ROOTS OF AFRICAN RESILIENCE

A TRANSFORMATIVE APPROACH

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Foreword

Africa faces a growing number of urgent and structural challenges that threaten to derail its development trajectory. These challenges, which span from the escalating impacts of climate change to deep-seated socio-economic vulnerabilities, are becoming increasingly complex, unpredictable, and interlinked. Despite the efforts and progress made so far, current solutions have not kept pace with the magnitude and intricacies of these issues, leading to significant losses in both lives and livelihoods. In this context, safeguarding development gains through resilience-building has become not just a priority but a necessity.

Resilience is more than a response; it is a proactive approach to managing uncertainties, addressing the dynamics of complex social-ecological systems, and ensuring that development gains are shock-proof and sustainable. It is through resilience-building that Africa can continue to progress toward achieving Agenda 2063: The Africa We Want.

The “Roots of African Resilience” (RoAR) report offers a transformative approach to resilience, designed specifically for the African context. It builds on a deep understanding of resilience, shaped by extensive research, stakeholder dialogues, and real-world case studies from across the continent. This report is the culmination of a collaborative effort between the African Union Commission and the United Nations Development Programme (UNDP), supported by the United Nations Research Institute for Social Development (UNRISD), and NORCAP - Part of Norwegian Refugee Council. The report is further enriched by the insights of experts and practitioners who have worked tirelessly to ensure that the RoAR is both robust and adaptable to Africa’s unique challenges.

The RoAR report identifies key dimensions and policy entry points for building resilience that are crucial for the continent. It also emphasizes the importance of addressing power dynamics, local knowledge, and community participation—often the missing links in resilience efforts. By integrating these elements, the RoAR offers a comprehensive and context-sensitive approach to resilience, one that can be applied at various scales, from local communities to national and continental levels.

This report is not just another addition to the resilience literature. It provides a much-needed reference for understanding and operationalizing resilience in Africa. It is an important resource to the toolbox for policymakers, development practitioners, and all stakeholders committed to building a resilient and prosperous Africa. The RoAR does not seek to replace existing efforts but rather to enhance them, offering a unified approach that can guide resilience-building across the continent.

As we move forward, let us embrace the principles and insights offered in this report, working together to ensure that Africa’s development is not only sustained but resilient to the myriad challenges that lie ahead.

Harsen Nyambe Nyambe
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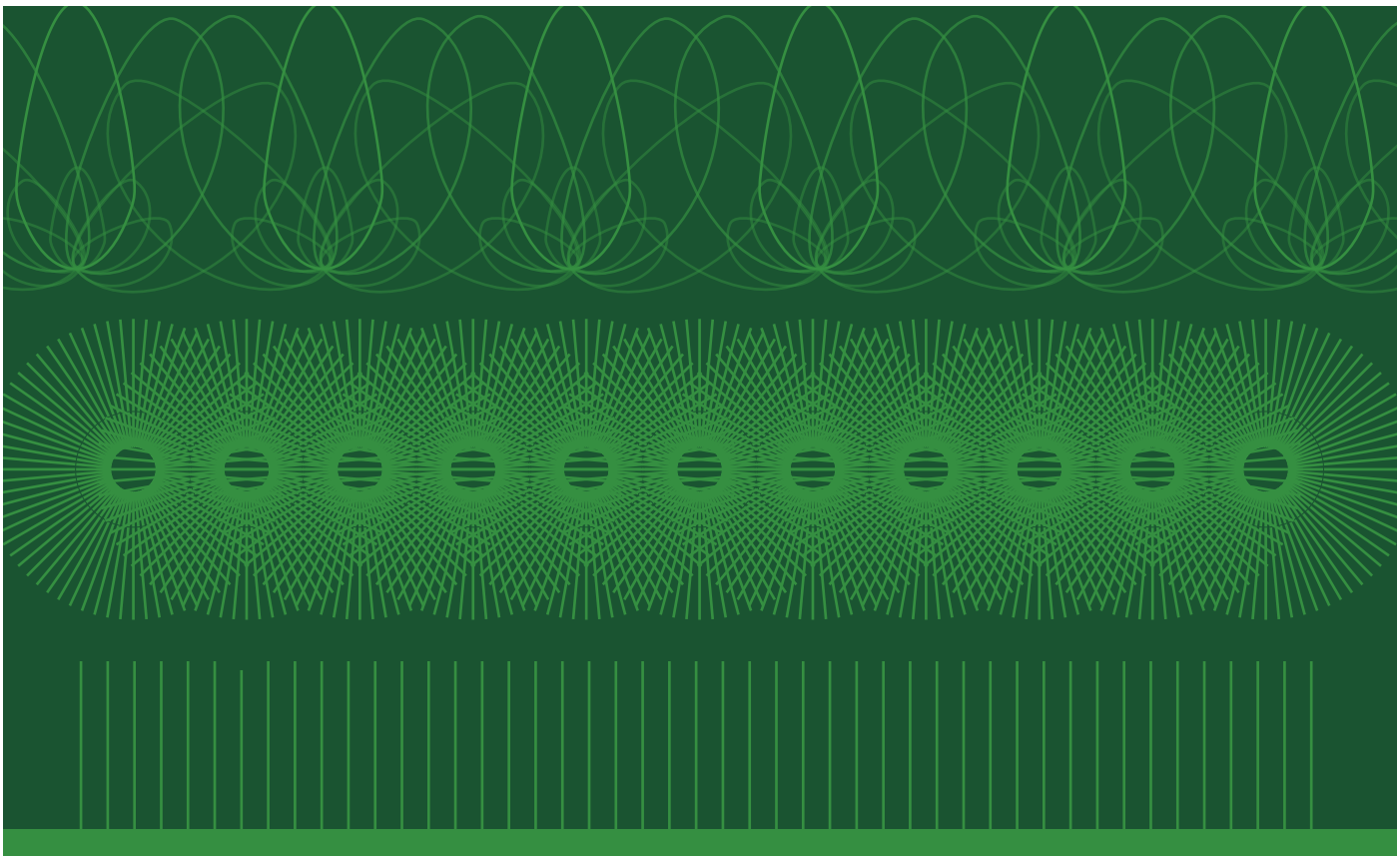
Executive Summary

Africa confronts a growing number of urgent and structural challenges and risks that can derail its development trajectory. They are turning out to be complex, unpredictable and cascading in nature. The current solutions have not yet kept pace with the complexity and scale of these challenges. As a result, there have been heavy losses both to lives and livelihoods on the continent. In this context, safeguarding development gains and reducing losses by virtue of resilience-building efforts has become a policy imperative. Resilience is an approach to address uncertainties, complex social-ecological system dynamics, and slow and fast nonlinear changes with the aim of shock-proofing development gains and ensuring continuous progress toward Agenda 2063: The Africa We Want.

There are a plethora of approaches to resilience-building and measurement. However, perspectives on how to operationalize resilience thinking through policies and programmes vary widely. Furthermore, the linkages between resilience and sustainable development are not yet fully explored. Hence, it is critical for the continent to establish an understanding of and approach to resilience that can support the African Union Commission (AUC), Regional Economic Communities, African Union member states and other stakeholders to advance toward achieving an integrated, prosperous and peaceful Africa.

The *Roots of African Resilience (RoAR)—a Transformative Approach* is based on a conceptual understanding of resilience that is conducive and flexible to the on-the-ground realities of Africa and was co-constructed in a consultative process to assist African



stakeholders in unpacking and enhancing resilience. The research reviewed resilience concepts, held multiple stakeholder dialogues with African practitioners and experts, and integrated case studies that demonstrate how resilience plays out in the African context in practice (see annex 4). The resulting draft document was then reviewed and discussed by an AUC and United Nations Development Programme (UNDP) technical interdepartmental roundtable consultation held in Bishoftu, Ethiopia, in October 2023. The Bishoftu feedback of AUC experts guided the final review and revision of the RoAR conceptual approach as well as the dimensions and indicators presented in this report. Overall, these interlinked activities (literature review, case studies, semi-structured interviews, stakeholder deliberations, online meetings and roundtable consultation) were used iteratively with the objectives to (i) understand resilience in the African context considering continental specificities; (ii) identify components and dimensions of resilience critical for the African context to develop resilience programmes and policies; and (iii) support measuring progress on resilience at the national level.

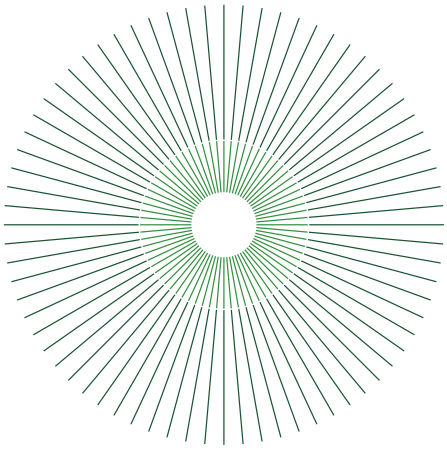
As a result, the RoAR identified five prominent dimensions and policy entry points for resilience that were widespread across the literature and that were also identified and validated as key dimensions in the African context by stakeholders. Questions of power dynamics, local knowledge and community participation were identified as some of the missing links. The RoAR findings indicate that resilience efforts have mostly focused on addressing a single risk in isolation, have been sector-specific, effective only in the short term and not coordinated and aligned at different spatial scales. In addition,

there is no commonly agreed upon definition or metric of resilience, as the understanding differs based on context and mandates. The analysis of resilience interventions revealed it as a long-term process, necessitating both active participation from multiple stakeholders and a shift away from bounce-back mentality toward transformational resilience. The importance of adaptive management, learning and innovation was underlined by practitioners, requiring us to focus not only on shocks and threats but also on the internal dynamics of the systems at hand.

The RoAR deliberated on the advantages and disadvantages of resilience assessment approaches described in the literature and those applied by development and humanitarian organizations. These included a mix of scorecards, checklists, capital counts, composite indices based on factor, principal component, regression, and thematic and discourse analysis, to name only a few. Given this richness, the RoAR understanding of resilience needed to be amenable to qualitative, quantitative and mixed methods. The sound way to build resilience was thus to envision it as an unfolding process of a shift toward a desirable system. Resilience can take multiple forms and shapes depending on the context; trying to be excessively precise can turn out to be counterproductive.

