contributed to an energy and food security crisis. Costs of living are going through the roof across the world. But the temperature ranges we are currently looking at over the decades to come – even with mitigation – will turn the climate impacts we are seeing now into knockout blows for generations to come.

We must get serious about adapting to climate change. And we must do it now.

Inger Andersen

Executive Director
United Nations Environment Programme

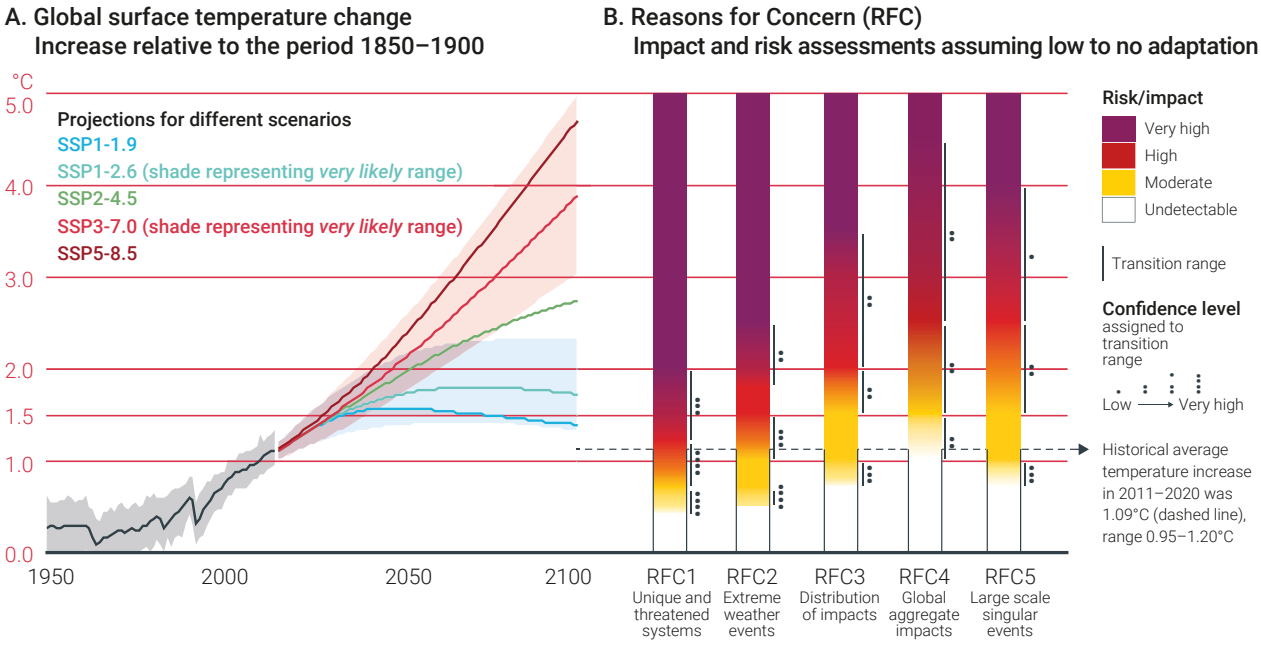
Executive summary

Climate risks are increasing as global warming accelerates. Strong mitigation and adaptation are both key to avoiding hard adaptation limits.

Climate impacts are increasing across the globe. A multi-year drought in the Horn of Africa, unprecedented flooding in South Asia, and severe summer heat and record-breaking droughts across multiple regions of the northern hemisphere, among others, point to mounting and ever-increasing climate risks. According to the recent Intergovernmental Panel on Climate Change (IPCC) Working Group II *Sixth Assessment Report* (IPCC WGII AR6), the world will face severe climate risks before the end of this century, even under low-emission scenarios (figure ES.1).

Ambitious, accelerated action to adapt to climate change is therefore paramount, together with strong mitigation efforts. However, even ambitious investment in adaptation cannot fully prevent climate change related impacts. Hence, dealing with losses and damages cannot be avoided and must be addressed adequately at the United Nations Framework Convention on Climate Change (UNFCCC) and at national levels.

Figure ES.1 Reasons for Concern as assessed in IPCC WGII AR6



Source: IPCC (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Pörtner, H.-O., Roberts, D.C. , Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A. *et al.* (eds.). Cambridge, UK and New York, NY, USA: Cambridge University Press. 3056. doi:10.1017/9781009325844.

Adaptation must not be sidelined because of large-scale, non-climate and compounding factors.

The war in Ukraine, global supply shortages and the global COVID-19 pandemic have all contributed to an evolving energy and food security crisis, with the cost of living as well as inflation surging in many countries across the world. However, unprecedented political will and many more long-term investments in adaptation are urgently needed to avoid the adaptation gap from widening. It is critical that the international climate community build on the Glasgow Climate Pact, agreed during the twenty-sixth session of the United Nations Climate Change Conference of the Parties to the UNFCCC (COP 26) in 2021, and deepen collective commitments on net-zero, adaptation, climate finance, and loss and damage.

Global efforts in adaptation planning, financing and implementation continue to make incremental progress but fail to keep pace with increasing climate risks.

This calls for groundbreaking acceleration in scientific research, innovative planning, more and better finance and implementation, increased monitoring and evaluation, and deeper international cooperation. Current processes under the United Nations climate negotiations, including the Glasgow–Sharm el-Sheikh work programme on the global goal on adaptation and the global stocktake, present an important opportunity to act upon the conclusions of this report and the IPCC WGII AR6.

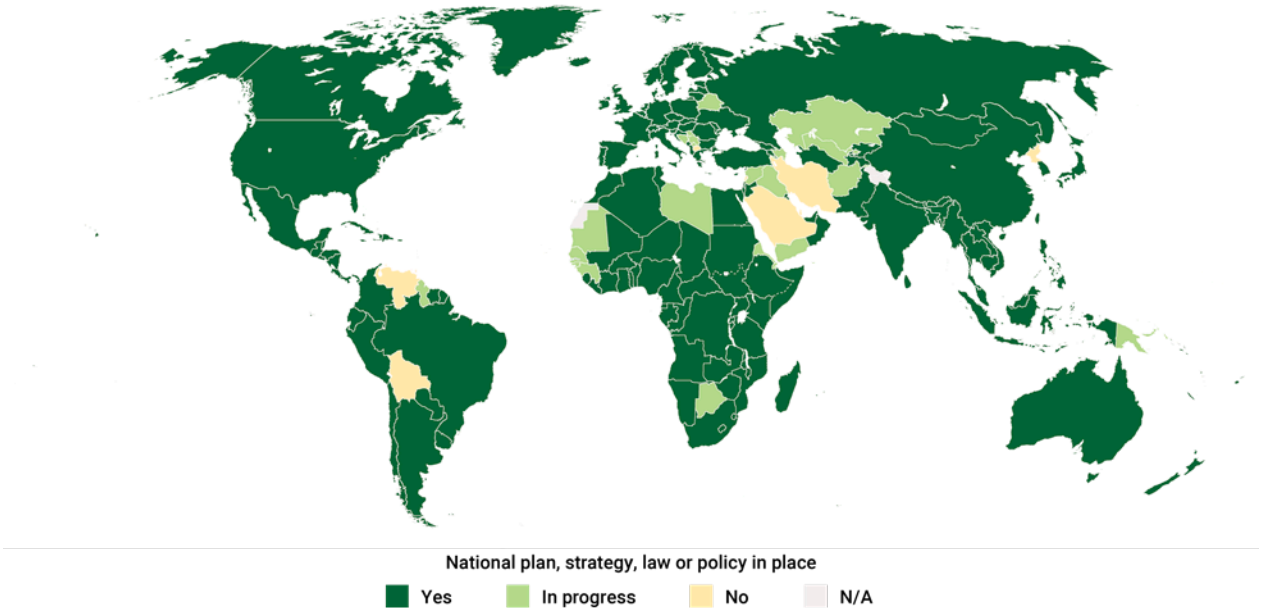
More than eight out of 10 countries now have at least one national adaptation planning instrument, and they are getting better and becoming more inclusive of disadvantaged groups.

At least 84 per cent of Parties to the UNFCCC, up 5 per cent from last year, have established adaptation plans, strategies, laws and policies, and about half of those have two or more planning instruments in place (figure ES.2). More than a third of all 198 Parties to the UNFCCC have incorporated quantified and time-bound targets, which are an increasing part of national adaptation planning. However, the majority of these targets do not capture the outcomes of adaptation action, such as the degree to which people and ecosystems are more resilient or less vulnerable to climate change. Countries are also increasing the implementability of adaptation planning instruments by defining objectives, determining time frames, considering future climate change, strengthening the science base, and improving the capacity and partnerships needed to ensure effective implementation. Moreover, nearly 90 per cent of planning instruments analysed display consideration for gender and/or historically disadvantaged groups, such as indigenous peoples.

The adaptation finance gap in developing countries is likely five to 10 times greater than current international adaptation finance flows and continues to widen.

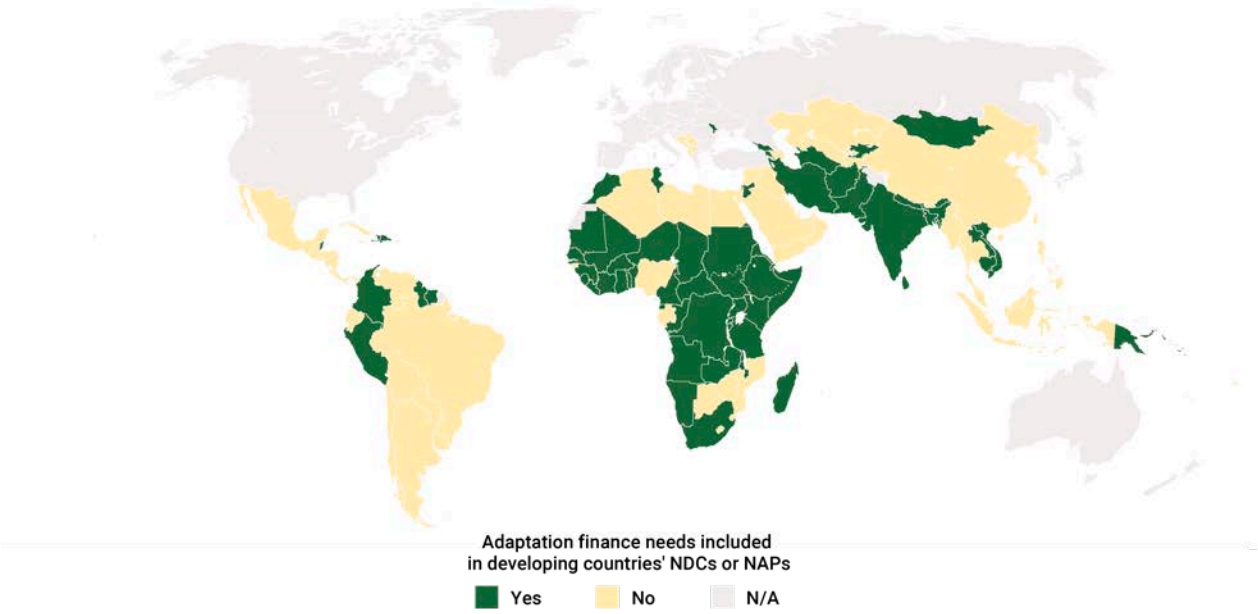
International adaptation finance to developing countries continues to rise, reaching US$28.6 billion in 2020. This represents a 34 per cent share of total climate finance to developing countries in 2020 and is a 4 per cent increase from 2019. Combined adaptation and mitigation finance flows in 2020 fell at least US$17 billion short of the US$100 billion pledged to developing countries, even by climate finance providers' own accounting. If the annual increase from 2019 persisted in the coming years, the US$100 billion target would not be met until 2025. This calls for significant acceleration in adaptation finance, especially if doubling of 2019 finance flows by 2025 is to be met, as the Glasgow Climate Pact urges.

Figure ES.2 Status of adaptation planning worldwide, as at 31 August 2022



Accounting for inflation, estimated annual adaptation costs/needs are in the range of US$160–340 billion by 2030 and US$315–565 billion by 2050. This range is in line with new findings estimating finance needs of US$71 billion per year between now and 2030 based on 76 developing countries' nationally determined contributions (NDCs) and national adaptation plans (NAPs) (figure ES.3). Based on this assessment, estimated adaptation cost/needs are currently between five and 10 times higher than international adaptation finance flows, and the adaptation finance gap continues to widen.

Figure ES.3 Information on adaptation finance needs included in developing countries' NDCs or NAPs

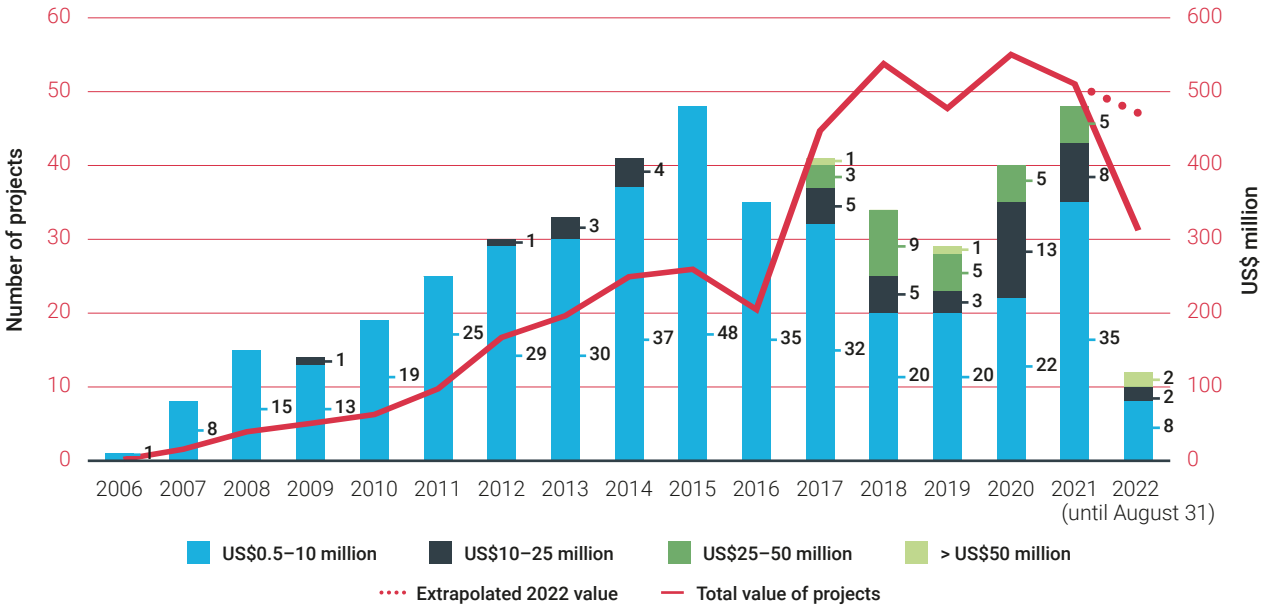


Adaptation implementation is increasing but not keeping up with climate impacts.

The number and volume of adaptation actions supported through international climate funds (Adaptation Fund [AF], Green Climate Fund [GCF], and the Global Environment Facility's [GEF] Least Developed Countries Fund [LDCF] and Special Climate Change Fund [SCCF]), multilateral finance and bilateral donor support continue to increase, though the rate may be slowing (figure ES.4). Actions are concentrated in the agriculture, water, ecosystems and cross-cutting sectors and primarily address rainfall variability, drought and flooding.

However, without a step change in financial support, adaptation actions could be outstripped by accelerating climate impacts, which would further widen the adaptation implementation gap. In addition, only three out of 10 principal adaptation actions (reflecting around 40 per cent of the funding volume) reported by climate finance providers to the Organisation for Economic Co-operation and Development (OECD) are explicitly targeting climate risk reduction, while the degree to which all other actions address adaptation is unclear. Better labelling of financial support could help clarify its contribution to adaptation.

Figure ES.4 Number of new adaptation projects per start year, size and combined annual funding value under the Adaptation Fund, Green Climate Fund and the Least Developed Countries Fund and Special Climate Change Fund of the Global Environment Facility, as at 31 August 2022



Current adaptation practice falls woefully short of what is required, but following best practices in adaptation planning and implementation can improve effectiveness.

Adaptation actions remain largely incremental in nature, typically do not address future climate change, and may reinforce existing vulnerabilities or introduce new risks, particularly for the most vulnerable. The main reasons for these shortcomings are:

- inadequate involvement of stakeholders through elite capture of resources and exclusion of marginalized groups, including women, indigenous peoples and local communities
- inadequate attention to local contexts and ownership through genuine local participation in adaptation design and implementation
- retrofitting development activities as adaptation actions without specifically addressing climate risks, often resulting in marginal resilience benefits or maladaptation
- short-term focus and neglect of future climate risks resulting in inadequate attention to the long-term viability of adaptation solutions
- narrow definitions of adaptation success that neglect diverse views regarding the purpose and effectiveness of adaptation interventions among those targeted and that miss elements encompassing social transformation and climate justice
- inadequate metrics reflecting what is easily measurable but often difficult to validate and interpret in terms of climate risk reduction.

Data to quantify adaptation effectiveness and adequacy are limited yet urgently needed, especially for higher levels of warming and complex or cascading risks. However, existing evidence shows that hybrid solutions addressing multiple dimensions of climate-related risks – for example by bringing together climate information, infrastructure, and nature-based and institutional solutions – tend to be more effective than single solutions. To be effective and adequate in the longer term, solutions must also be context-specific and address the root causes of vulnerability, such as underlying structural inequities and gendered disadvantages, in addition to reducing climate-related exposures and vulnerabilities to climate hazards.

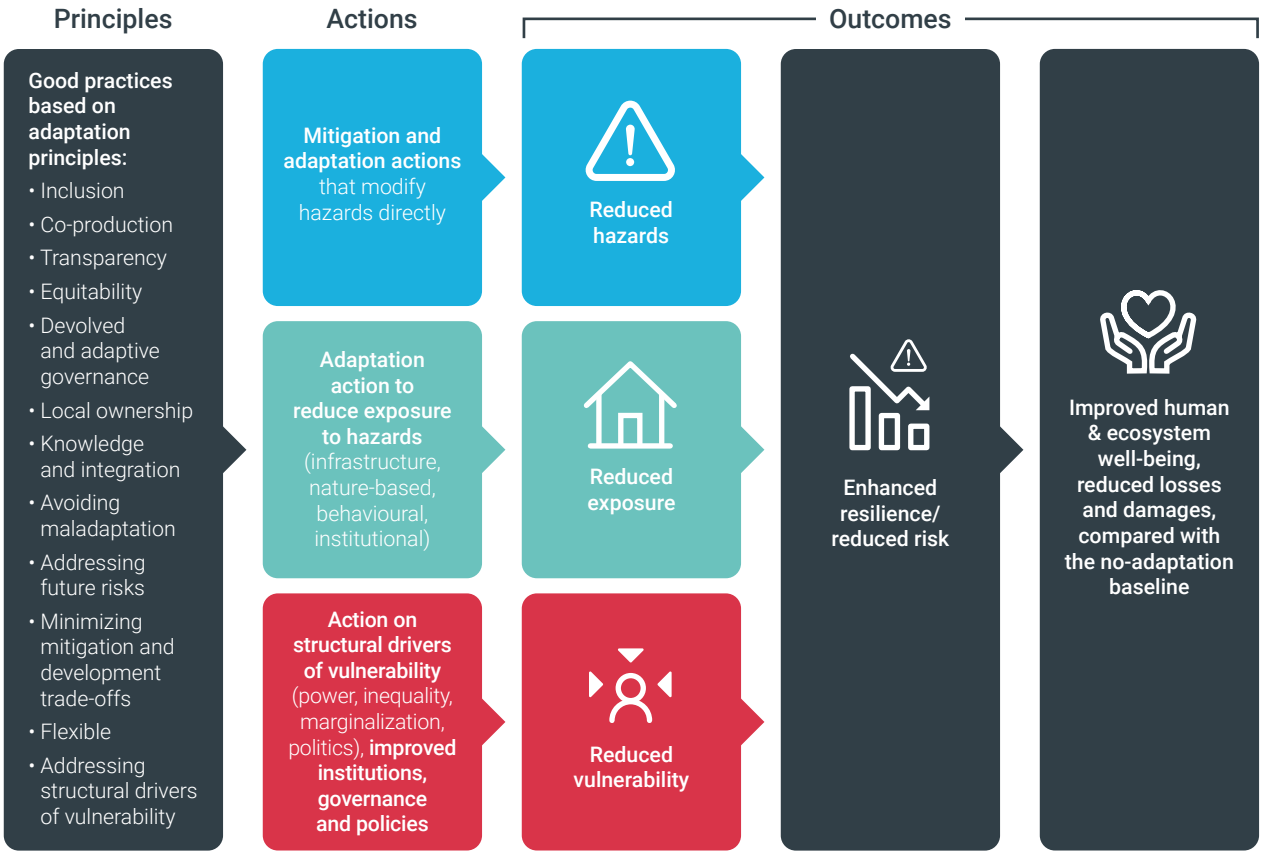
There are a number of general principles of good adaptation practice to ensure that adaptation actions are relevant, appropriate, sustainable, equitable and effective. These principles are quite consistent across the literature and can broadly be summarized as:

- genuine inclusion of stakeholders as well as local communities, indigenous peoples, women and other marginalized groups into decision-making and co-development of adaptation planning and implementation to reflect differing values, perspectives and interests and to produce equitable, fair and just adaptation outcomes
- transparency, accountability and predictability of support and integration of adaptation into national development priorities, strategies and the Sustainable Development Goals (SDGs)

- flexible programming and adaptative management of implementation to consider feedback and learnings and to enhance efficiencies
- investment in local capabilities, capacity-building and democratic governance structures in support of climate risk management and empowerment for long-term sustainability
- consideration of future risks, including climate trajectories and uncertainties, to minimize unintended consequences and maladaptation, while enhancing adaptation ambition
- integration of local, traditional, indigenous and scientific knowledge into design, implementation and monitoring and evaluation to enhance buy-in and ownership
- tackling inequalities and structural drivers of vulnerability in addition to reducing exposure and/or vulnerabilities to climate hazards to embark on climate-resilient development pathways.

Paying attention to these principles when designing, implementing and assessing adaptation interventions increases the likelihood of effective, adequate and sustained outcomes (figure ES.5).

Figure ES.5 An 'architecture' of risk reduction, including principles, actions and outcomes that can be used as a basis for assessing actual or likely adaptation effectiveness



Considering interlinkages of adaptation and mitigation action from the outset in planning, finance and implementation can enhance co-benefits.

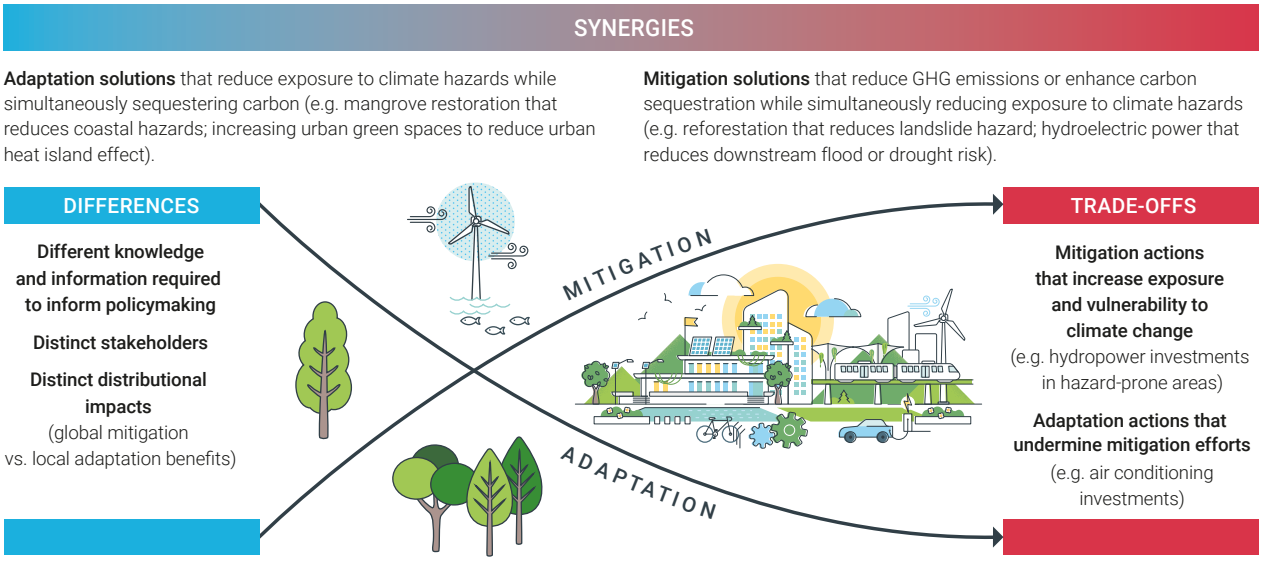
Strong mitigation action is needed to limit global warming to 1.5°C above pre-industrial levels and avoid reaching most hard adaptation limits. Enhanced adaptation support is needed to minimize climate impacts, and more losses and damages will occur if mitigation is insufficiently ambitious. Given this interrelationship and to enhance synergies while limiting trade-offs, this report devotes a section in the planning, finance and implementation chapters to adaptation–mitigation interlinkages.

Taking adaptation and mitigation jointly into account in planning, finance and implementation enhances opportunities for co-benefits, including ancillary and non-

market benefits, and limits trade-offs and maladaptation (such as hydropower reducing food security or irrigation increasing energy consumption). Moreover, some climate solutions effectively reduce climate risk and contribute to mitigation simultaneously (figure ES.6). However, while nature-based solutions such as planting and conserving mangroves, restoring salt marshes or protecting peatlands effectively reduce climate risks and remove carbon from the atmosphere, accelerating climate change is also heavily affecting their ability to provide these climate services.

Data from planning, finance and implementation show that adaptation–mitigation co-benefits are mainly sought in the agriculture, forestry, ecosystems, water and energy sectors. However, possible barriers, trade-offs and risks are frequently missed, and adaptation and mitigation actions are often implemented independent of each other. Addressing these shortcomings will be important to contribute to the Paris Agreement's article 2.1(c) goal of making finance flows consistent with low greenhouse gas (GHG) emissions and climate-resilient development.

Figure ES.6 Aligning climate change mitigation and adaptation action: differences, synergies and trade-offs



Source: Adapted from OECD (2021a). Strengthening adaptation-mitigation linkages for a low-carbon, climate-resilient future. OECD Environment Policy Papers, No. 23. Paris: OECD Publishing. https://doi.org/10.1787/6d79ff6a-en.

In summary, despite positive signs we must do much more towards net-zero climate-resilient development.

- Accelerating global warming is increasing climate impacts and puts countries at serious risk of experiencing adaptation limits and intolerable losses and damages.
- Avoiding hard adaptation limits requires the urgent scaling-up of mitigation and for adaptation to go beyond incremental change.
- Although efforts in adaptation planning, finance and implementation are continuing to increase, significant acceleration and shifts in scale are needed to avoid the adaptation gaps from widening further.
- Current adaptation practice falls woefully short of what is required, and following best practices in adaptation planning and implementation is needed to improve effectiveness.
- Despite the potential for substantial co-benefits to be realized when considering adaptation-mitigation interlinkages from the outset, more must be done to overcome silos and avoid potential trade-offs.
- Large-scale, non-climate and compounding factors continue to jeopardize adaptation investments and outcomes, and strong political will is needed for the international climate community to build on the Glasgow Climate Pact, agreed during COP 26 in 2021, and to deepen collective commitments on net-zero, adaptation, climate finance, and loss and damage.

1

Chapter 1

Setting the scene

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Part of the Margerie Glacier, Alaska breaks off into the sea.

Photo: © Kimberly Vardeman

Key messages

- According to the latest Intergovernmental Panel on Climate Change (IPCC) assessments, the world will face severe climate risks before the end of this century even under low-emission scenarios. This necessitates ambitious, accelerated action to adapt to climate change.
- Climate risks are increasing as global warming accelerates, and strong mitigation and adaptation are both key to avoiding hard adaptation limits.
- Even effective adaptation options cannot fully prevent all climate-related losses and damages. Comprehensive responses mixing ambitious adaptation and ambitious mitigation are therefore essential to avoid adaptation limits and minimize losses and damages.
- Adaptation must take centre stage in the United Nations Framework Convention on Climate Change (UNFCCC) negotiations to make progress on pledges made during the twenty-sixth session of the United Nations Climate Change Conference of the Parties to the UNFCCC (COP 26) in Glasgow, in particular on financial means of adaptation implementation, the global goal on adaptation, the global stocktake and exploring loss and damage. This priority must not be sidelined because of large-scale, non-climate and compounding factors, such as the war in Ukraine and evolving energy and food security issues.

1.1 The climate policy context of the Adaptation Gap Report 2022

The world is experiencing an unprecedented climate crisis that threatens to result in catastrophic outcomes at local to global scales, affecting key dimensions of human life and hindering the provision of global public goods, including peace and security, food security, health, sustainable energy supply and economic stability (IPCC 2022). This increases the fragility of the most vulnerable communities and limits their ability to adapt in a context of insufficient mitigation action (UNEP 2021a; IPCC 2022).

In light of the growing recognition of the magnitude of the threat to our society, adaptation has gained increasing prominence as a global challenge with local, subnational, national, regional and global dimensions (article 7.2 of the Paris Agreement). It is now a core topic on domestic and international political agendas and is recognized as being of equal importance to climate change mitigation (Khan and Munira 2021).

In the context of the UNFCCC process, the Glasgow Climate Pact for instance, which was adopted at COP 26 in 2021, stresses the urgency of enhancing ambition of action and finance in terms of both mitigation and adaptation to address the gaps in implementing the long-term global goals. Hence, the outcomes of COP 26 include the delayed launch of the two-year Glasgow–Sharm el-Sheikh work programme on the global goal on adaptation; the urgent call for developed countries to collectively at least double adaptation finance compared with 2019 levels by 2025; the establishment of the Santiago Network and the Glasgow Dialogue to address loss and damage; and the recognition of advances in the submission of adaptation communications (46 by August 2022) and national adaptation plans (NAPs) (UNFCCC 2022) as central instruments to communicate progress in adaptation actions and pledges towards the first global stocktake.

