Adaptation & Resilience Impact

A measurement framework for investors

April 2024

ARIC secretariat:

Adaptation & Resilience Investors Collaborative

UN environment programme | finance initiative

Disclaimer

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Mention of a commercial company or product in this document does not imply endorsement or recommendation by the members of the Adaptation and Resilience Investors Collaborative, the United Nations Environment Programme or Cadlas. The use of information from this document for publicity or advertising is not permitted.

Trademark names and symbols are used in an editorial fashion with no intention on infringement of trademark or copyright laws.

The views expressed in this guidance do not necessarily represent the views of each individual member of the Adaptation and Resilience Investors Collaborative (ARIC), the UN Environment Programme Finance Initiative, Cadlas or the group of external consultees that assisted in the preparation of the guidance. We regret any errors or omissions that may have been unwittingly made and make no warranty, express or implied, for the accuracy, completeness or any third party use or the results of such use of any information contained herein.

Photo credit: unsplash.com/@wilsanphotography

Suggested citation: Adapatation & Resilience Investors Collaborative (2024). Assessing Adaptation & Resilience Impact in Private Investments: A measurement framework for investors

Acknowledgments

Adaptation & Resilience Investors Collaborative

This guidance is based on discussions and work undertaken by the Adaptation and Resilience Investors Collaborative (ARIC) impact metrics working group. The working group includes representatives from the following institutions:

British International Investment, cdp, DFC, FinDev Canada, finnfund, FMO Entrepreneurial Development Bank, Global Innovation Fund, Nordic Development Fund, Proparco Groupe AFD, USAID From the American People

The report was co-developed by working group members:

Alar Cartan, Therese Rossiter, Chiara Trabacchi (British International Investment), Federica Fotino, Alessando Mancini, Giorgio Massotti (Cassa Depositi e Prestiti S.p.A.), Daniel Buckley, Beth Olberding (Development Finance Corporation), Stephanie Shumsky (FinDev Canada), Marko Berglund (Finnfund), Irene Barnhoorn, Charissa Bosma, Alyssa Pritts (FMO), Ken Chomitz (Global Innovation Fund), Sofia Chaichee, Mayra Da Silva (Nordic Development Fund), Caroline Corlin (Proparco)

The working group would like to thank the following external reviewers for their constructive and expert feedback, which helped to shape the final report:

Ellie Turner (60 Decibels), Mallory St. Claire (Aspen Network of Development Entrepreneurs), Malika Anand (Catalyst Fund), Ujala Qadir (Climate Bonds Initiative), Sagarika Chatterjee (Climate Champions), Jui Joshi (Climate Collective), Claire Cummins (Climate Fund Managers), Nijhad Jamal (Factore), Masrura Oishi (Global Impact Investing Network), Maarten Hage (Helios), Karl Schultz (International Platform on Adaptation Metrics), Hamid Asseffar (Invesco), Daouda Ben Oumar Ndiaye (Islamic Development Bank), Satomi Komachi (MUFG), Dr. Nicola Ranger, Dr. Mark Bernhofen (Oxford University), Sudeshna Raychaudhuri (PRI), Nicole DeMarsh (Sagana), David Goldsworthy (Standard Bank), Jenty Kirsch-Wood, Mathieu Verougstraete (UNDRR), Raphaele Deau, Sumalee Khosla (UNEP)

Technical support: Cadlas and Chiara Trabacchi (British International Investment)

Management: Drew Johnson, Paul Smith (UNEP FI)

Design: Rob Wilson (UNEP FI)

Funding for technical support to this project was provided by British International Investment.

CONTENTS

FIGURES AND TABLES

GLOSSARY

Adaptation (or climate change adaptation)
In human systems, the process of adjustment to actual or expected climate and its effects, to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects (Intergovernmental Panel on Climate Change [IPCC], 2022).

Adaptation & resilience enabling investment
An investment that provides adaptation and resilience solutions that contribute substantially to preventing or reducing the risk of adverse impacts, or adverse impacts, of the current and expected future climate on other people, nature, assets, and/or other economic activities.

Adapted investment
An investment that includes adaptation and resilience solutions that substantially reduce the risk of adverse impacts of current and expected future climate on that investment itself.

Aggregation (or aggregability)
The process of assembling and summing quantitative information obtained from multiple data points or information sources, to allow adaptation & resilience impact to be measured at portfolio level.

Baseline
A starting point from which progress towards a given goal or target may be measured.

Counterfactual
Analysis that considers what would have been the result if events had happened in a different way to how they actually happened.

Ex ante
A measurement that is based on forecasts at the time of investment, rather than actual results.

Ex post
A measurement that is based on actual results post-investment, rather than forecasts.

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.

Hazard
The potential occurrence of a natural or human-induced physical climate event, trend or impact 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.

Impact
The long-term effects of the investment project, directly or indirectly, intended or unintended, that may contribute to longer-term climate resilience, adaptive capacity, or reduced climate vulnerability.

Investment origination
The process by which investors identify promising investment opportunities.

Maladaptation
Actions that may lead to increased risk of adverse climate-related outcomes, including via increased greenhouse gas (GHG) emissions, increased or shifted vulnerability to climate change, more inequitable outcomes, or diminished welfare, now or in the future. Most often, maladaptation is an unintended consequence (IPCC, 2022).

Outcome
The short- and medium-term effects of the investment, responding to the project-specific context of climate vulnerability to build climate resilience.

Output
The immediate deliverables of an investment, for example the delivery of specific assets, activities or services that respond to the investment-specific physical climate risk context.

Physical climate risk
Risks resulting from climatic events, such as storms, floods or increasing temperatures. The determinants of physical climate risk are hazards, exposure, and vulnerability.

Physical climate risk scenario
An exercise to understand and navigate the uncertainties associated with future physical climate risks to ensure that projected future climate conditions and events can be withstood.

Resilience (or climate resilience)
The capacity of social, economic, and environmental systems to cope with climate-related hazardous events, trends or disturbances, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.

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.

ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
ARIC	Adaptation and Resilience Investors Collaborative
CIFAR	Climate Innovation for Adaptation and resilience
GARI	Global Adaptation and Resilience Investment working group
GHG	greenhouse gas
GIIN	Global Impact Investing Network
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
IDB	Inter-American Development Bank
IMP	Impact Management Platform
IPCC	Intergovernmental Panel on Climate Change
IRIS+	Impact Reporting and Investment Standards+
JPMAM	JP Morgan Asset Management
NAP	National Adaptation Plan
NDC	Nationally Determined Contribution
PRB	Principles for Responsible Banking
STAR	Species Threat Abatement and Recovery
UNEP	United Nations Environment Programme
UNEP FI	United Nations Environment Programme Finance Initiative
WCMC	World Conservation Monitoring Centre
WEF	World Economic Forum
WG	working group
WWT	water and wastewater treatment

EXECUTIVE SUMMARY

Investors increasingly recognize the opportunities for investments to cope with the risks and impacts of climate change. While there is broad agreement on what constitutes climate *mitigation* finance, the same is not true for climate *adaptation* finance and to how to assess its impact. This paper seeks to address that challenge.

Adaptation and resilience can be defined as the ability to prepare, prevent, respond to, and recover from climate-related shocks and stresses such as extreme weather events and shifts in climate and weather conditions.[1] There is growing investment—including private investment—in a wide range of assets, technologies and services that offer climate adaptation and resilience solutions (J.P. Morgan Asset Management [JPMAM], 2023).

However, to prioritize and scale up investment in adaptation and resilience,[2] investors need to better understand the dimensions of adaptation and resilience, what qualifies as adaptation finance in private investment, and how to accurately measure and report on the positive adaptation and resilience impacts of their investments.[3]

Adaptation and resilience investments improve the climate resilience of people, the planet, or the economy, assessing their impact in terms of the social, environmental *and* economic benefits that they confer.