The RoAR defines resilience as the “ability of systems to function in the face of disturbance” (Bahadur et al. 2015:5, based on Holling 1973). More specifically, it sees resilience as a system’s ability to anticipate, absorb and recover, adapt, and transform when faced with a wide range of evolving risks and uncertainties leveraging both scientific and indigenous knowledge and building on social norms and communal systems to reduce harm and maintain an acceptable level of functioning without compromising long-term prospects for sustainability, prosperity, peace and well-being for all. This definition establishes resilience as a complex process that requires contextualization, participation and deliberation across a number of interlinked dimensions to shape desirable, resilient systems. The RoAR adds to a rich landscape of guidance and frameworks. It does not duplicate or reject the relevance of existing efforts, but rather aims to address significant gaps to make sense of resilience in the African context and use it to inform development resilience strategies, programming and practice.

The RoAR presents a tree of resilience that is composed of structural drivers of resilience and desirable systems (roots), resilience enablers and capacities (trunk), along with system dimensions that represent our policy entry points and indicators (crown and branches) (see figure 1). Risks and risk drivers take different forms and can be shaped by system-inherent vulnerabilities as well as external hazards and shocks. Put together, the RoAR helps stakeholders explore interconnections between risks, development practices and resilience. It provides a sound basis for building resilience and can be applied at various scales, including at the continental, regional, national, subnational and local levels. The initial list of fixed indicators to

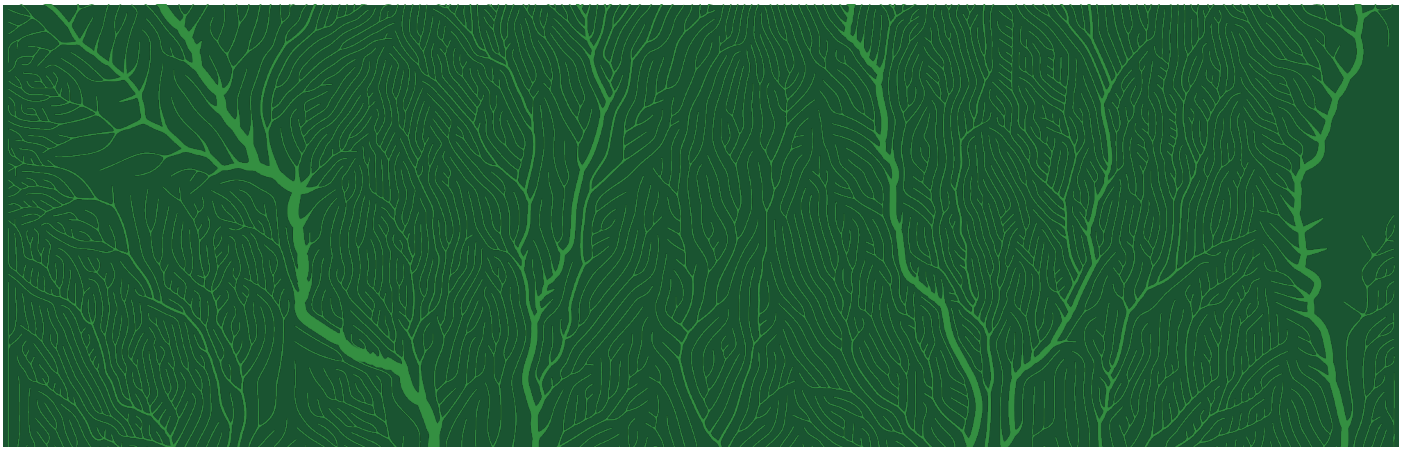


measure resilience which is based on open-source and credible data sources, often from national statistical offices, can inform a rapid and low-effort country-level resilience profile that can serve as a general pulse check on the state of resilience. The country's resilience profile can subsequently be expanded, strengthened and contextualized by using a wider set of indicators and methods. Furthermore, a long-term vision can be shaped by bringing stakeholders together to negotiate and deliberate desirable resilient futures. In this participatory manner, the RoAR can develop an understanding of and an approach to resilience for both policy and practice at a specific scale and support measuring resilience at the national and subnational levels.

The RoAR offers a means for assessing and building multisectoral resilience focused on multiple risks or uncertainties. The RoAR uses a systems approach that maintains people and communities at the core of resilience. It identifies key components of resilience in the African context and proposes an overarching approach within which relevant tools and indicators can be used. A resilience assessment is proposed through a combination of document analysis and facilitated stakeholder consultation that factor in lived experiences and knowledge of at-risk communities, expert evaluation and indicator analysis.

It is not meant to overwrite other stakeholders' approaches, but rather to facilitate a whole systems approach to resilience-building and to situate different context-specific and sector-specific approaches within the larger resilience landscape. The RoAR contributes to informing a developmental approach to resilience that allows us to identify common structural drivers of resilience and vulnerabilities and tackle contradictions in the current development model that hinder resilience-building. It is this combined focus on roots, dimensions (policy entry points), and enablers and capacities of resilience that allows us to understand the different channels of transmission that can make the difference between a hazard or shock being experienced as a mere event in one context and it turning into a disaster or crisis in the next.

Its strength lies in its ability to be contextualized to geography, multiple risks and the sociopolitical setting. It can also be leveraged as a conceptual tool to create a new set of indicators (based on primary data collection) or rely on a select set of indicators based on existing data from secondary sources and national statistical offices. It allows us to factor in changes in risk context and to develop different pathways of resilience grounded in meaningful engagement. It is amenable to different forms and methods of analysis. Having said that, it does not aim to wash over the differences or lay claim to an all-encompassing source of resilience thinking. Given the interlinked nature of policy entry points for resilience, choosing the most relevant indicators and assigning them to a single category is not always easy and entails value judgements based on the comprehensive research conducted. The RoAR provides a common grounding and shared sense of understanding to disparate resilience efforts.



Key points

The growing awareness of the changing nature of risks facing Africa requires continued and increasing commitment to resilience-building and a participatory, development-oriented approach to resilience to protect developmental gains, curb the development-related drivers of risk, and support the achievement of Agenda 2063 and the UN Sustainable Development Goals.

A comprehensive multirisk, multisectoral integrated approach to resilience is needed at different scales to tackle the root causes of vulnerability and account for complex system dynamics and interactions.

The RoAR brings together structural drivers of vulnerability, development vision and capacities and paves the way for articulation, negotiation and deliberation of a desirable system.

It offers an overarching approach and contextually relevant indicators for gauging resilience that can support policy processes to assess resilience and integrate a strong resilience lens into development plans and strategies.

It brings concrete examples and ideas of resilience grounded in diverse African experiences. It offers a means to contextualize resilience to the individual situation and challenges different African Union member states face while leveraging emerging opportunities and areas of progress.

It brings flexibility in implementation and understanding of resilience. It argues for resilience to coevolve and develop with changes in the realities and risks of social-ecological systems.

Figure1. Roots of African Resilience (ROAR) Framework

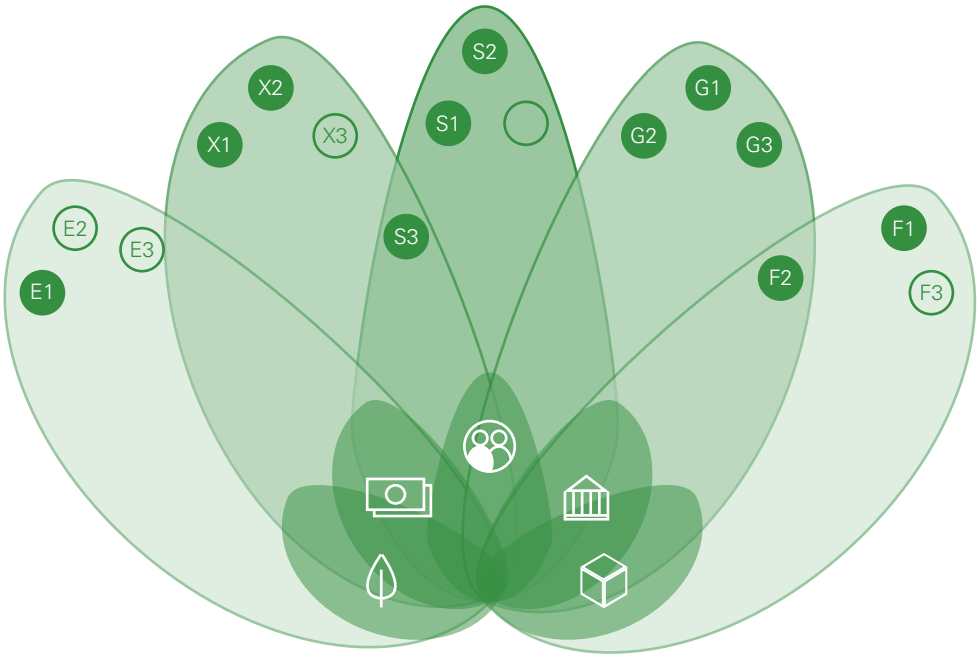
Indicators
A set of fixed general resilience indicators combined with a list of context-specific, customizable indicators to gauge the level of general resilience.

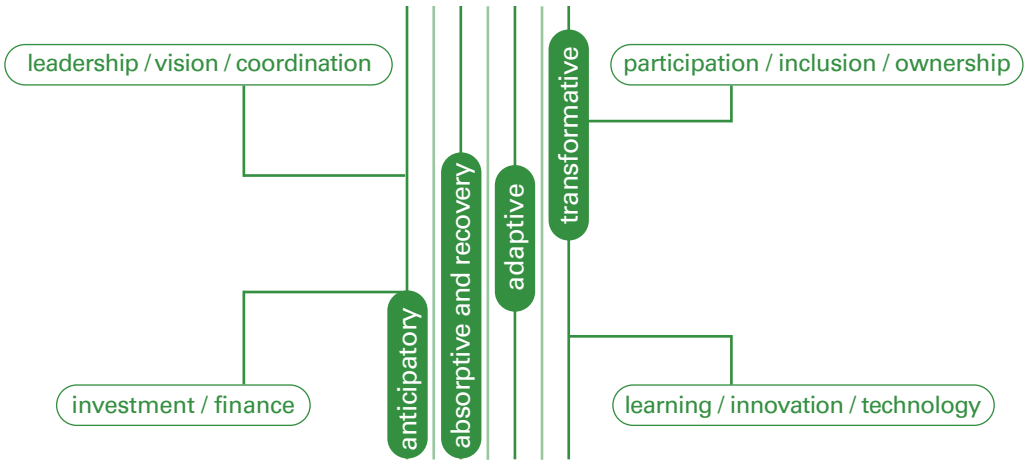
Policy entry points
These comprise five overlapping system dimensions and represent entry points for resilience-building efforts.