The global stocktake will take centre stage in 2023, providing an overview of what has been achieved in terms of adaptation action and support, and coinciding with the completion of the work programme on the global goal on adaptation. To that end, assessing, measuring and tracking progress on adaptation – at all levels – is of paramount importance but is underdeveloped (Schipper and Langston 2015; Berrang-Ford *et al.* 2017; UNEP 2017; Brooks *et al.* 2019; Magnan *et al.* 2021a). One of the critical challenges is for each country to build an understanding of adaptation that makes use of the national communication and other reporting instruments to improve visibility of different efforts and actions (Beauchamp and Bueno 2021). Providing such national narratives is considered essential to allow for the global stocktake to contextualize current interventions and plans and to review the adequacy and effectiveness of adaptation action and support towards achieving the global goal on adaptation.

The global stocktake also entails assessing progress in averting, minimizing and addressing loss and damage, at both the institutional and financial levels, including economic and non-economic losses. To inform its progress, and in light of the severity and magnitude of the extreme events

that have taken place recently and are having a significant impact on vulnerable developing countries, attention is focused on the outcomes of COP 27 which will take place in Egypt.

Beyond the policy context of the UNFCCC, large-scale non-climate and compounding factors are likely to jeopardize investments in adaptation in the short to medium term. The war in Ukraine, for example, is putting global energy and food security under pressure and could result in reduced adaptation support. Besides a decrease in resilience among populations affected by energy and food shortages, in particular among poor people and the most vulnerable populations, such large-scale non-climate compounding factors could also constrain the ability to respond to other climate hazards because finite resources are directed elsewhere.

On the other hand, the COVID-19 pandemic, which disrupted adaptation planning and disaster risk reduction financing (UNEP 2021b), highlighted to governments the importance of addressing compound risks through integrated risk management approaches. Hence, lessons from the war in Ukraine could be to quickly minimize the dependence on fossil fuels through investments in renewable energy and to diversify staple crops through climate-adapted species and varieties to limit dependence on a small number of breadbasket regions and crops.

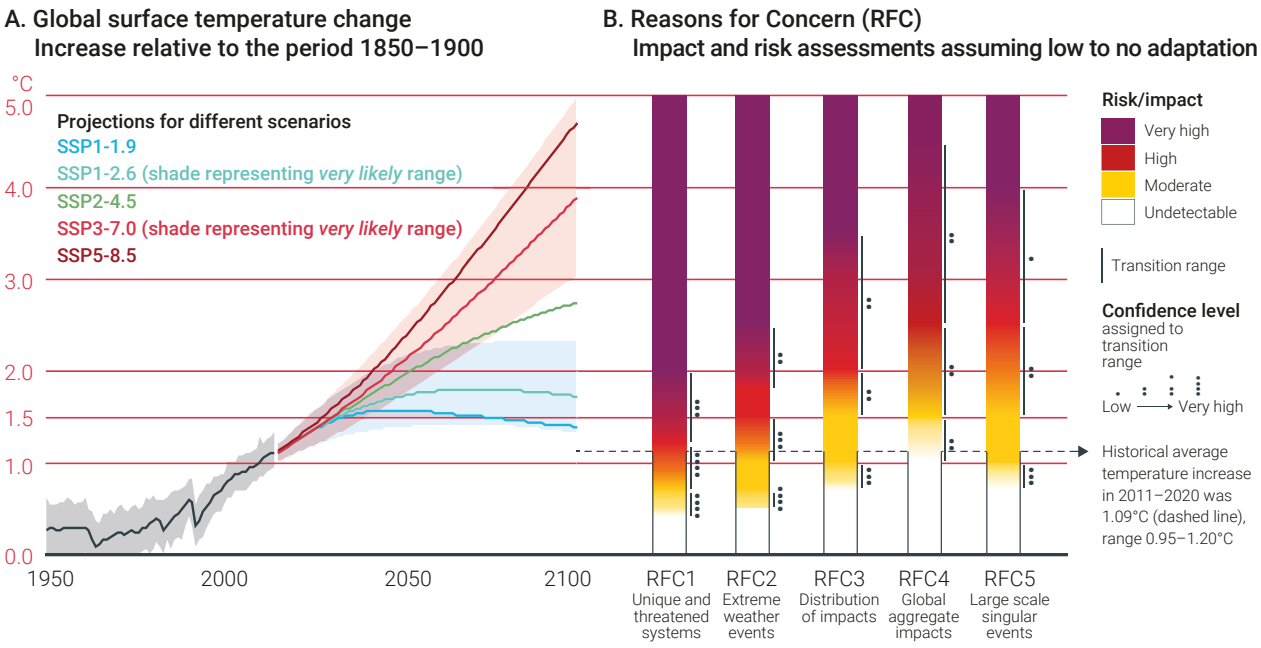
1.2 Status of global climate risk

Understanding the extent of current and future climate risks on ecosystems, their services and societies is critical in order to contextualize knowledge on societal adaptation efforts. The IPCC Working Group II *Sixth Assessment Report* (IPCC WGII AR6) released this year provides a comprehensive assessment of climate risk levels for various regions and sectors, and against contrasting warming scenarios ranging from +1.5°C to +4°C before pre-industrial levels, considering that we are already at +1.1°C (IPCC 2022).

The IPCC WGII AR6 uses 'Reasons for Concern' (RFCs) to illustrate five types of aggregated, cross-system and global-scale climate risks associated with:

- unique and threatened systems
- extreme weather events
- distribution of impacts
- global aggregate impacts
- and large-scale singular events

Figure 1.1 Reasons for Concern as assessed in IPCC WGII AR6



Note: The figure shows the change in the levels of impacts and risks assessed for global warming of 0°C–5°C global surface temperature change relative to the pre-industrial period (1850–1900) over the range.

Source: IPCC (2022)

Compared to the conclusions of the previous IPCC assessment report published in 2014, risk levels transition from high to very high in all RFCs (only two RFCs were regarded as very high in 2014) and at lower global warming levels (figure 1.1) (IPCC 2014, IPCC 2022, O'Neill, van Aalst and Ibrahim 2022). This finding aligns with recent estimates aggregating the risk assessments developed in the 2018 and 2019 IPCC Special Reports (IPCC 2018; IPCC 2019a; IPCC 2019b), and stating that by 2100, the global climate risk will increase by two- to fourfold under global warming of 2°C and 4°C respectively (Magnan *et al.* 2021b).

Lastly, science shows that every additional increment of warming makes a difference, and exceeding 1.5°C could trigger multiple tipping points that would fundamentally alter the Earth's climate (McKay *et al.* 2022). To strengthen the evidence of basic hydrometeorological information in support of climate impacts, particularly in small island developing states (SIDS) and least developed countries (LDCs), the World Meteorological Organization (WMO), the United Nations Development Programme (UNDP) and UNEP are investing in the Systematic Observations Financing Facility (SOFF) to overcome existing capacity gaps and rapidly implement the Global Basic Observing Network (see box 1.1).

The IPCC WGII AR6 also assessed eight representative key risks[1] to describe "severe climate risks" and thereby illustrate "dangerous interference with the climate system" that the UNFCCC refers to in its founding document. The findings show that some large ecosystems, such as biodiversity hotspots, regions with food and water insecurity (e.g. most of sub-Saharan Africa), warm water coral reefs, and arctic environments are already experiencing extreme and sometimes irreversible climate impacts. The IPCC WGII AR6 also warns that widespread and substantial climate risks will affect a growing number of systems over this century, including large and medium-sized urban systems in both hemispheres (Dodman *et al.* 2022; IPCC 2022). Such risks are sometimes anticipated to occur well before the end of this century and even under a low-emission scenario aligning with the +1.5°C/+2°C temperature goals of the Paris Agreement.

The assessment of adaptation efforts by the IPCC WGII AR6 also provides evidence that adaptation is taking place in all regions and sectors (Berrang-Ford *et al.* 2021; IPCC 2022) and predominantly addresses water-, food- and poverty-related issues. The vast majority of these responses are taking place at the local level (e.g. individuals, households and local governments). Beyond that, the scientific community raises seven main concerns (IPCC 2022; Magnan, Anisimov and Duvat 2022):

1. The trends in observed impacts and projected risks, as well as the gradual reaching of adaptation limits, call for global mitigation and adaptation to be more strongly coupled. This is captured by the term 'climate-resilient development' used in the IPCC WGII AR6 which describes a comprehensive climate response that builds on both synergies and trade-offs between mitigation and adaptation, in order to advance sustainable development under a changing climate. Climate-resilient development requires putting people and ecosystems at the centre, while recognizing the unequal challenges posed by climate impacts and risks, especially in developing countries.

2. From a global perspective, current adaptation efforts are largely anticipated to remain incremental, meaning that they do not sufficiently challenge the root causes of exposure and vulnerability (IPCC 2022).

3. There is agreement among the scientific community that the range of options for adaptation is shrinking with increasing warming (Haasnoot, Lawrence and Magnan 2021; IPCC 2022). As such, the still very high global trajectory of greenhouse gas (GHG) emissions will increasingly challenge the ability of societies to adapt in the near future.

4. The scientific literature still provides little evidence of effective risk reduction resulting from implemented action (Berrang-Ford *et al.* 2021). It therefore remains challenging to understand whether what is implemented today will lead to long-term benefits in terms of climate risk reduction. Similar concerns have been raised in previous Adaptation Gap Reports (AGRs) (e.g. UNEP 2021b) and motivated the inclusion of a chapter dedicated to effectiveness in this edition (chapter 5). As a result, the risk of maladaptation from current adaptation efforts should not be underestimated (UNEP 2019; IPCC 2022).

5. Risk assessments emphasize that even ambitious adaptation cannot fully prevent climate-change-related impacts, even at low levels of warming for some high-risk regions (IPCC 2018; O'Neill, van Aalst and Ibrahim 2022; IPCC 2022). This means that residual risks – i.e. risks that remain despite adaptation – and adaptation limits are expected to become closer and more fixed with climate change (Organisation for Economic Co-operation and Development [OECD] 2021). In that respect, the IPCC WGII AR6 extensively discusses losses and damages to refer to the irreversible impacts caused by anthropogenic climate change, highlighting progress made in attribution science since the IPCC's

1 Risks to low-lying coastal systems; terrestrial and marine ecosystems; critical infrastructure and networks; living standards; human health; food security; water security; and peace and mobility (O'Neill, van Aalst and Ibrahim 2022).

Fifth Assessment Report (AR5), and deliberately distinguishing it from the term 'Loss and Damage' in the Paris Agreement (article 8) and UNFCCC negotiations (Anisimov *et al.* 2022; Boyd *et al.* 2022).

6. Risk will not play out on an individual basis: climate impacts cascade across interconnected systems in the form of domino effects; compounding risks are increasingly observed as a result of cumulative interactions between several risks and/or risk drivers; and transboundary risks are emerging across sectors, jurisdictions and population groups and both within and across national borders. These elements will substantially influence the magnitude, duration, rate of emergence and spatial spreading of severe climate risks (O'Neill, van Aalst and Ibrahim 2022).

7. The IPCC recognizes the clear evidence on the role climate change plays in exacerbating inequity (in terms of gender, socioeconomics, loss of traditional knowledge and culture, stigma of colonialism, and so forth) through impacts to resources and livelihoods and, in turn, the role of increasing inequity in exacerbating climate risks (IPCC 2022). As a result, the IPCC states with high confidence that equity and justice are core pillars of the adaptation challenge, together with more specific decisions and actions to reduce climate risks (e.g. coastal protection, crop diversification).

Box 1.1 Financing for implementation of the Paris Agreement adaptation goal on systematic observations: the Systematic Observations Financing Facility

All weather, climate and water services, including early warning systems, are based on the use of basic hydrometeorological data from around the globe. Systematic observation data generation and exchange are part of the elements that underpin the effectiveness of adaptation. So far, the assumption has been that national governments bear the sole responsibility for acquiring and sharing such data, even though the data contribute to the provision of a global public good. Indeed, global data are needed for any weather and climate prediction horizon beyond 24–36 hours.

Currently, less than 10 per cent of required basic weather and climate data are available from LDCs and SIDS. For this reason, WMO, UNDP and UNEP established the SOFF as a United Nations multi-partner trust fund at COP 26. SOFF leverages the expertise of multiple partners to address the perennial problem of missing data. It provides long-term, systematic, technical and financial support to the countries with the largest capacity gaps, with a focus on LDCs and SIDS.

The UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA) at COP 26 in Glasgow encouraged Parties and relevant organizations to support SOFF to enhance and sustain the implementation of the Global Basic Observing Network in developing countries, including SIDS and LDCs. SOFF investments underpin the effectiveness and sustainability of other climate funds and act as a multiplier of climate finance. For every US$1 invested in SOFF, US$25 in socioeconomic benefits can be realized.

For more information on the SOFF, please see: https://alliancehydromet.org/soff/.

1.3 Framing of the Adaptation Gap Report 2022

Since 2020, the AGR has delivered regular assessments of adaptation efforts globally (box 1.2) in order to help answer three linked questions:

1. What has been done to adapt until today?

2. To what extent have climate risks been reduced?

3. Depending on the temperature trajectory, which is a function of mitigation action, are current adaptation efforts likely to reduce future climate risks?

The AGR2022 builds on national-level data from governments (for example, documents submitted under the UNFCCC), as well as project-level information from the databases of multilateral organizations and the OECD, and peer-reviewed scientific literature focusing on climate impacts and adaptation occurring at various scales (global to local).

Box 1.2 The role of the 'new look' Adaptation Gap Report

The AGR series was commissioned in 2014, in response to a request from UNFCCC Parties for a global assessment of adaptation that could support UNFCCC discussions on adaptation ahead of COP 21 in Paris. In the 2014 to 2018 editions of the AGR, the report series focused on either advancing knowledge on how to assess the 'adaptation gap' at the global level or providing in-depth assessments of the adaptation gap in certain sectors.[2]

From 2020 onwards however, the format of the report was altered in order to provide negotiators of Parties to the UNFCCC, the broader UNFCCC constituency and civil society with regular and robust assessments of global adaptation efforts and their effectiveness. Given its focus, the objectives of the 'new look' AGR are closely aligned with that of the UNFCCC's global stocktake. While this is the case, the AGR nevertheless remains an independent assessment that employs a distinct framework for assessing global adaptation efforts and is thus well positioned to provide valuable input to the global stocktake.

2 The foci of the AGRs between 2014 and 2018 were: 2014 – defining the adaptation gap and developing a preliminary framework for assessing it; 2016 – assessing the adaptation finance gap; 2017 – discussing approaches and challenges to assessing global progress on adaptation; 2018 – assessing the adaptation gap in the health sector. All the AGRs are available at https://www.unep.org/resources/adaptation-gap-report.

The three aforementioned questions (see chapter 6) raise important methodological issues and data challenges that the AGR attempts to address by:

- Focusing on national-level efforts and international cooperation, using information from policy documents, international agencies and donors.
- Focusing on three core dimensions of assessing adaptation progress at the global level: planning (chapter 2), finance (chapter 3) and implementation (chapter 4).
- Assessing adaptation outputs (i.e. processes, products and services) and outcomes (i.e. the effects of adaptation on risk reduction) in both quantitative and qualitative terms. Examples of output metrics used in this report are: the number of plans, the amount of financing committed, the type and scale of implementation activities and, from a more qualitative aspect, how actionable plans are and how they address climate risks, and the types and targets of action. The AGR2022 recognizes that assessing outcomes is substantially harder than tracking outputs, for example because of a gap in understanding the effects of adaptation on current climate risk levels (UNEP 2021b), as well as the value judgements associated with assessing the results of actions (UNEP 2017).
- Synthesizing knowledge on a specific topic such as nature-based solutions in the 2020 edition of the AGR (UNEP 2021c) and, in this year's report, on the effectiveness of adaptation (chapter 5). The AGR2022 understands effectiveness in adaptation as actions that reduce climate risks, building on the IPCC's climate risk framework (IPCC 2022), by reducing exposure and/or vulnerability (in the sense of sensitivity) to climate hazards. While such an approach does not necessarily capture well the wide range of enabling conditions and structural changes needed to achieve net-zero climate-resilient development,[3] it allows the report to focus on what is genuinely climate-related.

Lastly, as a new feature, this report includes an analysis of the interlinkages that exist between adaptation and mitigation. Adaptation–mitigation interlinkages are discussed across the planning, finance and implementation chapters and synthesized in chapter 6. The cross-chapter analysis focuses on the direct synergies and trade-offs that exist between adaptation and mitigation as they apply to adaptation planning, financing and implementation. The analysis included in this report highlights opportunities to reflect on

3 The need for development to be consistent with low-emission pathways is already a component of the IPCC's definition of climate-resilient development, which defines the term as "the process of implementing greenhouse gas mitigation and adaptation measures to support sustainable development for all" (IPCC 2022). To cater for those not familiar with the IPCC definition however, the AGR uses the term 'net-zero climate-resilient development' to emphasize that low emissions is a core component of achieving climate-resilient development.

synergies and trade-offs between climate risk reduction, GHG emissions reduction and sustainable development and, in this way, support the design of net-zero climate-resilient development strategies.[4] Table 1.1 provides an overview of the three broad types of adaptation–mitigation interlinkages that have been analysed in this year's AGR.

Table 1.1 Types of adaptation–mitigation interlinkages analysed in the AGR2022

Adaptation–mitigation interlinkages	Description
Future-proof adaptation and mitigation planning	As the magnitude of climate impacts is inherently linked to the extent to which climate change is mitigated, it is important that both adaptation and mitigation measures are compatible with a full range of possible future climate trajectories. The need to consider future temperature and precipitation regimes is most obvious for adaptation, where the failure to consider future climate trajectories will result in the effectiveness of adaptation measures degrading over time as the scale of climate impacts begins to exceed the parameters in which these measures can reduce climate risk effectively. In extreme situations, this may lead to adaptation measures becoming redundant or leading to maladaptive outcomes (e.g. the ability of coral reefs to reduce wave impacts will largely disappear above 2°C global warming). Similar risks apply with regards to mitigation, whereby failure to consider future climate changes in planning processes will increase the likelihood that mitigation investments will fail due to climate impacts undermining their ability to operate (e.g. investments in hydroelectric power generation could be undermined by decreases in water availability).
Adaptation and mitigation co-benefits	In addition to delivering benefits associated with their primary objective, adaptation and mitigation measures can – in some cases – deliver additional benefits that contribute to the other policy goal (e.g. mitigation measures can contribute to adaptation goals by reducing climate risk and vice versa). Adaptation and mitigation co-benefits can be promoted in adaptation and mitigation planning processes by integrating the ability of measures to either reduce GHG emissions or reduce climate risk (as relevant) into the broader criteria against which measures are selected or prioritized.
Trade-offs between adaptation and mitigation	Trade-offs between adaptation and mitigation refer to scenarios in which measures aimed at achieving one policy goal undermine efforts to achieve the other. Trade-offs can manifest themselves in two main ways: First, in some cases the limited availability of resources means that countries are often unable to pursue all the options that they consider to be a priority. Thus, countries may be required to choose between allocating resources towards achieving their adaptation goals at the expense of their mitigation goals or vice versa (Klein *et al.* 2007). Second, in some cases adaptation or mitigation measures will have negative implications for achieving goals in the other policy area. For example, adaptation to increased temperatures through cooling technologies can lead to increases in GHG emissions. Likewise, tree species optimal for carbon sequestration may not be well adapted to future climate conditions, thus leading to losses in the ecosystem's overall resilience to climate change (Frey and Gasbarro 2019). While trade-offs between adaptation and mitigation typically receive less attention than co-benefits, they must be considered if countries are to avoid unintended negative consequences from their adaptation and mitigation efforts (e.g. maladaptation) and are to maximize the effectiveness of resources used across adaptation and mitigation investments.

4 The analysis in this report is primarily limited to focusing on the interlinkages between adaptation and mitigation. When striving to achieve net-zero climate-resilient development however, policymakers will also need to consider how adaptation and mitigation measures will interact with development trajectories and objectives. Failure to do so will increase the likelihood that measures will fail to deliver development co-benefits (or worse, have negative consequences on development) or decrease their effectiveness in achieving their mitigation and adaptation objectives due to unexpected changes in development trajectories.

2

Chapter 2

Global progress on adaptation planning

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Photo: © UNEP / Duncan Moore

Key messages

- Countries are continuing to establish national adaptation planning instruments, including plans, strategies, laws and policies. At least 84 per cent of countries now have at least one adaptation planning instrument in place, up from 79 per cent in 2021.[1] As the world moves towards complete coverage by national adaptation planning instruments, a rapid shift towards financing and implementation will become even more vital.

- Quantified and time-bound adaptation targets are a growing part of national adaptation planning; at least one third of countries have incorporated quantified targets into their adaptation planning. However, the majority of these targets do not yet capture the outcomes of adaptation action, such as the degree to which people and ecosystems are more resilient or less vulnerable to climate change.

- Countries are systematically adhering to good practices that strengthen the implementability of their adaptation planning instruments. These include defining clear visions, goals and objectives to guide actions and to serve as the basis for assessing achievement of outcomes; clearly articulating trends in climate changes to strengthen the climate science basis of adaptation interventions; clearly prioritizing adaptation actions with indicative time frames; and building capacity and the partnerships needed to ensure effective implementation.

- A range of adaptation–mitigation interlinkages are highlighted in national adaptation planning instruments and related documents. These interlinkages are commonly identified in the agriculture, forestry, water and energy sectors, with particular focus on the potential to realize adaptation and mitigation co-benefits in these sectors. While co-benefits are an important type of interlinkage, it is important that countries also consider trade-offs.

- Data suggest that adaptation laws and policies are increasingly considering the needs of women and other historically disadvantaged groups, such as persons with disabilities, indigenous peoples and migrants. Almost 90 per cent of adaptation laws and policies studied contained reference to at least one disadvantaged group.

2.1 Introduction

This chapter seeks to offer insights into the current status of national adaptation planning worldwide and how countries are integrating key elements of adequate and effective adaptation planning. It builds on the previous editions of this chapter contained within the 2020 and 2021 editions of the Adaptation Gap Report (AGR). In the 2020 edition of the AGR, the chapter provided a snapshot of the number of countries that have at least one national adaptation planning instrument (e.g. a national adaptation plan [NAP], strategy, law or policy) in place, and the extent to which these adaptation planning instruments are likely to be adequate and effective. To assess the potential adequacy and effectiveness of these planning instruments, the chapter examined five proxy criteria (comprehensiveness, inclusiveness, implementability, integration and monitoring and evaluation [M&E]). The 2021 report updated this analysis, offering an up-to-date picture of where countries stand on adaptation planning, demonstrating progress made since the 2020 assessment.

Instead of updating the analysis conducted in 2020 and 2021, this year's chapter seeks to provide deeper analysis on specific dimensions of adequate and effective national adaptation planning. To do this, the chapter focuses on analysing the inclusiveness and implementability of national adaptation planning instruments. These two

1 The analysis presented in this chapter looks at national planning instruments created by country Parties to the UNFCCC. Thus, percentage values provided in this chapter that relate to countries are percentages of the 197 country Parties to the UNFCCC (this excludes the European Union, which is not a country Party). 193 of the country Parties to the UNFCCC are also Parties to the Paris Agreement.

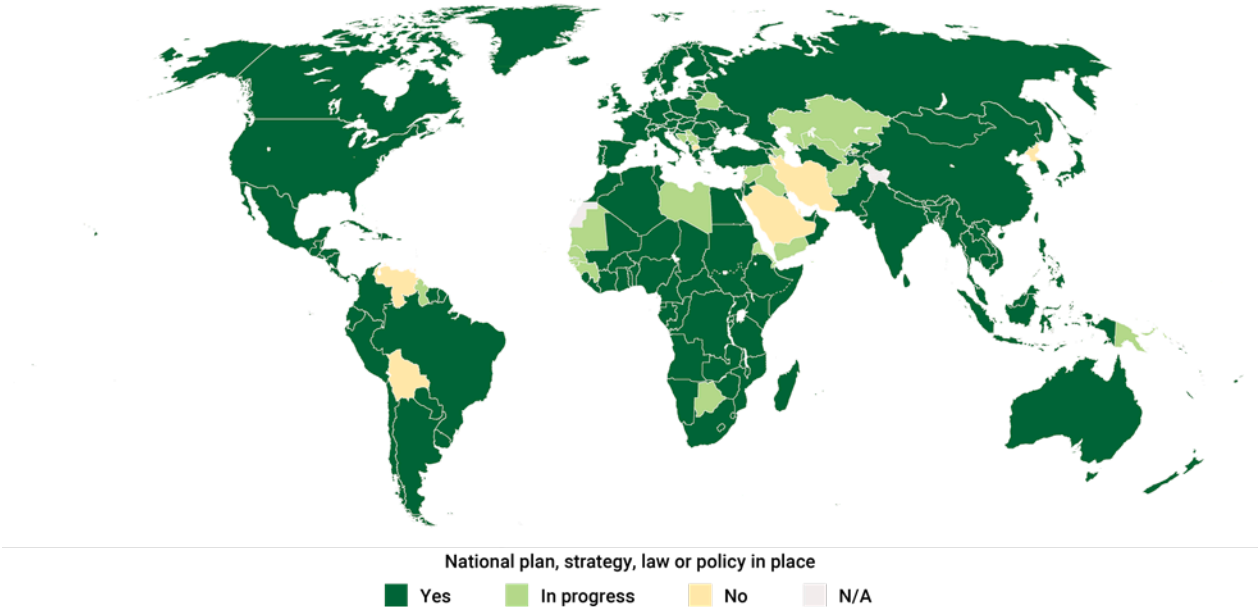
dimensions were not selected because they are more important than the other three, but rather as a response to recent developments in the realm of adaptation. Inclusive planning and governance, for example, was highlighted by the recent Intergovernmental Panel on Climate Change Working Group II *Sixth Assessment Report* (IPCC WGII AR6) as important in avoiding maladaptation and leading to more effective and sustainable adaptation outcomes (IPCC 2022). Implementation, meanwhile, has been emphasized as the core focus area by the incoming presidency of the twenty-seventh session of the United Nations Climate Change Conference of the Parties to the UNFCCC (COP 27), which is taking place under the slogan of "together for implementation." Better understanding the implementability of NAPs can thus help inform this shift towards paying greater attention to the implementation of climate action.

2.2 Progress in national adaptation planning worldwide

2.2.1 Status of national adaptation planning

Countries around the world have continued to add new plans, strategies, laws and policies to their portfolios of adaptation instruments (see figure 2.1). In 2022, 84 per cent of countries have at least one adaptation planning instrument in place, a total of five percentage points higher compared with 2021 (United Nations Environment Programme [UNEP] 2021a). At least 32 countries added new national adaptation planning instruments in this period. For eight of these countries, this represented their first such instrument (see figure 2.2). Annex 2.A (online) provides an overview of the data sources used in this assessment and the assessment presented in section 2.2.2.

Figure 2.1 Status of adaptation planning worldwide, as at 31 August 2022



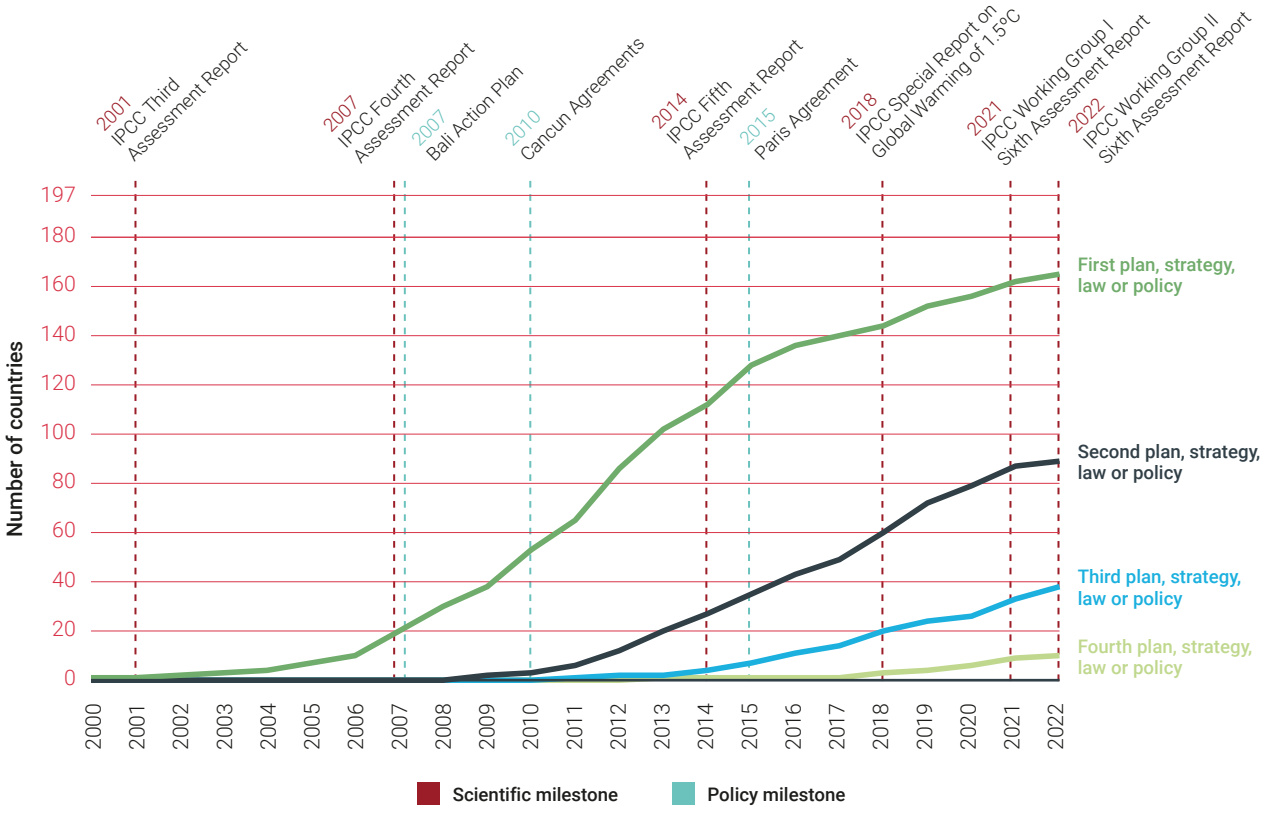
Note: Figure 2.1 was also informed by the UNFCCC Least Developed Countries Expert Group (LEG) report (2012) on NAPs.