A conceptual model for assessing the impact of adaptation and resilience investments is derived from best practice in impact management. This combines impact pathways (activities, outputs, outcomes and impact) with the Five Dimensions of Impact—*what, who, how much, contribution* and *risk*—as defined by the Impact Management Project (Impact Frontiers, 2024).

This approach combined with a proposed set of metrics provides an initial blueprint for investors to start applying and embedding adaptation and resilience impact assessment into their investments.

This will accelerate understanding of how private investment finance can most effectively support the climate resilience of people, the planet, and the economy. It will also support wider processes such as the evolution of sustainable finance and sustainability reporting standards, helping to bridge persistent gaps between adaptation and resilience policy frameworks and the delivery of finance on the ground.

1 See the Glossary for fuller definitions of the terms ‘adaptation’ and ‘resilience’.
2 The terms ‘climate change adaptation’, ‘adaptation’, ‘climate resilience’ and ‘resilience’ are often used interchangeably. This document uses the umbrella term ‘adaptation and resilience’ to cover all of them.
3 Throughout this document the term ‘investment’ is intended to refer to a specific investment venture or investee. It may include, but not be limited to, debt, equity, quasi-equity and guarantees.

1. INTRODUCTION

This guidance paper offers a practical and consistent framework for assessing the positive adaptation and resilience impacts of investments.

Investors are increasingly aware of the risks and impacts of climate change, and of the emerging opportunities for investments that help to cope with them. In 2024 the World Economic Forum (WEF) identified extreme weather as the second most significant global risk over the next two years, and the most significant global risk over the next ten years (WEF, 2024). This is resulting in increasing investment, including private investment, in a wide range of assets, technologies and services that offer climate adaptation and resilience solutions (JPMAM, 2023). This is anticipated to evolve into a multi-trillion-dollar market in the coming years (WEF, 2022).

However, where climate mitigation finance is relatively well understood and easy to measure against, the same is not yet true of climate adaptation finance. To prioritize and scale up investment in adaptation and resilience, investors need to better understand the types of adaptation and resilience,[4] what qualifies as adaptation finance in private investment, and have suitable methodologies to accurately measure and report on the positive adaptation and resilience impacts of their investments.[5] These methodologies need to be clear, consistent and comparable, with a focus on reporting the *positive impact* of the investment on adaptation and resilience of people, the planet and the economy, not just the quantity of finance committed.

This will support investors to better develop investment strategies, originate and prioritize investments, manage portfolios and report on impact. This will ultimately allow investees to communicate the positive impact of their practices and solutions, demonstrating their ability to thrive and attract capital in the face of intensifying climate change impacts. In turn, this will enable investors to pursue emerging commercial opportunities in this field, and to collaborate with other stakeholders, such as co-financiers and regulators, to scale investments.

In response to this need, the Adaptation and Resilience Investors Collaborative (ARIC) has collaborated with a broad range of private investors, international organizations, advisory firms and academics, to develop focused and applicable guidance for investors on the assessment of the adaptation and resilience impact of private investments. In this paper ARIC offers:

a **practical and consistent framework** for assessing the positive adaptation and resilience impacts of investments.

a conceptual approach to **embedding adaptation and resilience impact assessment in the investment cycle**, drawing upon best practices in impact management.

a **set of clear, aggregable metrics** that can be used to support the assessment and management of adaptation and resilience impact across investment portfolios.

4 The terms 'climate change adaptation', 'adaptation', 'climate resilience' and 'resilience' are often used interchangeably. This document uses the umbrella term 'adaptation and resilience' to cover all of them.

5 Throughout this document the term 'investment' is intended to refer to a specific investment venture or investee. It may include, but not be limited to, debt, equity, quasi-equity and guarantees.

2. STRUCTURE AND OVERVIEW

This guidance paper starts by setting out foundational definitions of adaptation and resilience and how assessment of adaptation and resilience impact can be integrated into the current investment cycle. It then provides a conceptual model for the assessment of adaptation and resilience impact that:

a. Complements other relevant systems of metrics and measurement for adaptation and resilience in investment or financing operations.
b. Draws upon best practices in investment impact assessment—as defined by the Five Dimensions of Impact (Impact Frontiers, 2024)—to guide the assessment of adaptation and resilience impact.

It then proposes a set of metrics that may be used to organize and, where possible, aggregate adaptation and resilience impact at portfolio- or sub-portfolio level, before looking forward to how practice and guidance on the assessment of adaptation and resilience impact could be further advanced.

2.1 ADAPTATION AND RESILIENCE: KEY DEFINITIONS

Adaptation and resilience can be defined as the ability to prepare, prevent, respond to and recover from climate-related shocks and stresses such as extreme weather events and shifts in climate and weather conditions.[6]

Resilience can be seen as three dimensions of resilience that vary in intensity of change (see Figure I):

a. **Absorptive capacity**—a low level of change that is defined as the ability to cope with changing climate conditions, e.g. savings/parametric insurance.
b. **Adaptive capacity**—a medium level of change that is defined as the ability to adjust incrementally and flexibly in anticipation of, or in response to, changing climate conditions, e.g. early warning systems, capacity building, adapted practices.
c. **Transformative capacity**—a high level of change that is defined as the ability to make fundamental and structural changes in response to experienced or anticipated changes in climate conditions. For example, systemic adaptation measures such as new infrastructure that enables the use of alternative water sources, or wholescale shifts to alternative agricultural production systems e.g. growing different crops.

All types of adaptive capacities can form part of an investment strategy that aims to positively impact adaptation and resilience in multiple contexts.

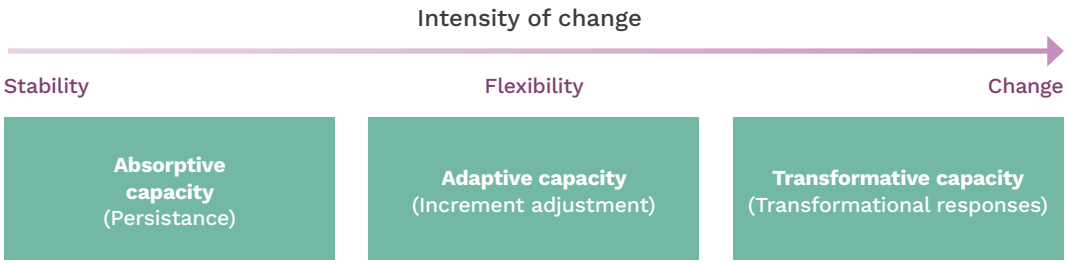


Figure I: Three dimensions of resilience: absorptive vs adaptive vs transformative capacities (Tanner *et al.*, 2017)

6 See the Glossary for fuller definitions of the terms 'adaptation' and 'resilience'.

This paper focuses on adaptation and resilience in the context of private investments that improve the climate resilience of **people** (e.g. individuals, families or communities), the **planet** (e.g. natural habitats, ecosystems or biodiversity), and/or the **economy** (e.g. economic assets, economic activities or economic systems) by helping them to adapt to actual or expected climate conditions.

The 'people, planet, and economy' lens provides a clear focus on the adaptation and resilience impact of investments in terms of the social, environmental *and* economic benefits that they confer, beyond their financial returns to the investor.

2.2 CONCEPTUAL MODEL FOR ASSESSING ADAPTATION AND RESILIENCE IMPACT

The adaptation and resilience impact of an investment may be assessed through the structured approach displayed conceptually in Figure II. This starts with defining the boundaries within which the investment's adaptation and resilience impact may be assessed, and the specific context of physical climate risk that is relevant for the investment. It then sets out a credible impact pathway that explains how the immediate results of the investment (outputs) contribute towards wider changes (outcomes). The contribution of those adaptation and resilience outcomes towards the achievement of adaptation and resilience impact in terms of the increased resilience of people, planet or the economy can then be understood and evaluated.