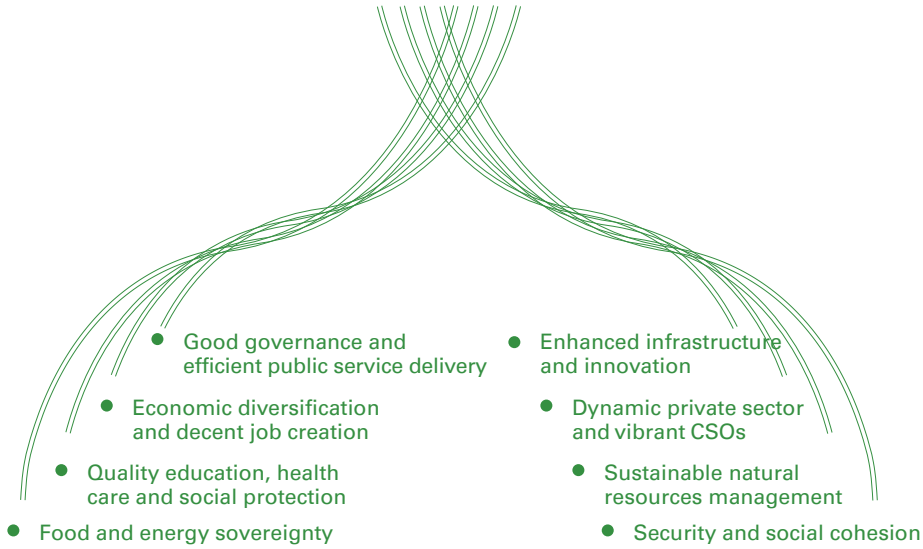
- Environmental
- Economic
- Social
- Governance
- Infrastructural

Resilience enablers and capacities
These are core characteristics drawn from resilience theory and known to lend resilience to the system in question.

Roots of resilience
Roots are the starting point of the framework and reflect an inclusive vision of desirable resilience and a prosperous Africa in line with the aspirations of Agenda 2063.



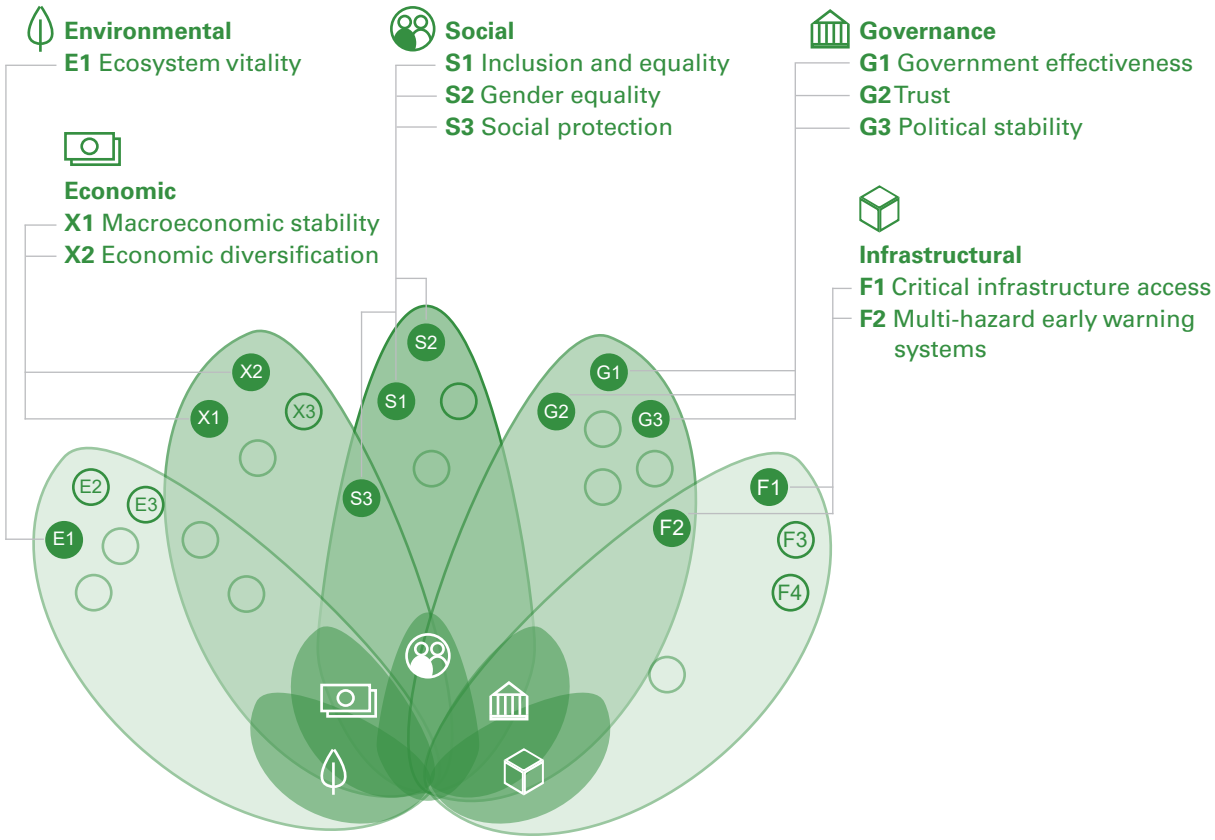




African Resilience Indicators

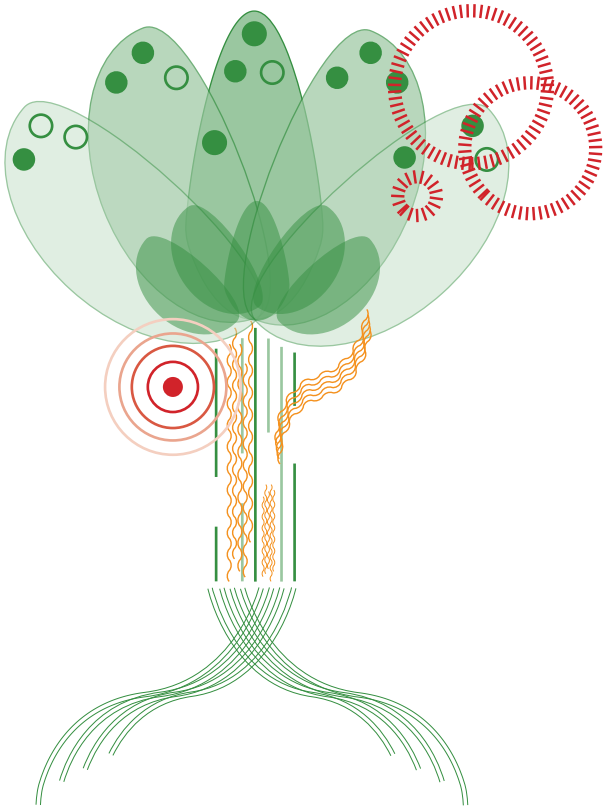
Highlighting indicators of general resilience for each policy entry point

- Fixed indicator
- Context-specific indicator



Risks and risk drivers

Risks and risk drivers are varied and a function of hazards (red) and vulnerabilities (orange). They can therefore be system-inherent or external and include climate change, terrorism, economic downturn etc.



Introduction

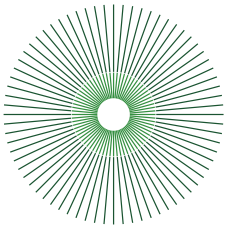
Resilience, arguably, has taken the pole position in development policy discourse. Politicians, civil servants, donors and researchers all lay emphasis on the virtues of resilient economies, nations and communities. It is seen as a solution to address the inevitable occurrence of crises and to find ways of shock-proofing development gains. In the international development arena, resilience has gained a positive connotation and is seen as a desirable quality of any given system, being able to adapt to shocks and withstand harm in the face of crisis. The explicit mentions of resilience in the African Union's Agenda 2063 and the UN's 2030 Agenda for Sustainable Development demonstrate the strong linkages and mutually reinforcing mechanisms between development and resilience. Higher levels of resilience can foster the achievement of development goals and vice versa. Shocks, stresses and crises that concur with a lack of resilience can reverse years of development progress and efforts to eradicate poverty.

Resilience is therefore often expressed as an aspiration and policy objective to secure progress in sustainable development. And yet, there are divergent views on how to define resilience and what it means in practice. This, to some extent, is understandable given how diverse risk contexts are and how rapidly they can change. The Roots of African Resilience (RoAR) research facilitated a critical engagement with the concept of resilience and its history as well as operationalization in the context of development policy and practice in Africa with the objectives to (i) establish what resilience means in an African context; (ii) identify what the key dimensions of resilience are; and (iii) share how it can be assessed and measured going forward.

A literature review was conducted, case studies reviewed, and the resilience concept and its usefulness in a development context

in Africa was discussed and reviewed by African Union Commission (AUC) experts in a technical interdepartmental roundtable which led to the development of the RoAR approach and understanding of resilience. The main part of the report presents a concise overview of the results and presents the RoAR approach and resilience understanding. There is a strong alignment with the approach to resilience-building adopted by the UN, albeit developed through a different and independent process. A full overview of the conceptual review of resilience, the approaches and challenges of measuring and tracking progress toward resilience, and an analysis of relevant dimensions and examples from Africa are available in the annexes alongside a description of the research process and methods.

The aspiration is to challenge how we think about resilience in development practice in Africa and to offer an approach that is suited to achieving sustainable human development despite the occurrence of crises on the continent. This implies a shift in design and thinking from fail-safe systems to those that are safe to fail (see, for example, Ahern 2011). The RoAR seeks to demystify resilience into a meaningful and measurable approach that is informed by a comprehensive review of academic and grey literature and deliberations with stakeholders and experts.



Aims of the RoAR

The African Union Commission, the United Nations Development Programme Resilience Hub for Africa and several other consulted organizations have received calls for guidance and support for resilience-building from their member states or constituencies. Additionally, stakeholders have asked for guidance on resilience that speaks to Africa's particularities. This admission by itself is a testament to the need and utility to hone in and unpack resilience to make it actionable. The challenge is multifaceted; many stakeholders shared difficulties in fully grasping the implications of resilience thinking and finding policy and programme entry points for resilience-building efforts. Furthermore, they expressed confusion stemming from different definitions and attributes attached to resilience.

The work on the RoAR provided the opportunity to reflect on and tackle these challenges in the African context. It seeks to close the following gaps:

(i) What resilience-building in African states could look like considering the complexity and multiple risks and shocks.
(ii) What dimensions of resilience should be defined and tracked.
(iii) How to support AUC, Regional Economic Communities (REC) and African Union member states to define the system-based resilience concept, track achievements and gaps in the basic dimensions of resilience across Africa, and develop relevant policies and programmes.