2.2.2 Quantified targets

As at 31 August 2022, over one third of countries have incorporated quantified adaptation targets in their adaptation communications ('adcoms'), nationally determined contributions (NDCs), or NAPs submitted to the UNFCCC alone. This represents an increase since 2018, at which point around a quarter of countries had defined quantified adaptation targets (UNEP 2018). The presence of such targets may suggest a trend towards "outcome-oriented and measurable adaptation planning" (UNEP 2021a).

The majority of these targets are based on process-related outputs that lend themselves to quantification and measurement. For example, these include targets related to actions such as planting trees, developing adaptation plans at various levels of governance or increasing the amount of designated marine or coastal protected areas. By contrast, only a few are based on the intended outcomes of adaptation measures. For example, achieving a 10 per cent reduction in the number of cases of human vector-borne diseases associated with climate change (decadal average) by 2030. Table 2.B.1, Annex 2.B (online) showcases a range of examples of quantified targets from different sectors.

Figure 2.2 Progress in global adaptation planning since 2000



In order for such targets to be measured and in turn facilitate increasingly more effective adaptation action over time, it is important that countries clearly articulate and establish mechanisms for their assessment. However, in the documents in which these targets are outlined, the arrangements for such assessments are often unclear. This may lead to challenges, in particular where quantified targets are centred on abstract concepts (such as vulnerability, resilience and adaptive capacity) that pose significant methodological challenges when it comes to measurement (UNFCCC Adaptation Committee 2021).

A number of countries have anchored targets expressed in their NDCs in national laws and policies. For example, the forest coverage target expressed in Kenya's NDC is reaffirmed in the country's 2018–2022 National Climate Change Action Plan (Kenya 2018; Kenya 2020).

Targets expressed in national laws and policies may take on legal force, be attached to budgets and be subject to M&E and interministerial or inter-agency coordination. It is therefore critical that countries take measures to integrate targets from NDCs into their national legal and policy frameworks.

2.3 Assessment of adequacy and effectiveness of adaptation planning

Of the five criteria of adequacy and effectiveness of adaptation planning defined previously (UNEP 2021a; UNEP 2021b), this chapter focuses on two: inclusiveness and implementability. The purpose of focusing on only two is to enable deeper and more nuanced analysis compared with the broader but more surface-level analyses conducted in previous years.

2.3.1 Inclusiveness

When analysing the inclusiveness of national adaptation planning, the 2021 edition of the AGR found that 70 per cent of countries developed their adaptation plans through stakeholder consultations, while 73 per cent noted the importance of integrating gender considerations into adaptation planning. This section expands on this analysis by examining national laws and policies to assess whether the following disadvantaged groups are being considered in planning processes:

- Persons with disabilities
- Children, young people and future generations

- Gender[2]
- Indigenous peoples
- Migrants
- Local communities

These are groups whose participation in these processes is often overlooked and whose rights the preamble to the Paris Agreement recognizes as requiring particular consideration in the formulation of climate change policies. Therefore, an appraisal of the degree to which they are included in adaptation planning, while not to be taken as an indication of whether policies are specifically being targeted towards meeting the needs of these groups, provides a proxy indicator of how inclusive the resulting plans are.

To conduct this assessment, keyword lists were created for each of the above groups, and instances of each keyword were identified across the full texts of 563 English-language national law and policy documents that relate directly to climate change adaptation. Annex 2.C (online) provides further information about the methodology underlying this assessment.

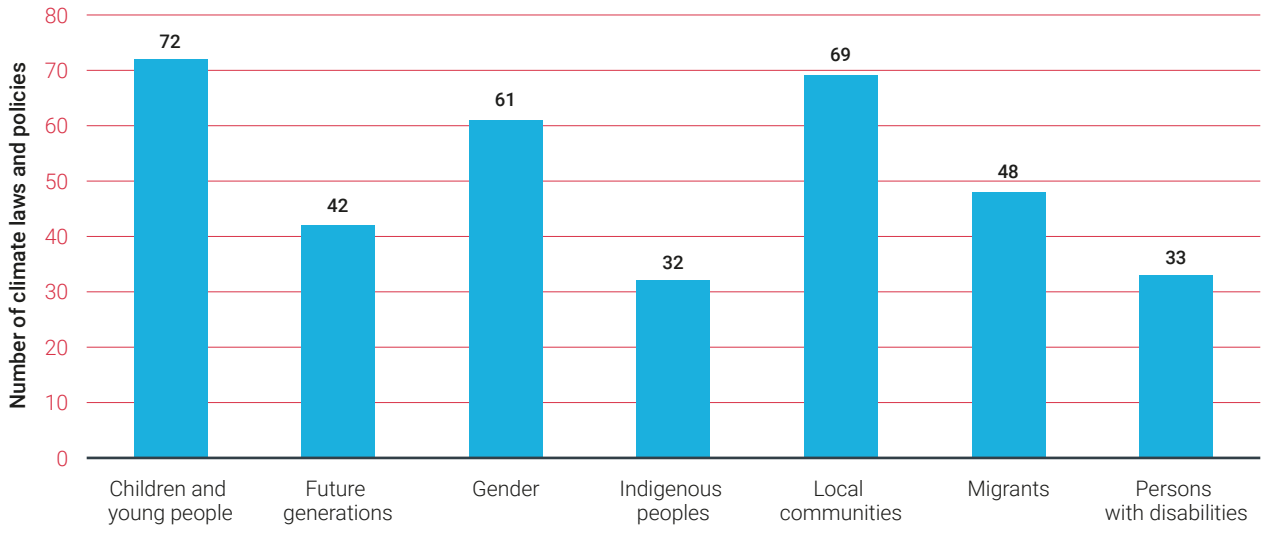
SUMMARY OF FINDINGS

The analysis suggests the following overall points about inclusiveness in adaptation laws and policies:[3]

- **Frequency:** reference to gender and disadvantaged groups in adaptation laws and policies appears to have increased with time, as does the number of adaptation laws and policies with titles that indicate an explicit focus on gender or disadvantaged groups.
- **Framing:** reference to gender and disadvantaged groups ranges from emphasis on the particular vulnerability of these groups to emphasis on their agency and roles in responding to the impacts of climate change.
- **Representation:** different groups appeared to be represented to differing extents in adaptation laws and policies. For example, while references to children, young people and future generations were identified in most documents studied, relatively low reference was found to indigenous peoples. However, this may reflect the fact that this is only a relevant term for communities living in certain countries.
- **Diversity of policy response:** although references to certain groups were identified across the laws and policies of a large number of countries, this does not necessarily represent a uniform policy response to groups' needs. For example, while Kiribati's 2013 National Framework for Climate Change and Climate Change Adaptation articulates the Government's advocacy for "permanent migration as a form of adapting to the adverse effects of climate change", the Federated States of Micronesia's 2013 Nationwide Integrated Disaster Risk Management and Climate Change Policy makes the strategic objective to "Prevent environmental migration through adaptation strategies" (Kiribati 2013; Federated States of Micronesia 2013).

The total number of laws and policies containing reference to each group is shown in figure 2.3.

Figure 2.3 Number of climate laws and policies referencing different stakeholder groups



2 While gender is not a social group in itself, in this section we have analysed reference both to groups (e.g. women or girls) and to gender-relevant concepts (e.g. gender equality or reproductive rights); see Annex 2.C (online) for a full list of search terms included.

3 For a full account of the detailed findings from this section, please see Annex 2.C (online).

The apparent increase in frequency with which adaptation laws and policies refer to historically overlooked groups is encouraging. Countries should continue to increase their efforts to integrate consideration of these groups into adaptation planning and to ensure that recognition of the particular needs of each group in adaptation laws and policies translates into concrete measures that aim to meet those needs.

As alluded to in the 2021–2022 NAP Global Network Synthesis Report (Dazé and Hunter 2022), it is also important that such consideration of historically overlooked groups extends beyond the positioning of, for example, women or persons with disabilities as vulnerable or disadvantaged, and towards measures which emphasize the roles of these groups as agents of change in responding to climate change.

Further research should examine possible disparities in the degree to which different groups are represented in adaptation laws and policies.

2.3.2 Implementability

The 2020 and 2021 editions of the AGR examined the implementability of adaptation plans by evaluating four indicators, namely the presence of: 1) a central administrative body to oversee adaptation policymaking and implementation, 2) regulations, 3) incentives and 4) direct investments/funding. At the same time, the 2021 edition of the AGR concluded by stating that "the ultimate test of [the] adequacy and effectiveness [of adaptation planning] will be whether these plans are implemented and, in turn, whether this implementation reduces risk and vulnerability and bolsters resilience and adaptive capacity".

This year's chapter looks at the evidence of the consideration of the following additional elements that are essential to enable implementation of adaptation based on submitted NAPs before 31 August 2022:

- Adaptation vision, goals and/or objectives of the specific country
- Trends in climate change
- Prioritized adaptation actions and indicative time frames
- Capacity needs for implementation
- Partners to support implementation

Other indicators equally important for implementation but not considered in this section include indication of the adaptation needs (additionality), costing of adaptation actions, lessons learned, barriers and risk factors. Annex 2.D (online) provides for further information about the methodology underlying this assessment.

SUMMARY OF FINDINGS

Below are key findings from the analysis of the above-mentioned elements:[4]

- The NAPs contain clearly defined **visions, goals and/or objectives** to guide adaptation at the national level. Though different among countries, key features include interlinkages to sustainable development, a focus on reducing vulnerability, strengthening resilience and building adaptive capacity, details on coordination and leadership, regulatory frameworks, inclusiveness, implementation, finance and cooperation towards climate-resilient development. The visions, goals or objectives serve as the primary guide for leadership and institutional arrangements, regulatory frameworks, implementation and M&E.

- **Integration with national development:** Countries' adaptation priorities are becoming strongly aligned with national development, thereby enhancing their viability and investment potential, which are key to ensuring implementability. This is consistent with the explicit UNFCCC objective to formulate and implement NAPs that integrate adaptation into national development planning processes.

- **Essential capacity for implementation:** In addition to adaptation priorities in key systems, the NAPs contain activities to strengthen adaptation planning at the national and subnational levels and to facilitate implementation. A majority of these relate to institutional arrangements and coordination, capacity development, systems to access financial and other support, systems to facilitate integration of adaptation into national development planning, data and information collection and analysis, and multi-stakeholder engagement.

- **Expanded set of partners:** A wide range of national, regional and international partners are identified throughout the NAPs to support implementation. Government agencies in charge of coordinating climate change work and related national committees will serve as central coordination mechanisms for implementation, to engage and coordinate with different partners.

4 For a full account of the detailed findings from this section, please see Annex 2.D (online).

2.4 Promoting adaptation–mitigation interlinkages in adaptation planning

Reflecting the three broad types of adaptation–mitigation interlinkage presented in table 1.1, countries present interlinkages between adaptation and mitigation in a wide variety of ways in their national planning instruments and related documents. In the case of mitigation benefits arising from adaptation actions, for example, some simply observe the potential that some adaptation interventions may result in mitigation co-benefits, while others highlight that they have specifically designed programmes to both strengthen resilience and adaptive capacity and also make mitigation contributions.

While not exhaustive, mitigation co-benefits are commonly cited in sectors such as agriculture (e.g. reduced emissions from improved crop or post-harvest management), forestry (e.g. increased carbon sequestration from forest restoration), water (e.g. improved water availability to sustain hydropower stations) and energy (e.g. reduced emissions from efforts to diversify energy resources and promote efficiency). In some cases, effective adaptation is also framed as a precondition for effective mitigation efforts. For example, in their updated NDC, Fiji (2020) notes that investments in climate adaptation will "help ensure that investments in renewable solutions are sustainable and resilient to climate adversities".

Countries also highlight a range of adaptation co-benefits arising from mitigation actions. For example, introducing high-efficiency stoves is expected to reduce pressure on forest resources, which in turn is expected to reduce impacts from extreme rainfall events. Increasing public transport is expected to lead to increased mobility for low-income populations and increased resilience of transport infrastructure in addition to reducing emissions.

Because large climate impacts are already being observed and the benefits of mitigation are not expected to materialize in the near term, the climate impacts and negative consequences on development in vulnerable countries could be reduced by prioritizing adaptation over mitigation action (GIZ 2018). Some countries thus take additional steps to understand and mitigate potential trade-offs between mitigation and adaptation. For example, Zimbabwe (2021) stated that adaptation is their overriding priority and therefore assessed all proposed mitigation actions to understand potential impacts, both positive and negative, on climate resilience. Chile (2020) has specified various conditions that its afforestation measures must meet in order to deliver adaptation benefits on top of their carbon sequestration functions.

In practice, however, there are a range of challenges associated with navigating and exploiting the potential synergies that exist between adaptation and mitigation in planning and implementation (UNFCCC Adaptation Committee 2022). For example, integrating mitigation objectives into adaptation projects (or vice versa) requires engaging more stakeholders with diverging expertise and interests. Ultimately, this will increase the coordination burden of such projects and make them more difficult to implement. Additionally, countries also note the absence of appropriate methodologies for quantifying the mitigation co-benefits of adaptation and point to domestic efforts to improve such quantification and understanding more broadly. Moreover, striving to achieve adaptation and mitigation co-benefits does not necessarily lead to an optimal mix of adaptation and mitigation interventions being achieved.

Nonetheless, pursuit of adaptation–mitigation co-benefits (and consideration of interlinkages between adaptation and mitigation more broadly) can, however, help countries make the best use of limited resources and ensure that the various strands of their climate action are proceeding in a coherent and complementary manner. National adaptation planning provides a key entry point for this consideration.

Looking ahead, the recently established work programme under the framework for non-market approaches referred to in article 6, paragraph 8, of the Paris Agreement has the potential to help enhance our understanding of challenges and innovative solutions in integrating interlinkages between mitigation and adaptation actions in national planning, taking account of both co-benefits and trade-offs. It may, for example, provide countries with opportunities for non-market-based cooperation to implement mitigation and adaptation actions in their NDCs.

3

Chapter 3

Global progress on adaptation financing in developing countries

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The Thames Barrier is a retractable barrier system built to protect the floodplain of most of Greater London from exceptionally high tides and storm surges moving up from the North Sea.

Photo: © Tom Wheatley

Key messages

- New estimates of adaptation finance needs for developing countries have emerged in recent years. The 76 developing countries that have communicated such estimates in updated nationally determined contributions (NDCs) or national adaptation plans (NAPs) indicate finance needs of US$71 billion per year from now to 2030.
- An extrapolation of this figure to all developing countries, on a per capita basis, indicates that adaptation finance needs could be around US$202 billion/year (ranging from US$79 billion/year to US$612 billion/year) this decade. This new evidence reinforces the estimates reported in previous editions of the Adaptation Gap Report (AGR).
- Combined mitigation and adaptation finance flows in 2020 fell short of the annual US$100 billion global goal pledged by developed countries, even by finance providers' own accounting, which according to the Organisation for Economic Co-operation and Development (OECD) amounts to US$83.3 billion.
- Self-reporting of finance providers indicates that there has been a trend of gradually increasing international adaptation finance to developing countries in recent years, reaching US$28.6 billion in 2020. However, the share of adaptation in total climate finance to developing countries was 34 per cent in 2020, still far behind mitigation finance.
- This evidence suggests that for developing countries, estimated adaptation costs – and likely adaptation financing needs – could be five to 10 times greater than current international adaptation finance flows.
- The outcome of the United Nations climate conference in Glasgow (COP 26) urged developed countries to at least double their collective provision of adaptation finance from 2019 levels by 2025. However, even when assuming a steep increase in finance as well as its effective use, the analysis here finds that this would be insufficient to close the adaptation finance gap. The nature and size of the new collective, quantified goal on climate finance, to be set prior to 2025 by the Parties to the United Nations Framework Convention on Climate Change (UNFCCC), will be fundamental to closing the adaptation finance gap.
- A growing body of evidence indicates that finance providers are not strategically targeting adaptation assistance towards the most vulnerable countries and population groups. Among the most vulnerable populations, access to and provision of adaptation finance should be considered carefully in finance for adaptation, including addressing gender and other social inequities.
- Climate finance rarely addresses mitigation and adaptation simultaneously. This could change in the context of article 2.1(c) of the Paris Agreement to make finance flows consistent with low greenhouse gas (GHG) emissions and climate-resilient development. However, this will involve barriers, trade-offs and risks that need to be considered carefully.

3.1 Introduction

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 (United Nations Environment Programme [UNEP] 2014). In practice, this is a simplification since estimating the finance gap is challenging, both conceptually and quantitatively (UNEP 2016). 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 5) and there will be 'soft' and 'hard limits' to adaptation (see glossary).

This chapter provides an update on the adaptation finance gap for developing countries (the non-Annex I countries defined under the UNFCCC[1]). It reviews the evidence base on the estimated costs of adaptation and considers the emerging estimates of reported country adaptation needs (section 3.2). The chapter also reviews the latest data on global adaptation finance flows to developing countries (section 3.3). The comparison of adaptation costs versus finance flows is then used to assess the indicative adaptation finance gap (section 3.5). In addition, the chapter discusses the interlinkages between mitigation and adaptation finance (section 3.4).

3.2 The costs of adaptation and adaptation finance needs for developing countries

Previous editions of the AGR have reviewed the evidence base for the costs of adaptation in developing countries, concluding that there is no definitive estimate, not least because there is no agreed (quantitative) adaptation goal. The wide range of cost estimates in the scientific literature reflects major differences in targets, future scenarios, methods, assumptions, coverage (sectors and impacts), investment periods, and the costs of implementation (UNEP 2016; UNEP 2021a).

A key challenge in assessing the global costs of adaptation is the uncertainty associated with alternative future emission scenarios (i.e. whether or not Paris Agreement goals will be achieved), socioeconomic scenarios, and climate model outputs. The amount of adaptation needed also depends on the benefits that it delivers (its effectiveness), including the potential level of maladaptation, and the objectives that are set, due to the trade-off between costs, benefits and residual damages. Estimates also vary depending on whether countries' existing adaptation deficits are included (from natural climate variability and extremes) and on the differentiation between development and adaptation.

3.2.1 Global costs of adaptation in developing countries

Based on a combination of global integrated, global sectoral, and national studies, the data presented in the 2016 edition of the AGR, adjusted to current levels (2020 prices[2]), estimate that the annual costs of adaptation in developing countries could be between US$160 billion and US$340 billion by 2030. With increasing levels of climate change, this annual cost was projected to increase to between US$315 billion and US$565 billion by 2050. The costs of adaptation are lower if the Paris Agreement goals are met, especially in the medium to long term.

Since the 2016 edition of the AGR, there have not been any major new global assessments. However, the recent Intergovernmental Panel on Climate Change Working Group II *Sixth Assessment Report* (IPCC WGII AR6) provides an update to the literature. Chapter 17 (New *et al.* 2022) reviewed the global costs of adaptation for developing countries. This drew on the AGR series as well as other literature.

The corresponding values are shown in table 3.1. The upper range of reported values in the IPCC WGII AR6 are higher than the AGR estimates, though the median estimates are below those mentioned in the AGR. However, the IPCC WGII AR6 included very low estimates of the costs of adaptation (which affect its reported median values), which the AGR does not include, because these lower values are an order or magnitude smaller than the current global goal for adaptation finance, and significantly lower than current annual finance flows for adaptation.

Table 3.1 Comparison between the AGR and the IPCC WGII AR6

	Annual cost of adaptation for developing countries	
	2030	2050
AGR	US$160 billion/year to US$340 billion/year	US$315 billion/year to US$565 billion/year
IPCC WGII AR6	US$15 billion to US$411 billion/year (median US$127 billion/year)	US$47 billion to US$1,088 billion/year (median US$295 billion/year)

The IPCC WGII AR6 also provided additional synthesis information on sector and national studies. A comparison of this literature with earlier AGRs indicates higher adaptation costs. For example, the coastal chapter (Glavovic *et al.* 2022) reports adaptation costs that are significantly higher than in the original AGR analysis. Similarly, the chapter on Africa (Trisos *et al.* 2022) reports estimates of the costs of adaptation that are higher than the original AGR estimates and identifies a large adaptation finance gap for the continent.

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

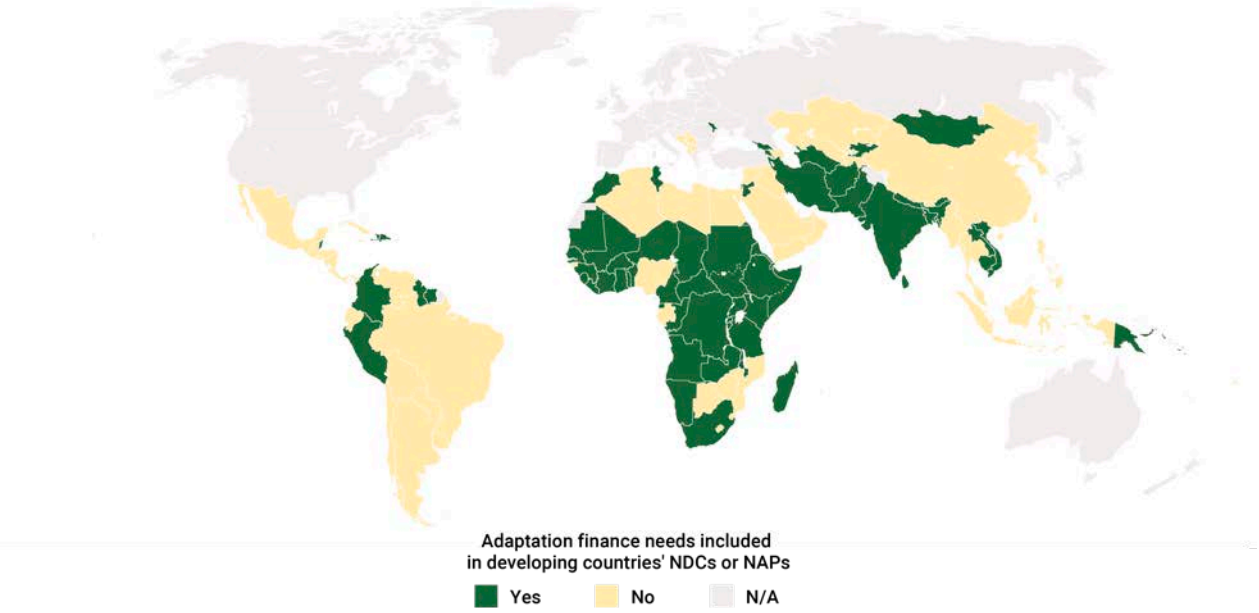
2 All values in this chapter are reported in 2020 prices. This has included updating previous AGR estimates and aggregating adaptation finance needs to a consistent year.

3.2.2 Adaptation finance needs in developing countries

The finance needs reported in countries' domestic adaptation ambitions, as submitted to the UNFCCC in the form of NDCs and NAPs, provide alternative insights into the cost estimates for adaptation in developing countries. They use different assumptions and methods (focusing on programme- and project-based costing). A significant number of updated NDCs and NAPs have emerged since the 2021 edition of the AGR. As at 31 August 2022, all but two of the 197 country Parties had submitted their first NDCs and 161 country Parties had revised them (UNFCCC Secretariat 2022a). A total of 37 developing countries had submitted their NAPs (UNFCCC Secretariat 2022b).

A total of 76 developing countries have communicated their adaptation finance needs for the 2021–2030 period in their NDCs or NAPs (figure 3.1). These are highly heterogeneous in terms of their objectives, sectoral coverage, implementation period and other aspects. They have limited transparency regarding the underlying methodology for estimation (Chapagain *et al.* 2020; Pauw *et al.* 2020; UNEP, 2021a) and should be interpreted with these limitations in mind.

Figure 3.1 Information on adaptation finance needs in developing countries' NDCs or NAPs



Note: N/A refers to Annex I countries.

Source: Data taken from UNFCCC (2022c).

Recent analysis undertaken by Chapagain and Watkiss for the UNFCCC Adaptation Committee's synthesis report on the efforts of developing countries in assessing and meeting the costs of adaptation (UNFCCC 2022c) has normalized and collated these estimates. In aggregate, the above-mentioned 76 developing countries indicated that they need around US$71 billion per year (on average) during 2021–2030. Most developing countries make these ambitions conditional to international support in the form of finance, capacity-building and/or technology, but often this conditionality is neither well defined nor well described (see also Pauw *et al.* 2020).

These adaptation finance needs were further analysed (Chapagain and Watkiss 2020) to produce adaptation finance needs in per capita adaptation terms and as a percentage of gross domestic product (GDP) – see table 3.2. The per capita adaptation finance needs range from US$10/year to US$95/year (interquartile range, median US$30/year) for the 2021–2030 period. Annual adaptation finance needs as a percentage of GDP range from 0.7 per cent to 4.2 per cent (median 2.1 per cent). For those countries that have reported, the median per capita annual adaptation finance needs are around US$23 for low-income countries (LICs), US$36 in lower-middle-income countries (LMCs) and US$63 in upper-middle-income countries (UMCs). The median estimate of annual adaptation finance needs as a percentage of GDP in LICs is 3.5 per cent but it is 1.9 per cent in LMCs and 1.1 per cent in UMCs. This indicates that, on average, rich countries have higher adaptation finance needs in absolute US$ values, but the adaptation finance needs in poor countries are much larger relative to their GDP.

These estimates have been used to extrapolate to all developing countries and derive an indicative global estimate for this AGR. This has used the aforementioned median and interquartile range and 2020 population sizes. This extrapolation estimates that total adaptation finance needs for all developing countries is in the range of US$79 billion to US$612 billion per year with a median estimate of US$202 billion for the 2021–2030 period.

Table 3.2 Potential developing countries adaptation finance needs for the 2021–2030 period by region

Region	Annual adaptation finance needs in US$ billion (2020 value)		Annual adaptation finance needs as a percentage of GDP	
	Median	Min–Max	Median	Min–Max
East Asia & Pacific	69	27-208	0.35	0.14–1.05
South Asia	59	23–177	1.69	0.66–5.10
Sub-Saharan Africa	36	14–109	2.10	0.82–6.34
Latin America & Caribbean	21	8–62	0.41	0.16–1.25
Middle East & North Africa	15	6–44	0.47	0.19–1.43
Europe & Central Asia	4	1–11	0.69	0.27–2.08
Global	**202**	**79–612**	**0.60**	**0.24–1.80**

Source: UNFCCC (2022c)

3.3 Overarching global estimates and trends in adaptation-related finance for developing countries

The understanding of finance for adaptation is heavily constrained by data availability and limitations. Challenges include definitions, methodological differences among finance providers, accounting issues, confidentiality restrictions and a lack of universally accepted impact metrics (an overview of challenges for understanding finance for adaptation is provided in Annex 3.A [online]). Several studies claim that the self-reporting of finance providers to the UNFCCC and the OECD and the lack of independent quality control result in low data reliability and sometimes substantial overestimations of finance flows in reporting (UNEP 2021b; Toetzke, Stünzi and Egli 2022; Weikmans *et al.* 2017). An overview of how adaptation finance provided is reported by Annex II countries[3] is provided in Annex 3.B (online). These challenges prevent accountability and transparency of climate finance, which are fundamental for building trust in climate negotiations (Pauw *et al.* 2022). A standardized tracking system based on the principles of accountability and transparency that provides up-to-date data on finance flows is therefore essential (Roberts and Weikmans 2022).

Access to finance is a challenge for vulnerable developing countries (United Nations 2022; UNFCCC Adaptation Committee 2021). In addition, disbursement of adaptation-related finance is significantly lower than committed finance (Savvidou *et al.* 2021; Atteridge *et al.* 2019). Other barriers to accessing finance and full implementation of adaptation projects include low grant-to-loan ratios; co-financing requirements; rigid rules of climate funds; and inadequate programming capacity within many countries (United Nations 2022; UNFCCC Adaptation Committee 2021; Omari-Motsumi *et al.* 2019).

3.3.1 Total climate-related finance for developing countries

According to the OECD, total climate-related finance[4] (mitigation and adaptation) provided to developing countries reached US$83.3 billion in 2020 (OECD 2022a). This falls US$16.7 billion short of the US$100 billion target for 2020. If the 4 per cent increase from 2019 continued, the target would not be met until 2025. Out of the US$83.3 billion, 34 per cent (US$28.6 billion) was reported as adaptation, with an additional 7 per cent tagged as cross-cutting.

3 Annex II countries: Australia, Austria, Belgium, Canada, Denmark, the European Economic Community, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States of America.

4 This OECD figure captures four components of climate finance provided and mobilized by developed countries: i) bilateral public climate finance provided by developed countries' institutions (based on biennial reports to the UNFCCC); ii) multilateral public climate finance provided by multilateral development banks and multilateral climate funds, attributed to developed countries; iii) climate-related officially supported export credits, provided by developed countries' official export credit agencies; and iv) private finance mobilized by bilateral and multilateral public climate finance, attributed to developed countries.

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). While this is not reflected in the data included in this AGR (which only reaches the end of 2020), the decision is likely to increase the adaptation share of climate finance.

There is no formal agreement among countries providing climate finance about who will provide what share of the US$100 billion. However, a recent study determining fair shares based on gross national income, cumulative territorial CO_2 emissions and population concludes that only seven developed countries provided and mobilized their fair share and pledged the full amount up to 2025. It also notes that the United States of America is overwhelmingly responsible for the climate finance gap (Colenbrander, Pettinotti and Cao 2022).