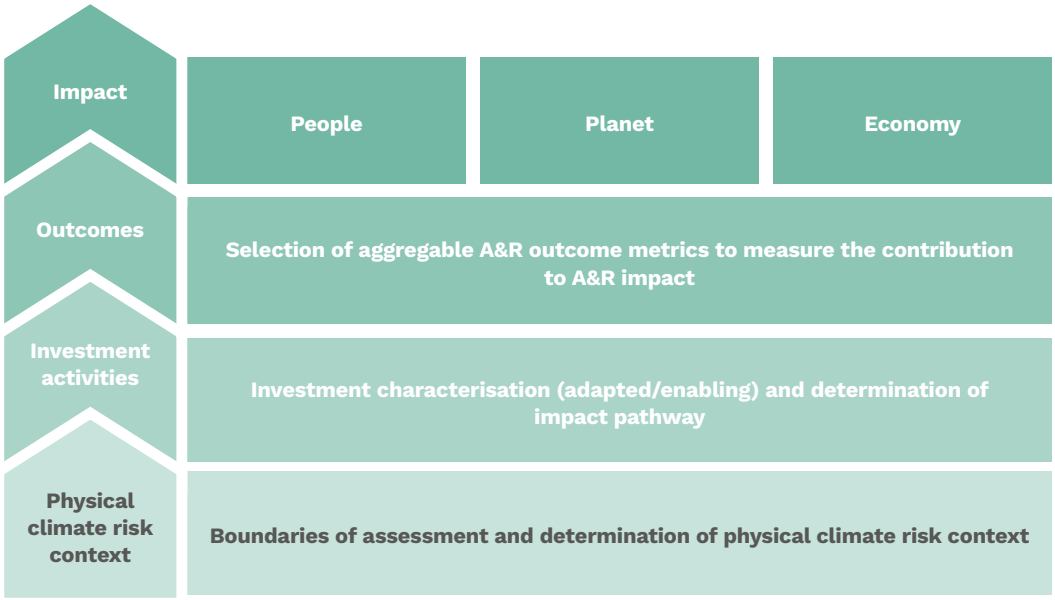


Figure II: Conceptual model for the assessment of investment adaptation and resilience impact

2.3 ADAPTATION AND RESILIENCE IMPACT MANAGEMENT IN THE INVESTMENT CYCLE

Investors may integrate adaptation and resilience impact assessment into the investment cycle—from investment origination through to investor exit—by drawing on the Operating Principles for Impact Management process for integrating the positive impact of adaptation solutions throughout the investment cycle as illustrated in Figure III (Operating Principles for Impact Management, 2019). Investors may integrate an assessment of the investment's expected adaptation and resilience impact into the impact dashboard (or equivalent) during investment origination and

structuring. This may then be used to monitor and manage investment adaptation and resilience impact while the investment is in the investor's portfolio.

Figure III: Managing adaptation and resilience impact along the investment cycle (adapted from Impact Principles)

2.4 ALIGNING WITH OTHER APPROACHES TO ADAPTATION AND RESILIENCE MEASUREMENT

In preparing this work, ARIC has drawn upon the extensive experience of its members and has consulted with a wide range of private investors that are active in the adaptation and resilience space, including leading impact investors, and funds specializing in adaptation and resilience investment. In addition, ARIC has consulted with leading industry associations in the field of adaptation and resilience impact assessment, including the Global Impact Investing Network (GIIN), UNEP FI's Principles for Responsible Banking (PRB) and the Climate Innovation for Adaptation and resilience (CIFAR) Alliance, amongst others. It has also taken stock of other relevant systems of metrics for adaptation and resilience assessment, such as the GIIN's Climate Adaptation and resilience Metrics (GIIN, 2024), the Deutsche Gesellschaft für Internationale Zusammenarbeit's (GIZ) Repository of Adaptation Indicators (GIZ, 2014), UNEP's Land Use Impact Hub, and others.

This framework fills an important market-gap in this field by providing a higher-level orientation for investors on the integration of adaptation and resilience metrics into the investment process and into the assessment and management of adaptation and resilience impact at portfolio level.

3. ADAPTATION AND RESILIENCE IMPACT ASSESSMENT: APPLYING THE 'FIVE DIMENSIONS OF IMPACT'

The Five Dimensions of Impact (Impact Frontiers, 2024) as defined by the Impact Management Project is a widely recognized framework for assessing the positive impact of investments. This guidance uses the Five Dimensions of Impact as an organizing logic for assessing of adaptation and resilience impact. The Five Dimensions of Impact are summarised in Table 1:

Table 1: Overview of the Five Dimensions of Impact

What?	What outcome the enterprise is contributing to, whether it is positive or negative, and how important the outcome is to stakeholders.
Who?	Which stakeholders are experiencing the outcome and how underserved they are in relation to the outcome.
How much?	How many stakeholders experienced the outcome, what degree of change they experienced, and how long they experienced the outcome.
Contribution	Whether an enterprise's and/or investor's efforts resulted in outcomes that were likely better than what would have occurred otherwise.
Risk	The likelihood that impact will be different than expected.

Assessing adaptation and resilience impact in investments can be integrated into wider investment impact assessment in line with the Five Dimensions of Impact and mapped against the activity/output/outcome/impact framework, as illustrated in Figure II.

Section 4 provides 'how to measure' guidance for adaptation and resilience impact assessment, structured around the Five Dimensions of Impact: *what, who, how much, contribution* and *risk*.

3.1 WHAT?

This dimension of adaptation and resilience impact focuses on **what** outcome the investment is contributing to and how important it is to stakeholders, and describes the expected adaptation and resilience benefits of the investment.

This begins by recognizing the need for an adaptation and resilience investment, informed by understanding the investment's **physical climate risk context**. Contextualizing the assessment of adaptation and resilience impact enables investors to articulate a theory of change that has the investment's physical climate risk context as its starting point. The Intergovernmental Panel on Climate Change (IPCC) identifies the following key determinants of physical climate risk (IPCC, 2022):

- **Hazards:** Physical climate-related events or trends that may potentially occur causing negative impacts within the investment's boundaries of assessment.
- **Exposure:** The presence within the boundaries of assessment of people, natural systems, and economic or other assets in places and settings that could be adversely affected.
- **Vulnerability:** The propensity or predisposition of people, natural systems and economic or other assets to be adversely affected.

Given the inherent uncertainties and frequent data gaps (especially in emerging markets), assessing physical climate risk information and its application in adaptation and resilience assessment requires pragmatic and proportionate approaches that use reliable external information sources such as:

- IPCC reports or other authoritative sources to identify emerging hazards and vulnerabilities by sector or region based on the best available science, supported where appropriate by socio-economic and/or environmental studies.
- Nationally Determined Contributions (NDCs), and National Adaptation Plans (NAPs), to identify climate resilience priorities and solutions that are relevant to specific country contexts, including downscaled national or regional climate information on hazards and vulnerabilities.

There are two types of investments that can confer adaptation and resilience benefits:

- **Enabling investments**, in addition to being themselves adapted, make other people, businesses, natural or physical assets more climate-resilient by providing adaptation and resilience solutions (e.g. technologies, products or services).
- **Adapted investments** are themselves made climate-resilient through the effective management of physical climate risks, but do not necessarily make others more climate resilient.

For example, an enabling investment could finance the research and development of new types of climate-resilient crops, creating a wider system impact that improves sector-level resilience. An adapted investment could build a road more resistant to landslides or floods, which makes the entire investment in that area more resilient. However, some investments have both enabling and adapted characteristics, as illustrated in Box 1.