The RoAR research aims to address these gaps by exploring resilience through a systems-level, timely, practical and process-driven approach that can be operationalized in the African context with a high level of rigour and coherence. It takes inspiration from the notion of negotiated resilience (Harris et al. 2018) which stresses the negotiated and shared-learning process and procedures of resilience as opposed to a single agreed upon goal. This notion encourages the RoAR to consider different priorities, interests and reconciliations entailed in developing multiple resilience pathways and will hopefully turn it into a deliberative and actionable tool in development policy and practice of Africa. The RoAR approach is based on the following key elements of resilience:

THE ROAR CONCEIVES RESILIENCE AS A FUNCTION OF COUPLED SOCIAL AND NATURAL SYSTEMS WHICH PRODUCE COMPLEX AND UNPREDICTABLE RESULTS.

Resilience of what—a system of systems

The RoAR conceives resilience as a function of coupled social and natural systems which produce complex and unpredictable results and should be treated as such. This view recognizes the importance of scales (from local to global) and feedback mechanisms in shaping the risk environment. A clear definition of the boundaries of the system, components and stakeholders is created. The understanding and strengthening of systems, in turn, becomes paramount. By looking at resilience as a timely and practical concept, the RoAR implies that the time lag between evidence generation and data availability for programmatic needs is minimized for actionable policy and programming. The RoAR builds on current understandings and leverages publicly available data sets with high decision-making value to keep additional effort as low as possible. The focus on a system in need of resilience-building, comprising of varying degrees of resilience understanding and capacities, is methodologically useful as it allows for the consideration of different capacities and components to address risks and build resilience (see box 1). It moves resilience up in the policy agenda and helps align it with overall development objectives.

Resilience to what—shared understanding of risk

Based on the whole system approach, the focus is on building general resilience in all parts of the system that could prove useful in response to a broad range of risks and their domino effects. General resilience is understood as the ability to manage a variety of risks and unpredictable situations across the whole system instead of focusing only on a specific risk. The known and somewhat predictable hazards include climate shocks and stressors, violence, and fragility, but the study also remains cognizant of unforeseen future threats. Whereas conventional risks are understood and defined and can be effectively addressed using current risk management practices, systemic risks are characterized by interconnected causal structures and have distinct features that challenge conventional risk management practices: “they are highly complex, transboundary and global in nature, nonlinear in their cause and effect, they include tipping

points, and are underestimated in public policy arenas" (UNDRR 2021:7, based on Schweizer and Renn 2019; see also Maskrey et al. 2021). Only through deep and critical engagement can we usher in sustainable development to challenges that involve these interconnected risks.

Resilience for whom—multiple stakeholders

The participation and inclusion of multiple stakeholders in a meaningful and timely way is crucial to resilience efforts. The way each country undertakes this process, the actors involved, methods and emphasis will of course vary, but the core enablers remain universal. Resilience-building is the obligation and duty of multiple stakeholders across levels of governance, including at the local and community levels and involving the private sector.

Resilience capacities

We distinguish between the distinct capacities that allow a system to anticipate, absorb and recover; adapt, or transform altogether; and the more generic enablers that represent system attributes conducive to resilience and sustainable development. The resilience capacities fulfil different functions within resilience-building. Depending on the risk and capacity context, they are geared toward a specific objective (shock anticipation and absorption, recovery, adaptation or system transformation).

Timescale

The focus of the RoAR is resilience-building efforts that unfold over the medium to long term, but the approach can be adjusted for more rapid short-term analysis. Resilience measurements proposed at the national level can be undertaken biannually or annually, stretching over a time horizon of decades.

This document is meant for experts and development practitioners working on resilience and sustainable development in Africa and will inform the development of an AUC Common Guidance on Resilience. It sets out to facilitate national, regional and continental discussions on resilience-building that are based on a common understanding while leaving sufficient flexibility and room for contextualization to the specific situations and needs of different countries and regions. The process-driven approach means that the study sets up resilience as an emergent and iterative process through which ideals, policies, and agendas are deliberated and pursued by a wide group of stakeholders (Harris et al. 2017). Overall, this vision demands us to take a leap toward transformative pathways (see, for example, Ensor et al. 2021; Matin et al. 2018) where we undertake co-learning and participatory research and are accepting of different worldviews.

Box 1. Adopting a systems approach

Using a systems approach brings a number of advantages for resilience-building. It focuses on understanding the interlinkages and interdependencies between the different parts that make up a complex, social-ecological system and can thereby overcome silo approaches. Instead of looking at problems in a singular instance or location, it starts by mapping the system at hand in order to identify all relevant elements, stakeholders and their connections to understand the dynamics than can lead to cascading effects or systemic risks, for example, as experienced in the case of food security following the war in Ukraine.

By understanding feedback loops between different elements of the system, this approach can identify policy interventions that harness synergies and reduce trade-offs. It can also help uncover concentrations of risks and vulnerabilities that result from high levels of connectivity and a lack of redundancy and diversity of resources. Redundancy ensures that a system can continue functioning in times of shock or stress as it introduces substitutable or interchangeable components (resources, assets or institutions) that function as fall-back options and can be leveraged to compensate for the failure of other components (Biggs et al. 2015; Bujones et al. 2013; SRC 2015). Redundancy can, for example, be achieved by decentralizing governance structures and allowing a certain overlap of responsibilities that can be activated in case of crisis or by incorporating redundant elements into critical infrastructure systems, such as energy and health care facilities, to ensure continuous functioning should some facilities fail. Diversity enhances resilience as it increases the number of response options available and distributes critical functions spatially and to a greater number of elements and actors (see Lade et al. 2020; Leslie and McCabe 2014). In Kenya, the nomadic Turkana employ diversity in herd composition and movement as part of their response to droughts, disease and raiding (Leslie and McCabe 2014; see case study 1).

A systems approach also recognizes the system as "a complex network of individual and institutional actors with different and often conflicting interests, values and worldviews" (OECD et al. 2020:18) which influences how problems are framed and which solutions are perceived as appropriate and desirable. Engaging all relevant stakeholders and differing perspectives is therefore crucial to design robust policy solutions. Using a systems approach can further help situate Africa within global systems which can in turn identify specific challenges and structural constraints that emanate from the current international order. This could relate, for example, to legacies of colonialism that established African economies as sites of extraction and supply and created "structural dependencies and value-chain lock-ins that long outlasted formal independence" (Power Shift Africa 2023:15). Using a systems approach to identify risks and undesirable system characteristics can also facilitate work toward system transformation.

SYSTEMIC RISKS CARRY A 'DOMINO EFFECT' SPANNING INFRASTRUCTURAL, SOCIAL, ENVIRONMENTAL, POLITICAL AND ECONOMIC SYSTEMS LEADING TO DISRUPTIONS.

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Limitations

We identify three main limitations that deserve attention. Despite the comprehensive effort undertaken, there will inevitably remain uncertainty and contention on which resilience characteristics are most relevant for resilience in a particular risk context or geographic area. This also makes direct intercountry comparison difficult and, in some cases, impractical. The heterogeneity of systems and national contexts requires that standards for resilience indicators should be set within countries to accommodate the local context and constraints. The RoAR therefore offers a comprehensive and iterative list of indicators that can be selected based on relevance in the respective context (see table 3).

Another limitation is that some of these characteristics are hard to measure. Several of them can only be measured through subjective perceptions or expert judgment. We need to contend with reliability and bias issues. This can be addressed by leveraging well-balanced expert judgement and multi-stakeholder consultations. The definition of what constitutes a desirable system to be made resilient is a comprehensive exercise requiring resources, time and participation from a much wider range of stakeholders than the RoAR study could undertake. It emphasizes the procedural and negotiated aspects of resilience, highlighting resilience as a process that necessitates participation from a diverse range of actors with different interests. This is inherently political and contentious, entailing prioritization and trade-offs. It is through a process of deliberation that different pathways of resilience across stakeholder groups, time and space will be identified. Finally, resilience measurement and analysis is not a one-time exercise. It needs to be conducted regularly to grasp the changes and trajectory of resilience over time.

Risk context in Africa

Africa confronts several pertinent and structural challenges that act as risk drivers, including extreme poverty, climate change, food insecurity, conflicts and instability, governance shortcomings, and debt distress, to name a few (Ngang 2021; AfDB 2022). Furthermore, a sense of unpredictability looms from the spillover effects of the COVID-19 pandemic and war in Ukraine. Africa made significant progress in rolling out vaccines against COVID-19. As of January 2023, 27.3 percent of the continent's 1.3 billion people were fully vaccinated (Africa CDC 2023). However, global vaccine inequality is making it especially difficult to reach the targeted 70 percent (see Africa CDC 2022). The pandemic resulted in a 2.7 percent increase in the 2020 poverty headcount rate, leading an additional 31 million people into extreme poverty and causing the loss of 22 million jobs (Valensisi 2020). It also revealed how systemic risks carry a 'domino effect' spanning infrastructural, social, environmental, political and economic systems leading to disruptions (African Union 2022a).

The Russia-Ukraine war has triggered a spike in commodity prices, undermining food security and energy sustainability (IMF 2022). We have entered a global polycrisis—where threats emerging in one system spread to others to diminish our ability to cope and flourish (Pillay 2015; Janzwood and Homer-Dixon 2022). It is differentiated from the past when a problem could be attributed to a single cause and solved by means of a single solution (Tooze 2022). Instead, we see causally entangled and interacting crises that produce greater harm because of deeply interconnected systems (Janzwood and Homer-Dixon 2022:2) that require effective multilateral response mechanisms to support resilience at continental, regional, national, subnational and community levels.

Climate change implications

Temperatures have seen a steady increase in Africa at 0.56°C to 0.63°C above the 1981–2010 long-term mean, with significant regional variations and temperatures exceeding 2°C above the 1981–2010 average recorded in South Africa, Namibia and parts of Angola (WMO 2020). Large tracts of Africa will enter unprecedented high-temperature climates earlier in this century in comparison to wealthier, higher latitude countries (IPCC 2022). Annual precipitation totals in 2019 were below the long-term means in Southern Africa, east of the Gulf of Guinea, along the southwest coast of West Africa and northwest of the High Atlas Mountains (WMO 2020).

An increase in the frequency and magnitude of climate and weather extremes is already exposing millions of people to acute food insecurity and is expected to drive further displacement (IPCC 2023). Flooding and heavy precipitation events are projected to become more frequent and intensify in most of Africa at 1.5°C global warming (IPCC 2023).