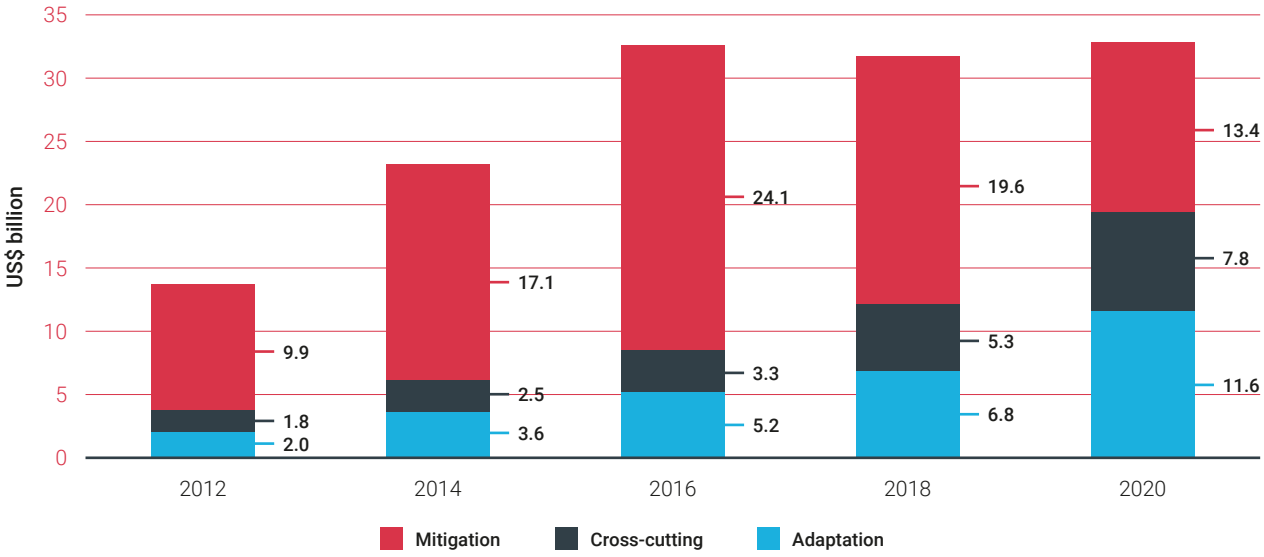
Finally, formal deliberations among countries for a new collective quantified goal on climate finance began at COP 26 in Glasgow, using the US$100 billion as a floor. The characteristics and size of this goal will be set by 2025. Recent research indicates that it is critical to reconsider adaptation-relevant issues such as the adaptation–mitigation balance and the mobilization of private finance and it suggests setting a subtarget on grants (Pauw *et al.* 2022).

3.3.2 Public adaptation finance to support developing countries

ASSESSMENT OF BILATERAL PUBLIC FINANCE FLOWS FOR ADAPTATION

Bilateral public adaptation-related finance flows to developing countries from Annex II countries has increased over recent years (see blue bars in figure 3.2). In 2020, the share of adaptation flows in climate finance was 35 per cent, with an additional 24 per cent being cross-cutting flows.

Figure 3.2 Adaptation, mitigation and cross-cutting bilateral flows from Annex II countries to developing countries between 2012 and 2020



Notes: Data for the years 2012, 2014, 2016 and 2018 represent flows reported by Annex II countries through their biennial reports to the UNFCCC. 2020 values arelso flows from Annex II countries as reported in the OECD Development Assistance Committee (DAC) database but considering the coefficients applied to Rio marker data when reporting to the UNFCCC. The 2020 values represent climate finance providers' commitments and are in constant 2020 US$. The country coefficients and the methodology followed are provided in Annex 3.B (online).

Source: Data taken from OECD (2022b), UNFCCC Standing Committee on Finance (2021)

There is growing evidence that climate finance providers are not strategically targeting their adaptation support towards countries and population groups with the greatest vulnerability and needs (Savvidou *et al.* 2021; Garschagen and Doshi 2022; Alcayna 2020). Nevertheless, the share of total adaptation-related finance committed to the least developed countries (LDCs) increased from 17 per cent in 2019 to 25 per cent in 2020. The share for small island developing states (SIDS) doubled from 3 per cent in 2019 to 6 per cent in 2020. Within countries, it is important to target the most vulnerable population, including women and girls who are disproportionately vulnerable to the impacts of climate change in certain contexts (Global Gender and Climate Alliance 2016; Gannon *et al.* 2022). In 2020, around 63 per cent of finance from Annex II countries marked as relevant to adaptation was also marked as supporting

gender equality for 2020. However, most of this funding (84 per cent) has a "significant"[5] objective for the gender marker, compared to just 16 per cent for a "principal" objective,[5] even though funded programmes considering gender aspects have been found to be more effective and efficient at achieving their adaptation objectives (Roy *et al.* 2022; UNDP 2018). A short overview of gender and climate justice within adaptation finance is provided in Annex 3.D (online).

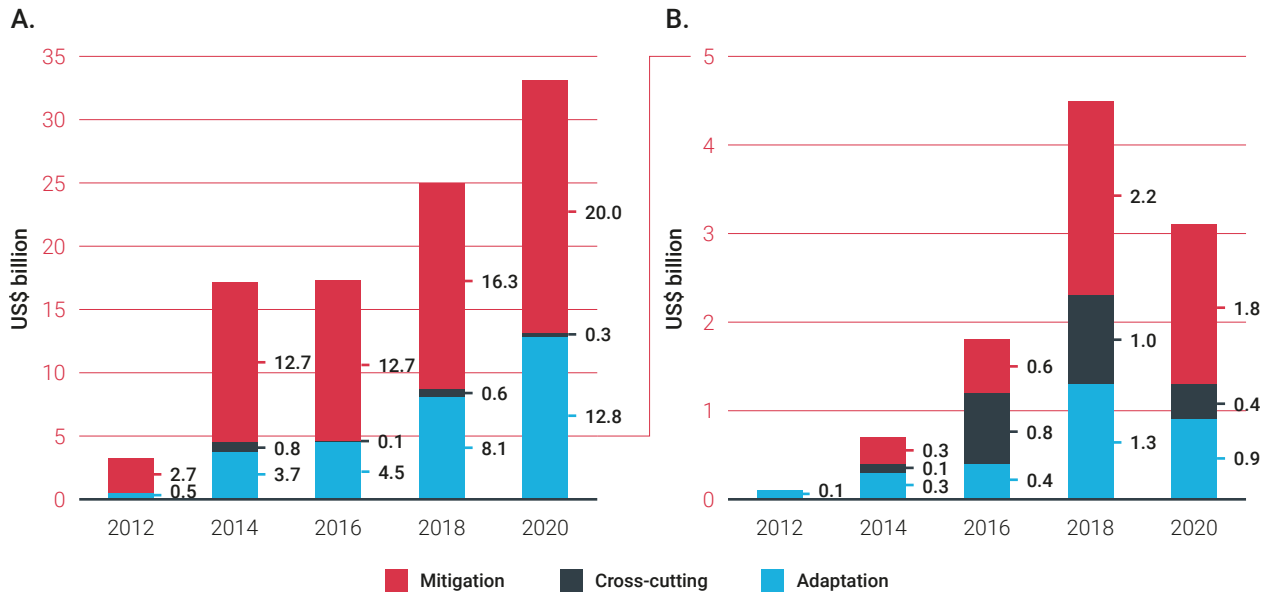
ASSESSMENT OF MULTILATERAL PUBLIC FINANCE FLOWS FOR ADAPTATION

Adaptation-related financial commitments to developing countries by multilateral development banks (MDBs) show an increasing trend (figure 3.3, panel A).[6] MDBs do not report disbursement amounts. In 2020, support for adaptation as a share of overall MDB climate finance was 39 per cent. Cross-cutting finance continues to be negligible.

Adaptation-related MDB finance provided to LDCs increased from 31 per cent in 2019 to 38 per cent in 2020, while there were no reports of MDBs financing SIDS. In contrast to bilateral finance, the bulk of commitments to adaptation from MDBs comes from debt instruments (83 per cent).

Total adaptation-related financial flows to developing countries by funds under the UNFCCC financial mechanism saw a significant decrease in 2020 compared to 2018 (figure 3.3, panel B). Despite their small contributions (9 per cent of total multilateral adaptation finance in 2020), the funds have a critical role to play, given their exclusive focus on supporting climate change objectives. In contrast to MDBs, in 2020 multilateral climate funds used almost entirely grants for their contributions.

Figure 3.3 Adaptation-related multilateral flows to developing countries between 2012 and 2020 by multilateral development banks (panel A) and multilateral climate funds (panel B)



Notes: Data represent climate finance providers' commitments and are in constant 2020 US$. Amounts are presented at face value. Data providers use different methods: MDBs use their own methodology named "Climate Components" in the OECD DAC database; multilateral climate funds use "Rio marker" methodology (Annex 3.B [online]). Data shown in this graph apply the shares of multilateral climate finance attributable to developed countries to the data reported to the OECD DAC.

Source: Data taken from OECD (2022b), UNFCCC Standing Committee on Finance (2021).

3.3.3 Assessment of private finance flows related to adaptation

As reported in past editions of the AGR, the size of private investments in adaptation continues to be unclear. Data on adaptation finance from the private sector are still largely missing, because of challenges associated with context dependency, confidentiality restrictions, uncertain causality, and a lack of agreed-upon impact metrics (Buchner *et al.* 2021). And 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

5 According to the Rio marker methodology, adaptation and mitigation can be targeted as a "principal" objective (whereby mitigation or adaptation "is explicitly stated as fundamental in the design of, or the motivation for, the activity"), a "significant" objective (whereby the objective "is explicitly stated but is not the fundamental driver or motivation for undertaking the activity") or may not be "targeted" at all (OECD 2016).

6 A comprehensive list of MDBs is provided in Annex 3.C (online).

actions taken, inhibit meaningful aggregation (Dale *et al.* 2021). Information about mobilized private finance for adaptation is also largely absent from Party submissions to the UNFCCC (Dale *et al.* 2021).

Private finance, however, continues to be a critical component of the global financing landscape. Governments are also increasingly recognizing the importance of stimulating private investments, despite important concerns about the motivation of the private sector to finance certain types of adaptation or to finance the most effective adaptation options in all circumstances (a short discussion about the potential limitations of private finance is provided in Annex 3.E [online]).

3.3.4 Assessment of domestic finance flows for adaptation

As reported in the 2021 edition of the AGR, domestic budgets are an underexamined yet vitally important source of adaptation finance and current data are largely based on case studies. While available data make it impossible for this report to provide a reliable quantitative estimate of the size of domestic finance flows, there is growing evidence that such funding may already constitute a very significant share of total adaptation finance (UNEP, 2021b).

3.4 Interlinkages between mitigation and adaptation

Climate finance primarily addresses mitigation and adaptation in isolation: only 2.4 per cent of the known total climate-related finance in 2019–2020 was cross-cutting (Buchner *et al.* 2021) and only 9 per cent of the mobilized climate finance in the 2016–2020 period was cross-cutting (OECD 2022a). Some funds are dedicated to either mitigation or adaptation. The Green Climate Fund (GCF) might be an anomaly because it finances a relatively large share of its adaptation through cross-cutting projects (Pauw, König and Valverde 2022). Given that developed countries were urged to at least double their collective provision of adaptation finance in the outcome document of the UN climate conference in Glasgow (COP 26) (UNFCCC Adaptation Committee 2021), it is important that adaptation components in cross-cutting projects are sincere and that adaptation results are monitored and reported on (Pauw, König and Valverde 2022).

Cross-cutting projects are not necessarily more cost-effective than projects that address mitigation or adaptation in isolation. Empirical evidence that quantifies or monetizes co-benefits is limited, in particular for areas besides air quality and health (Karlsson *et al.* 2020). Many (co)benefits are of ancillary, non-market nature. As a result, integration of mitigation and adaptation in projects may make sense from an economic perspective, but not from a financial one (for private investors) (Watkiss and Klein 2019). However, not considering adaptation in mitigation projects and vice versa can increase the overall economic costs. For example, when mitigation projects lead to high-density urban planning without considering adaptation, it can increase urban heat island effects and increase the use of air conditioning.

Article 2.1(c) of the Paris Agreement may provide a new impetus in stimulating co-benefits. Countries agreed to make finance flows consistent with net-zero climate-resilient development pathways. This new narrative goes much beyond traditional climate finance flows and relates to all sectors and actors (Zamarioli *et al.* 2021). Finance flows are consistent only when the effects of an investment in adaptation have a neutral or a positive impact on mitigation and vice versa. In other words, an investment in mitigation is not climate consistent when it simultaneously reduces resilience (Cochran and Pauthier 2019; Jachnik, Mirabile and Dobrinevski 2019).

3.5 Estimating the adaptation finance gap

Evidence for the adaptation finance gap in AGR2022 is brought together in table 3.3. The information presented suggests that for developing countries, estimated adaptation costs and adaptation financing needs could be five to 10 times greater than current international public adaptation finance flows.

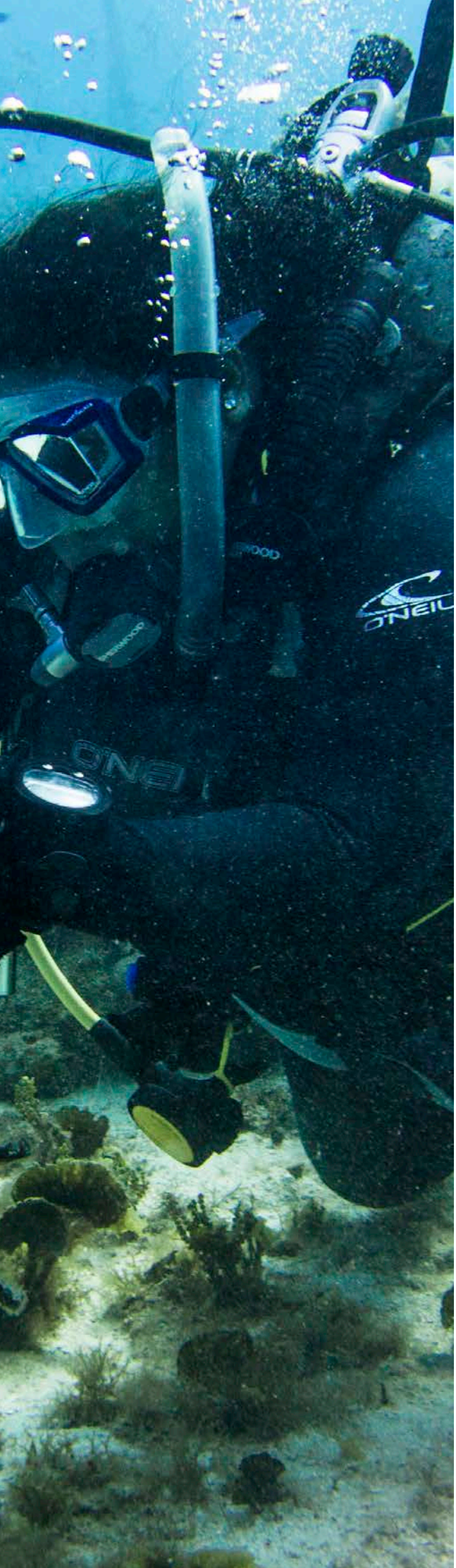
Table 3.3 Summary of the adaptation finance gap in developing countries, based on available evidence

Costs of adaptation	Adaptation finance needs based on NDC/NAP costs	Adaptation finance flows
US$160 billion – US$340 billion annually by 2030 (rising to US$315 billion – US$565 billion by 2050)	US$71 billion per year (up to 2030) in submitted NDC/NAPs (76 countries) Extrapolating to all developing countries indicates US$202 billion per year (median), ranging from US$79 billion to US$612 billion for the 2021–2030 period	US$28.6 billion in 2020
Source: The Adaptation Finance Gap Report (UNEP 2016)	*Source:* UNFCCC 2022c (see also section 3.2.2)	*Source*: OECD (2022a)

Pictured here is a nursery in Mangatsiotra village in Madagascar's coastal Vatovavy Fitovinany region, where local community members are being trained to grow alternative climate resilient crops such as coffee, ginger and vanilla. Like many coastal communities in Madagascar, Mangatsiotra is experiencing increasingly erratic rainfall and more extreme weather events, threatening the livelihoods, health and well- being of local populations. Focusing on four coastal sites which have been identified as being particularly vulnerable to climate change, with support from the Global Environment Facility, the 'Adapting Coastal Zone Management to Climate Change in Madagascar' project aims to build the long term resilience and capacity of target communities through various ecosystem-based adaptation interventions.
Learn more about this project here.

Photo: © UNEP / Lisa Murray


4



Chapter 4

Global progress on adaptation implementation

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Coral nursery at Discovery Bay, Jamaica. The image shows the young coral is being re-planted on the reefs in a project supported by UNEP and regional partners.

Photo: © Kadir van Lohuizen / NOOR

Key messages

- The number and financial volume of adaptation actions supported by the Adaptation Fund (AF), the Green Climate Fund (GCF) and the Global Environment Facility (GEF) have more than doubled between 2016 and 2018 and have remained constant since 2019 at an average of around US$500 million per year. Without further increases, increasing climate risks could outstrip adaptation actions and thus widen the adaptation gap even more.
- Only around one third (40 per cent in relation to funding volume) of the actions reported by bilateral climate finance providers as primarily aiming at adaptation were found to directly target climate risk reduction. Actions labelled as adaptation must better elaborate their contribution to adaptation.
- Not every climate action can be expected to deliver substantial co-benefits for adaptation or mitigation. The potential for co-benefits between adaptation and mitigation is higher in some sectors than in others.
- Attention needs to be paid to potential trade-offs in the implementation of adaptation and mitigation to avoid progress in one objective hampering another or hampering sustainable development. Trade-offs can occur despite substantial co-benefits and therefore need to be considered independently.

4.1 Introduction

Since its first appearance in the 2020 Adaptation Gap Report (AGR), the implementation chapter has aimed to provide an overview of implemented adaptation worldwide, that is, analysing what adaptation actions are undertaken, for whom, where and against which climate hazards and risks (UNEP 2021a; UNEP 2021b). This information cannot be distilled from financial flows, but it is vital for assessing the effectiveness of adaptation actions and for determining remaining gaps (see chapter 5).

Adaptation to climate change is undertaken by a variety of actors at different scales – from individuals and households to international initiatives. An indication of global adaptation action therefore requires combining multiple data sources that cover different parts of the adaptation landscape (Garschagen *et al.* 2022). This year, three data sources with global coverage are used: project documents from global funds that serve the United Nations Framework Convention on Climate Change (UNFCCC) and/or the Paris Agreement; adaptation entries in the Climate-Related Development Finance data set from the Organisation for Economic Co-operation and Development (OECD) Development Assistance Committee (DAC) (OECD 2022); and information on adaptation actions provided in countries' adaptation communications. New features in this year's implementation chapter include an estimation of the potential of adaptation actions to reduce exposure and vulnerability to climate hazards (section 4.4) and an analysis of actions that jointly address mitigation and adaptation to understand how these two policy goals are linked in practice (section 4.5). Further details on the scope, methodology and data sources are described in Annex 4.A–C (online).

4.2 Implemented adaptation actions in developing countries

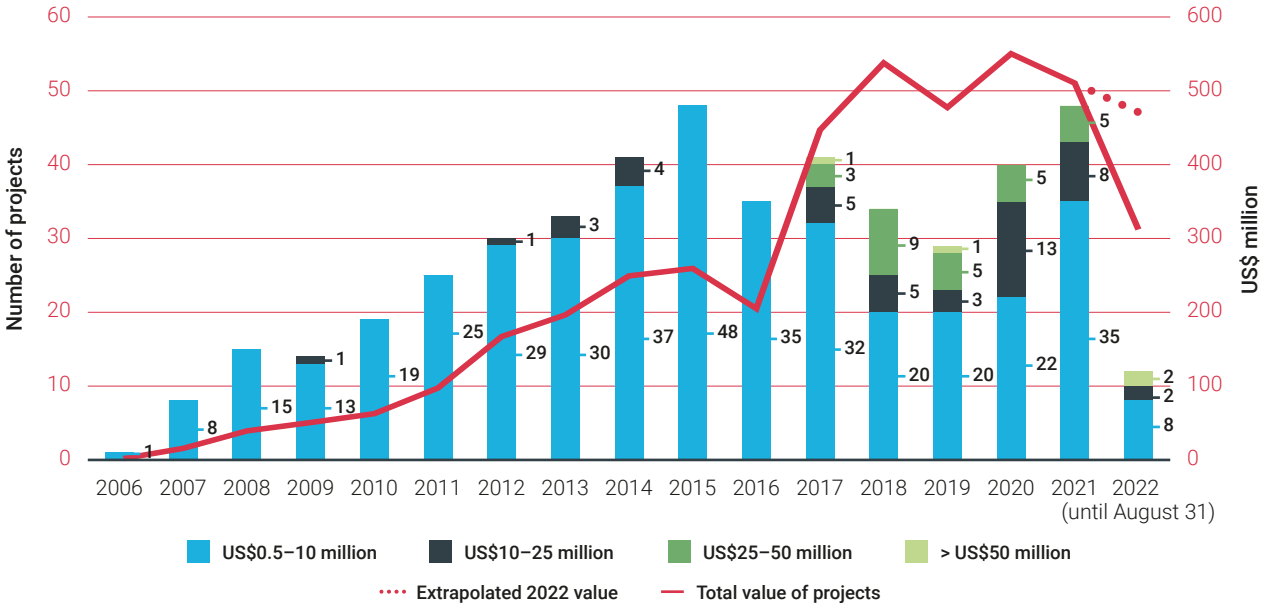
Adaptation actions supported by the global funds serving the UNFCCC and/or the Paris Agreement, namely the AF, GCF as well as the two climate funds under the GEF, the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF), are of particular relevance to developing countries. Between 2006 and 31 August 2022,[1] almost 470 adaptation projects[2] had been implemented with a funding volume of over US$4 billion (excluding co-funding from other climate finance providers and host countries – see Annex 4.C [online] for details). The top three climate hazards addressed by these projects are drought, flooding and rainfall variability (UNEP 2021a). Since 2017,

1 The first of these dedicated global adaptation funds serving the UNFCCC were established in the period following COP 7 in Marrakech in 2001. The first adaptation projects (excluding planning or readiness activities) funded through these funds started implementation in 2006.

2 This chapter only counts projects whose implementation has begun (see the Annex 4.B [online]).

implemented projects have increasingly grown in size (see figure 4.1). This increase, largely due to GCF-funded projects, could help scale up adaptation beyond isolated projects and pilot applications. The combined annual funding value of newly starting projects had steadily increased until 2015, before briefly dropping in 2016. By 2018, however, it had more than doubled to US$550 million. Since then, it has remained at an average of about US$500 million per year (assuming the extrapolated 2022 value will be reached).

Figure 4.1 Number of new adaptation projects per start year, size and combined annual funding value under the Adaptation Fund, Green Climate Fund and the Least Developed Countries Fund and Special Climate Change Fund of the Global Environment Facility, as at 31 August 2022



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. The figure is not based on actual disbursement data because it is not publicly available for every fund. The number of projects for the last two years has changed slightly compared with those reported in AGR2021 due to updates communicated by the funds' secretariats (see Annex 4.C [online]).

In 2020, the AF, GCF and GEF's LDCF and SCCF accounted for 9 per cent of total multilateral adaptation funds (see chapter 3). Hence, the more than 470 adaptation projects form just a small part of implemented adaptation funded through multilateral sources and an even smaller part of all adaptation being implemented globally. In addition to multilateral funds, the top 10 bilateral adaptation finance providers, as determined by OECD DAC data, funded over 2,600 adaptation projects during 2010–2019 (UNEP 2021b). Developing countries also use domestic sources to fund adaptation efforts, although the extent varies with the level of economic development, political priorities and other factors (Pardoe *et al.* 2020; Intergovernmental Panel on Climate Change [IPCC] 2022). For instance, according to national adaptation databases, more than 60 per cent of adaptation actions in South Africa and almost 20 per cent of those in Kenya were domestically funded (see UNEP 2021c).

Adaptation communications, or 'adcoms', are a new source of information submitted under the Paris Agreement. Adcoms can cover a variety of topics including vulnerabilities, support needs, adaptation policies and actions taken (UNFCCC Adaptation Committee 2022). They can be submitted as stand-alone documents or as part of an existing document like a nationally determined contribution (NDC) or national action programme (NAP). By 31 August 2022, 31 developing countries had registered adcoms, 40 per cent of them in the form of new stand-alone documents. These documents report 39 adaptation projects that are additional to those included in figure 4.1. In addition to these projects, adcoms also include numerous actions that do not constitute multi-year projects and thus are not comparable to projects supported by the global funds serving the UNFCCC and/or Paris Agreement. Moreover, a significant proportion of actions are not sufficiently described to allow their size or nature to be determined, preventing meaningful comparison with actions reported by other countries as well as those supported by the global funds serving the UNFCCC and/or Paris Agreement. While this is the case, their inclusion in adcoms demonstrates that additional adaptation actions are being implemented through domestic and other sources. Reporting domestic adaptation actions either through national progress reports or submissions to UNFCCC could become an important new source to complement the global picture of adaptation progress.

4.3 Implemented adaptation actions in developed countries

Most developed countries are in their second, third or fourth cycle of national adaptation planning (see chapter 2). At least 15 of them have already reported on their adaptation progress through implementation reports or evaluations (Leiter 2021). Recently, New Zealand introduced a mechanism for tracking and reporting on adaptation progress, and Canada seeks to develop one together with its first national adaptation strategy (New Zealand, Ministry for the Environment 2022; Lesnikowski and Leiter 2022). Since 2021, European Union member states are required to report biennially on adaptation actions based on a consistent reporting structure (European Environment Agency [EEA] 2022).[3] A review of the first round of reporting found that most European Union member states have actively mainstreamed adaptation into planning and decision-making processes, but many adaptation actions remain limited to capacity-building, and only a few member states have dedicated budgets for adaptation (EEA 2022). A higher proportion of adaptation responses in Europe compared with other global regions consists of technological or infrastructural measures, but evidence of non-incremental adaptation remains scarce (Berrang-Ford *et al.* 2021).

In the absence of a unified database of adaptation actions across developed countries, adcoms have the potential to provide additional information if reported consistently. By 31 August 2022, 14 developed countries had submitted adcoms, 12 of them in the form of stand-alone documents. In total, more than 50 adaptation programmes, actions or initiatives were reported. Although implementation of adaptation in developed countries is increasing, its scale, depth and speed do not yet contend with the increasing climate risks (IPCC 2022).

4.4 Estimating the potential for risk reduction

The 2021 edition of the AGR examined the number and sectoral composition of adaptation projects supported by the top 10 bilateral adaptation finance providers as determined by the OECD DAC during the decade 2010–2019 (UNEP 2021b). This year's implementation chapter explores the complete OECD DAC Climate-Related Development Finance data set which includes adaptation actions of all bilateral climate finance providers and multilateral development banks for the period 2010–2020. In addition to covering their sectoral foci and evolution over time, the chapter also estimates the extent to which these actions target reductions in exposure and vulnerability, which are the key dimensions of risk as defined in the recent IPCC Working Group II *Sixth Assessment Report* (IPCC WGII AR6) as well as much of the literature on disaster risks (UNDRR 2013; Cremen, Galasso and McCloskey 2022; O'Neill *et al.* 2022). Details of the analysis are described in Annex 4.C (online).

On average, only about three out of 10 entries (29 per cent) marked as principal adaptation appear to explicitly address climate risk reduction. The proportion varies between 27 per cent and 37 per cent of the total number of principal adaptation actions annually over the period 2010–2020, while their relative contribution to the total amount of funding is higher, ranging between 38 per cent to 48 per cent (see figure 4.2). Accordingly, actions that directly target climate risk reduction receive a significantly larger average funding volume than the rest (US$3.2 million compared with US$1.9 million). One explanation for this is that the entries in the OECD DAC database cover all types of support, including individual events or studies. This means that not every entry represents a project. Additionally, sectors with a higher risk reduction potential require higher material investments.

3 From 2015, European Union member states had been reporting on adaptation through a scorecard. The respective regulation was updated to biennial reporting in 2018 (European Environment Agency 2022). Country submissions are available on the Climate-ADAPT portal: https://climate-adapt.eea.europa.eu/#t-countries.

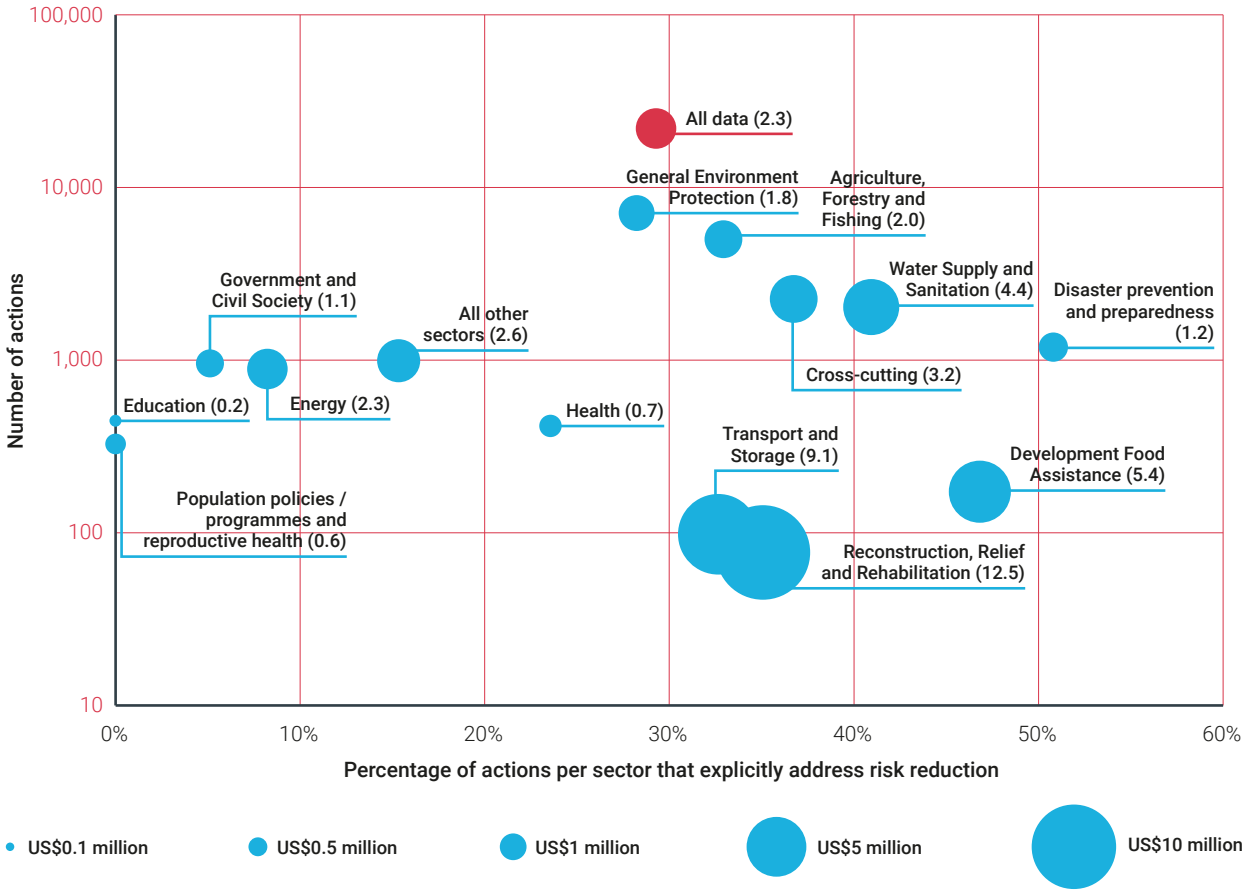
Figure 4.2 Evolution of principal adaptation projects in the OECD DAC Climate-Related Development Finance data set. **Panel A:** The red line reflects the total number of actions and the blue line the proportion targeting the reduction of risk to specific climate hazards. **Panel B:** The red line reflects the total amount of funding per year for all actions and the blue the proportion allotted to actions that reduce climate risk.