Box 1: Examples of investments with enabling and adapted characteristics

An ARIC member that invested in a company in an African country that develops and markets cereal crop seeds. The **adapted** investment component financed a grain drying unit to minimize grain losses due to changes in precipitation patterns leading to severe flooding. The **enabling** investment component financed the expansion of crop breeding programmes to develop climate-smart maize varieties that would benefit other maize growers.

Another ARIC member invested in a joint venture platform for financing water and wastewater treatment (WWT) investments in African countries. This platform will finance multiple WWT assets that may have to face and address a variety of physical climate risks (e.g. droughts, floods, hydrological variability, extreme heat), with a variety of expected adaptation and resilience outcomes. This will be achieved by making existing WWT assets more resilient to physical climate risks (adapted) and through extending new, reliable and climate-resilient WWT services to users, e.g. cities, communities and households (enabling). As illustrated in Figure IV, in addition to themselves being adapted, climate-resilient infrastructure investments may also enable the climate resilience of a wider range of users of the services they provide and enhance resilience at the systems level, thus supporting a wide range of beneficiaries from businesses to households and natural systems.

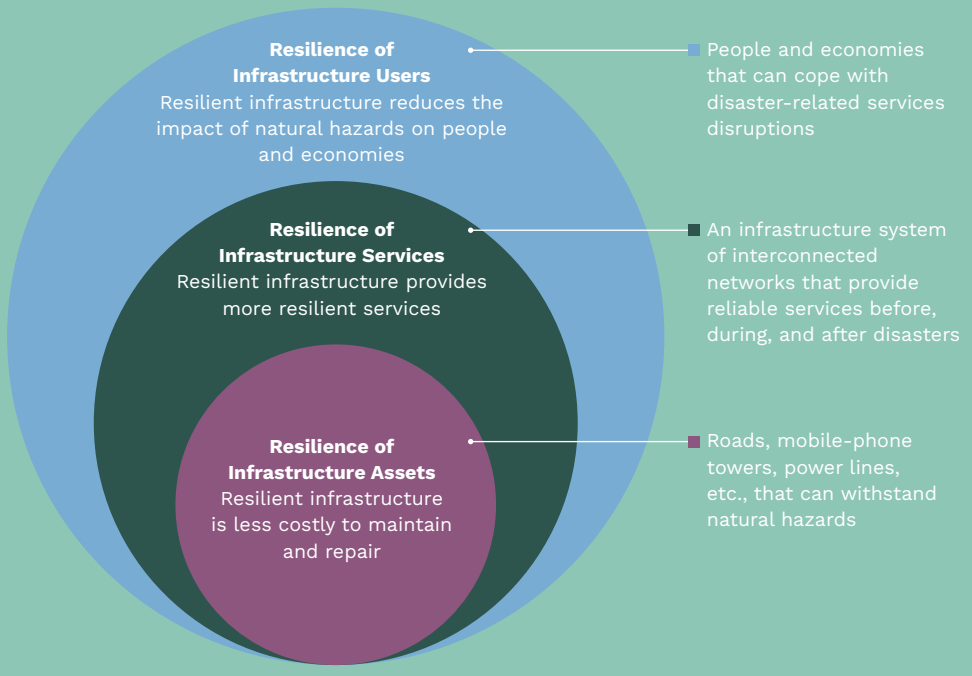


Figure IV: System-wide approach to infrastructure resilience (Asian Development Bank [ADB], 2022)

Adapted investments can often make the investee itself more climate-resilient and adaptable, while enabled investments can bring wider, system-level impact. An investor may decide to focus on enabling or adapted investments due to their investment strategies or the processes and procedures that they may need to integrate into their risk management systems. For example, an investor may have a strategy focused on enabling investments but may still need to make sure that these are adapted to be able to deliver their commercial and wider impact objectives.

3.2 WHO?

This dimension of adaptation and resilience impact focuses on **who** experiences the adaptation and resilience outcome, and on their climate vulnerability, using three aspects of adaptation and resilience impact: people, planet and economy.

People: people (e.g. individuals, households, communities) supported to be more resilient to climate change impacts

Planet: natural systems (e.g. habitats, ecosystems or biodiversity) that are protected in ways that make them more resilient to climate change impacts

Economy: economic activity conducted in ways that are more resilient to climate change impacts, e.g. climate-resilient physical assets such as climate-resilient water infrastructures, or climate-resilient businesses such as agribusinesses or financial institutions.

An investment may deliver more than one aspect of adaptation and resilience impact, as illustrated in Box 2.

Box 2: Example of any investment involving multiple aspects of adaptation and resilience impact

An ARIC member invested in a food processing platform linking producers with technology and market access to reduce post-harvest losses in a South Asian country. This investment aimed to deliver adaptation and resilience impact across the *people and economy* aspects. The *people* aspect covered the number or people supported to be more climate resilient through the technology and services provided through the investment, while the *economy* aspect covered the increased producer revenues and the economic value of avoided post-harvest losses.

3.3 HOW MUCH?

This dimension of adaptation and resilience impact focuses on how much the adaptation and resilience outcome is experienced, the degree of change experienced, and the length of time over which the change occurs. The assessment of adaptation and resilience impact entails the assessment of the *scale* of impact, the *depth* or intensity of impact, and the duration of the adaptation and resilience impact.

1. **Scale** of adaptation and resilience impact refers to the extent of the system boundary within which climate vulnerability is reduced. It may be assessed using output-level metrics, e.g. number of people trained in climate-smart agricultural techniques, or hectares of agricultural land fitted with efficient irrigation equipment.
2. **Depth** of adaptation and resilience impact refers to the extent of the reduction of climate vulnerability. It may be assessed using outcome-level metrics, e.g. such as number of farmers maintaining income levels during droughts, or increased crop production per unit water used.
3. **Duration** of adaptation and resilience refers to the length of time over which the adaptation and resilience outcome is experienced. It may be assessed using metrics that can be measured over a reasonable investment time horizon for private investors. Output-level metrics may be more appropriate for measurement over shorter time frames, whereas outcome-level metrics may require longer timeframes for measurement (Inter-American Development Bank [IDB], 2019).

Table 2 provides an outline of how the concepts of *scale* and *depth* may be applied over the three aspects of adaptation and resilience impact (people, planet, economy), and Box 3 provides a specific investment example.

Table 2: Assessing scale and depth across the three aspects of adaptation and resilience (people, planet and economy)

Aspect of adaptation & resilience impact	Assessment of scale	Assessment of depth
People	May require the use of 'people based' metrics, possibly at output level e.g. number of people given access to flood risk awareness training	May entail assessing the degree to which people are made more climate resilient using outcome-level metrics, e.g. number of people able to avoid income losses during flood events
Planet	May require the use of more specific output-level metrics such as hectares of protected habitat	May require bespoke assessment to account for the high context-specificity of climate change impacts on different types of natural systems
Economy	Scale and depth may be conflated through the use of value-based metrics such as USD/year of avoided climate-related losses	

Box 3: Example of the assessment of adaptation and resilience impact involving depth of impact

An ARIC member invested in an agri-tech company supporting African smallholders and businesses. As part of this investment, the investor ran a dedicated *ex post* study involving an interview-based survey of >100 smallholder farmers to assess the farmers' perceived improvements in their climate resilience as a result of the investment. This covered issues such as quality of life, ability to access enablers, improved knowledge and increased yields and revenues.