Climate change will have implications for food production, health, water security and ecosystems. Ecosystem degradation is a sweeping problem across the continent because of overlogging and overfishing. According to the World Bank, 32 million people in West Africa and 38.5 million people in the five Lake Victoria Basin countries could be compelled to move within their countries by 2050 because of the slow onset of climate impacts (Rigaud et al. 2021). Compounding the problem is the fact that Africa is considered to be the world's least climate-resilient region (AfDB 2022).

Economic and political challenges

Economic growth is uneven across the continent, with North Africa at 11.7 percent and East Africa at 4.8 percent in 2021 (AfDB 2022). Meanwhile, West and Central Africa stood at 4.3 and 3.4 percent respectively (AfDB 2022). Countries like Equatorial Guinea, Republic of the Congo and South Sudan rely heavily on oil exports that reach more than 40 percent of GDP (IMF 2022). As of February 2022, 23 African countries were either in or at risk of debt distress (AfDB 2022). There is compelling argument for countries to undertake

economic diversification and shift from dependence on commodity exports (IMF 2022). Many central banks are currently facing tough choices between inflationary pressure and growth recovery.

Africa is one of the world's fastest urbanizing regions, with the urban population projected to grow from 43.5 percent in 2020 to 59.1 percent of the total population by 2050 (UNCTAD 2021a). This creates several challenges, including concentration of poverty and the growth of informality and slum settlements (Gaisie et al. 2021). Furthermore, cities confront a gamut of climate risks that harm lives and infrastructure (Kareem et al. 2020). Slum and informal settlement dwellers occupy high-risk locations that lack the requisite infrastructure and access to public and relief services to cope with risks (Richmond et al. 2018; Taylor and Peter 2014). Ernstson et al. (2014:1567) find that "conditions of violence, informality, poverty and forced mobility tend to undermine urban security, stability and everyday predictability". Urban resilience measures must include bottom-up approaches and collaboration as well as reforms to urban policies (Taylor and Peter 2014; Ziervogel et al. 2017; Kareem et al. 2020).

Many African countries grapple with limited resources and state capacity which makes it difficult to maintain the rule of law and justice and provide public services and economic opportunities for their citizens (Ncube and Jones 2013). Often, this can be traced back to the continent's colonial past which weakened institutions and led to fractures in societies (Kaplan 2009). As a result, there is an increased risk of (transboundary) conflicts, refugee flows and organized crime which has impact on resilience (Baker 2017; de Boer et al. 2016).

Democratic functioning has been constrained in six countries, namely Burkina Faso, Chad, Guinea, Guinea-Bissau, Mali and Niger over the past few years (IMF 2022) and also with the situation in Sudan. The threat of terrorism and armed conflict looms in Burkina Faso, the Central African Republic, the Democratic Republic of the Congo, Ethiopia, Mali, Niger and Nigeria. Active conflicts include inter-ethnic violence in Burkina Faso, Chad, Mali, Mauritania and Niger; civil war in Libya and Somalia; an insurgency in Mozambique; the "Anglophone crisis" in Cameroon; and natural resource-driven conflict in the Democratic Republic of the Congo (UN DESA 2022). The continent has the highest number of displacements due to conflict and violence, which reached 7.5 million in 2018 (IDMC 2019). These vulnerabilities are exacerbated by a global political economy that continues to produce unequal trade relations, a high debt burden, and limited access to finance and technology, all of which take a toll on socioeconomic development.

Positive developments and policy environment for resilience

Despite these challenges, there are also positive developments in the form of fiscal debt reduction from 5.1 to 4 percent of GDP (AfDB 2022) and an increase in life expectancy and school enrolment (World Bank 2019). The projected working-age population increase from 54

percent in 2010 to 64 percent by 2090 is a window of opportunity for higher growth and yield through a demographic dividend (Drummond et al. 2014). There are untapped opportunities that can be leveraged through green and decent job creation and digitization. Urban growth and expansion are already contributing to spurs in consumption and business (Leke and Barton 2022). The continent now boasts of the world's largest free trade area and a 1.3 billion-person market (Zeufack et al. 2022; Leke and Barton 2022; UNCTAD 2021b).

The African Union's continental vision, sector policies, strategies and frameworks further create a policy environment for resilience and highlights the urgency for resilience-building across systems (see table 1). Indeed, there are common areas of focus between the RoAR and the *Climate Change and Resilient Development Strategy and Action Plan (2022–2032)*. Both speak to the need for the resilience of systems, including food, mobility and transport; infrastructure; ecosystems; water; urban areas; and underscore the need for transformation to achieve development goals: "The cross-cutting systems also contribute significantly to human development, poverty reduction, and the attainment of the Agenda 2063 and the SDGs, and research shows that investing in these cross-sectoral opportunities, including as part of post-COVID-19 stimulus packages, can aid in a sustainable green recovery" (African Union 2022b).

Based on the recognized need to approach climate and disaster risk management and development priorities in tandem in order to address root causes and underlying risk factors (see, for example, African Union 2022a, 2017), the RoAR considers both risks and risk drivers and highlights questions of equity in resilience-building. It further emphasizes the role of meaningful partnerships at international, continental, regional, transboundary and bilateral levels in line with main policy documents (see, for example, African Union 2022a, 2017).

While the abovementioned documents emphasize resilience, others are less focused on resilience. The Programme for Infrastructure Development in Africa (PIDA), for instance, aims to forecast demand for infrastructure services and boost competitiveness. Its priorities include increasing efficiencies, accelerating growth, facilitating integration in the world economy, improving living standards and unleashing intra-African trade.

The RoAR can play a positive role in strengthening and reinforcing resilience into the complex policy ecosystem. Conceptually, it helps the policy ecosystem expand on capacities (anticipatory, absorptive and recovery, adaptive, and transformative) central to resilience. The abovementioned reports have well-established quantitative indicators that provide us with a high-level understanding of different policy parameters. The RoAR approach can build on this and connect the different insights to advance an understanding of the whole of system resilience. It can be applied to different levels and is an ongoing process that becomes clear and effective as it goes through refinements and pilots.

TO ADDRESS ROOT CAUSES AND UNDERLYING RISK FACTORS, THE ROAR CONSIDERS BOTH RISKS AND RISK DRIVERS AND HIGHLIGHTS QUESTIONS OF EQUITY IN RESILIENCE-BUILDING.

Case study 1. Arum-Rum and response diversity in Turkana District, Kenya

Water stress and conflict
Turkana pastoralists reside in a harsh arid environment with their livelihood tied closely to livestock. Rainfall unpredictability presents a daunting challenge which is exacerbated by challenging sociopolitical configurations, livestock disease, and intertribal livestock raiding and violence. The Turkana pastoralists are confronted with the dual challenge of drought and conflict.

Social organization and herding
The pastoralists apply a combination of strategies to minimize the risk of losing their livestock. In response to intensifying risks of livestock raids and violence, a social organization innovation called Arum-Rum has emerged. Households use a collective form of security arrangement and gather within a set of actively guarded fortified fences at night. The Arum-Rum assigns a leader and all participating households move together under their stewardship. This arrangement comes with trade-offs as it leads a large horde of livestock competing for forage in a limited area. In other words, better access to forage for livestock is compromised for enhanced security through social organization.

Livestock mobility is known as a common risk management strategy among pastoralists and herders who move frequently in response to changing environmental conditions. There is diversity and nuance in herd movement: One herder may move to a place recently abandoned by another herder, making use of the leftover resources. In another case, a herder may move to areas of lower productivity along the watercourse. Camels can exploit the browsing available along dry watercourses in places where grazing livestock would find little suitable food. As a result, herds are shielded from rivals and raiders.

The Turkana pastoralists also practice multispecies herding which comprises a variety of livestock species including cattle, camels and goats, plus smaller numbers of fat-tailed sheep and donkeys. While this practice is uncommon as it creates additional labour and complicates herding strategies, it comes with several advantages. The species pose different herding needs in terms of forage and water. Cattle and camels leverage different energy sources that differ in timing and flux. While cattle utilize energy available in the rapid flush of grasses during rainy periods, camels browse in trees and tap vegetation characterized by less dramatic peaks but for longer duration.

Diversity
Pastoralists respond to a variety of risks, some known and some unpredictable, based on their traditional knowledge and long-standing experience. Pastoralists inevitably suffer from livestock loss due to adverse circumstances. Social networks that expand beyond familial bonds are crucial support pillars for recovering from shocks and supporting long-term restocking. They are based on mutual obligations for exchange and redistribution of livestock and can leverage the advantages of herd diversity to spread risk and minimize losses.

Social organization and response diversity allows them to leverage opportunities and ensure the long-term survival of their herds. It stands out that the practices aim for long-term success rather than productivity gain or efficiency which highlights the importance of redundancy and diversity.

Sources: Derbyshire et al. 2021; Leslie and McCabe 2014; McCabe 1984; Waila et al. 2018.