Note: Monetary values presented in Panel B are in constant 2020 US$.

Figure 4.3 shows the relationship between the number of actions by sector and the proportion to which they directly address climate risk, which corresponds with the opportunities that sectors offer to reduce exposure and/or vulnerability to concrete climate hazards. For instance, in the disaster preparation, food aid and water sectors, 40–50 per cent of actions are deemed to directly target risk reduction. On the other hand, energy and support to governments and civil society address climate risk in less than 10 per cent of actions, while education and population programmes do not explicitly address climate risk at all due to the connection to climate risk reduction being much less apparent. All other sectors cover the middle ground with a quarter to just over a third of actions directly targeting climate risk. The size of the bubbles reflects the average funding volume of actions in the sectors. Actions in sectors that typically require greater material investments, in particular reconstruction and transport but also water and food aid (due to logistics), have average funding volumes that are significantly above the average (visualized in figure 4.3 by the red bubble). On the side of the sectors with large risk reduction potential, disaster prevention and preparedness stand out in terms of lower average costs per action. Actions that enhance climate preparedness (like early warning or climate information systems, among others), have demonstrated cost-effectiveness in reducing climate risk (IPCC 2022). Increasing adaptation in the health sector, for instance by climate-proofing health infrastructure or developing climate-related action plans (UNEP 2018), could similarly result in cost-effective risk reduction and aligns with the priority of health indicated in most recent NDCs.

The finding that between 50–70 per cent of actions in the OECD DAC database do not provide evidence of targeting risk reduction is striking. For one, it suggests that some of the entries have been incorrectly labelled as "principal adaptation", confirming a common critique of the over-reporting of adaptation actions (e.g. Weikmans *et al.* 2017; UNEP 2021b; Toetzke, Stünzi and Egli 2022). Although the absence of explicit evidence of addressing climate risk does not exclude the possibility that risk reduction still occurs, the magnitude of the finding reinforces the need to improve adaptation reporting and more clearly design adaptation interventions in ways that make risk reduction against current and future climate hazards more likely (see chapter 5 and UNEP 2021b).

Figure 4.3 Number of actions per sector in the OECD DAC database plotted against the proportion to which they explicitly address elements of climate risk. The size of the bubbles reflects the average funding volume per action in US$ million



Notes: The number of actions presented on the x-axis is given in logarithmic scale. Average funding volumes for each sector are reflected in the size of the bubble and denoted in the parentheses included in each label identifying the sectors. Average funding volumes are in constant 2020 US$.

Source: Data taken from OECD (2022)

4.5 Interlinkages between implementing adaptation and mitigation

Adaptation and mitigation have often been implemented separately, but integrated approaches that utilize co-benefits while avoiding trade-offs have been increasingly called for (UNFCCC Adaptation Committee 2020; OECD 2021). This section examines the extent of actions that jointly pursue both objectives and assesses the level of integration among the GCF's cross-cutting projects.

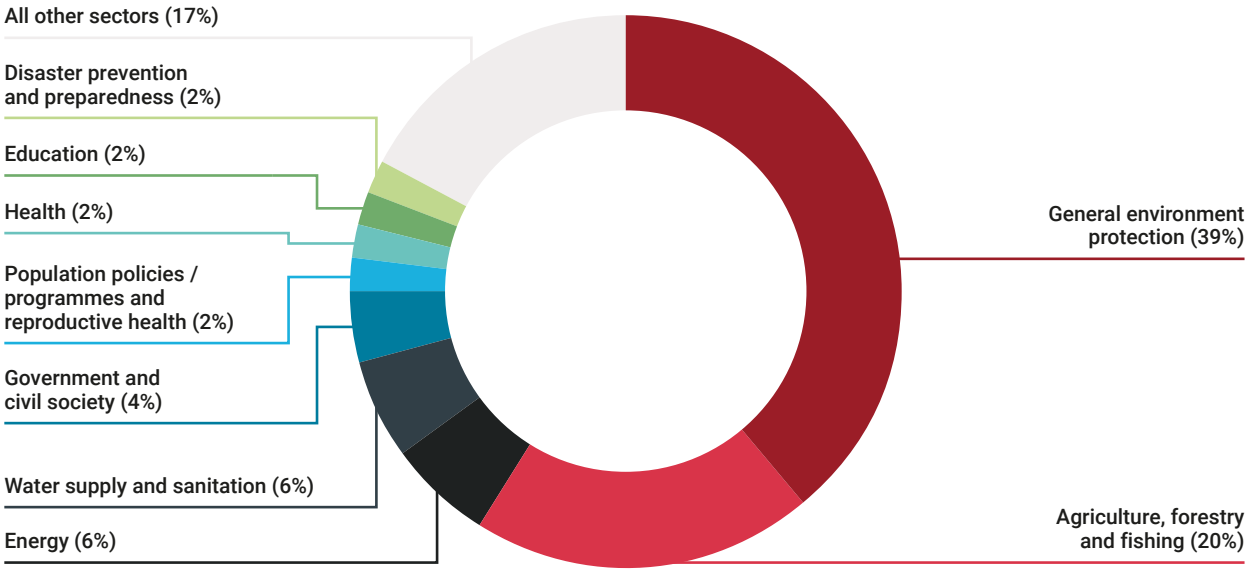
4.5.1 Extent of adaptation–mitigation interlinkages among bilaterally funded activities

Bilateral climate finance providers that report climate finance under the OECD DAC can indicate whether an activity addresses mitigation, adaptation or both, and whether each one serves as the prime motivation for the activity ('principal objective'), an explicit objective among other aims ('significant objective') or no objective (OECD 2016). While the accuracy of self-classification by bilateral climate finance providers has been repeatedly questioned

(Weikmans *et al.* 2017; Cooperative for Assistance and Relief Everywhere [CARE] 2021; UNEP 2021b; Toetzke, Stünzi and Egli 2022), the climate markers provide a rough approximation of the extent to which adaptation and mitigation are jointly addressed.

Out of all the activities during the 2011–2020 period that were marked as addressing adaptation with a principal objective according to the self-classification of bilateral climate finance providers, almost half (47 per cent) were marked as also addressing mitigation, either with a "principal" objective (~34 per cent) or with a "significant" objective (~13 per cent). The sectoral distribution of these cross-cutting projects for the 2011–2020 period is shown in figure 4.4. Almost 40 per cent of entries fall into the category of "General Environment Protection" which likely indicates activities that address climate change in general, such as awareness-raising or climate policy development, rather than integrated approaches aimed at co-benefits. Of the remaining 60 per cent, the sectors "agriculture, forestry and fishing", "energy" and "water supply and sanitation" together account for more than half of the entries, supporting the notion that interlinkages between adaptation and mitigation carry a higher potential in some sectors than in others. Due to the concerns about the quality of the climate markers, further analysis about the degree of integration and trade-offs is required to better understand the practical interactions between these two policy goals.

Figure 4.4 Sectoral distribution of entries in the OECD DAC Climate-Related Development Finance database targeting both adaptation and mitigation for the period 2011–2020

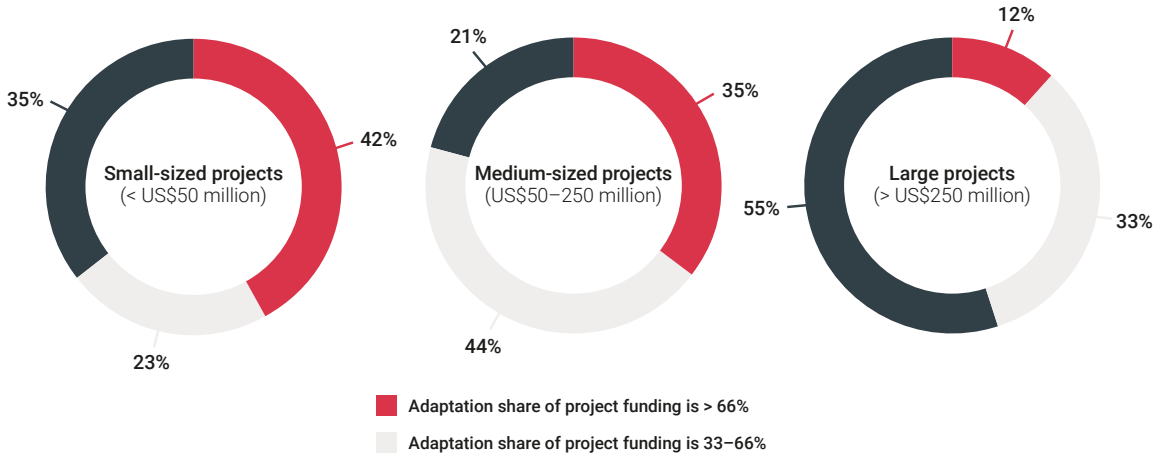


4.5.2 Cross-cutting projects of the Green Climate Fund

Projects funded by the GCF are classified as either mitigation, adaptation or cross-cutting. The latter requires a climate rationale for both adaptation and mitigation and an aligned theory of change (GCF 2020). As at 31 August 2022, the GCF had approved 55 projects jointly addressing mitigation and adaptation, 41 of which were under implementation.[4] Among those under implementation, the adaptation component tends to be larger than the mitigation one in projects up to US$50 million whereas it is typically smaller in projects of the largest size (figure 4.5).

4 This list can be found at: https://www.greenclimate.fund/projects?f[]=field_theme:237.

Figure 4.5 Adaptation share within cross-cutting Green Climate Fund projects



The GCF has defined eight result areas that projects can address, four associated with mitigation and four associated with adaptation.[5] Among the mitigation-associated areas, "Forests and land use" is most commonly involved in cross-cutting projects, almost three times as much as the second most frequent one ("Energy") (see table 4.1). Out of the four adaptation result areas, "Livelihoods" is most commonly involved, followed by "Ecosystems". "Transportation" had the fewest connections with adaptation result areas. These findings imply that certain combinations of sectors or result areas have a higher potential for cross-cutting approaches, while others appear to require an approach that is focused on either adaptation or mitigation.

Table 4.1 Combinations of mitigation and adaptation result areas of cross-cutting Green Climate Fund projects (excluding result areas with contributions below 10 per cent of the total funding volume of a project)

Result areas		Mitigation			
		Transport	Buildings	Energy	Forests
Adaptation	Infrastructure	4	7	3	3
	Health	0	2	7	15
	Ecosystems	0	1	4	26
	Livelihoods	2	5	10	26

Note: The figures presented in table 4.1 denote the amount of times cross-cutting GCF projects are marked as being relevant to a specific adaptation results area and a specific mitigation results area. There are 41 cross-cutting GCF projects in total, however as these projects are typically relevant to multiple results areas – the total number of occurrences for each results area can exceed 41.

Among the 41 cross-cutting projects already under implementation, a higher proportion focuses more on adaptation than on mitigation (~41 per cent compared with ~17 per cent), while 42 per cent address both to a similar extent (table 4.2).

A qualitative analysis of the way adaptation and mitigation interact was also undertaken (see Annex 4.C.3 [online]). It found that in 64 per cent of the 41 projects, mitigation and adaptation actions reinforced each other, meaning a higher chance for co-benefits. In 22 per cent of the projects, activities were linked to the same hazards, problems or locations, but the actions as such were not directly connected. In 14 per cent of the 41 projects categorized as cross-cutting by the GCF, mitigation and adaptation measures appeared to be separate from each other to the extent that they could have been separate projects. The concept of net-zero climate-resilient development, as outlined in the the recent IPCC WGII AR6 (Schipper *et al.* 2022), appeared as a useful basis for projects to elaborate an integrated approach that fosters co-benefits.

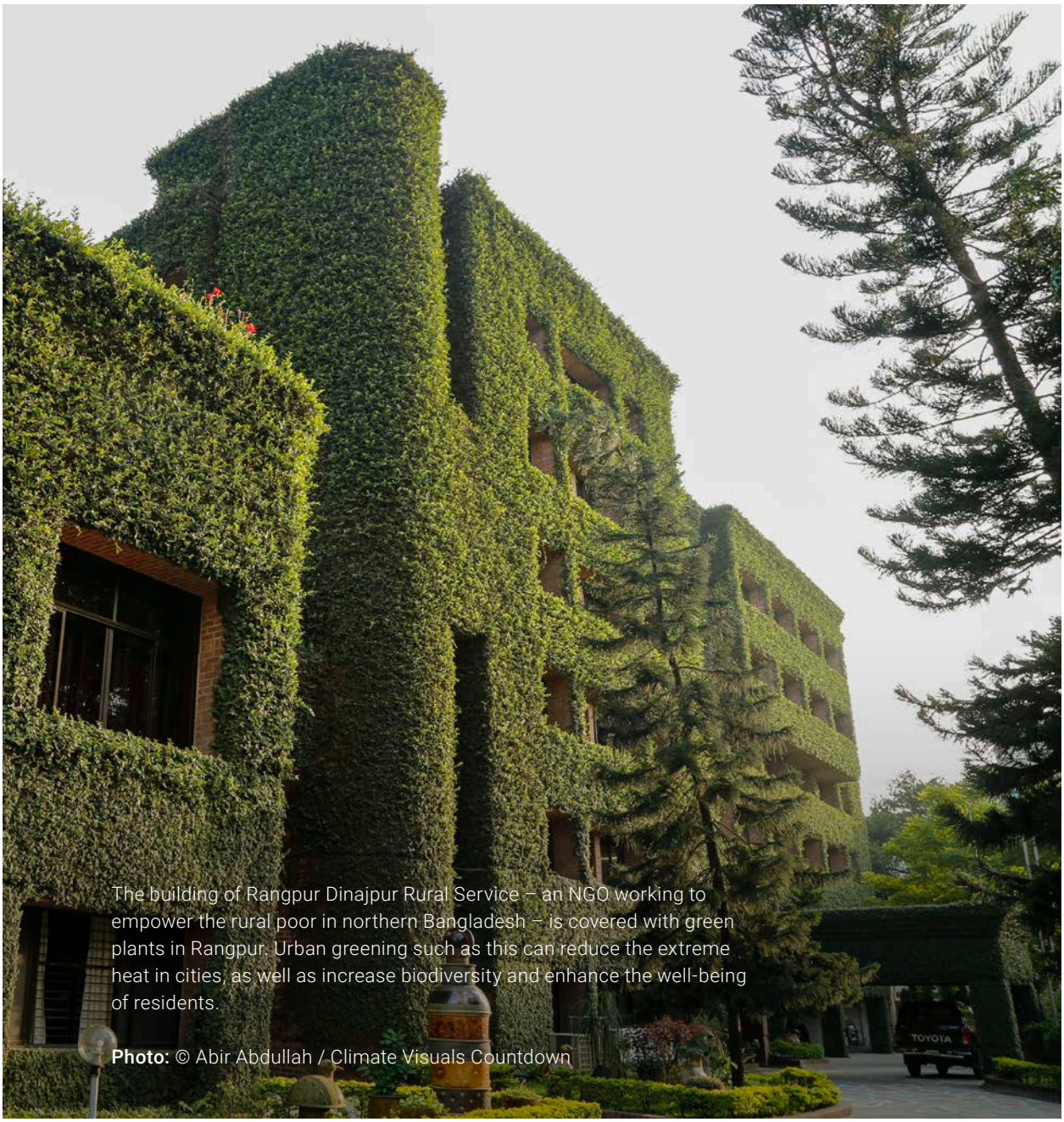
Trade-offs are not required to be discussed in GCF's project template. Indeed, they are rarely mentioned by the cross-

5 See: https://www.greenclimate.fund/themes-result-areas.

cutting project proposals even though the literature has identified trade-offs in similar projects/cases (Schipper *et al.* 2022). Failing to consider trade-offs could harm the achievement of one or both policy objectives. Moreover, in line with the analysis presented in AGR2021, the climate rationale provided in GCF project descriptions was typically better elaborated for mitigation than it was for adaptation.

Table 4.2 Relative proportion of mitigation and adaptation in cross-cutting Green Climate Fund projects

Type of cross-cutting project	Proportion among GCF cross-cutting projects under implementation (41 projects)
Mainly mitigation with adaptation co-benefits	6%
More mitigation than adaptation	11%
Mitigation and adaptation to a similar extent	42%
More adaptation than mitigation	22%
Mainly adaptation with mitigation co-benefits	19%



The building of Rangpur Dinajpur Rural Service – an NGO working to empower the rural poor in northern Bangladesh – is covered with green plants in Rangpur. Urban greening such as this can reduce the extreme heat in cities, as well as increase biodiversity and enhance the well-being of residents.

Photo: © Abir Abdullah / Climate Visuals Countdown

5

Chapter 5

Effectiveness of adaptation

Lead authors: Chandni Singh (Indian Institute for Human Settlements), Nick Brooks (Garama 3C and University of East Anglia), Henry Neufeldt (United Nations Environment Programme [UNEP] Copenhagen Climate Centre)

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Amazonian women in Quito, Ecuador during the mobilization for International Women's Day, March 8, 2020.

Photo: © Karen Toro / Climate Visuals Countdown

Key messages

- Current adaptation practice falls woefully short of what is required, in both nature and extent. Adaptation actions remain largely incremental in nature, typically do not address future risks from climate change, and may reinforce existing vulnerabilities or introduce new risks (maladaptation), particularly for the most vulnerable, by inadequately involving stakeholders, retrofitting development activities as adaptation, and not paying sufficient attention to local contexts and power dynamics.
- Data availability on the effectiveness and adequacy of adaptation is poor, especially for higher warming levels. However, hybrid solutions addressing multiple dimensions of climate-related risks and underlying structural inequities – such as gendered disadvantages, perverse incentives and the root causes of vulnerabilities – are typically more effective and supportive of climate-resilient development.
- Deliberately using plural metrics that reflect different dimensions and normative goals to assess adaptation effectiveness and adequacy over space and time is key to understanding longer-term outcomes, in particular related to synergies and trade-offs with the Sustainable Development Goals (SDGs) and mitigation. However, this is not common practice.

5.1 Introduction

As climate change accelerates further due to rising emissions, adaptation is inevitably about sustaining and improving human and ecological well-being in the face of potentially harmful climate change impacts, and securing sustainable development outcomes in the face of these impacts (Beauchamp *et al.* 2022). Therefore, the effectiveness of adaptation will ultimately be measured in terms of the extent to which reduced risk results in improved human and ecological well-being and development outcomes (relative to a 'no-adaptation' baseline) in the context of changing climatic conditions and evolving climate hazards (Owen 2020; Brooks and Fisher 2014). However, attempts at such measurement are rare due to data constraints, the challenges of linking well-being and development metrics with climate information to track adaptation over appropriate timescales, and the lack of well-established methodologies.

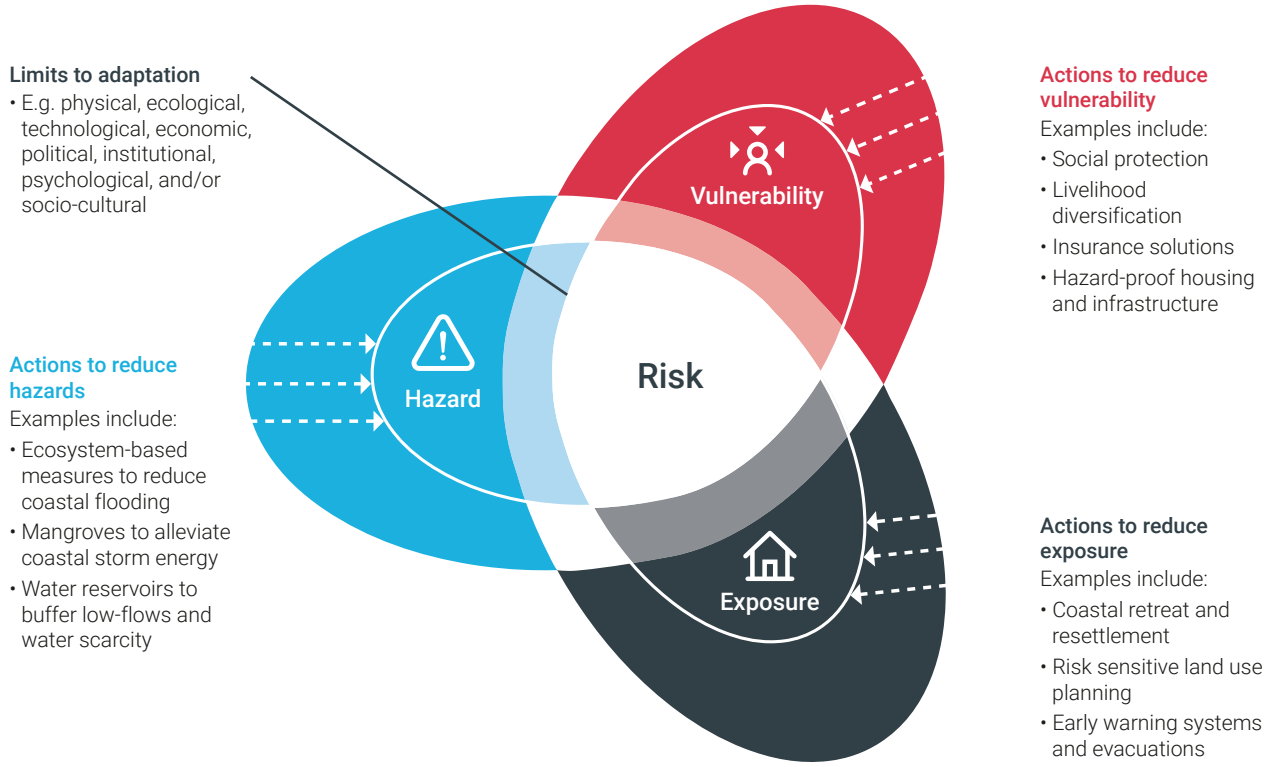
Changes in well-being and the achievement of successful development outcomes in the face of climate change can be viewed as the results of a host of actions to reduce the risks that climate change poses to individuals, human and natural systems. The Intergovernmental Panel on Climate Change (IPCC) defines climate risk as a function of exposure and vulnerability to climate hazards (O'Neill *et al.* 2022) (figure 5.1), all of which are affected by ongoing adaptation and mitigation responses. Reducing exposure, vulnerability or both to a climate hazard, or reducing the climate hazard (primarily through mitigation), will thus reduce climate risk. Whether or not the adaptation action leading to the reduction in climate risk is adequate to meet the challenges of current and future climate impacts depends on the state and trajectory of climate hazards at any given location. Effectively reducing climate risk can therefore be understood as locally limiting exposure and/or vulnerability to climate hazards. Where it is not possible or practical to assess adaptation effectiveness in terms of its longer-term consequences for human and ecological well-being and the achievement of development outcomes, changes in exposure and vulnerability provide us with useful proxies for assessing risk reduction.

Many adaptation interventions are intended to reduce exposure or vulnerability, or to enhance the adaptive capacities of people and systems to shocks and stresses associated with climate and other hazards. This may be pursued directly, through risk reduction measures that target specific hazards, risks and impacts, or indirectly, through capacity-building, policy or governance mechanisms. Increasingly, it is being recognized that adaptation requires more transformative, system-wide changes that address the root causes of vulnerability. These

are often linked to political and economic marginalization, exclusion of vulnerable groups (e.g. indigenous peoples, local communities, women, persons with disabilities) and structural inequalities associated with power relations within and between countries (Eriksen *et al.* 2021; Scoones *et al.* 2020; Feola 2015; Tschakert *et al.* 2013). Addressing these factors may not directly reduce risk, but may be necessary if the conditions for just, effective and sustainable adaptation actions are to be established.

Notably, not all adaptation leads to positive outcomes, and there is growing evidence of 'maladaptation', i.e. the unintended negative consequences of adaptation (Schipper 2020; Juhola *et al.* 2016; Gajjar, Singh and Deshpande 2019; Magnan *et al.* 2016). For example, actions taken to address climate risks in one place may have consequences elsewhere (e.g. a dam to regulate flood risk may lead to water shortages downstream) and thus may do more harm than good.

Figure 5.1 Risk as defined by the IPCC



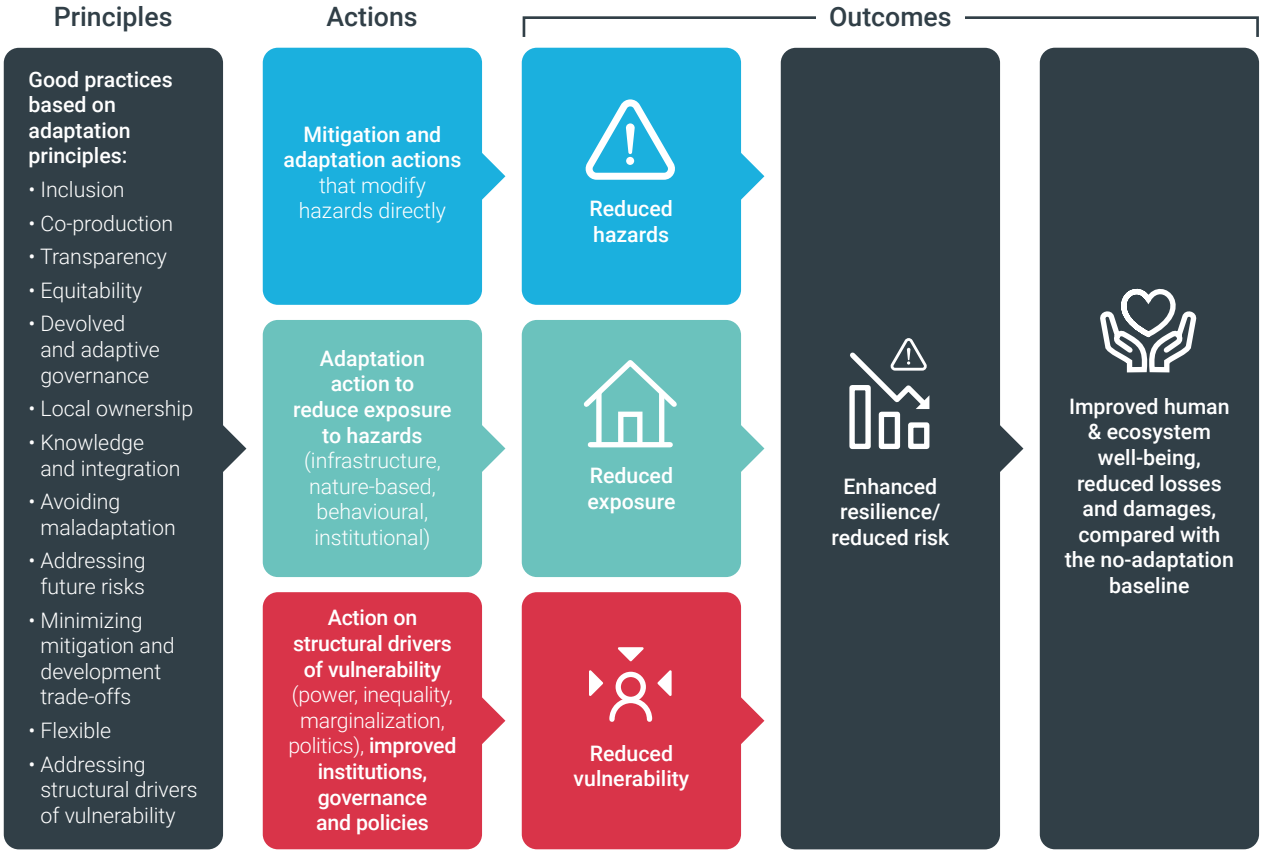
Notes: The figure shows risk as a function of climate hazards, exposure and vulnerability. Adaptation and mitigation actions can modify hazards, while adaptation actions can also reduce exposure and vulnerability.

Source: Abram *et al.* (2019)

Ultimately, the effectiveness of adaptation will only be demonstrated through long-term trajectories of human and ecological well-being, and the extent to which the SDGs and related outcomes are achieved in the face of climate change (Beauchamp *et al.* 2022). However, on shorter timescales, the likelihood of effective adaptation can be inferred through assessments of exposure, vulnerability and resilience. Other metrics such as losses and damages may also be employed to assess actual or anticipated risk outcomes (Birkmann *et al.* 2022). Adaptation interventions may be evaluated against adaptation principles (e.g. Brooks *et al.* 2019a; Soanes *et al.* 2021; Singh *et al.* 2021) representing best practice, to assess whether they are consistent with best practice and have adequately considered the root causes of vulnerability, future climate risks and impacts, and possible maladaptation.

Finally, the role of climate change mitigation in attenuating hazards and thereby overall risk cannot be ignored. The greater the magnitude of warming, the greater the likelihood that climate change impacts will overwhelm human and ecological systems, rendering adaptation insufficient and ineffective and leading to hard adaptation limits. Strong mitigation is therefore the best way of ensuring there is space for adaptation to remain feasible and effective.