3.4 CONTRIBUTION

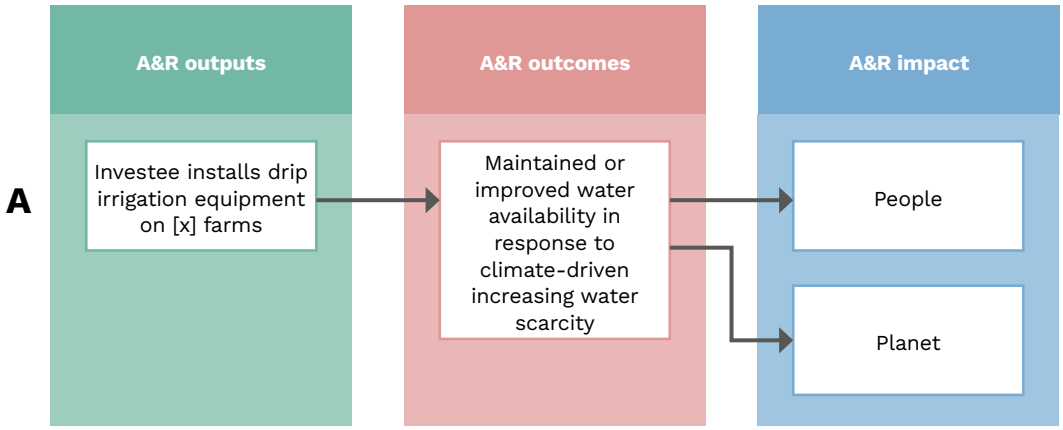
This dimension of adaptation and resilience impact focuses on how the efforts of the investor or investee result in better adaptation and resilience outcomes than would have been expected if the investment had not taken place.

This may entail the assessment of adaptation and resilience impact against a 'without investment' counterfactual—a hypothetical situation in which the investment does not take place. Investors may define these counterfactuals themselves, or use external analysis and partnerships (e.g. academics) to define them. A credible baseline—a state against which change is measured (IPCC, 2018)—may support the development of this counterfactual. This could be a current baseline, representing observable, present-day conditions, or it could be a future baseline based on projected future conditions. Investors will need to select appropriate baselines that take account of the specific investment context and physical climate risk context to accurately inform their assessment of adaptation and resilience impact. Box 4 provides an example.

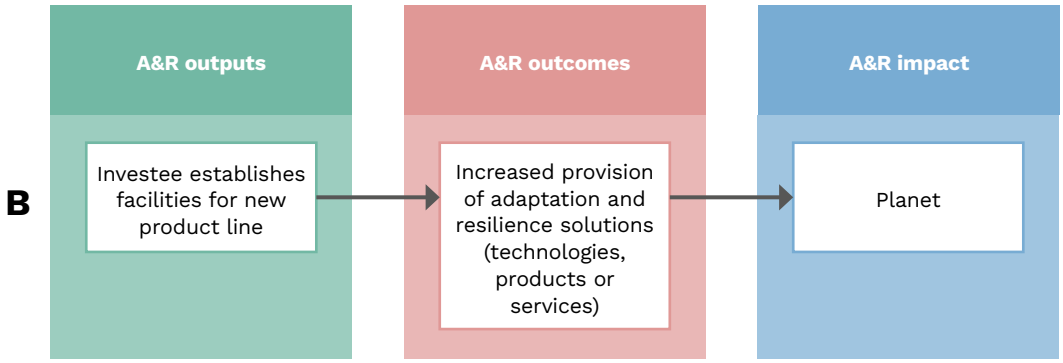
Box 4: Hypothetical baseline example for a port infrastructure investment

A private port operator is considering investing in upgraded coastal flood water drainage infrastructure to handle increased sea level rise and flooding due to physical climate scenarios. Historical data may show that areas of the port currently flood three times per year on average during sea water inundation events. Climate change projections may estimate that without investment, the port assets would flood ten times per year in the next 30 years due to increased rainfall. By making the investment in upgraded infrastructure, the port may assess that those flood-prone areas will flood only five times per year even with climate change. Comparing the futures with and without the investment (ten floods per year versus five floods per year) allows the port operator to quantify the impact and value of investing in climate adaptation. This counterfactual helps to set measurable targets and assess performance of the infrastructure investment over its intended lifespan.

Defining an impact pathway can set out a credible thesis for how an investment can contribute towards adaptation and resilience impact, as illustrated below. These impact pathways are also referred to as theories of change or theories of impact. Essentially, they are representations of the logical linkages between activities or investments and the expected outputs and outcomes.

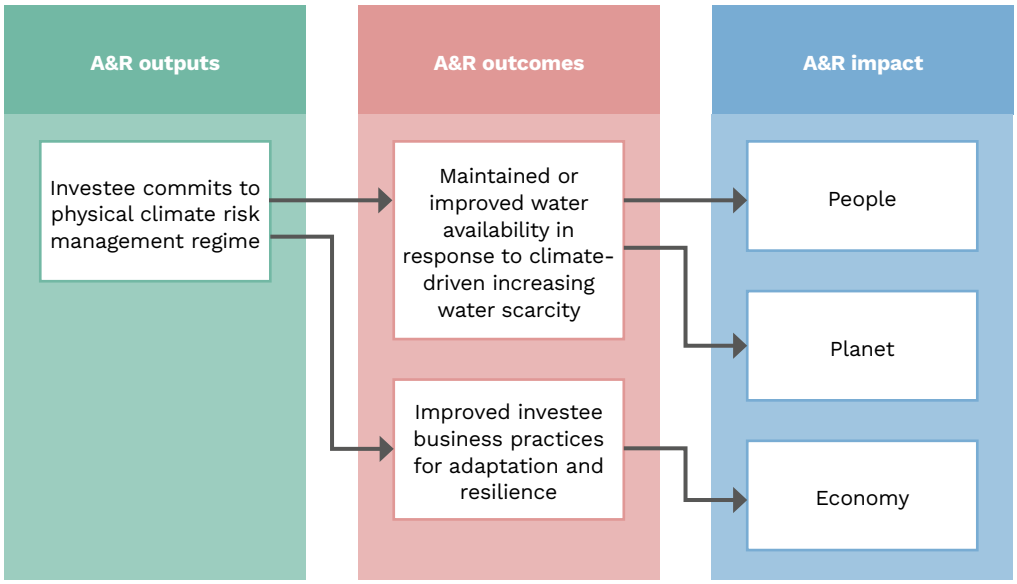


Pathway A shows an investment that improves water availability, making agricultural production and the food security of people more climate resilient.



Pathway B shows an investment that established new production facilities for a new product line of flood warning technologies for wastewater treatment plants, which makes the plants more resilient to flood risk and reduces the discharge of untreated wastewater during flood events.

C



Pathway C shows an investment with a multiple adaptation and resilience impact pathway, through improving physical climate risk management practices in a mining company that i) minimizes shutdowns due to extreme drought, which makes the industry's economic output more climate resilient, and ii) reduces water abstraction, which improves the climate resilience of freshwater ecosystems in the area where the company operates.

At output level, successful investments into the three companies will reasonably result in installing drip irrigation, establishing new facilities, and committing to a risk management regime. At the outcome level, the investment company expects to see changes such as maintained or improved water availability as a result of proper risk management and enhanced irrigation, for example.

3.5 RISK

This dimension of adaptation and resilience impact focuses on the likelihood that adaptation and resilience impact will be different than expected. Some actions that are intended to reduce physical climate risks may instead increase climate vulnerability through inappropriate implementation or unintended consequences—a situation referred to as maladaptation. Some examples of maladaptation are provided in Box 5.

These maladaptation risks require robust assessment so that the potentially positive adaptation and resilience impacts of investments are not undermined, resulting in greater climate vulnerability over the longer term. Assessing maladaptation may require a consideration of the wider impacts or unintended consequences that an adaptation and resilience investment may have, as part of investment due diligence and impact monitoring. It may also require a consideration of changing external conditions (e.g. environmental, social, available technologies, etc.) that could alter the overall adaptation and resilience outcomes of the investment.

Another example of maladaptation may be provided by an investment in solar-powered irrigation pumps, which may benefit some users through low-cost water abstraction for irrigation but may increase overall water scarcity risks through excessive abstraction of groundwater that reduces water availability for others.