Table 1. African Union policy environment for resilience

Policy document	Objectives
Agenda 2063: The Africa We Want	Agenda 2063 is the continent's 50-year strategic framework that aims to deliver on its goal for inclusive and sustainable development and is a concrete manifestation of the Pan-African drive for unity, self-determination, freedom, progress and collective prosperity pursued under Pan-Africanism and African Renaissance.
Africa Water Vision (AWV) 2025	The AWV is intended to move Africa from where it is today to where it needs to be to ensure that water available in the future is sustainable and adequate in quantity and quality to meet competing demands in the long term.
AU sector policies, strategies and frameworks	
Comprehensive African Agricultural Development Programme (CAADP)	CAADP is Africa's policy framework for agricultural transformation, wealth creation, food security and nutrition, economic growth, and prosperity for all.
Climate Change and Resilient Development Strategy and Action Plan (2022-2032)	The AU Climate Strategy provides a continental framework for collective action and enhanced cooperation in addressing climate change issues that improves livelihoods and well-being, promotes adaptation capacity, and achieves low-emission, sustainable economic growth.
Great Green Wall Initiative	The objective of the GGWI is the restoration of agricultural, pastoral and dryland forestlands, to support ecosystem functions and services, while strengthening people's livelihoods, well-being and resilience against the myriad of stresses and shocks to which the continent is prone.
Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods	The Malabo Declaration provides the direction for Africa's agricultural transformation within the framework of the CAADP as a vehicle to contribute to the achievement of the objectives of the First 10-Year Implementation Plan of Agenda 2063.
African Climate Resilient Agricultural Development Programme (2022–2032)	The programme is to enhance adaptation to climate change and build the resilience of farmers to climate-related and economic shocks, including scaling up climate-smart agriculture to enhance food security and agricultural livelihoods.
Climate for Development in Africa Programme	The programme was established to create a solid foundation for Africa's response to climate change. Its purpose is to explore actions required in overcoming climate information gaps for analyses leading to appropriate policies and decision-making at all levels.
Integrated African Strategy on Meteorology (2021–2030)	The strategy positions weather and climate services as essential components in national and regional development frameworks. Its objective is to enhance cooperation between member states and to strengthen the capabilities of their National Meteorological Services.
Strategic Framework for Drought Risk Management and Enhancing Resilience in Africa	The strategic framework aims for a drought-resilient and prepared Africa based on six principles and policy priorities that tackle underlying risk factors, knowledge gaps and the policy and governance framework for drought risk management in order to enhance resilience across all segments of society.
Programme of Action (PoA) for the Implementation of the Sendai Framework on Disaster Risk Reduction in Africa	The PoA is the strategic plan for the implementation of the Sendai Framework in Africa. It is intended to provide guidance and direction for actions at the continental, regional, national and subnational/local levels in Africa to prevent and reduce the risk of disasters for resilience in line with the Sendai Framework.
Africa Multi-Hazard Early Warning and Early Action System (AMHEWAS)	AMHEWAS seeks to reduce disaster losses through increasing availability of and access to multi-hazard early warning and disaster risk information and fostering coordinated response and early action.
African Union Sustainable Forest Management Framework	The framework serves to guide member states and other African stakeholders in the forestry sector in their efforts to eliminate deforestation and forest degradation by 2063. It provides a scope and lists priority areas for investments and partnerships in the forest sector.
Africa Blue Economy Strategy (ABES)	ABES guides the development of an inclusive and sustainable blue economy to become a significant contributor to continental transformation and growth.
Programme for Infrastructure Development in Africa (PIDA)	PIDA provides a common framework for African stakeholders to build the infrastructure necessary for more integrated transport, energy, ICT and transboundary water networks to boost trade, spark growth and create jobs.
Science, Technology and Innovation Strategy for Africa	The strategy is to accelerate the transition of African countries to become innovation-led and knowledge-based economies. This will be achieved by improving science, technology and innovation readiness in Africa and implementing specific policies and programmes which address societal needs in a holistic and sustainable way.

RoAR understanding of resilience

The RoAR's understanding of resilience is rooted in resilience thinking and the understanding put forward in the AUC Climate Change and Resilient Development Strategy and Action Plan 2022–2032 as well as the UN Common Guidance on Helping Build Resilient Societies (2020). Resilience thinking is seen as a response or counternarrative to linear thinking and command-and-control approaches to risk management as it sees inextricable links between social and ecological systems, which are complex and non-linear, characterized by feedback loops and uncertainty (Berkes et al. 2003). Resilience thinking acknowledges that changes in ecological systems will impact social systems and vice versa and searches for ways to navigate them in ways that safeguard or improve social development and well-being within planetary boundaries (see Rockström et al. 2009). It thus enables us to acknowledge the unpredictability inherent in socioenvironmental change and provides a way to prepare for unavoidable and unanticipated shocks (Tyler and Moench 2012).

Hence, the RoAR defines resilience as the "ability of systems to function in the face of disturbance" (Bahadur et al. 2015:5, based on Holling 1973). More specifically, it sees it as a system's ability to anticipate, absorb and recover, adapt, and transform when faced with a wide range of evolving risks and uncertainties leveraging both scientific and indigenous knowledge and building on social norms and communal systems to reduce harm and maintain an acceptable level of functioning without compromising long-term prospects for sustainability, prosperity, peace and well-being for all. The RoAR conceptualizes resilience as a participatory and negotiated process to define and pursue a desirable set of systems that can address risks and operates within planetary boundaries to enhance human well-being. A high level of resilience of a system in an undesired state is sometimes referred to as "resistant" (Folke et al. 2010). The "resistant" state tends to fall outside of planetary boundaries and/or diminishes human well-being.

There is also a tendency to assume resilience means "robust", able to stay the same or bounce back to a prior state despite stress or a disturbance which ignores the deeper, systemic and structural problems that manifest risks and chip away at resilience (see Walker 2020). In contrast, resilience thinking goes beyond framing resilience as the ability to withstand shocks and enables us to distinguish between the capacity to maintain a system in its current state

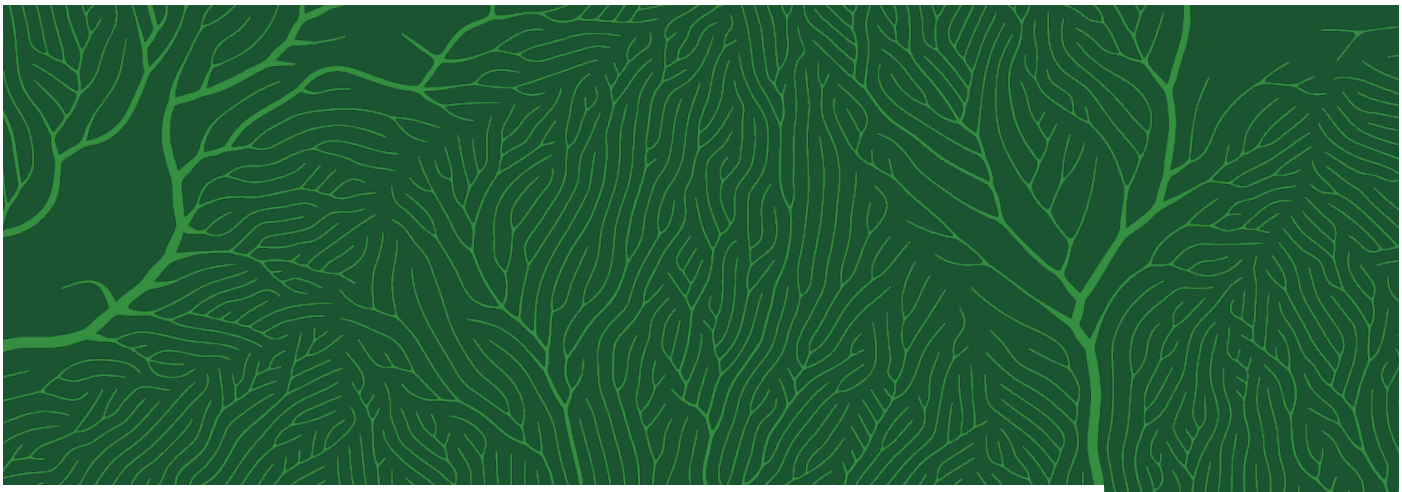
(adaptability) and the capacity to deliberately create a new and more desirable system (transformability) (Walker et al. 2004). It is, therefore, not always about “bouncing back” or resisting change in relation to a prior state but can also mean adapting, changing or reorganizing while coping with disturbance (Reyers et al. 2018). It presents an opportunity to build agile systems that are better prepared for future disruptions and to adapt to new conditions (African Union 2022a). In this understanding, “[r]esilience is largely about learning how to change in order not to be changed” (Walker 2020: 11) and can be seen as a dynamic process that paves the way for fundamental reform over time (Raco and Street 2012). In this line of thinking, resilience is intrinsically neither good nor bad; it is a system property that needs to be assessed and understood in its context. It does not seek to bounce back into an already vulnerable, weak and often unequal system. Instead, depending on the context, it aims to bounce forward into a system with stronger, more desirable roots so that when confronted with risks and shocks, it responds, recovers or transforms in stronger and more inclusive ways. This does not mean that different resilience capacities are mutually exclusive. Strengthening adaptability and existing coping mechanisms or reducing disaster risk will contribute significantly to resilience. However, depending on the context, transformative resilience capacity will be needed to deal with all the challenges arising from multiple interlinked risks and crises (Magnan et al. 2020; see Schipper and Langston 2015). Table 2 gives an overview of what resilience is and is not.

RESILIENCE IS INTRINSICALLY NEITHER GOOD NOR BAD; IT IS A SYSTEM PROPERTY THAT NEEDS TO BE ASSESSED AND UNDERSTOOD IN ITS CONTEXT.

Table 2. What resilience-building is and is not based on RoAR research findings[1]	
Resilience-building requires addressing the root causes of vulnerability and fragility.	Resilience-building is not only about minimizing the impact of a crisis or shock.
Resilience-building accepts and embraces learning and change.	Resilience-building is not managing against change.
Resilience-building is about managing complexity, learning and moving away from the status quo wherever necessary and possible.	Resilience-building is not necessarily about maintaining the status quo.
Resilience-building embraces indigenous knowledge and identifies existing capacities; it is value-laden and assumes a political process of deliberation.	Resilience-building is not only about techno-managerial solutions.
Resilience-building is the obligation and duty of multiple stakeholders across levels of governance, including at the local and community levels and involving the private sector.	Resilience-building is not about shifting responsibility to a single stakeholder.
Resilience-building is a process of transparent deliberation, negotiation, creating synergies and mitigating trade-offs.	Resilience-building is not a command-and-control approach.

Resilience is not confined to one scale. We "cannot understand or manage the resilience of a complex system at one scale. All complex systems function at multiple scales and the interactions between the scales are critical to resilience" (Walker 2020). In some cases, the cross-scale effects can cause policy interventions or approaches to resource use to have positive impacts on resilience at one scale and negative ones at another. This has, for example, been demonstrated in cases of environmental conservation efforts, such as the designation of protected areas that restrict local populations' access to natural resources which their livelihoods depend on and in transboundary river basins where upstream water use can enhance local resilience while increasing vulnerability downstream (Bunce et al. 2010). Finally, it is important to stress that resilience is not about shifting responsibility to communities. This does not mean relegating families and communities as passive victims when they are central actors shaping systems and often first responders in the event of crises. There is a strong argument for encouraging local coping mechanisms as a form of resilience. However, this cannot be encouraged to alleviate state actors and other players of their primary role and responsibility in creating an appropriate environment for resilience to flourish.

[1] These resilience characteristics were derived from the in-depth literature review and particularly the work of Walker (2020) and Folke et al. (2021).