Figure 5.2 An 'architecture' of risk reduction, including principles, actions and outcomes that can be used as a basis for assessing actual or likely adaptation effectiveness



The 'architecture' of actions and outcomes related to successful risk reduction provides a framework for identifying entry points for interrogating actual and likely adaptation effectiveness (figure 5.2). The remainder of this chapter uses this framework to synthesize what can be said about the effectiveness of adaptation and its measurement for a policy-oriented audience. The following section (5.2) uses case studies illustrating adaptation outcomes over time and space. This is followed by section 5.3 which addresses gaps and shortcomings in adaptation practice in terms of risk reduction and its measurement and section 5.4 which presents principles of effective adaptation. The chapter ends with a set of key messages and recommendations (section 5.5).

5.2 Illustrating adaptation outcomes over time and space

Using five illustrative cases that capture different regions, risk types and combinations of adaptation actions, this section assesses the positive, neutral and negative outcomes of adaptation actions qualitatively (table 5.1[1]). The case studies considered are heat action plans in North America, flood risk management in Western and Central Europe, climate-smart agriculture in West Africa, infrastructural adaptation in small island developing states (SIDS) and planned relocation in South and South-East Asia (individual descriptions of these case studies are provided in Annex 5.A [online]).

Each case focuses on a particular climate hazard (e.g. flooding, extreme heat) and has a clear set of adaptation strategies being implemented. The effectiveness of these implemented actions is assessed in terms of (1) their implications on reducing risks for human and ecological systems; (2) whether risk reduction is equitably distributed; (3) how effectiveness changes over time; (4) whether there are any reported trade-offs with climate mitigation goals; (5) contextual factors shaping effectiveness; and (6) potential limits to adaptation. Key findings are summarized in table 5.1.

1 A more detailed version of this table (table 5.A.1) is provided in Annex 5.A (online).

Table 5.1 Summary of the five illustrative cases assessed in section 5.2

Climate risks	Adaptation	Effectiveness outcomes (positive, negative, neutral, mixed, insufficient evidence)				Mitigation	Context specificity	Adaptation adequacy and limits
		For vulnerable people	For at-risk ecosystems	For goals of equity, gender justice	Over time			
Heat, heatwaves	Heat action plans in North America	Mostly positive	Insufficient evidence, potential for modest or positive	Mixed	Positive	Mixed	The efficacy of heat alerts depends on targeting vulnerable populations, support for action, behaviour change and local climate conditions. Urban greening is broadly effective but contextual (e.g. greening parking lots is more effective in high-rises than green roofs on low-rise buildings). Air conditioning is consistently and highly effective in reducing mortality across contexts.	Benefits of typical actions in heat action plans (e.g. urban greening, early warnings) may become insufficient unless they are widespread and extensive and combined with changes in labour laws, building codes and transformative urban planning. Air conditioning is highly effective, even at very high temperatures, though incurs substantial and potentially prohibitive cost, equity and mitigation trade-offs.
Riverine, inland floods	Flood risk management in Western and Central Europe	Mixed	Mixed	Mixed	Mixed	Mixed	Effectiveness depends on geographical location, type of flood hazard, people exposed, prior investments in adaptation and current levels of vulnerability. The effectiveness of early warning systems depends on timing, severity and usability of warnings.	Damages can be significantly reduced even at higher warming (2–4°C) if high levels of adaptation are implemented. However, even when multiple options are implemented, risk of flooding will remain.
Drought, rainfall variability	Climate-smart agriculture in West Africa	Mixed	Positive	Mixed	Insufficient evidence, with potential for positive	Positive	The effectiveness of climate-smart agriculture largely depends on the agroecological conditions, farm size, and intervention type.	Climate-smart agriculture builds capacities to deal with hazards at current warming. However, there is insufficient evidence about how it performs at higher warming levels and how compound hazards might potentially lead to limits being reached early.
Coastal flooding	Infrastructural adaptation in SIDS	Mixed	Negative	Not assessed	Negative	Negative	The effectiveness of infrastructural adaptation depends on rates of sea level rise, type of infrastructure, and the existence of other interventions such as mangrove restoration and building codes.	At higher levels of sea level rise, sea walls will eventually become unaffordable and impractical.
Cyclones	Planned relocation in South/South-East Asia	Mixed	Insufficient evidence, slightly negative	Mixed	Insufficient evidence, mostly mixed	Insufficient evidence	The effectiveness of planned relocation depends on conditions under which relocation is undertaken (agency over decisions to move) and the destination conditions where people are being relocated.	In most low-lying coastal areas, planned relocation is a last resort strategy and due to a combination of hazards (e.g. cyclones, coastal flooding, soil salinization). At higher levels of warming, in some areas, planned relocation will be the only effective strategy but there is high uncertainty about when limits will be reached.

Notes: The table presents how each of the assessed adaptation activities are effective for people, ecosystems and equity (including gender). Existing adaptation actions have mostly mixed outcomes that are highly risk- and context-specific. In all cases, there is insufficient evidence about the adequacy of these but soft limits to adaptation are reached or being approached. A more detailed version of this table (table 5.A.1) is provided in Annex 5.A (online). Please refer to this table to see explanations of why effectiveness outcomes in this table were allocated as well as expanded descriptions of the context specificity of each approach presented in this table and their adequacy and limits.

Each risk tends to have suites of adaptation interventions being implemented, with differing but potentially complementary risk reduction outcomes. For example, flood risk management in Western Europe has a suite of adaptation interventions, from infrastructural solutions such as building dams and dikes to nature-based solutions (NbS) such as bioswales and water harvesting, and institutional solutions such as flexible/adaptive and long-term decision-making, all with differing levels of effectiveness in reducing risk.

The case study from adapting to extreme heat in North America also finds that heat action plans are broadly effective in reducing the health impacts of extreme heat, though effectiveness depends on the types of actions and implementation processes. To illustrate, heat risk reduction measures are estimated to reduce heat-related deaths by up to 19 per cent in the United States of America (Lim and Skidmore 2020). However, heat alerts and education do not necessarily translate into individual behaviour to decrease heat exposure, (Hasan *et al.* 2021; Toloo *et al.* 2013) and early warning systems appear more effective where heat alerts trigger an institutional response (e.g. outreach to vulnerable populations, mobilization of social and health care, coordination of response services) (Benmarhnia *et al.* 2019; Weinberger *et al.* 2018). The risk reduction potential of an adaptation action depends greatly upon local contexts: to be effective, the threshold at which early warning systems trigger an alert needs to be specific to the heat tolerance of the local population (Davis *et al.* 2003; Kalkstein and Sheridan 2007).

Adaptation that reduces risk is not necessarily inclusive. Climate-smart agriculture initiatives across sub-Saharan Africa have invested in providing early-maturing or drought-tolerant crop varieties, developing and disseminating seasonal forecasts, improving irrigation infrastructure, and restoring soil health, all of which reduce exposure to – and build capacities to deal with – the hazard of unpredictable rainfall and water scarcity. Together, these strategies have helped increase household income and nutritional intake, strengthened local agriculture supply chains and provided better risk insurance cover (Partey *et al.* 2018; Nyasimi *et al.* 2014). Yet smallholder farmers' adoption of these technologies is often hindered by their availability and affordability (Senyolo *et al.* 2018; Zerssa *et al.* 2021). To be effective, enabling conditions must be created alongside the adaptation measures.

Adaptation effectiveness depends on which metrics we use. As Singh *et al.* (2021) show, utilitarian metrics tend to focus on costs versus benefits, whereas equity and justice-based framings of effective adaptation tend to highlight outcomes for procedural, recognitional and distributive justice – i.e. who is benefiting and how are they included/excluded. For instance:

- In the health sector, adaptation effectiveness is most commonly understood through reduced risk of loss of life (e.g. heat action plans tend to focus on reduced heat mortality) (Lim and Skidmore 2020), with less attention given to other health-related metrics or the drivers of inequality that in turn affects health outcomes.

- The SIDS case shows that a cost/benefit approach to effectiveness of sea walls fails to consider non-economic benefits such as place attachment, community relationships, livelihoods and spiritual and cultural significance of locations, which would justify sea walls for smaller communities (McNamara, Westoby and Smithers 2017; Crichton and Esteban 2018).

- The planned relocation case from Asia discusses how post-disaster relocation might reduce exposure to hazards but deepen gendered inequities through unsafe housing, precarious livelihoods, increased care work for women, and so forth (Jain, Singh and Malladi 2021). This lack of use/acknowledgement of other metrics to assess effectiveness tends to lead to an incomplete understanding of adaptation outcomes and, more seriously, a dangerous underestimation of possibly maladaptive outcomes.

Hybrid solutions are more effective than single interventions. Most of the case studies report a suite of strategies being implemented to reduce vulnerability and exposure. There is emerging consensus that a combination of strategies, especially bringing together infrastructural, nature-based and institutional solutions, tend to be more effective than single interventions (Dodman *et al.* 2022; Glavovic *et al.* 2022; Bednar-Friedl *et al.* 2022). For example, to reduce coastal flooding risk, hybrid solutions such as built infrastructure, NbS such as mangrove restoration, and institutional interventions such as restricted building and coastal development in hazard-prone areas are more effective than individual options alone (Glavovic *et al.* 2022; Waryszak *et al.* 2021; Sutton-Grier, Wowk and Bamford 2015).

Data availability on adaptation adequacy is poor, especially for higher warming levels and for specific risks that are very complex (e.g. drought and rainfall variability), but there is clear evidence that single adaptation interventions are less adequate than bundles of interventions. Further, adequacy is context-dependent (e.g. adequacy of the same heat action plans can be different in different populations acclimatized to different levels of heat). However, as expected, at higher warming levels, adaptation adequacy declines and the rate and quantum of reduction is unknown based on current evidence. To be adequate, adaptation needs to incorporate future climate risks that are relevant to the sectors or systems (e.g. the typical duration of infrastructure or of sector planning cycles).

5.3 Addressing gaps and shortcomings in adaptation practice

Many adaptation interventions fail to reduce risk or are maladaptive, meaning they inadvertently increase risk by reinforcing, redistributing or creating vulnerability because of the way they are conceived, designed and implemented (Magnan 2014; Juhola *et al.* 2016, Schipper 2020; Eriksen *et al.* 2021; Bakaki 2022). This section discusses factors that result in such maladaptation and ways of addressing them, drawing heavily on a review conducted by Eriksen *et al.* (2021), summarizing them into seven elements that capture the essence of a literature review on the topic. A more comprehensive version of the analysis presented here is provided in Annex 5.B (online).

Entrenching existing power relations. Adaptation interventions driven by external climate finance providers often rely on existing partnerships and networks, meaning that adaptation resources are channelled to the same groups, which tend to be those most capable of engaging with climate finance providers and their proxies. This may result from logistical and political pragmatism, and a desire for efficient implementation, but it can reinforce existing systems of power and influence dominated by particular elite groups. Interventions can consequently result in elite capture and the exclusion of the poorest, most vulnerable and most marginalized (Eriksen *et al.* 2021). These groups are likely to have the least capacity to engage and may be difficult to reach due to factors such as geographic isolation. Adaptation interventions need to be based on engagement with a diverse range of actors, beyond those sections of society that are readily accessible and have high capacity to engage. They need to pay close attention to the needs of poor, vulnerable and marginalized groups to avoid entrenching inequality and exacerbating vulnerability.

Inadequate attention to local contexts. Interventions driven by external actors may fail to understand or account for specific factors driving vulnerability that are related to local contexts and political economy, particularly where interventions are highly technocratic in nature (Nightingale *et al.* 2020). Such interventions may undermine local adaptation responses that are more environmentally, financially and politically sustainable (Eriksen *et al.* 2021). Local ownership of adaptation actions and genuine local participation in adaptation design and implementation are critical to avoid such pitfalls (Soanes *et al.* 2021).

Neglecting the root causes of vulnerability. People's vulnerability to climate and other hazards is often described in terms of capacity, assets, access to resources and services, livelihoods, and other factors related to socioeconomic status. However, vulnerability is ultimately driven by large-scale political and economic conditions, related to power, ideology and structural inequalities. Interventions that ignore these root causes of vulnerability are likely to be limited in their effectiveness and sustainability. While addressing these structural factors is extremely challenging, greater diversity, inclusion and actions to enhance the agency of those whose voice is already heard may help create the conditions for the more transformational changes required for effective adaptation (Soanes *et al.* 2021; Singh *et al.* 2021).

Retrofitting development activities as adaptation. Adaptation resources are often used to support existing development activities and priorities, particularly where this can be justified on the grounds that such activities are 'climate-sensitive'. This tends to result in highly incremental approaches to adaptation that do not address the extent to which existing systems and practices may or may not be viable under future climatic conditions (Gajjar, Singh and Deshpande 2019; Berrang-Ford *et al.* 2021). These approaches often emphasize general measures to reduce vulnerability and enhance resilience that pay little attention to how specific hazards are evolving, for example in terms of magnitude, duration and frequency (Venable, Brooks and Vincent 2022). Measures to address general vulnerability and resilience to a range of hazards need to be complemented by measures to address specific hazards and risks (e.g. through reduced exposure) and vice versa (IPCC 2022; Bednar-Friedl *et al.* 2022).

Short-term focus and neglect of future climate risks. Retrofitting development as adaptation, and the desire to deliver immediate development benefits ('quick wins'), means that adaptation often focuses on current and near-term risks but fails to consider how such risks might evolve over time. The resulting incremental approaches are inadequate for addressing potentially large and even existential risks that are likely to arise in the foreseeable future. Adaptation strategies need to be underpinned by assessments of the viability of existing systems and practices under potential future climatic conditions through approaches that can identify robust strategies in the context of uncertain future risks (Brown *et al.* 2012; Daron 2015; Ray and Brown 2015; Bhave *et al.* 2016).

Narrow definitions of adaptation effectiveness. A major shortcoming in current adaptation practice is the ambiguity regarding what constitutes effective and successful adaptation. Such success tends to be defined in very narrow terms by climate finance providers and multilateral organizations, neglecting diverse views regarding the purpose and effectiveness of adaptation among those targeted by adaptation interventions (Adger, Arnell and Tompkins 2005; Weiler, Klöck and Dornan 2018). While adaptation is generally motivated by a desire to reduce climate change risks and impacts, it is increasingly recognized that effective adaptation must encompass concepts such as social transformation and climate justice, and that attention to such issues may be a prerequisite for reducing more tangible risks in many contexts (Singh *et al.* 2021).

Inadequate metrics. The performance of adaptation interventions tends to be measured using metrics relating to the number of people receiving support or adopting specific technologies or practices, based on the assumption

that such support and adoption will enhance resilience. However, such assumptions are often based on scant or contested evidence, particularly in relation to uncertain future risks. Metrics relating to economic well-being, development outcomes, and losses and damages are also used as proxies for adaptation success. For example, the Adaptation Fund includes a core impact indicator measuring "increased income or avoided decrease in income" (Adaptation Fund 2019: 2). The Green Climate Fund (GCF) includes a core indicator measuring "change in expected losses of economic assets due to the impact of extreme climate-related disasters in the geographic area of the GCF intervention" (Green Climate Fund 2021: 10). However, the measurement of such metrics, and their interpretation in the context of information on involving climate hazards, remains extremely challenging (Brooks *et al.* 2019a).

At the more local scale, adaptation effectiveness is often measured using indicators of vulnerability or resilience. Vulnerability indicators tend to be much more diverse and context-specific, focusing on capacities, capabilities, assets, access to resources and services, livelihoods, income, socioeconomic status, and a variety of contextual factors (e.g. Food and Agriculture Organization of the United Nations 2016; Venable, Brooks and Vincent 2022). Resilience indicators represent the characteristics and capacities of systems that make them better able to anticipate, absorb/accommodate, recover from, and adapt to evolving hazards (Bahadur *et al.* 2015; Brooks *et al.* 2019b).

Challenges remain in relation to the selection, validation and interpretation of vulnerability and resilience indicators, particularly where these are based on secondary data that may not capture important contextual factors. Furthermore, incremental improvements in vulnerability and resilience need to be interpreted very carefully in terms of what they tell us about a system's ability to accommodate a specific hazard (Venable, Brooks and Vincent 2022). This might be addressed through greater use of the concept of the 'coping range', or the range of values in a variable representing the magnitude of a hazard (e.g. extreme temperature, river level) that a system can accommodate without experience significant harm (European Commission 2013).

Assessment of adaptation effectiveness needs to examine the extent to which adaptation actions address both the drivers of vulnerability and the capacity of target systems and populations to manage risks associated with well-defined (current and future) hazards. The limitations of quantitative metrics mean that typical indicator-based approaches need to be complemented with more qualitative approaches, including process-based approaches and approaches based on narratives and stakeholder feedback (Venable, Brooks and Vincent 2022).

5.4 Principles for effective adaptation

A variety of organizations and authors have proposed general adaptation principles that address the aforementioned gaps and shortcomings, and to ensure that adaptation actions are relevant, appropriate, sustainable, equitable and effective. These principles are based on relevant literature and summarized in box 5.1 (these sets of adaptation principle are provided in full in table 5.C.1 in Annex 5.C [online]). Attention to these principles in the design, implementation and assessment of adaptation interventions represents another approach to reducing risk by embedding good practice in adaptation, and thus increasing the likelihood that interventions will be sustained, adequate and effective. There is a large degree of overlap between the above-mentioned sets of principles, most if not all of which emphasize issues such as inclusion, transparency, co-production of knowledge and solutions, support for the most vulnerable, and the need to address inequality and structural drivers of vulnerability.

For example, the International Institute for Environment and Development (IIED) developed Article 7 principles that emphasize the need to combine local, traditional and indigenous knowledge with scientifically informed risk assessments to ensure local relevance and ownership of adaptation interventions while also enhancing adaptation ambition (Brooks *et al.* 2019a). The locally led adaptation principles, also developed by IIED, emphasize devolved decision-making, and longer-term, flexible funding that moves away from dependence on external climate finance providers (Soanes *et al.* 2021). The power-sensitive design principles, published by Vij *et al.* (2021), emphasize empowerment, dialogue and multi-actor coalitions. Principles published by Singh *et al.* (2021) emphasize justice and equity, ecological approaches, and the need to anticipate unintended consequences (maladaptation) and long-term impacts.

The integration of local, traditional and indigenous knowledge into adaptation design, implementation, monitoring, evaluation and learning can enhance local buy-in and ownership of adaptation actions, thus increasing the effectiveness of risk reduction and the likelihood that these actions will deliver benefits that are sustained beyond the end of an intervention's lifetime (Leal Filho *et al.* 2022; Zvobgo *et al.* 2022). Integrating local and indigenous knowledge into monitoring, evaluation and learning systems can improve the tracking of adaptation outcomes and related phenomena (e.g. climate trends and changes in hazard behaviour and associated impacts) and enhance useful learning (Barratt and Bosak 2018).

Such integration also expands definitions of adaptation effectiveness and 'success', which otherwise risk being narrowly defined in terms of the economic and development priorities set by climate finance providers. More pluralistic approaches based on genuine inclusion and co-production can also encourage the use of a wider range of metrics to assess adaptation effectiveness and the extent to which it is equitable (e.g. addressing structural and gendered vulnerabilities), and to guard against maladaptation by addressing key gaps in current practice.

Principles related to risk assessment, the consideration of future risks, and building the capacity of stakeholders to understand these risks and engage with external actors are essential if adaptation is to address challenges associated with large and potentially existential risks.

Box 5.1 Synthesis of principles for best adaptation practice

- Genuine inclusion of stakeholders, local communities, women and marginalized groups (e.g. indigenous peoples) into decision-making and co-development of adaptation planning and implementation to reflect differing values, perspectives and interests and produce equitable, fair and just adaptation outcomes
- Transparency, accountability and predictability of support and integration of adaptation into national development priorities, strategies and the SDGs
- Flexible programming and adaptative management of implementation to consider feedback and learnings and to enhance efficiencies
- Investment in local capabilities, capacity-building and democratic governance structures in support of climate risk management and empowerment for long-term sustainability
- Consideration of future risks including climate trajectories and uncertainties to minimize unintended consequences and maladaptation, while enhancing adaptation ambition
- Integration of local, traditional, indigenous and scientific knowledge into design, implementation and monitoring and evaluation to enhance buy-in and ownership
- Tackling inequalities and structural drivers of vulnerability in addition to reducing exposure and/or vulnerabilities to climate hazards to embark on climate-resilient development pathways

Sources: Brooks *et al.* (2019a), Soanes *et al.* (2021), Vij *et al.* (2021) and Singh *et al.* (2021).

5.5 Conclusions and recommendations

Shortcomings in approaches to resilience building and the reduction of exposure and vulnerability mean that adaptation is currently inadequate to deliver the reductions in risk that will be required to confront the impacts of warming consistent with, and very likely in excess of, the temperature goals of the Paris Agreement. With the exception of certain infrastructural contexts, resilience- and vulnerability-based approaches tend to be rather vague and general in nature and focus on existing climate risks, lacking the ambition required to achieve the transformations that are needed to confront uncertain – but potentially very large – future climate change impacts. There is an urgent need to enhance adaptation ambition to address such future risks, and action is required now to plan for large and potentially existential risks in certain geographical contexts.

Adaptation needs to be better informed by quantitative and qualitative assessments of current and potential future climate hazards. It must be based on robust decision-making that is informed by climate projections but that also considers 'unknown unknowns' and avoids simplistic 'predict then act' approaches. However, for adaptation to be just, equitable, effective and sustainable, it also needs to be 'owned' by those it is intended to benefit. This requires the genuine co-production of adaptation actions by coalitions of stakeholders that blend scientific expertise with local, traditional and indigenous knowledge and perspectives.

Currently, assessment of adaptation effectiveness is heavily focused on metrics such as the number of people supported and adoption of specific technologies and techniques, based on the assumption that such support and adoption will enhance resilience and reduce risk. However, whether

this is the case is rarely tested. Other metrics include avoided losses and deaths, although generally these are not measured in relation to climate hazards.

Risk reduction – and hence adaptation effectiveness – may be assessed retrospectively in terms of observed changes in human and ecological well-being, the achievement (or otherwise) of desired development outcomes, and losses and damages associated with climate change impacts. It may also be assessed in a predictive fashion, based on anticipated changes in these metrics, or on changes in exposure and vulnerability, measured using appropriate quantitative or qualitative data. This may extend to the creation of enabling environments and actions to address the underlying, structural drivers of vulnerability and tackle maladaptation in the context of climate-resilient development.

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Chapter 6

Synthesis on global adaptation progress

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The 'Ecosystem-based Adaptation South' project seeks to help the Seychelles, Nepal and Mauritania to adapt to climate change, in part by restoring natural habitats across all types of ecosystems. In the Seychelles, on-the-ground ecological restoration will rehabilitate 29 hectares of mangrove and wetland forests, thus providing natural flood barriers. Learn more about this project here.

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6.1 Overarching takeaways: are current adaptation efforts making a difference?

- **Accelerating global warming puts countries at serious risk of experiencing adaptation limits and intolerable risks.** There are two major implications of this. First, urgently scaling up greenhouse gas (GHG) emissions reductions in order to limit global mean temperature rise to 1.5°C (Intergovernmental Panel on Climate Change [IPCC] 2022b; UNEP 2022) is vital to avoiding most hard adaptation limits. Second, ambitious adaptation needs to go beyond incremental action, contributing much more to raising socio-ecological system resilience (IPCC 2022a).

- **Adaptation planning, finance and implementation continue to rise steadily.** The volume and share of international climate adaptation finance to developing countries is growing (currently US$28.6 billion i.e. about 34 per cent of the total climate finance to date). 84 per cent of countries now have national-level planning instruments, which are becoming increasingly inclusive (e.g. of gender and equity issues), and more and larger projects targeting adaptation are starting in an increasing number of sectors.

- **Climate risks also are expected to rise.** Current scientific evidence warns of climate risks intensifying, lasting longer and occurring both sooner and at larger scales than previously assessed. Science also highlights the existence of residual risks (i.e. risks that remain after adaptation), limits to adaptation and the potential for maladaptation (i.e. when adaptation responses increase risk over time and space, instead of reducing it).

- **There are however no signs of the acceleration and shifts in scale needed for ambitious adaptation.** Globally, adaptation action remains incremental in scale. First, policies and projects tend to be oriented towards the short term and focused on single hazards. Second, they are in general narrow in scope, meaning that they inadequately address the root causes of climate exposure and vulnerability, and insufficiently address the compounding and cascading nature of climate risk. Third, policies and projects are not being implemented at the necessary scale. Last, international support is not sufficiently aligning with the needs expressed by countries in their NDCs.

- **The adaptation gap is therefore widening.** Planning for and investments in national- or project-level adaptation are not found to be at the sufficient scale to keep up with the sharp acceleration of observed climate impacts and projected climate risks. Adaptation costs are growing faster than finance for adaptation, and there are still large uncertainties about whether what has been done to date and what is currently being done today will effectively reduce current and future climate risks.

- **Considering adaptation–mitigation interlinkages from the outset enhances the co-benefits.** Taking the interlinkages between adaptation, mitigation and sustainable development into account during planning, finance and implementation allows exploring synergies and limiting trade-offs more effectively. There is, however, evidence that not every climate action can be expected to deliver substantial co-benefits for both adaptation or mitigation, and that trade-offs can occur despite substantial co-benefits and therefore need to be considered independently.

- **Large-scale, non-climate and compounding factors continue to jeopardize adaptation investments and outcomes.** The war in Ukraine, for instance, dominates media headlines and adds pressure on global energy and food systems. This report, however, warns of one emergency supplanting another and makes urgent calls for deep, unprecedented political will and far more long-term investments towards adaptation. This means that adaptation-related policies must go beyond the status quo; international, public and private funding partners need to invest in actions that effectively reduce exposure and vulnerability and to measure the projects' contributions to risk reduction; and the scientific community must scale up knowledge on effectiveness and long-term adaptation strategies.

- **Adaptation needs to move beyond the incremental.** This calls for groundbreaking acceleration in scientific research, innovative planning, more and better finance and implementation, increased monitoring and evaluation (M&E) and deeper international cooperation (UNEP 2021a; IPCC 2022a; Magnan, Anisimov and Duvat 2022). This also calls for deep, long-term commitments by the international community towards more ambitious adaptation and mitigation (UNEP 2022). Current processes in the United Nations climate negotiations, including the Glasgow–Sharm el-Sheikh work programme on the global goal on adaptation and the global stocktake, present an important and immediate opportunity to act upon the conclusions of this report and the recent IPCC Working Group II *Sixth Assessment Report* (IPCC WGII AR6).

6.2 Cross-chapter synthesis

6.2.1 What has been done to adapt until today?

Most countries demonstrate some degree of **national-level planning** for climate adaptation. For example, currently 84 per cent of Parties to the UNFCCC (5 per cent higher than in 2021) have at least one planning instrument devoted to adaptation, and new instruments, national laws or policies continue to emerge every year. Evidence suggests that the quality of these instruments is improving each year, notably by including more context-specific information on climate trends, quantified adaptation targets and associated time frames. Planning instruments are also increasingly reflecting considerations of specific vulnerable groups, such as youth, migrants and persons with disabilities (respectively in 77, 48 and 33 per cent of the 563 adaptation laws and policies studied) as well as gender considerations (in 61 per cent of the laws and policies).

Despite these elements, it remains difficult to decide whether progress in national adaptation planning is sufficient. For example, the proportion of countries that have not yet incorporated quantified adaptation targets in their national laws, policies, strategies, plans or related documents submitted to the UNFCCC decreased from about three quarters in 2018 to about two thirds in 2022. Such a trend is encouraging but, although defining quantifiable adaptation targets is challenging, the fact that nearly two thirds of all countries still do not base their adaptation strategies upon evaluable and monitorable objectives is a concern.

Finance for adaptation is growing. An increasing number of developing countries (76) mention their adaptation finance needs in their nationally determined contributions (NDCs) or national adaptation plans (NAPs). While these are reported in different ways, calculated using different approaches and contain methodological uncertainties, the adaptation finance needs for these 76 countries are estimated at US$71 billion/year (in 2020 prices) from now to 2030. Extrapolating this to all developing countries could mean around US$202 billion/year (with a range of US$79–612 billion). On the other hand, combined mitigation and adaptation flows in 2020 have increased compared to previous years but fell at least US$16.7 billion short of the annual US$100 billion global goal pledged by developed countries.

Although there are methodological limitations, especially to estimate private investments worldwide, the report concludes that the adaptation finance gap is still widening. In other words, the difference is growing between increasing adaptation costs – US$160 billion to US$340 billion annually by 2030, rising to between US$315 billion and US$565 billion by 2050 for developing countries only (in current prices) – and the available funding for adaptation from public/private and domestic/bilateral/multilateral sources. In addition, data indicates that support to quickly operationalize actions such as relatively low-cost, no-regret interventions (e.g. some nature-based solutions) is increasing. The limitations of such interventions to deliver the changes needed in the face of the climate crisis are recognized, and thus so is the need for more major investment in the medium term and beyond. The report acknowledges that making financial flows consistent with net-zero climate-resilient development pathways will also help mobilize additional funds and avoid carbon lock-ins.

On the **implementation** side, international climate finance providers continue to increase their support. The total number of implemented adaptation projects funded by multilateral climate finance providers (Adaptation Fund, Green Climate Fund and Global Environmental Facility) shows a 2 per cent increase compared with last year's estimate (up to 473 projects[1] in 2021) (UNEP 2021a). The trend towards larger funding volumes per project (> US$10 million excluding co-financing) also continues. Similarly, support by bilateral climate finance providers continues to increase, along with around a doubling in the annual number of newly starting adaptation projects since 2015.

More projects are addressing both mitigation and adaptation, but integrated approaches that actually capitalize on synergies remain under-represented. Here also, however, taking stock on the progress-gap ratio remains difficult. For example, there is no clear idea of the number and diversity of projects actually needed to face the adaptation challenge worldwide i.e. both in developing and developed countries. Therefore, judging whether the volume of 473 projects started in developing countries is adequate represents a challenge. In addition, not all projects can be beneficial to both adaptation and mitigation, depending on the nature of adaptation and context-specificities, and in some cases, trade-offs can occur together with co-benefits. Yet, assessing the co-benefits and trade-offs ratio remains difficult in scientific terms.