Box 5: Examples of maladaptation in investments

One example of possible maladaptation may be provided by an investment in strengthening riverside flood defences to reduce the risk of flooding for an asset such as a factory. Maladaptation could occur if the flood defences increase the risk of flooding for downstream communities, whose adaptation and resilience needs may not have been considered in the investment.

4. ADAPTATION AND RESILIENCE METRICS

The Five Dimensions of Impact—especially the '*what*' dimension—calls for the use of metrics for measuring an investment's impact. In the context of adaptation and resilience impact assessment, the use of such metrics should take account of:

1. The investment's **physical climate risk context** so that the use of adaptation and resilience metrics is appropriately contextualized
2. Whether the investment is **enabling or adapted (or both)**, as this may call for differentiated adaptation and resilience outcome metrics to ensure that the adaptation and resilience impact assessment across these different investment types is clear, consistent and comparable
3. The aspect of **adaptation and resilience impact (i.e. people, planet, economy)** that is relevant for the investment in question

4.1 PROPOSED ADAPTATION & RESILIENCE IMPACT METRICS

Table 3 sets out a proposed set of adaptation and resilience metrics for use in assessing the adaptation and resilience impact of investments, in line with the above guidance and the Five Dimensions of Impact. It is important to note that this is an **indicative** and **non-exhaustive** set of metrics, as the highly contextualized nature of climate change impacts, and of adaptation and resilience investment needs, will require context-specific responses. Table 3 therefore provides only a high-level guide to the kinds of metrics that may be used.

The metrics in Table III are set out against a set of adaptation and resilience outcomes metrics and a series of other criteria as follows:

Adaptation and resilience outcomes: An indicative and non-exhaustive set of adaptation and resilience outcomes, illustrating the key adaptation and resilience themes drawn from the experience of ARIC members**:**

- Increased provision of **adaptation and resilience solutions**
- Increased provision of **climate-resilience infrastructure**
- Maintained or improved **water availability** in response to climate-driven increasing water scarcity and drought
- Maintained or improved **agricultural productivity** in response to identified specific physical climate risks
- Maintained or improved **human health** in response to identified specific physical climate risks
- Improved management of **natural assets** for adaptation and resilience
- **Business practices** within investees that improve their ability to take action on adaptation and resilience, such as adopting corporate adaptation and resilience strategies, or physical climate risk assessment (at investee or entity-level)

Enabling/Adapted: An indication of whether and how the metrics may be applied in enabling and adapted investments. In some cases, the adaptation and resilience outcome may apply to only one or the other, but in other cases both options may be possible. One example is climate-resilient infrastructure—such investments may be adapted if they focus only on making the asset itself climate resilient but may be considered as enabling if the focus is on transformative infrastructure that enables improved climate resilience for people, planet or the economy beyond the asset itself (see Figure IV).

Example investment types: examples of what this investment could be (for reference).

Aspect of positive adaptation and resilience impacts addressed: An indicative identification of the aspect of adaptation and resilience impact (people, planet, economy) that may be relevant for a given investment, noting that this will be an investment-specific decision reflecting the individual investment context and strategic intent of the investor. The specific aspect (people, planet, economy) may in turn inform the metrics used.

Output-level adaptation and resilience metrics: Examples of output metrics that may be used, recognizing that the broad and diverse nature of adaptation and resilience investments means a wide and diverse range of metrics may be used. The metrics included are illustrative only, non-exhaustive and limited in number. They focus on measuring the **scale** of adaptation and resilience impact, in line with the '*how much*' element of the Five Dimensions of Impact.

Outcome-level adaptation and resilience metrics: Examples of outcome metrics that may be used, which are also non-exhaustive and illustrative only. In line with the Five Dimensions of Impact ('*how much*'), the application of these outcome metrics should go beyond scale to entail a consideration of **depth** of adaptation resilience impact. See Table 2 for high-level guidance on assessing the depth of adaptation and resilience impact.

Example metrics from existing frameworks: Example metrics from existing, relevant results frameworks for adaptation and resilience such as the UK International Climate Fund, the GIIN/IRIS+ Climate Adaptation and resilience Metrics, UNEP's Land Use Impact Hub and GIZ's Repository of Adaptation Indicators (although other relevant frameworks may also be applied). These partial examples illustrate how this guidance ensures interoperability with these existing frameworks, providing investors with a logical organizing structure for using these existing metrics in a way that is consistent with and supportive of the investment cycle.

Table 3: Proposed set of adaptation and resilience metrics (non-exhaustive examples only)

A&R outcomes	**Enabling/ adapted**	**Example Investment types**	**Aspect of A&R impact addressed**	**Output-level A&R metrics** (focus on scale)	**Outcome-level A&R metrics** *(additional focus on depth required)*	**Example indicators from other sources**
Increased provision of adaptation and resilience solutions (technologies, products or services)	**Enabling**	Investment in the development, production, or distribution of technologies, products or services that confer adaptation and resilience benefits on their users, e.g. water efficiency equipment, flood warning equipment, or novel immunizations for climate-driven vector-borne diseases (technologies), or weather-related insurance, information services such as mobile phone extreme weather warnings (services)	**People**	Number of people (#) adopting adaptation and resilience solutions made available due to the investment (e.g. number of customers)	Number of people (#) supported to be more climate resilient by adaptation and resilience solutions made available due to the investment	Number of people supported to better adapt to the effects of climate change (UK Government, 2023)
			Economy	Value of adaptation and resilience solutions (USD) produced by the investee due to the investment	Investee turnover (USD/ year) derived from the production of adaptation and resilience solutions due to the investment	

Key:

A&R: Adaptation and resilience

Enabling or adapted investment

Enabling investment

Adapted investment

Aspect of adaptation and resilience impact addressed

People

Planet

Economy

A&R outcomes	**Enabling/ adapted**	**Example Investment types**	**Aspect of A&R impact addressed**	**Output-level A&R metrics** (focus on scale)	**Outcome-level A&R metrics** *(additional focus on depth required)*	**Example indicators from other sources**
Increased provision of climate-resilient infrastructure	**Enabling**	Investment in the provision of infrastructure that reduces the climate vulnerability of people, planet or economy beyond the infrastructure asset itself, e.g. transformative infrastructure such as large-scale desalination or water conveyance systems	**People**	Number of people (#) using climate-resilient infrastructure provided through the investment	Number of people (#) supported to be more climate resilient through the provision of climate-resilient infrastructure due to the investment	Number of individuals benefiting from enhanced climate resilience flood measures (GIIN, 2024)
			Economy	Number of businesses (#) using climate-resilient infrastructure provided through the investment	Turnover of businesses (USD/year) supported to be more climate resilient through the provision of climate-resilient infrastructure through the investment	
	Adapted	Investment in the integration of physical or non-physical adaptation and resilience measures in existing physical assets to reduce their climate vulnerability	**Economy**	Number of adaptation and resilience measures (#) integrated into the asset due to the investment	Value of assets (USD) made more climate resilient due to the investment	Value of power grid assets that have become more resilient (GIIN, 2024)

A&R outcomes	**Enabling/ adapted**	**Example Investment types**	**Aspect of A&R impact addressed**	**Output-level A&R metrics** (focus on scale)	**Outcome-level A&R metrics** *(additional focus on depth required)*	**Example indicators from other sources**
Maintained or improved water availability in response to climate-driven increasing water scarcity	**Adapted**	Investment in the adoption of water efficient equipment or practices (e.g. water harvesting or water recycling equipment, etc.) that provide water savings in water-stressed settings	**People**	Number of people (#) adopting water efficient equipment or practices due to the investment	Number of people (#) supported to be more climate-resilient through the adoption of water efficient equipment or practices due to the investment	
			Planet	Reduction in water abstraction (m^3/ year) from freshwater habitats that are sensitive to water scarcity due to the investment	Improved environmental function of freshwater habitats (e.g. species richness) due to the investment	Volume of water storage capacity (UNEP & World Conservation Monitoring Centre [WCMC], 2023)
Maintained or improved agricultural productivity in response to identified specific physical climate risks	**Adapted**	Investment in the introduction of improved, climate-resilient crop production techniques, e.g. investments in low-till crop production or agroforestry techniques	**People**	Number of people (#) adopting climate-resilient crop production techniques due to the investment	Number of people (#) supported to have more climate-resilient livelihoods due to the investment	
			Economy	Number of businesses (#) adopting climate-resilient crop production techniques due to the investment	Turnover of businesses (USD/year) supported to be more climate resilient through adoption of climate resilient crop production techniques due to the investment	Increased turnover of agribusinesses using adaptation and resilience technologies (GIIN, 2024)