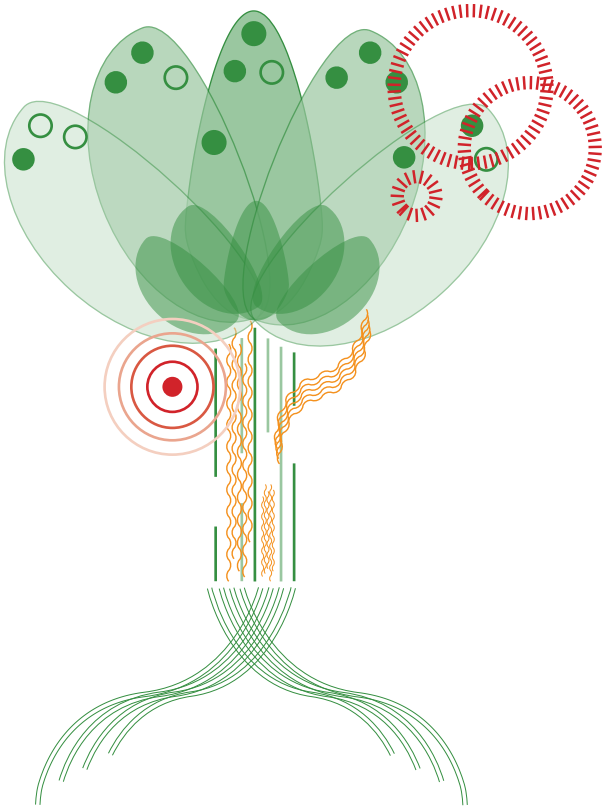


The Roots of African Resilience (RoAR) Approach

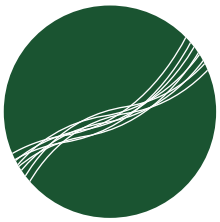
Based on this understanding of resilience, the RoAR approach represents the building blocks or fundamentals to understand, assess and build resilience in the African context. It links and reconciles development and resilience-building objectives and engages with the following questions:

- What inhibits African communities, nations and regions from providing a conducive environment where ideas, people and potentials can flourish despite shocks?
- What structural elements facilitate and constrain actors from building resilience?
- What influences/drives the risk-creation process?
- How are key risks addressed while supporting the most marginalized and poor segments of the population?
- How equitable, responsive, and functional is the relationship dynamics between duty bearers and rightsholders when it comes to resilience-building?
- Are evolving and systemic risks part of existing and emerging risk management practices?
- Are tools and know-how available and applied to address systemic risks and do they apply a whole systems approach to resilience-building?
- Are resilience measures reflected in and do they support development policy and planning portfolios?

Figure 2. RoAR tree of resilience overview



The tree of resilience (figure 2) represents the system of systems that calls for resilience-building. Different parts of the tree represent key components of resilience, including the structural drivers of resilience and desirable systems (roots), resilience enablers and capacities (trunk), and policy entry points and indicators (crown and branches). The tree is surrounded by a variety of risks and risk drivers, some of which are intertwined with it whereas others are coming from outside of our system of interest. Put together, the RoAR tree provides us with a logic to hone in on resilience policy and programme entry points, resilience capacities, measurement, evaluation and learning in a particular context.



Roots of resilience

Roots are the starting point or foundation of resilience efforts. They represent the “big picture” vision of desirable resilience and are intrinsically linked to development policy and practice. By engaging with aspirations and goals for resilient development and comparing them to the status quo, roots can also help identify drivers of vulnerability and risks countries are grappling with. The roots imply that we detect vicious cycles and break down or interrupt the processes that nurture conditions of risk.

Roots of resilience may vary from context to context but are based on overarching development objectives that countries have already agreed upon. Here, we draw from commonly understood policy objectives, which imply deeper levels of change and deviation from the status quo and provide a snapshot of what the African

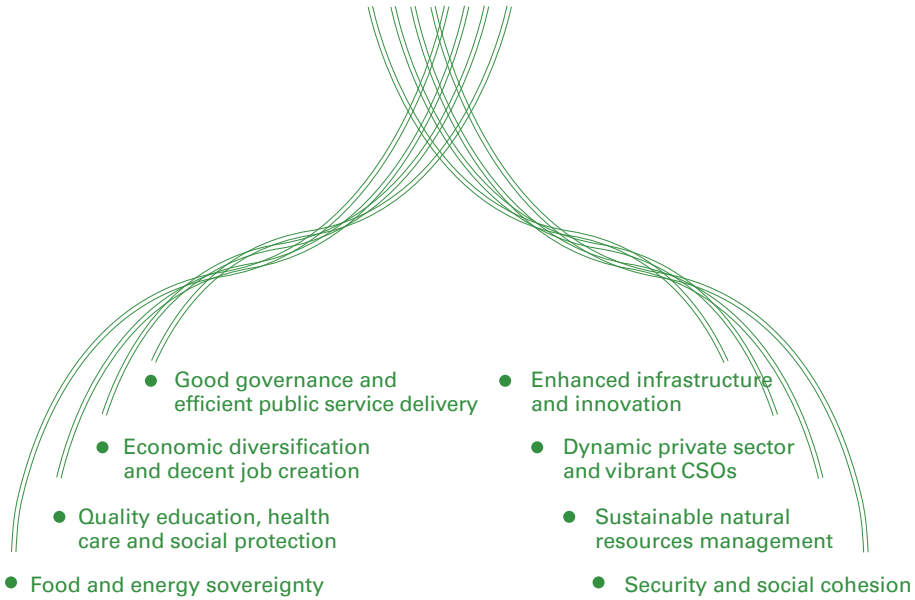
citizenry deems desirable (for example, see African Union 2015 and figure 3). These objectives reflect the state of development that ought to be resilient against all types of hazards and shocks. It is important to note, however, that roots are dynamic, context-specific and long-term objectives that should lead toward the fulfilment of the aspirations set out in Agenda 2063. As such, they can be adjusted, refined and expanded upon for each context the RoAR is applied to over time.

The roots of resilience are not shaped and determined by a single powerful actor in the system but rather are based on a shared vision of different stakeholder groups on what is desirable. Strengthening roots of resilience represent shifts from gender discrimination to gender equality, poverty to prosperity, exclusion to meaningful participation, and land degradation to sound natural resources management. Taken together, they reflect key characteristics of a desirable system:

- Good governance and efficient public service delivery
- Economic diversification and decent job creation
- Quality education, health care and social protection
- Food and energy sovereignty
- Enhanced infrastructure and innovation
- Dynamic private sector and vibrant civil society organizations (CSOs)
- Sustainable natural resources management
- Security and social cohesion

Since the roots of resilience reflect an inclusive, co-constructed vision of desirable resilience and prosperity, they translate through to the resilience enablers and capacities and policy entry points and indicators, shaping the rest of the tree.

Figure 3. Roots of resilience



Roots of resilience
Roots are the starting point of the framework and reflect an inclusive vision of desirable resilience and a prosperous Africa in line with the aspirations of Agenda 2063.

Case study 2. Early warning systems in the Lake Victoria Basin region

Extreme weather events

The fishing communities in Lake Victoria Basin, considered East Africa's lifeblood and the largest inland fishery in Africa, are vulnerable to sudden-onset extreme weather events. Every year, many marine accidents are brought on by extreme climatic events like storms, thunderstorms and powerful winds and waves, which pose risks to the local population and threaten the lives of fishers.

Early warning systems

A regional early warning system was put in place by the World Meteorological Organization to reduce casualties and property damage. Additionally, the project supported regional cooperation between the National Meteorological and Hydrological Services of Kenya, Rwanda, Uganda and the United Republic of Tanzania.

Even though initial emphasis was on the Lake Victoria Basin, the project's overall goal was to increase human resilience to weather and climatic shocks and economic development in the East African region. Forecasters from the weather service offices in East Africa collaborated with beach management units and fishing community leaders to create improved marine forecasts and hazardous warnings.

From the outset, the project used a co-designed and needs-based approach to assist countries bordering the lake (Kenya, Uganda and United Republic of Tanzania) in providing timely, accurate, convenient, and understandable forecasts and early warning services. The project collaborated with the most popular radio stations among fishing communities in the region and involved them in the co-design process of the forecast bulletins. During the media training workshops for radio personnel or journalists, weather forecasters and leaders from fishing communities joined to help create more concise bulletins in local languages that contained all the essential weather-related information needed by the listeners.

Furthermore, more than 50 local and regional radio stations now provide weather forecasts with nearly half also providing twice-daily forecast bulletins for fishers in regional languages. The project also took advantage of the growing use of smartphones in the region and introduced using WhatsApp features to send individuals direct weather forecasts and warning messages, including regional and national weather alerts, seasonal forecasts, locust swarm movement information and safety guidelines for COVID-19.

Leveraging technology

Early warning systems are a crucial tool in resilience-building as they generate important information that enables people to anticipate shocks and take mitigating measures. The case of the Lake Victoria Basin demonstrates how technological innovation and regional collaboration can boost the resilience of local communities. It also illustrates the importance of adapting solutions to specific contexts and ensuring risk communication via multiple languages and channels.

Sources: IFRC 2014; Roberts et al. 2022; WMO 2021.

Case study 3. Ebola legacy and learnings for COVID-19 response

COVID-19 spread

Many predicted that the COVID-19 outbreak would cause mayhem and misery in African countries, particularly in the continent's densely populated megacities. Nigeria was one of 13 countries identified as high risk for COVID-19 spread (based on either direct linkages or high travel volumes to and from China). With a population of about 21 million, Lagos has the highest population density in Africa and is the industrial and economic hub of Nigeria. Rapid urbanization and population growth, much of it informal, has put additional pressure on the environment and infrastructure and presents a challenge for public service delivery.

Institutional mechanisms

On 7 January 2020, the Nigeria Centre for Disease Control established a multi-sectoral National Coronavirus Preparedness Group, just one week after China first reported positive cases of COVID-19 and three weeks before the World Health Organization (WHO) declared the disease to be of international concern. Furthermore, Nigeriaalso established diagnostic capacity for COVID-19 in three laboratories within the country in one month. At the end of March 2020, President Muhammadu Buhari imposed a full lockdown on Lagos and Ogun states as well as Abuja, closing almost all businesses and limiting essential businesses' operating hours for over five weeks.

The 2014 Ebola virus outbreak led to significant investments in public health emergency management and triggered the establishment of standard operating procedures on the use of personal protective equipment as well as improved diagnostic capacity of the National Reference Laboratory for epidemic-prone pathogens. It catalyzed collaboration protocols with Port Health Services for screening persons arriving in Lagos State via its land, sea and air borders. The Nigeria Centre for Disease Control also supported the establishment of Emergency Operations Centres (EOC) in 22 other states and trained rapid response teams in all 36 states.