6.2.2 To what extent are implemented adaptation actions effectively reducing climate impacts and risks today?

The 2022 edition of the Adaptation Gap Report (AGR) examines the effectiveness of adaptation interventions, that is, the extent to which climate impacts (observed) and risks (not yet realized) are reduced over space and time. It concludes that adaptation effectiveness is most often measured through reduced risk of loss of life and/or sets of quantifiable metrics (e.g. people supported, adoption of specific technologies and techniques, and so on). This raises two main concerns. First, the metric dealing with avoided human mortality refers to extreme climate impacts only, which de facto limits the scope of the outcomes that need to be considered when defining and assessing successful adaptation or maladaptation. Second, the use of exclusively quantifiable metrics limits the consideration

1 Only projects for which the implementation has actually started are considered here (see more details in chapter 4).

of non-economic benefits and losses such as biodiversity, socioeconomic and sociocultural equity, and distributional outcomes of adaptation interventions. Yet, these latter dimensions are indisputably recognized as critical to the effectiveness of adaptation interventions over time.

Recent studies (Berrang-Ford *et al.* 2021; O'Neill *et al.* 2022) help identify what "ambition for adaptation" could mean beyond its ultimate goal of reducing climate risks over space and time. Among others, three complementary components refer to (i) the *anticipatory nature* of interventions i.e. short- versus long-term view, (ii) their *depth* i.e. the extent to which they address the risk drivers and (iii) their *extent* i.e. across socio-ecological systems and spatial coverage.

Aligning with recent IPCC findings (IPCC 2022a), the 2022 edition of the AGR concludes that national-level and project-led adaptation globally demonstrate major gaps, as most interventions (i) are rather short-term, fragmented and focused on current climate impacts and (ii) still poorly address the most influential underlying causes of climate risks in an integrated way. In addition, (iii) the number of adaptation interventions across regions and sectors is estimated as remaining too limited. So, despite early signs of change (UNEP 2021a), adaptation seems to remain limited in both extent (across scales) and scope (under consideration of non-economic risk drivers). Yet, the report warns that a scoping of adaptation interventions that is too narrow leads to a dangerous underestimation of the potential for maladaptation and therefore of the human-induced increase of climate risks. This refers back to the general lack of a long-term perspective in the design and implementation of adaptation-related action.

Last, the report acknowledges that due to the multiplicity of factors driving the effectiveness of adaptation interventions (e.g. long-term policy support, social acceptability of the measures), there is no inherent correlation between the actions and effective adaptation.

These conclusions face limitations due to, for example, gaps in climate risk baselines against which to assess progress and measure the direct and indirect effects of specific adaptation interventions. Nevertheless, there is compelling evidence that the world is not on track to drastically reduce climate risks, nor that today's adaptation practice is robust enough to support climate-resilient development worldwide.

6.2.3 Are current adaptation efforts likely to reduce future climate risk?

Estimating the long-term effects of adaptation on climate risk reduction and whether current planning, finance and implementation efforts are adequate or not to avoid breaching adaptation limits is a highly challenging exercise. The report contributes to this through the identification of six key elements:

- Deep and sustained mitigation is decisive given that the adaptation solution space (that is, the range of adaptation interventions and their potential effectiveness) will shrink as global warming intensifies. It is therefore critical to be able to judge adaptation progress and gaps in light of mitigation efforts.

- Scientific advances strengthen the argument that the dominant pattern of current adaptation progress – that is, the fact that too much adaptation continues to be incremental in scale – results from and reinforces the status quo of fragmented governance approaches, inadequate institutional and financial capacities, unequal power hierarchies, lack of long-term vision and so on. Not striving towards more equitable development and enabling structures will therefore make future adaptation harder and more inequitable. Though climate adaptation action needs to stay focused on its core goal of reducing climate risk, it must also be twinned with broader development patterns.

- The knowledge gap on the effectiveness of current adaptation interventions and funding considerably limits the assessment of future adaptation benefits and trade-offs (e.g. maladaptation). This calls for further scientific research worldwide on several related topics (e.g. effectiveness, maladaptation, residual risks, adaptation limits) as well as for some degree of global-scale coordination in terms of collecting and gathering information (Magnan, Anisimov and Duvat 2022).

- The scientific approach to losses and damages (i.e. climate risks that can surpass adaptation limits) is increasingly seen as a way to understand the consequences of inaction in both mitigation and adaptation on socio-ecological systems (IPCC 2021). Applying this framing could help inform policy processes such as the UNFCCC Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts (WIM).

- The size of private investments in adaptation remains unclear. While private finance is not a panacea to close the adaptation finance gap, significantly enhancing the private sector's actions towards making business operations, supply chains, suppliers and customers more resilient will be critical, as will supporting adaptation action driven by the public sector.

- There is mounting concern that non-climate compounding factors operating today at a large scale will have a considerable influence on vulnerability trends and societies' ability to keep up with adaptation needs. This will affect the extent, time of emergence and rates of climate risks. As discussed in the 2021 edition of the AGR, it is likely that the COVID-19 pandemic will have profound implications for adaptation efforts and outcomes (UNEP 2021a). The war in Ukraine is also a major source of concern due to its consequences on global energy and food security well as its implications for climate-vulnerable populations worldwide.

The findings of the 2022 edition of the AGR suggest that, despite strong uncertainty surrounding the future of adaptation, action needs to be ramped up to contend with the increasing climate risks. This view aligns with the conclusions of the recent IPCC report which shows that engaging in drastic adaptation efforts will have multiple co-benefits at the crossroads of mitigation, climate risk reduction and sustainable development goals.

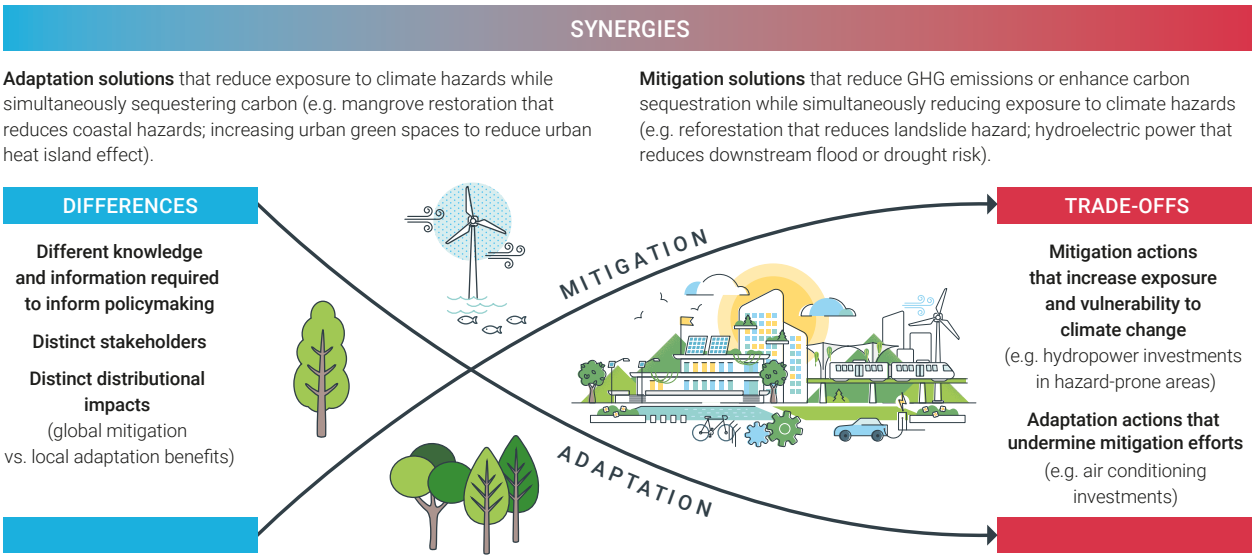
Incremental adaptation is therefore no longer sufficient, and reducing exposure and vulnerabilities to climate-induced hazards more systematically is now fundamental to future climate-resilient development pathways.

Box 6.1 Synthesis of the report's findings on adaptation–mitigation interlinkages

Very ambitious and immediate mitigation action is essential to limiting global warming to 1.5°C in the long term. This limit is critical to keeping climate risks at manageable levels and avoiding accelerating losses and damages as well as hard adaptation limits to an increasing number of systems, ranging from unique or threatened (e.g. tropical coral reefs, arctic environments) to global aggregate impacts and large-scale singular events (e.g. collapse of the Gulf Stream; multi-breadbasket heat and drought-related food production losses) (IPCC 2022a; see chapter 1).

This report therefore features analysis of adaptation–mitigation interlinkages in planning, finance and implementation. While a combined focus on both adaptation and mitigation enhances the chances of co-benefits, including ancillary and non-market benefits, the report is cognizant of the fact that trade-offs between adaptation, mitigation and sustainable development are possible, in particular where climate change is weakening the effectiveness of systems in reducing climate risk efficiencies (e.g. tropical reefs) (UNEP 2021b). Although the vast majority of nexus literature shows that co-benefits strongly dominate and may reduce maladaptation (IPCC 2022a), co-development of adaptation and mitigation may make some systems less effective. Figure 6.1 visualizes the differences, synergies and trade-offs that need to be considered when aligning mitigation and adaptation action.

Figure 6.1 Aligning climate change mitigation and adaptation: differences, synergies and trade-offs



Source: Adapted from: Organisation for Economic Co-operation and Development (OECD) (2021)

Box 6.1 (continued)

National planning documents show that adaptation–mitigation co-benefits are frequently sought in agriculture (e.g. reduced emissions from improved crop or post-harvest management), forestry (e.g. increased carbon sequestration from forest restoration), water (e.g. improved quantity of water to sustain hydropower stations) and energy (e.g. reduced emissions from efforts to diversify energy resources and promote efficiency). This is consistent with results from the IPCC, with the exception of urban planning and buildings, which have been shown to provide opportunities for co benefits between adaptation and mitigation (IPCC 2022a; IPCC 2022b). However, national planning documents frequently miss potential trade-offs, which need to be addressed more systematically.

The finance chapter shows that less than 10 per cent of mobilized climate finance between 2016 and 2019 was cross-cutting (OECD 2021) and only 2.4 per cent of the known total climate-related finance in 2019–2020 went to 'dual uses' (Buchner *et al.* 2021). Going forward, the Paris Agreement's article 2.1(c) may stimulate adaptation–mitigation co-benefits because countries agreed to make climate finance flows consistent with net-zero climate-resilient development pathways whereby investments in mitigation are only climate-consistent if they do not reduce resilience and vice versa (Cochran and Pauthier 2019; Jachnik, Mirabile and Dobrinevski 2019).

Similar to the analysis of planning documents, analysis of the Green Climate Fund (GCF) project portfolio shows that certain sectoral combinations are more likely to feature combined adaptation–mitigation approaches. However, a qualitative analysis of project documents found that both were often implemented independently of each other and adaptation benefits were far less well elaborated than mitigation benefits. In addition, there is a tendency to under-report trade-offs.

In conclusion, considering adaptation–mitigation interlinkages in planning, finance and implementation offers important opportunities for achieving co-benefits across environmental, social and economic dimensions and for limiting possible trade-offs more systematically.

‘Ecosystem-based Adaptation South’ project seeks to help the Seychelles, Nepal and Mauritania to adapt to climate change, in part by restoring natural habitats across all types of ecosystems. In the Seychelles, on-the-ground ecological restoration will rehabilitate 29 hectares of mangrove and wetland forests, thus providing natural flood barriers.
Learn more about this project here.

Photo: © UNEP / Aidan Dockery

References

Chapter 1

Anisimov, A., Aleksandrova, M., Bauer, S. and Vallejo, L. (2022). The EU and the Glasgow Dialogue: Advancing a Balanced Approach to Loss and Damage. IDDRI Policy Brief 05/2022. https://www.iddri.org/sites/default/files/PDF/Publications/Catalogue%20Iddri/Propositions/202206-PB0522-loss%20damage%20EU.pdf.

Beauchamp, E. and Bueno, M. (2021). Global stocktake: Three Priorities to Drive Adaptation Action. International Institute for Environment and Development. https://pubs.iied.org/20601iied.

Berrang-Ford, L., Siders, A.R., Lesnikowski, A., Fischer, A.P., Callaghan, M.W., Haddaway, N.R. *et al.* (2021). A systematic global stocktake of evidence on human adaptation to climate change. *Nature Climate Change* 11(11), 989-1000. https://doi.org/10.1038/s41558-021-01170-y.

Berrang-Ford, L., Wang, F.M., Lesnikowski, A., Ford, J. and Biesbroek, R. (2017). Towards the assessment of adaptation progress at the global level. In: *The Adaptation Gap Report: Towards Global Assessment*. Olhoff, A., Neufeldt, H., Naswa, P. and Dorkenoo, K.E.J. (eds). Nairobi: United Nations Environment Programme, chapter 5. https://unepccc.org/wp-content/uploads/2019/05/adaptation-gap-report-2017.pdf.

Boyd, E., Chaffin, B.C., Dorkenoo, K., Jackson, G., Harrington, L., N'Guetta, A. *et al.* (2022). Loss and damage from climate change: A new climate justice agenda. *One Earth* 4(10), 1365-1370. https://doi.org/10.1016/j.oneear.2021.09.015.

Brooks, N., Anderson, S., Aragon, I., Smith, B., Kajumba, T., Beauchamp, E. *et al.* (2019). Framing and tracking 21st century climate adaptation: Monitoring, evaluation and learning for Paris, the SDGs and beyond. Working paper, November 2019. London: International Institute for Environment and Development. https://www.iied.org/10202iied.

Dodman, D., Hayward, B., Pelling, M., Castan Broto, V., Chow, W., Chu, E. *et al.* (2022). Cities, settlements and key infrastructure. In: *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Pörtner, H.-O., Roberts, D.C. , Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A. *et al.* (eds.). Cambridge, UK and New York, NY, USA: Cambridge University Press. 907-1040, https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_Chapter06.pdf.

Frey, M. and Gasbarro, F. Adaptation and mitigation synergies and trade-offs. In: *Climate Action. Encyclopedia of the UN Sustainable Development Goals*. Filho, W.L., Azul, A.M., Brandli, L., Özuyar, P.G. and Wall, T. (eds.). Cham, Switzerland: Springer. https://link.springer.com/referenceworkentry/10.1007/978-3-319-95885-9_17.

Haasnoot, M., Lawrence, J. and Magnan, A.K. (2021). Pathways to coastal retreat. *Science* 372(6548), 1287-1290. https://doi.org/10.1126/science.abi6594.

Intergovernmental Panel on Climate Change (2014). *Climate Change 2014: Impacts, Adaptation and Vulnerability.* Field, C.B., Barros, V.R., Dokken, D.J., Mach, K.J., Mastrandrea, M.D., Bilir, T.E. *et al.* (eds.). Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press. https://www.ipcc.ch/report/ar5/wg2/.

_____ (2018). *Global Warming of 1.5°C: An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.* Masson-Delmotte, V., Zhai, P., Pörtner, H.-O., Roberts, D., Skea, J., Shukla, P.R. *et al.* (eds.). Cambridge, UK and New York, NY, USA: Cambridge University Press. https://www.ipcc.ch/sr15/.

_____ (2019a). *Climate Change and Land: An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems*. Shukla, P.R., Skea, J., Calvo Buendia, E., Masson-Delmotte, V., Pörtner, H.-O., Roberts, D.C. *et al.* (eds.). In press. https://www.ipcc.ch/srccl/.

_____ (2019b). *The Ocean and Cryosphere in a Changing Climate: Special Report of the Intergovernmental Panel on Climate Change.* Pörtner, H.-O., Roberts, D.C., Masson-Delmotte, V., Zhai, P. Tignor, M., Poloczanska, E. *et al.* (eds.). Cambridge, UK and New York, NY, USA: Cambridge University Press. https://www.ipcc.ch/srocc/.

_____ (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Pörtner, H.-O., Roberts, D.C., Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A. *et al.* (eds.). Cambridge, UK and New York, NY, USA: Cambridge University Press. https://www.ipcc.ch/report/ar6/wg2/.

Khan, M.R. and Munira, S. (2021). Climate change adaptation as a global public good: implications for financing. *Climatic Change* 167, article 50. https://doi.org/10.1007/s10584-021-03195-w.

Klein, R.J.T., Huq, S., Denton, F., Downing, T.E., Richels, R.G., Robinson, J.B. *et al.* (2007). Inter-relationships between adaptation and mitigation. In: *Climate Change 2007: Impacts, Adaptation and Vulnerability.* Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. and Hanson, C.E. (eds.) Cambridge, UK: Cambridge University Press. pp.745–777. https://www.ipcc.ch/site/assets/uploads/2018/02/ar4-wg2-chapter18-1.pdf.

Magnan, A.K., Anisimov, A. and Duvat, V.K.E. (2022). Strengthen climate adaptation research globally. *Science* 376(6600), 1398-1400. https://doi.org/10.1126/science.abq0737.

Magnan, A.K., Anisimov, A., Duvat, V.K.E., Deenapanray, P.N.K., Fall, B., Kauppaymuthoo, V. *et al.* (2021a). *Global Adaptation Progress Tracker. GAP-Track. Pilot study report 2021.* IDDRI and French Development Agency (AFD). https://www.iddri.org/en/publications-and-events/report/global-adaptation-progress-tracker-gap-track-pilot-study-report-2021.

Magnan, A.K., Pörtner, H.-O., Duvat, V.K.E., Garschagen, M., Guinder, V.A., Zommers, Z. *et al.* (2021b). Estimating the global risk of anthropogenic climate change. *Nature Climate Change* 11, 879-885. DOI: https://doi.org/10.1038/s41558-021-01156-w.

McKay, D.I.A., Staal. A., Abrams, J.F., Winkelmann, R., Sakschewski, B., Loriani, S. *et al.* (2022). Exceeding 1.5°C global warming could trigger multiple climate tipping points. *Science* 377(6611), 1-10. https://doi.org/10.1126/science.abn7950.

O'Neill, B.C., van Aalst, M. and Ibrahim, Z.Z. (2022). Key risks across sectors and regions. In*: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Pörtner, H.-O., Roberts, D.C. , Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A. et al. (eds.). Cambridge, UK and New York, NY, USA: Cambridge University Press. https://www.ipcc.ch/report/ar6/wg2/.

Organisation for Economic Co-operation and Development (2021). *Managing Climate Risks, Facing up to Losses and Damages*. Paris: OECD Editions. https://doi.org/10.1787/55ea1cc9-en.

Schipper, E.L.F. and Langston, L. (2015). A comparative overview of resilience measurement frameworks: analysing indicators and approaches. Working paper 422. London: Overseas Development Institute. https://odi.org/documents/4886/9754.pdf.

United Nations Environment Programme (2017). *The Adaptation Gap Report 2017: Towards Global Assessment*. Nairobi. https://www.unep.org/resources/adaptation-gap-report-2017.

_____ (2019). *Frontiers 2018/19: Emerging Issues of Environmental Concern.* Nairobi. https://www.unep.org/resources/frontiers-201819-emerging-issues-environmental-concern.

_____ (2021a). *Emissions Gap Report 2021: The Heat Is On – A World of Climate Promises Not Yet Delivered.* Nairobi. https://www.unep.org/resources/emissions-gap-report-2021.

_____ (2021b). *Adaptation Gap Report 2021: The Gathering Storm – Adapting to Climate Change in a Post-Pandemic World.* Nairobi. https://www.unep.org/resources/adaptation-gap-report-2021.

_____ (2021c). *Adaptation Gap Report 2020.* Nairobi. https://www.unep.org/resources/adaptation-gap-report-2020.

United Nations Framework Convention on Climate Change (2019). *25 Years of Adaptation under the UNFCCC: Report by the Adaptation Committee.* Bonn, Germany: United Nations Climate Change Secretariat. https://unfccc.int/sites/default/files/resource/AC_25%20Years%20of%20Adaptation%20Under%20the%20UNFCCC_2019.pdf.

_____ (2022). Report of the Conference of the Parties on its twenty-sixth session, held in Glasgow from 31 October to 13 November 2021. Addendum Part two: Action taken by the Conference of the Parties at its twenty-sixth session. FCCC/CP/2021/12/Add.1, 8 March 2022. https://unfccc.int/documents/460954.

Chapter 2

Chile (2020). *Chile's Nationally Determined Contribution*. Santiago. https://unfccc.int/sites/default/files/NDC/2022-06/Chile%27s_NDC_2020_english.pdf.

Dazé, A. and Hunter, C. (2022). *Gender-Responsive National Adaptation Plan (NAP) Processes: Progress and Promising Examples (NAP Global Network Synthesis Report 2021–2022).* Winnipeg: International Institute for Sustainable Development. https://napglobalnetwork.org/resource/gender-responsive-nap-processes-progress-promising-examples/.

Federated States of Micronesia (2013). *Nation Wide Integrated Disaster Risk Management and Climate Change Policy.* Palikir. https://countrysafeguardsystems.net/sites/default/files/Micronesia%20Disaster%20Risk%20ClimateChange%20Policy%202013.pdf.

Fiji (2020). *Fiji's Updated Nationally Determined Contribution*. Suva. https://unfccc.int/sites/default/files/NDC/2022-06/Republic%20of%20Fiji%27s%20Updated%20NDC%2020201.pdf.

GIZ (2018). Linking mitigation and adaptation in long-term strategies. Discussion paper. Bonn and Eschborn. https://www.weadapt.org/system/files_force/18wk_giz.pdf?download=1.

Intergovernmental Panel on Climate Change (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability. Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Pörtner, H.-O., Roberts, D.C., Tignor, M.M.B., Poloczanska, E., Mintenbeck, K., Alegria, A. *et al.* (eds.). Cambridge and New York: Cambridge University Press. https://www.ipcc.ch/report/ar6/wg2/.

Kenya (2018). *Kenya's National Climate Change Action Plan: 2018-2022*. Nairobi. https://www.lse.ac.uk/GranthamInstitute/wp-content/uploads/2018/10/8737.pdf.

Kenya (2020). *Kenya's Updated Nationally Determined Contribution*. Nairobi. https://unfccc.int/sites/default/files/NDC/2022-06/Kenya%27s%20First%20%20NDC%20%28updated%20version%29.pdf.

Kiribati (2013). *Kiribati's National Framework for Climate Change and Adaptation*. Tarawa. https://www.president.gov.ki/presidentgovki/wp-content/uploads/2019/04/National-Framework-for-Climate-Change-Climate-Change-Adaptation.pdf.

United Nations Environment Programme (2018). *Adaptation Gap Report 2018*. Nairobi. https://www.unep.org/resources/adaptation-gap-report-2018.

_____ (2021a). *Adaptation Gap Report 2021: The Gathering Storm. Adapting to Climate Change in a Post-Pandemic World*. Nairobi. https://www.unep.org/resources/adaptation-gap-report-2021.

_____ (2021b). *Adaptation Gap Report 2020*. Nairobi. https://www.unep.org/resources/adaptation-gap-report-2020.

United Nations Framework Convention on Climate Change Adaptation Committee (2021). *Approaches to Reviewing the Overall Progress Made in Achieving the Global Goal on Adaptation: Technical Paper by the Adaptation Committee*. Bonn. https://unfccc.int/documents/309030.

_____ (2022). *Information Paper on Linkages Between Adaptation and Mitigation. Information Paper by the Adaptation Committee*. Bonn. https://unfccc.int/documents/460926.

United Nations Framework Convention on Climate Change Least Developed Countries Expert Group (2012). *National Adaptation Plans: Technical Guidelines for the National Adaptation Plan Process*. Bonn. https://unfccc.int/files/adaptation/cancun_adaptation_framework/application/pdf/naptechguidelines_eng_high__res.pdf.

Zimbabwe (2021). *Zimbabwe Revised Nationally Determined Contribution*. Harare. https://unfccc.int/sites/default/files/NDC/2022-06/Zimbabwe%20Revised%20Nationally%20Determined%20Contribution%202021%20Final.pdf.

Chapter 3

Alcayna, T. (2020). *At What Cost? How Chronic Gaps in Adaptation Finance Expose the World's Poorest People to Climate Chaos*. Flood Resilience Alliance. https://europe.mercycorps.org/sites/default/files/2020-07/1087-PA-ZFRA-AtWhatCost-V15c-WEB.pdf.

Atteridge, A., Savvidou, G., Sadowski, S., Gortana, F., Meintrup, L. and Dzebo, A. (2019). Aid Atlas. https://aid-atlas.org. Accessed 24 October 2022.

Buchner, B., Naran, B., Fernandes, P., Padmanabhi, R., Rosane, P., Solomon, M. *et al.* (2021). *Global Landscape of Climate Finance 2021*. Climate Policy Initiative. https://www.climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2021.

Chapagain, D., Baarsch, F., Schaeffer, M. and D'haen, S. (2020). Climate change adaptation costs in developing countries: insights from existing estimates. *Climate and Development* 12(10), 934–942. https://doi.org/10.1080/17565529.2020.1711698.

Cochran, I. and Pauthier, A. (2019). A framework for alignment with the Paris Agreement: Why, what and how for financial institutions? Discussion paper, September. Paris, France. https://www.i4ce.org/en/publication/framework-alignment-with-paris-agreement-why-what-and-how-for-financial-institutions.

Colenbrander, S., Pettinotti, L. and Cao, Y. (2022). A fair share of climate finance? An appraisal of past performance, future pledges and prospective contributors. ODI Working Paper. London: Overseas Development Institute. https://cdn.odi.org/media/documents/A_fair_share_of_climate_finance.pdf.

Dale, T.W., Gao, J., Avashia, V.K., Konrad, S. and Garg, A. (2021). *Private Sector Adaptation Reporting as a Source of Input to the Global Stocktake*. UNEP DTU Partnership and Indian Institute of Management Ahmedabad. https://orbit.dtu.dk/en/publications/private-sector-adaptation-reporting-as-a-source-of-input-to-the-g.

Gannon, K.E., Castellano, E., Eskander, S., Agol, D., Diop, M., Conway, D. *et al.* (2022). The triple differential vulnerability of female entrepreneurs to climate risk in sub-Saharan Africa: Gendered barriers and enablers to private sector adaptation. *WIREs Climate Change* 13(5), e793. https://doi.org/10.1002/wcc.793.

Garschagen, M. and Doshi, D. (2022). Does funds-based adaptation finance reach the most vulnerable countries? *Global Environmental Change* 73. https://doi.org/10.1016/j.gloenvcha.2021.102450.

Glavovic, B.C., Dawson, R., Chow, W., Garschagen, M., Haasnoot, M., Singh, C. *et al.* (2022). Cross-chapter paper 2: Cities and settlements by the sea. In: *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Pörtner, H.-O., Roberts, D.C. , Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A. *et al.* (eds.). Cambridge, UK and New York, NY, USA: Cambridge University Press. 2163–2194. https://www.ipcc.ch/report/ar6/wg2/.

Global Gender and Climate Alliance (2016). *Gender and Climate Change: A Closer Look at Existing Evidence*. https://wedo.org/wp-content/uploads/2016/11/GGCA-RP-FINAL.pdf.

Jachnik, R., Mirabile, M. and Dobrinevski, A. (2019). Tracking finance flows towards assessing their consistency with climate objectives. Environment Working Paper No. 146. Organisation for Economic Co-operation and Development. https://doi.org/10.1787/82cc3a4c-en.

Karlsson, M., Alfredsson, E. and Westling, N. (2020). Climate policy co-benefits: a review. *Climate Policy* 20(3), 292-316. https://doi.org/10.1080/14693062.2020.1724070.

New, M., Reckien, D., Viner, D., Adler, C., Cheong, S.-M., Conde, C. *et al.* (2022). Decision-making options for managing risk. In: *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Pörtner, H.-O., Roberts, D.C. , Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A. *et al.* (eds.). Cambridge, UK and New York, NY, USA: Cambridge University Press. 2539-2654. https://www.ipcc.ch/report/ar6/wg2/.

Omari-Motsumi, K., Barnett, M. and Schalatek, L. (2019). Broken connections and systemic barriers: overcoming the challenge of the "missing middle" in adaptation finance. Global Commission on Adaptation Background Paper. https://www.wri.org/initiatives/global-commission-adaptation/background-papers.

Organisation for Economic Co-operation and Development (2016). *OECD DAC Rio Markers for Climate. Handbook*. The Development Assistance Committee. https://www.oecd.org/dac/environment-development/Revised%20climate%20marker%20handbook_FINAL.pdf.

_____ (2022a). *Aggregate Trends of Climate Finance Provided and Mobilised by Developed Countries in 2016-2020: Insights from Disaggregated Analysis*. Paris, France. https://doi.org/10.1787/d28f963c-en.

_____ (2022b). *Climate Change: OECD DAC External Development Finance Statistics*. https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm. Accessed 24 October 2022.

Pauw, W.P., Castro, P., Pickering, J. and Bhasin, S. (2020). Conditional nationally determined contributions in the Paris Agreement: foothold for equity or Achilles heel? *Climate Policy* 20(4), 468-484. https://doi.org/10.1080/14693062.2019.1635874.

Pauw, W.P., König, M. and Valverde, M.J. (2022). The Green Climate Fund's contribution to the US$ 100 billion target. Frankfurt: Frankfurt School – UNEP Collaboration Centre for Climate & Sustainable Energy Finance. https://www.fs-unep-centre.org/wp-content/uploads/2022/01/GCF-Monitor-7_Final.pdf.

Pauw, P.W., Moslener, U., Zamarioli, L.H., Amerasinghe, N., Atela, J., Affana, J.P.B. *et al.* (2022). Post-2025 climate finance target: how much more and how much better? *Climate Policy*. https://doi.org/10.1080/14693062.2022.2114985.

Roberts, J.T. and Weikmans, R. (2022). Checking contentious counting. *Nature Climate Change* 12, 887-888. https://doi.org/10.1038/s41558-022-01483-6.

Roy, J., Prakash, A., Some, S., Singh, C., Kerr, R.B., Caretta, M.A. *et al.* (2022). Synergies and trade-offs between climate change adaptation options and gender equality: a review of the global literature. *Humanities & Social Sciences Communications* 9, article 251. https://doi.org/10.1057/s41599-022-01266-6.

Savvidou, G., Atteridge, A., Omari-Motsumi, K. and Trisos, C.H. (2021). Quantifying international public finance for climate change adaptation in Africa. *Climate Policy* 21(8), 1020-1036. https://doi.org/10.1080/14693062.2021.1978053.