A&R outcomes	**Enabling/ adapted**	**Example Investment types**	**Aspect of A&R impact addressed**	**Output-level A&R metrics** (focus on scale)	**Outcome-level A&R metrics** *(additional focus on depth required)*	**Example indicators from other sources**
Maintained or improved human health in response to identified specific physical climate risks	**Adapted**	Investment in mainstreaming climate resilience into healthcare services and systems	**People**	Number of people (#) immunized against climate-driven vector-borne diseases as a result of the investment	Number of people (#) supported to be more climate resilient through reduced ill health from climate-driven vector-borne diseases, due to the investment	
Improved management of natural assets for adaptation and resilience	**Adapted**	Investment in the protection of natural habitats to safeguard their ecological integrity in the face of physical climate risks	**Planet**	Area of habitat under climate-resilient management (hectares)	Maintained biodiversity (number of species) in the habitat protected due to the investment	Species Threat Abatement and Restoration (STAR) value of land under management for restoration (UNEP, 2023)
Improved investee business practices for adaptation and resilience	**Adapted**	Investment that incentivizes the investee to adopt practices that improve adaptation and resilience performance at the entity level (e.g. physical climate risk assessment and disclosure or corporate adaptation and resilience strategy)	**Economy**	Number of adaptation and resilience practices (#) adopted by the investee	Turnover of businesses (USD/year) supported to be more climate resilient through the adoption of entity-level adaptation and resilience practices	

4.2 AGGREGATING ADAPTATION & RESILIENCE IMPACT

Beyond the investment level of assessment, investors may also wish to **aggregate adaptation and resilience outcome metrics** so that they can monitor, manage and demonstrate adaptation and resilience impact at the **portfolio or sub-portfolio level**. This may be useful for strategic portfolio management by allowing investors to understand parts of their investment portfolios, for example broken down by sector, geography or some other consideration.

While this may be possible to some extent, it is important to be aware of likely limitations to the aggregability of adaptation and resilience outcomes, which mean that aggregation may not be possible or meaningful in certain cases. The aggregability of adaptation and resilience outcome metrics may vary across the three aspects of adaptation and resilience impact (people, planet and economy):

People: Aggregation may be facilitated by the use of people-based metrics such as the number of people supported to be more climate resilient. However, caution should be exercised as the *scale* of this impact (number of people) is more readily aggregated than its *depth* (the degree to which those people are made more climate resilient). Investors may wish to consider establishing a qualifying threshold of depth of impact to ensure that the aggregation is meaningful. As illustrated in Box 3 (p.18), people-based metrics may often require ex post assessment and may be challenging to assess ex ante.

Planet: Aggregation requires careful consideration of the context specificity of climate change impacts on natural systems and of limitations to comparability between diverse types of ecosystems. Planet-based metrics tend to be more specific to certain environmental outcomes, such as increased species richness or increased area of protected habitat. Table III provides examples of planet-based adaptation & resilience that may be aggregable within specific planet-based adaptation and resilience outcome categories, for example reduction in water abstraction (m^3/year) from freshwater habitats that are sensitive to water scarcity, or area of habitat (hectares) under climate-resilience management practices.

Economy: Aggregability may be facilitated by the use of value-based metrics, especially in relation to the scale of impact which may be assessed using metrics such as USD or USD/year. In this way, an outcome metric such as 'value of assets made more climate resilient' can be aggregated across multiple investments and sectors.

5. LOOKING FORWARD

This guidance provides practical support to investors who wish to assess and finance private investments that target real-world climate adaptation and resilience impact. Further piloting and refinement will facilitate socialization and development in this area. This work should build upon the experience and firm evidence base provided by impact investing, expanding its applicability to other types of investment operations, including banks, funds and other commercial investors. It should also support the development and application of consistent definitions of adaptation and resilience investments, for example the Climate Bonds Resilience Taxonomy that is currently under development (Climate Bonds Initiative, 2023). The application of clear and consistent adaptation & resilience impact metrics in a taxonomy of this kind may help to set clear thresholds for the eligibility of investments to be included in climate resilience bond issuances on the grounds of their contributions towards improved adaptation & resilience outcomes. It can also support investors' efforts to align with and support wider initiatives to guide progress towards international adaptation & resilience objectives, such as the United Nations Global Goal on Adaptation with its thematic and dimensional targets for adaptation and resilience.

In the meantime, this guidance provides an initial blueprint for investors to start applying and embedding adaptation and resilience impact assessment into their investments. This approach will accelerate understanding of how private investment finance can most effectively support the climate resilience of people, the planet and the economy. It will also support wider processes such as the evolution of sustainable finance and sustainability reporting standards, helping to bridge persistent gaps between adaptation and resilience policy frameworks, and the delivery of finance on the ground.

With climate change impacts intensifying, the ability of investors to credibly demonstrate the real-world adaptation and resilience impact of their financing is growing in importance. In this respect, this proposed guidance is a significant step forward for both private investors and the wider adaptation and resilience community.

ANNEX: REFERENCES

Asian Development Bank, 2022. *Disaster-Resilient Infrastructure Unlocking Opportunities for Asia and the Pacific*. Manila, Philippines. Available at: adb.org/sites/default/files/publication/791151/disaster-resilient-infrastructure-opportunities-asia-pacific.pdf.

BlackRock, 2023. *BlackRock Corporate Website*. New York, USA. Available at: blackrock.com/corporate/literature/whitepaper/bii-megaforces-december-2023.pdf.

Climate Innovation for Adaptation and Resilience Alliance, 2022. *The Climate Innovation for Adaptation and Resilience Alliance*. Available at: cifaralliance.org/news/the-climate-innovation-for-adaptation-and-resilience-alliance.

Climate Bonds Initiative, 2023. *Resilience Taxonomy White Paper*. London. Available at: climatebonds.net/files/reports/resiliencewhitepaper_climatebondsinitiative_undrr.pdf.

DeBare, D., 2023. *A Solution for Measuring Climate Resilience*. New York, USA, 60 Decibels. Available at: 60decibels.com/insights/measuring-climate-resilience/.

Global Impact Investing Network, 2024a. *Climate Adaptation and resilience*. New York, USA. Available at: navigatingimpact.thegiin.org/climate-adaptation-and-resilience/.

Global Impact Investing Network, 2024b. *Improving household resilience to flood risk*. New York, USA. Available at: navigatingimpact.thegiin.org/strategy/car/improving-household-resilience-to-flood-risk/.

Global Impact Investing Network, 2024c. *Improving power systems resilience*. New York, USA. Available at: navigatingimpact.thegiin.org/strategy/car/improving-power-systems-resilience/.

Global Impact Investing Network, 2024d. *Increasing agricultural resilience through technology*. New York, USA. Available at: navigatingimpact.thegiin.org/strategy/car/increasing-agricultural-resilience-through-technology/.

Deutsche Gesellschaft für Internationale Zusammenarbeit, 2014. *Repository of Adaptation Indicators: Real case examples from national Monitoring and Evaluation Systems*. Eschborn, Germany. Available at: adaptationcommunity.net/download/me/me-guides-manuals-reports/giz2014-en-climate-adaptation-indicator-repository.pdf.