Trisos, C.H., Adelekan, I.O., Totin, E., Ayanlade, A., Efitre, J., Gemeda, A. *et al.* (2022). Africa. In: *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Pörtner, H.-O., Roberts, D.C. , Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A. *et al.* (eds.). Cambridge, UK and New York, NY, USA: Cambridge University Press. 1285-1455.

United Nations (2022). *Accessing Climate Finance: Challenges and Opportunities for Small Island Developing States*. https://www.un.org/ohrlls/sites/www.un.org.ohrlls/files/accessing_climate_finance_challenges_sids_report.pdf.

United Nations Development Programme (2018). *Climate Change Adaptation in Africa: UNDP Synthesis of Experiences and Recommendations*. Bangkok: Bangkok Regional Hub. https://www.undp.org/publications/climate-change-adaptation-africa.

United Nations Environment Programme (2014). *The Adaptation Gap Report: A Preliminary Assessment*. Nairobi. https://www.unep.org/resources/adaptation-gap-report-2014.

_____ (2016). *The Adaptation Finance Gap Report*. Nairobi. https://unepccc.org/publications/the-adaptation-finance-gap-report/#:~:text=The%202016%20Adaptation%20Gap%20Report,the%20%E2%80%9Cadaptation%20finance%20gap%E2%80%9D.

_____ (2021a). *The Adaptation Gap Report 2020*. Nairobi. https://www.unep.org/resources/adaptation-gap-report-2020.

_____ (2021b). *Adaptation Gap Report 2021: The Gathering Storm – Adapting to Climate Change in a Post-Pandemic World*. Nairobi. https://www.unep.org/resources/adaptation-gap-report-2021.

United Nations Framework Convention on Climate Change Adaptation Committee (2021). Capacity gaps in accessing adaptation funding. Revised information note (AC20). AC20/INFO/7A. https://unfccc.int/documents/302884.

United Nations Framework Convention on Climate Change Secretariat (2022a). Nationally Determined Contributions Registry. https://unfccc.int/NDCREG. Accessed 20 September 2022.

_____(2022b). UNFCCC NAP Central. https://www4.unfccc.int/sites/napc/Pages/Home.aspx. Accessed 20 September 2022.

_____ (2022c). *Developing Countries Adaptation Finance Needs: Insights from Domestic Adaptation Plans* [Manuscript in preparation].

United Nations Framework Convention on Climate Change Standing Committee on Finance (2021). *Fourth (2020) Biennial Assessment and Overview of Climate Finance Flows*. Bonn. https://unfccc.int/topics/climate-finance/resources/biennial-assessment-and-overview-of-climate-finance-flows.

Watkiss, P. and Klein, R.J.T. (2019). *Long-term Strategies in a Changing Climate*. Berlin, Germany. https://www.adaptationcommunity.net/wp-content/uploads/2019/06/Research-Paper_Linking-Mitigation-and-Adaptation-in-LTS.pdf.

Weikmans, R., Timmons Roberts, J., Baum, J., Bustos, M.C. and Durand, A. (2017). Assessing the credibility of how climate adaptation aid projects are categorised. *Development in Practice* 27(4), 458-471. https://doi.org/10.1080/09614524.2017.1307325.

Zamarioli, L.H., Pauw, W.P., Koenig, M. and Chenet, H. (2021). The climate consistency goal and the transformation of global finance. *Nature Climate Change* 11, 578-583. https://doi.org/10.1038/s41558-021-01083-w.

Chapter 4

Berrang-Ford, L., Siders, A.R., Lesnikowski, A., Fischer, A.P., Callaghan, M.W., Haddaway, N.R. *et al.* (2021). A systematic global stocktake of evidence on human adaptation to climate change. *Nature Climate Change* 11, 989-1000. https://www.nature.com/articles/s41558-021-01170-y.

Cooperative for Assistance and Relief Everywhere (2021). *Climate Adaptation Finance: Fact or Fiction?* The Hague. https://careclimatechange.org/climate-adaptation-finance-fact-or-fiction/.

Cremen, G., Galasso, C. and McCloskey, J. (2022). Modelling and quantifying tomorrow's risks from natural hazards. *Science of The Total Environment* 817, 152552. https://doi.org/10.1016/j.scitotenv.2021.152552

European Environment Agency (2022). *Advancing Towards Climate Resilience in Europe. Status of National Adaptation Actions in 2021*. Copenhagen. https://www.eea.europa.eu/publications/advancing-towards-climate-resilience-in-europe/.

Garschagen, M., Leiter, T., Biesbroek, R., Magnan, A.K., Reckien, D., New, M. *et al.* (2022). Cross-chapter box PROGRESS | Approaches and challenges to assess adaptation progress at the global level. In *Climate Change 2022. Impacts, Adaptation and Vulnerability. Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Pörtner, H.-O., Roberts, D.C., Tignor, M.M.B., Poloczanska, E., Mintenbeck, K., Alegria, A. *et al.* (eds.). Cambridge and New York: Cambridge University Press. Chapter 17. 2610-2613. https://www.ipcc.ch/report/ar6/wg2/.

Green Climate Fund (2020). *GCF Programming Manual: An Introduction to the Green Climate Fund Project Cycle and Project Development Tools for Full-Size Projects*. Incheon. https://www.greenclimate.fund/sites/default/files/document/gcf-programming-manual_0.pdf.

Intergovernmental Panel on Climate Change (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability. Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Pörtner, H.-O., Roberts, D.C., Tignor, M.M.B., Poloczanska, E., Mintenbeck, K., Alegria, A. *et al.* (eds.). Cambridge and New York: Cambridge University Press. https://www.ipcc.ch/report/ar6/wg2/.

Leiter, T. (2021). Do governments track the implementation of national climate change adaptation plans? An evidence-based global stocktake of monitoring and evaluation systems. *Environmental Science & Policy* 125, 179-188. https://doi.org/10.1016/j.envsci.2021.08.017.

Lesnikowski, A. and Leiter, T. (2022). *Assessing Progress on Climate Adaptation in Canada. Building Blocks and Best Practices for a Robust Monitoring and Evaluation System. Ottawa: Canada Climate Institute*. https://climateinstitute.ca/publications/assessing-progress-on-climate-adaptation-in-canada/.

New Zealand, Ministry for the Environment (2022). *Adapt and Thrive: Building a Climate-Resilient New Zealand. Aotearoa New Zealand's First National Adaptation Plan*. Wellington. https://environment.govt.nz/assets/publications/climate-change/MFE-AoG-20664-GF-National-Adaptation-Plan-2022-WEB.pdf.

O'Neill, B., van Aalst, M., Ibrahim, Z.Z., Ford, L.B., Bhadwal, S., Buhaug, H., Diaz, D. *et al.* (2022). Key risks across sectors and regions. In *Climate Change 2022: Impacts, Adaptation and Vulnerability. Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Pörtner, H.-O., Roberts, D.C., Tignor, M.M.B., Poloczanska, E., Mintenbeck, K., Alegria, A. *et al.* (eds.). Cambridge and New York: Cambridge University Press. https://www.ipcc.ch/report/ar6/wg2/.

Organisation for Economic Co-operation and Development (2016). *OECD DAC Rio Markers for Climate: Handbook*. Paris. https://www.oecd.org/dac/environment-development/Revised%20climate%20marker%20handbook_FINAL.pdf.

_____ (2021). Strengthening adaptation-mitigation linkages for a low-carbon, climate-resilient future. OECD Environment Policy Paper, No. 23. Paris. https://www.oecd-ilibrary.org/environment/strengthening-adaptation-mitigation-linkages-for-a-low-carbon-climate-resilient-future_6d79ff6a-en.

_____ (2022). Climate Change: OECD DAC External Development Finance Statistics. https://www.oecd.org/dac/financing-sustainable-development/development-finance-topics/climate-change.htm. Accessed 24 October 2022.

Pardoe, J., Vincent, K., Conway, D., Archer, E., Dougill, A.J., Mkwambisi, D. *et al.* (2020). Evolution of national climate adaptation agendas in Malawi, Tanzania and Zambia: the role of national leadership and international donors. *Regional Environmental Change* 20, 118. https://doi.org/10.1007/s10113-020-01693-8.

Schipper, E.L.F., Revi, A., Preston, B.L., Carr, E.R., Eriksen, S.H., Fernández-Carril, L.R. *et al.* (2022). Climate resilient development pathways. In *Climate Change 2022: Impacts, Adaptation and Vulnerability. Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Pörtner, H.-O., Roberts, D.C., Tignor, M.M.B., Poloczanska, E., Mintenbeck, K., Alegria, A. *et al.* (eds.). Cambridge and New York: Cambridge University Press. Chapter 18. 2655-2807. https://www.ipcc.ch/report/ar6/wg2/.

Toetzke, M., Stünzi, A. and Egli, F. (2022). Consistent and replicable estimation of bilateral climate finance. *Nature Climate Change* 12, 897-900. https://doi.org/10.1038/s41558-022-01482-7.

United Nations Environment Programme (2018). *Adaptation Gap Report 2018*. Nairobi. https://www.unep.org/resources/adaptation-gap-report-2018.

_____ (2021a). *Adaptation Gap Report 2020*. Nairobi. https://www.unep.org/resources/adaptation-gap-report-2020.

_____ (2021b). *Adaptation Gap Report 2021: The Gathering Storm. Adapting to Climate Change in a Post-Pandemic World*. Nairobi. https://www.unep.org/resources/adaptation-gap-report-2021.

_____ (2021c). *Adaptation Gap Report 2021: The Gathering Storm. Adapting to Climate Change in a Post-Pandemic World - Online Annexes*. Nairobi. https://www.unep.org/resources/adaptation-gap-report-2021.

United Nations Framework Convention on Climate Change Adaptation Committee (2020). *Seventeenth meeting of the Adaptation Committee. Information paper on linkages between mitigation and adaptation*. Bonn. https://unfccc.int/sites/default/files/resource/ac17_8b_ada_miti.pdf.

_____ (2022). *Draft Supplementary Guidance for Voluntary Use by Parties in Communicating Information in Accordance with the Possible Elements of an Adaptation Communication (AC22)*. 25 August. AC22/GUID/6B. https://unfccc.int/documents/611369.

United Nations Office for Disaster Risk Reduction (2013). *Proposed Elements for Consideration in the Post-2015 Framework for Disaster Risk Reduction*. Geneva. https://www.preventionweb.net/files/35888_srsgelements.pdf.

Weikmans, R., Roberts, J.T., Baum, J., Bustos, M.C. and Durand, A. (2017). Assessing the credibility of how climate adaptation aid projects are categorised. *Development in Practice* 27, 458-471. http://dx.doi.org/10.1080/09614524.2017.1307325.

Chapter 5

Abram, N., Gattuso, J.-P., Prakash, A., Cheng, L., Chidichimo, M.P., Crate, S. *et al.* (2019). Framing and context of the report. In: *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate*. Pörtner, H.-O., Roberts, D.C., Masson-Delmotte, V., Zhai, P., Tignor, M., Poloczanska, E. *et al.* (eds.). Cambridge, UK and New York, NY, USA: Cambridge University Press. 73–129. https://doi.org/10.1017/9781009157964.003.

Adaptation Fund (2019). *Strategic Results Framework*. https://www.adaptation-fund.org/document/strategic-results-framework-of-the-adaptation-fund-amended-in-march-2019/.

Adger, N.W., Arnell, N., and Tompkins, E.L. (2005). Successful adaptation to climate change across scales. *Global Environmental Change* 15(2), 77-86. https://doi.org/10.1016/j.gloenvcha.2004.12.005.

Bahadur, A.V., Peters, K., Wilkinson, E., Pichon, F., Gray, K. and Tanner, T. (2015). The 3AS: Tracking resilience across BRACED. Working paper. Overseas Development Institute. https://www.odi.org/publications/9840-3as-tracking-resilience-across-braced.

Bakaki, Z. (2022). The impact of climate summits. *Nature Climate Change* 12(7), 617-618. https://doi.org/10.1038/s41558-022-01416-3.

Barrett, K. and Bosak, K. (2018). The role of place in adapting to climate change: A case study from Ladakh, Western Himalayas. *Sustainability* 10(4), 898. https://doi.org/10.3390/su10040898.

Beauchamp, E., Marsac, C., Brooks, N., D'Errico, S. and N. Benson (2022). *From What Works to What Will Work. Integrating Climate Risks into Sustainable Development Evaluation — a Practical Guide*. London: International Institute for Environment and Development. https://www.iied.org/21026iied.

Bednar-Friedl, B., Biesbroek, R., Schmidt, D.N., Alexander, P., Børsheim, K.Y., Carnicer, J. *et al.* (2022). Europe. In: *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Pörtner, H.-O., Roberts, D.C., Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A. *et al.* (eds.). Cambridge, UK and New York, NY, USA: Cambridge University Press. https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_Chapter13.pdf.

Benmarhnia, T., Schwarz, L., Nori-Sarma, A. and Bell, M.L. (2019). Quantifying the impact of changing the threshold of New York City heat emergency plan in reducing heat-related illnesses. *Environmental Research Letters* 14, 114006. https://iopscience.iop.org/article/10.1088/1748-9326/ab402e/pdf.

Berrang-Ford, L., Sietsma, A.J., Callaghan, M., Minx, J.C., Scheelibeek, P.F.D., Haddaway, N.R. *et al.* (2021). Systematic mapping of global research on climate and health: a machine learning review. *The Lancet Planetary Health* 5(8): e514-e525. https://doi.org/10.1016/S2542-5196(21)00179-0.

Bhave, A.G., Conway, D., Dessai, S. and Stainforth, D.A. (2016). Barriers and opportunities for robust decision making approaches to support climate change adaptation in the developing world. *Climate Risk Management* 14, 1-10. https://doi.org/10.1016/j.crm.2016.09.004.

Birkmann, J., Llwenga, E., Pandey, R., Boyd, E., Djalante, R., Gemenne, F. *et al.* (2022). Poverty, livelihoods and sustainable development. In: *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Pörtner, H.-O., Roberts, D.C., Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A. *et al.* (eds.). Cambridge, UK and New York, NY, USA: Cambridge University Press. 2411-2538. https://www.ipcc.ch/report/ar6/wg2/.

Brooks, N. and Fisher, S. (2014). *Tracking Adaptation and Measuring Development: A Step-by-Step Guide*. London: International Institute for Environment and Development. https://pubs.iied.org/10100IIED/.

Brooks, N., Anderson, S., Aragon, I., Smith, B., Kajumba, T., Beauchamp, E. *et al.* (2019a). Framing and tracking 21st century climate adaptation. Working paper. Monitoring, Evaluation and Learning; Climate Change. London, UK: International Institute for Environment and Development. https://www.iied.org/10202iied.

Brooks, N., Faget, D. and Heijkoop, P. (2019b). *Tools for Measurement of Resilience in Nepal*. London, UK: Department for International Development. https://assets.publishing.service.gov.uk/media/5cff7c18e5274a3cc494e7b1/Resilience_measurement_LitRev_FINAL-updated1_ML_June_2019.pdf.

Brown, C., Ghile, Y., Laverty, M. and Li, K. (2021). Decision scaling: Linking bottom-up vulnerability analysis with climate projections in the water sector. *Water Resources Research* 48(9). https://doi.org/10.1029/2011WR011212.

Crichton, R. and Esteban, M. (2018). Limits to coastal adaptation in Samoa: Insights and experiences. In: *Limits to Climate Change Adaptation.* Filho, W.L. and Nalau, J. (eds.). Springer Cham. 283-300.

Daron, J. (2015). Challenges in using a robust decision making approach to guide climate change adaptation in South Africa. *Climatic Change* 132(3), 459-473. https://doi.org/10.1007/s10584-014-1242-9.

Davis, R.E., Knappenberger, P.C., Novicoff, W.M. and Michaels, P.J. (2003). Decadal changes in summer mortality in U.S. cities. *Int J Biometeorol* 47, 166-175. https://doi.org/10.1007/s00484-003-0160-8.

Dodman, D., Hayward, B., Pelling, M., Castan Broto, V., Chow, W., Chu, E. *et al.* (2022). Cities, settlements and key infrastructure. In: *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Pörtner, H.-O., Roberts, D.C., Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A. *et al.* (eds.). Cambridge, UK and New York, NY, USA: Cambridge University Press. 907-1040. https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_Chapter06.pdf.

Eriksen, S., Schipper, E.L.F., Scoville-Simonds, M., Vincent, K., Adam, H.N., Brooks, N. *et al.* (2021). Adaptation interventions and their effect on vulnerability in developing countries: Help, hindrance or irrelevance? *World Development* 141, 105383. https://doi.org/10.1016/j.worlddev.2020.105383.

European Commission (2013). Adapting infrastructure to climate change. Commission Staff Working Document SWD (2013) 137. Brussels.

Feola, G. (2015). Societal transformation in response to global environmental change: A review of emerging concepts. *Ambio* 44(5), 376-390. https://doi.org/10.1007/s13280-014-0582-z.

Food and Agriculture Organization of the United Nations (2016). *RIMA-II: Resilience Index Measurement and Analysis - II*. Rome.

Gajjar, S.P., Singh, C. and Deshpande, T. (2019). Tracing back to move ahead: a review of development pathways that constrain adaptation futures. *Climate and Development* 11(3), 223-237. https://doi.org/10.1080/17565529.2018.1442793.

Glavovic, B.C., Dawson, R., Chow, W., Garschagen, M., Haasnoot, M., Singh, C. *et al.* (2022). Cross-chapter paper 2: cities and settlements by the sea. In: *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Pörtner, H.-O., Roberts, D.C. , Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A. *et al.* (eds.). Cambridge, UK and New York, NY, USA: Cambridge University Press. 2163-2194. https://www.ipcc.ch/report/ar6/wg2/.

Green Climate Fund (2021). Integrated Results Management Framework. https://www.greenclimate.fund/document/integrated-results-management-framework.

Hasan, F., Marsia, S., Patel, K., Agrawal, P. and Razzak, J.A. (2021). Effective community-based interventions for the prevention and management of heat-related illnesses: a scoping review. *International Journal of Environmental Research and Public Health* 18(16), 8362. https://doi.org/10.3390/ijerph18168362.

Intergovernmental Panel on Climate Change (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Pörtner, H.-O., Roberts, D.C. , Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A. *et al.* (eds.). Cambridge, UK and New York, NY, USA: Cambridge University Press. https://www.ipcc.ch/report/ar6/wg2/.

Jain, G., Singh, C. and Malladi, T. (2021). (Re)creating disasters – A case of post-disaster relocations in Chennai. In: *Rethinking Urban Risk and Resettlement in the Global South.* Johnson, C., Jain, G. and Lavell. A. (eds.). UCL Press. 269-289. https://doi.org/10.2307/j.ctv1ctgr0k.25.

Juhola, S., Glaas, E., Linnér, B.O. and Neset, T.S. (2016). Redefining maladaptation. *Environmental Science and Policy* 55 (Part 1), 135-140. https://doi.org/10.1016/j.envsci.2015.09.014.

Kalkstein, A.J. and Sheridan, S.C. (2007). The social impacts of the heat–health watch/warning system in Phoenix, Arizona: assessing the perceived risk and response of the public. *International Journal of Biometeorology* 52(1), 43-55. https://doi.org/10.1007/s00484-006-0073-4.

Leal Filho, W., Wolf, F., Totin, E., Zvobgo, L., Simpson, N.P., Musiyiwa, K. *et al.* (2022). Is indigenous knowledge serving climate adaptation? Evidence from various African regions. *Development Policy Review*, e12664. https://doi.org/10.1111/dpr.12664.

Lim, J. and Skidmore, M. (2020). Heat vulnerability and heat island mitigation in the United States. *Atmosphere* 11(6), 558. https://doi.org/10.3390/atmos11060558.

Magnan, A. (2014). Avoiding maladaptation to climate change: towards guiding principles. *SAPIENS Online* 7(1), 12. http://journals.openedition.org/sapiens/1680.

Magnan, A.K., Schipper, E.L.F., Burkett, M., Bharwani, S., Burton, I., Eriksen, S. *et al.* (2016). Addressing the risk of maladaptation to climate change. *Wiley Interdisciplinary Reviews: Climate Change* 7(5), 646-665. https://doi.org/10.1002/wcc.409.

McNamara, K.E., Westoby, R. and Smithers, S.G. (2017). Identification of limits and barriers to climate change adaptation: case study of two islands in Torres Strait, Australia. *Geographical Research* 55(4), 438-455. https://doi.org/10.1111/1745-5871.12242.

Nightingale, A.J., Eriksen, S., Taylor, M., Forsyth, T., Pelling, M., Newsham, A. *et al.* (2020). Beyond technical fixes: climate solutions and the great derangement. *Climate and Development* 12(4), 343-352. https://doi.org/10.1080/17565529.2019.1624495.

Nyasimi, M., Amwata, D., Hove, L., Kinyangi, J. and Wamukoya, G. (2014). Evidence of impact: climate-smart agriculture in Africa. CCAFS working paper no. 86. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). Copenhagen, Denmark. https://ccafs.cgiar.org/resources/publications/evidence-impact-climate-smart-agriculture-africa-0.

O'Neill, B., van Aalst, M., Zaiton Ibrahim, Z., Berrang Ford, L., Bhadwal, S., Buhaug, H. *et al.* (2022). Key risks across sectors and regions. In: *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Pörtner, H.-O., Roberts, D.C., Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A. *et al.* (eds.). Cambridge, UK and New York, NY, USA: Cambridge University Press. 2411-2538. https://www.ipcc.ch/report/ar6/wg2/.

Owen, G. (2020). What makes climate change adaptation effective? A systematic review of the literature. *Global Environmental Change* 62(May), 102071. https://doi.org/10.1016/j.gloenvcha.2020.102071.

Partey, S.T., Zougmoré, R.B., Ouédraogo, M. and Campbell, B.M. (2018). Developing climate-smart agriculture to face climate variability in West Africa: Challenges and lessons learnt. *Journal of Cleaner Production* 187(June), 285-295. https://doi.org/10.1016/j.jclepro.2018.03.199.

Ray, P.A. and Brown, C.M. (2015). *Confronting Climate Uncertainty in Water Resources Planning and Project Design*. World Bank Group. https://openknowledge.worldbank.org/handle/10986/22544.

Schipper, E.L.F. (2020). Maladaptation: When adaptation to climate change goes very wrong. *One Earth* 3(4), 409-14. https://doi.org/10.1016/j.oneear.2020.09.014.

Scoones, I., Stirling, A., Abrol, D., Atela, J., Charli-Joseph, L., Eakin, H. *et al.* (2020). Transformations to sustainability: combining structural, systemic and enabling approaches. *Current Opinion in Environmental Sustainability* 42, 65-75. https://doi.org/10.1016/j.cosust.2019.12.004.

Senyolo, M.P., Long, T.B., Blok, V. and Omta, O. (2018). How the characteristics of innovations impact their adoption: An exploration of climate-smart agricultural innovations in South Africa. *Journal of Cleaner Production* 172(January), 3825-3840. https://doi.org/10.1016/j.jclepro.2017.06.019.

Singh, C., Iyer, S., New, M.G., Few, R., Kuchimanchi, B., Segnon, A.C. *et al.* (2021). Interrogating 'effectiveness' in climate change adaptation: 11 guiding principles for adaptation research and practice. *Climate and Development* (August), 1-15. https://doi.org/10.1080/17565529.2021.1964937.

Soanes, M., Bahadur, A.V., Shakya, C., Smith, B., Patel, S., Rumbaitis del Rio, C. *et al.* (2021). Principles for locally led adaptation. Issue paper January. International Institute for Environment and Development. https://www.iied.org/sites/default/files/pdfs/2021-01/10211IIED.pdf.

Sutton-Grier, A.E., Wowk, K. and Bamford, H. (2015). Future of our coasts: The potential for natural and hybrid infrastructure to enhance the resilience of our coastal communities, economies and ecosystems. *Environmental Science & Policy* 51, 137-148. https://doi.org/10.1016/j.envsci.2015.04.006.

Toloo, G., FitzGerald, G., Aitken, P., Verrall, K. and Tong, S. (2013). Evaluating the effectiveness of heat warning systems: systematic review of epidemiological evidence. *International Journal of Public Health* 58(5), 667-681. https://doi.org/10.1007/s00038-013-0465-2.

Tschakert, P., van Oort, B., St. Clair, A.L. and LaMadrid, A. (2013). Inequality and transformation analyses: a complementary lens for addressing vulnerability to climate change. *Climate and Development* 5(4), 340-350. https://doi.org/10.1080/17565529.2013.828583.

Venable, L., Brooks, N. and Vincent, K (2022). *Lessons for Measuring Resilience from the BRACC Programme.* Learning Brief. BRACC. https://bracc.kulima.com/resource/lessons-measuring-resilience-bracc-programme.

Vij, S., Biesbroek, R., Stock, R., Gardezi, M., Ishtiaque, A., Groot, A. *et al.* (2021). 'Power-sensitive design principles' for climate change adaptation policy-making in South Asia'. *Earth System Governance* 9 (September): 100109. https://doi.org/10.1016/j.esg.2021.100109.

Waryszak, P., Gavoille, A., Whitt, A.A., Kelvin, J. and Macreadie, P.I. (2021). Combining gray and green infrastructure to improve coastal resilience: lessons learnt from hybrid flood defenses. *Coastal Engineering Journal* 63(3), 335-350. https://doi.org/10.1080/21664250.2021.1920278.

Weiler, F., Klöck, C. and Dornan, M. (2018). Vulnerability, good governance, or donor interests? The allocation of aid for climate change adaptation. *World Development* 104 (April), 65-77. https://doi.org/10.1016/j.worlddev.2017.11.001.

Weinberger, K.R., Zanobetti, A., Schwartz, J. and Wellenius, G.A. (2018). Effectiveness of National Weather Service heat alerts in preventing mortality in 20 US cities. *Environment International* 116, 30-38. https://doi.org/10.1016/j.envint.2018.03.028.

Zerssa, G., Feyssa, D., Kim, D.G. and Eichler-Löbermann, B. (2021). Challenges of smallholder farming in Ethiopia and opportunities by adopting climate-smart agriculture. *Agriculture* 11(3), 192. https://doi.org/10.3390/agriculture11030192.

Zvobgo, L., Johnston, P., Williams, P.A., Trisos, C.H., Simpson, N.P. and Global Adaptation Mapping Initiative Team (2022). The role of indigenous knowledge and local knowledge in water sector adaptation to climate change in Africa: a structured assessment. *Sustainability Science* 17(April). https://doi.org/10.1007/s11625-022-01118-x.

Chapter 6

Berrang-Ford, L., Siders, A.R., Lesnikowski, A., Fischer, A.P., Callaghan, M.W., Haddaway, N.R. *et al.* (2021). A systematic global stocktake of evidence on human adaptation to climate change. *Nature Climate Change* 11(11), 989–1000. https://doi.org/10.1038/s41558-021-01170-y.

Buchner, B., Naran, B., Fernandes, P., Padmanabhi, R., Rosane, P., Solomon, M. *et al.* (2021). *Global Landscape of Climate Finance 2021.* Climate Policy Initiative. https://www.climatepolicyinitiative.org/publication/global-landscape-of-climate-finance-2021/.

Cochran, I. and Pauthier, A. (2019). A framework for alignment with the Paris Agreement : Why, what and how for financial institutions? Discussion paper September. Paris, France.

Intergovernmental Panel on Climate Change (2021). *Climate Change 2021: The Physical Science Basis.* Masson-Delmotte, V., Zhai, P., Pirani, A., Connors, S.L., Péan, C., Chen, Y. *et al.* (eds.). Cambridge and New York: Cambridge University Press. https://www.ipcc.ch/report/sixth-assessment-report-working-group-i/.

_____ (2022a). *Climate Change 2022: Impacts, Adaptation and Vulnerability. Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Pörtner, H.-O., Roberts, D.C., Tignor, M.M.B., Poloczanska, E., Mintenbeck, K., Alegria, A. *et al.* (eds.). Cambridge and New York: Cambridge University Press. https://www.ipcc.ch/report/ar6/wg2/.

_____ (2022b). *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Shukla, P.R., Skea, J., Reisinger, A., Slade, R., Al Khourdajie, A., van Diemen, R., McCollum, D., Pathak, M., Some, S., Vyas, P., Fradera, R., Belkacemi, M., Hasija, A., Lisboa, G., Luz, S. and Malley, J. (eds.). Cambridge and New York: Cambridge University Press. https://www.ipcc.ch/report/sixth-assessment-report-working-group-3/.

Jachnik, R., Mirabile, M. and Dobrinevski, A. (2019). Tracking finance flows towards assessing their consistency with climate objectives. Environment working paper no. 146. Organisation for Economic Co-operation and Development.

Magnan A.K., Anisimov, A. and Duvat, V.K. (2022). Strengthen climate adaptation research globally. *Science* 376(6600), 1398–1400. https://doi.org/10.1126/science.abq0737.

O'Neill B.C., van Aalst, M., Ibrahim, Z.Z., Ford, L.B., Bhadwal, S., Buhaug, H. *et al.* (2022). Key risks across sectors and regions. In Climate Change 2022: *Impacts, Adaptation and Vulnerability. Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Pörtner, H.-O., Roberts, D.C., Tignor, M.M.B., Poloczanska, E., Mintenbeck, K., Alegria, A. *et al.* (eds.). Cambridge and New York: Cambridge University Press. Chapter 16. 2411–2538. https://www.ipcc.ch/report/ar6/wg2/.

Organisation for Economic Co-operation and Development (2021). Strengthening adaptation-mitigation linkages for a low-carbon, climate-resilient future. OECD environment policy paper no. 23. Paris: OECD Publishing. https://doi.org/10.1787/6d79ff6a-en.

United Nations Environment Programme (2021a). *Adaptation Gap Report 2021: The Gathering Storm. Adapting to Climate Change in a Post-Pandemic World.* Nairobi. https://www.unep.org/resources/adaptation-gap-report-2021.

_____ (2021b). *Adaptation Gap Report 2020.* Nairobi. https://www.unep.org/resources/adaptation-gap-report-2020.

_____ (2022). *Emissions Gap Report 2022.* Nairobi. https://www.unep.org/resources/emissions-gap-report-2022.

A man points to the level that the water came up to on the side of his home when floods swept through his village in Pakistan's Sindh province in August 2010.

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