Impact Frontiers, 2024. *Five Dimensions of Impact*. Stamford, USA, Bridges Impact Foundation. Available at: impactfrontiers.org/norms/five-dimensions-of-impact/.

Inter-American Development Bank, 2019. *A Framework and Principles for Climate Resilience Metrics in Financing Operations*. Washington, D.C., USA. Available at: publications.iadb.org/publications/english/viewer/A_Framework_and_Principles_for_Climate_Resilience_Metrics_in_Financing_Operations_en.pdf.

Intergovernmental Panel on Climate Change, 2018. *Climate Change 2014: Annex II: Glossary* [Agard, J., E.L.F. Schipper, J. Birkmann, M. Campos, C. Dubeux, Y. Nojiri, L. Olsson, B. Osman-Elasha, M. Pelling, M.J. Prather, M.G. Rivera-Ferre, O.C. Ruppel, A. Sallenger, K.R. Smith, A.L. St.Clair, K.J. Mach, M.D. Mastrandrea, and T.E. Bilir (eds.)]. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1757-1776. Available at: ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-AnnexII_FINAL.pdf.

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* [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama eds.]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, ipcc.ch/report/ar6/wg2/.

International Union for the Conservation of Nature, 2024. *Species Threat Abatement and Restoration (STAR) metric*. Gland, Switzerland. Available at: iucn.org/es/node/32099

JP Morgan Asset Management, 2023. *Adapting to a warmer planet*. New York, USA. Available at: am.jpmorgan.com/content/dam/jpm-am-aem/global/en/sustainable-investing/climate-adaptation.pdf.

Operating Principles for Impact Management, 2019. *The 9 Principles | Operating Principles for Impact Management*. New York, USA. Available at: impactprinciples.org/9-principles.

Tanner, T., Bahadur, A. and Moench, M., 2017. *Challenges for resilience policy and practice*. London, UK, Overseas Development Institute. Available at: core.ac.uk/download/pdf/223210854.pdf.

UK Department for International Development, UK Department of Energy & Climate Change and UK Department for Environment Food & Rural Affairs, 2011. *UK International Climate Fund Tackling climate change, reducing poverty*. London, UK, HM Government. Available at: assets.publishing.service.gov.uk/media/5a78cc0140f0b6324769a3df/3389-uk-international-climate-fund-brochure.pdf.

UK Government, 2023. *Number of people supported to better adapt to the effects of climate change as a result of International Climate Finance*. ICF KPI 1 Methodology Note February 2023, London, UK, HM Government. Available at: assets.publishing.service.gov.uk/media/63fe279d8fa8f527f4f54b03/international-climate-finance-KPI_1_Methodology_Note_People_supported_to_adapt_to_the_effects_of_climate_change.pdf.

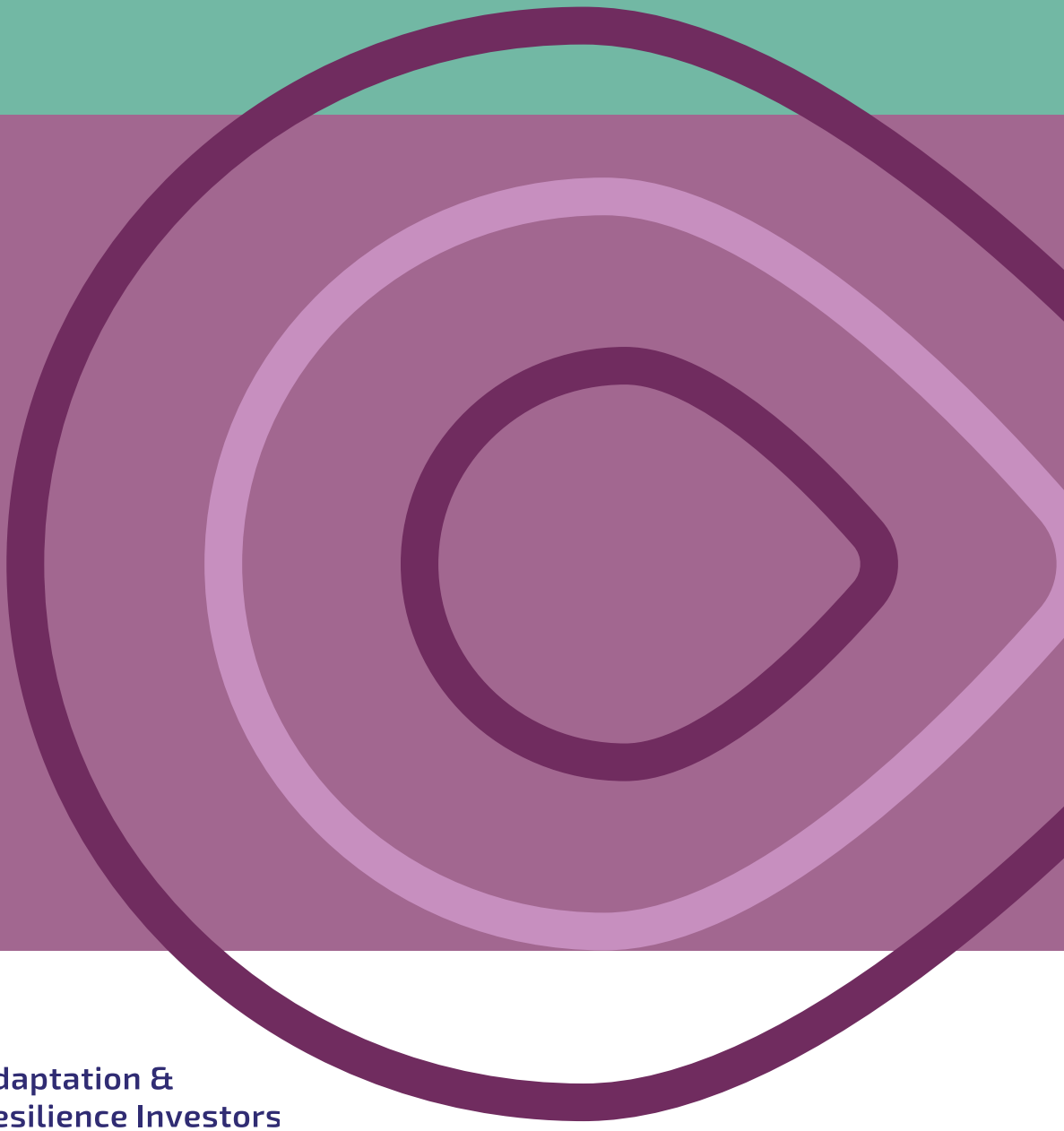
United Nations Environment Programme Finance Initiative, 2023. *Climate Adaptation Target Setting*. Geneva, Switzerland. Available at: unepfi.org/industries/banking/climate-adaptation-target-setting/.

United Nations Environment Programme World Conservation Monitoring Centre, 2023. Land Use Impact Hub. Nairobi, Kenya. Available at: landuseimpacthub.com/en/kpis.

World Economic Forum, 2022. *Climate adaptation: the USD2 trillion market the private sector cannot ignore*. 1 November 2022. Geneva, Switzerland. Available at: weforum.org/agenda/2022/11/climate-change-climate-adaptation-private-sector/

World Economic Forum, 2024. *Global Risks Report 2024*. Geneva, Switzerland. Available at: weforum.org/publications/global-risks-report-2024/.

The Adaptation and Resilience Investors Collaborative (ARIC) is an international partnership of development finance institutions (DFIs) working together to accelerate and scale up private investment in climate adaptation and resilience in developing countries. To unlock investment in climate adaptation and resilience, we build know-how, tools and join forces to develop pipelines of bankable investments.



Adaptation &
Resilience Investors
Collaborative