Nigeria was able to learn and benefit from its experience and successful incident management during the 2014 Ebola virus outbreak to take early action in COVID-19 response. Both infrastructure and lessons learned from Ebola (and Polio before that) proved crucial in shaping the country's successful response to COVID-19, which, despite its challenges, was able to stem the tide through lockdowns and social distancing, including bans on social and religious gatherings.

The state had already institutionalized an EOC in 2014 that focused on: epidemiology and surveillance; communication and social mobilization; case management and infection prevention control; laboratory services; point of entry (port health); and management and coordination. The creation of the EOC can be traced back to the country's infrastructure for the eradication of Polio in which made use of a SMS-based application supporting disease surveillance through networks of community volunteers and health care workers. During COVID-19, this application was leveraged by adding surveillance questions.

The fact that the EOC was in place in Lagos State before the COVID-19 pandemic began helped to get an early start as the virus reached Lagos. Four weeks before its first reported case, an incident command system was already established that allowed for immediate diagnosis and contact tracing. The first case was confirmed within six hours of arrival at the Lagos Mainland Infectious Disease Hospital.

Learning and preparedness

The risks of a public health system breakdown and the spread of COVID-19 were significant in Nigeria, but did not materialize. The country's strong response protocols were aided by early diagnosis, swift quarantine of cases and prompt contact tracing. We can surmise that many institutional and coordination mechanisms that were required for a swift response to COVID-19 were already in place due to earlier disease outbreaks. In other words, a country's ability to learn from previous crises to build or improve institutional mechanisms and define roles and responsibilities across the stakeholder spectrum can be crucial for resilience and helping them bounce forward.

Sources: Abayomi et al. 2021; Ihekweazu 2020; J-PAL n.d; Kapata et al. 2020; Otu et al. 2017; Shuaib et al. 2014; WHO 2015; WHO Regional Office for Africa 2020.

Resilience enablers and capacities

The trunk of our tree comprises resilience enablers and capacities, which are core characteristics that contribute to a system's resilience regardless of the specific risk context (figure 4). We distinguish between the capacities that allow a system to anticipate, absorb and recover, adapt, or transform in order to prevent harm, bounce back from shocks, and leverage opportunities for positive change and the more generic enablers that represent system attributes conducive to resilience and sustainable development. The resilience capacities fulfil different functions within resilience-building. Depending on the risk context, they are geared toward a specific objective: anticipation and prevention of shocks, recovery, adaptation or system transformation.

DEPENDING ON THE RISK CONTEXT, RESILIENCE CAPACITIES ARE GEARED TOWARD A SPECIFIC OBJECTIVE: ANTICIPATION AND PREVENTION OF SHOCKS, RECOVERY, ADAPTATION OR SYSTEM TRANSFORMATION.

Anticipatory capacity aims to reduce the potential impacts of shocks and stresses through early warning, preparedness and planning. It entails proactive steps to prevent harm, either by avoiding or reducing exposure or by minimizing vulnerability to foreseeable hazards (Bahadur et al. 2015). Measures that enhance anticipatory capacity typically include the establishment or improvement of (multi-hazard) early warning (see case study 2) or disease prevention and monitoring systems (see case study 3), but they can also encompass climate information services that enable farmers to anticipate and adapt to changing climate conditions. In Senegal, the use of seasonal and shorter term weather forecasts allow farmers to adjust their practices to avoid crop losses or waste fertilizer (CCAFS 2015).

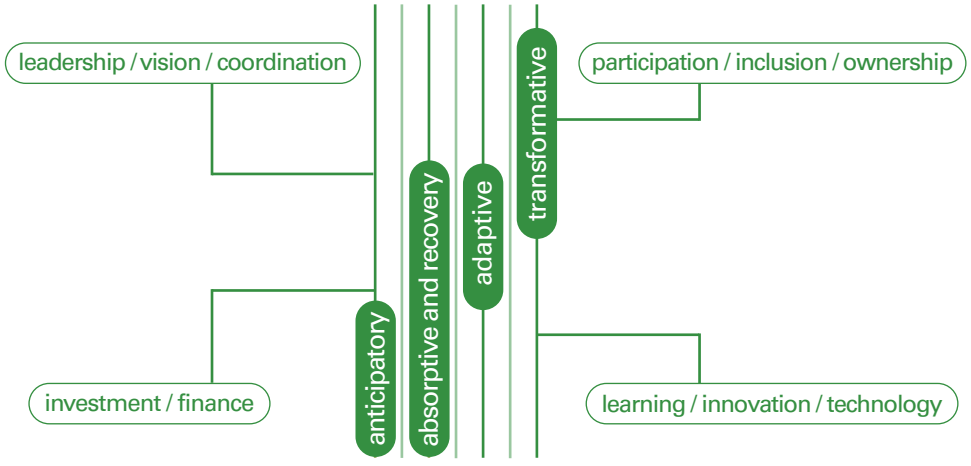
Many definitions of resilience emphasize capacities to limit damage from disturbance and recover from shocks (Bahadur and Pichon 2016) which we have combined into **absorptive and recovery capacity**. Absorptive capacity aims to moderate the impacts of shocks and stresses by leveraging available skills, knowledge and resources to cope. It is primarily concerned with post-disturbance actions to reduce the immediate impact on people's livelihoods and basic needs (Bahadur et al. 2015). The closely connected recovery capacity aims at bouncing back from disaster or crisis in ways that reduce vulnerabilities and harness development opportunities (see African Union 2021). In Kenya, the National Drought Management Authority is building absorptive and recovery capacity by establishing early warning systems and contingency plans, pre-positioning relief supplies and promoting drought-resistant agricultural practices, all of which aim to attenuate possible impacts from recurrent droughts (NDMA Strategic Plan 2018–2022). In addition, the Hunger Safety Net Programme provides households in some of the poorest and most arid counties with social assistance and is designed to include emergency scale-ups expanding coverage to additional vulnerable households in times of drought or other emergency (HSNP 2023; Ulrichs et al. 2019).

Adaptive capacity allows people or institutions to take deliberate and planned action to adjust to multiple, long-term and future risks and changes in order to moderate potential harm or to

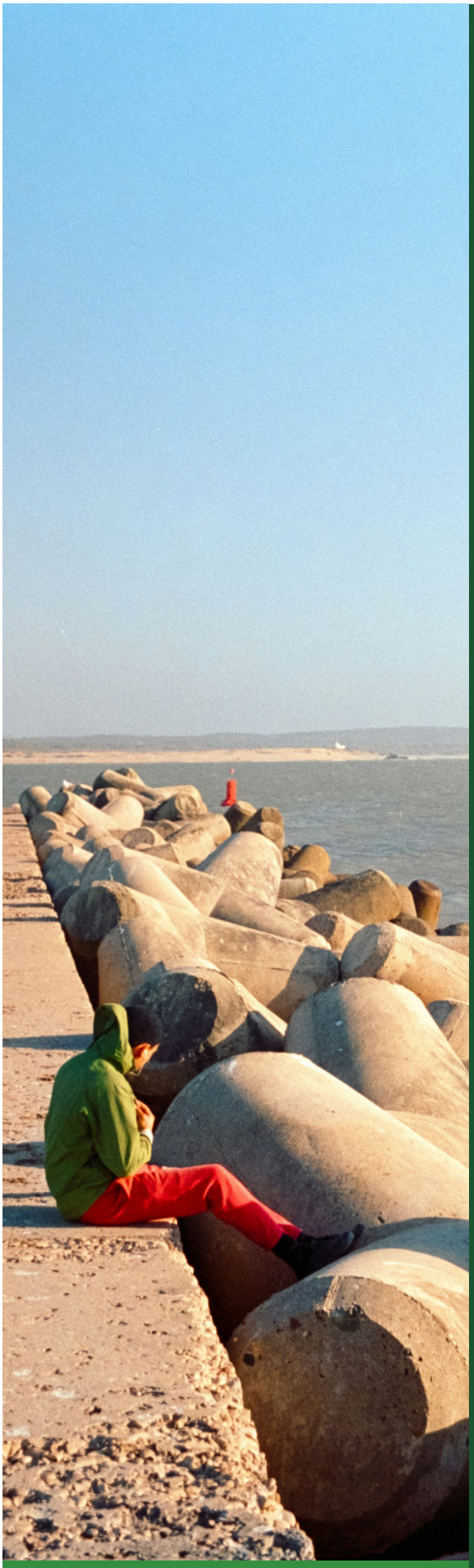
take advantage of change or disturbance (see Bahadur et al. 2015). It is closely linked to the ability to learn and provides resources and assets that can be mobilized to adapt to changing circumstances when needed. Building or enhancing adaptive capacity includes a wide range of interventions targeting improvements in governance and institutional mechanisms to address uncertainty and risks, training and capacity-building for different groups of stakeholders, or community-based initiatives increasing and diversifying asset and resource bases of households and individuals. In Cameroon, for example, the Ministry of Environment, Protection of Nature and Sustainable Development and the International Fund for Agricultural Development are implementing a project that seeks to increase community resilience to climate change through youth entrepreneurship and integrated natural resources management. Its key components focus on building adaptive capacity through mainstreaming adaptation into institutional and regulatory frameworks, improving knowledge on ecosystem vulnerability and ecosystem-based adaptation, and training and support for sustainable management of natural resources and green entrepreneurship (Adaptation Fund 2021).

Transformative capacity aims to design fundamentally new systems to overcome undesirable structures that keep creating risks and vulnerabilities. It comes to play when the other capacities do not suffice to address the root causes of risk, vulnerability and inequality that hamper resilience. The focus of transformative capacity is often put on agency and participation that challenges power asymmetries and transforms decision-making processes for greater inclusion, equality and sustainability (Morchain et al. 2019; Ziervogel et al. 2016). Examples of projects that enhance transformative capacity include those that introduce innovative technologies and practices as well as those that emphasize the value of local and indigenous knowledge and recognize its importance for policy making and programming. In South Africa, the Fostering Local Wellbeing (FLOW) project worked with out-of-work local youth to build both individual and community transformative capacity through interventions that reconnect people to nature, support creativity and foster agency and social cohesion (Ziervogel et al. 2016).

Figure 4. Resilience enablers and capacities



Resilience enablers and capacities
These are core characteristics drawn from resilience theory and known to lend resilience to the system in question.



Case study 4. Proactive and preventative flood response in Morocco

Flood risks

The rainy season in Morocco, stretching from October to April, brings flood risks to large tracts of the country. Morocco has faced more than 80 flood events since 1951. More recently, several cities, despite the presence of flood control infrastructure, have suffered flood damages. The impacts of floods are far higher than that of any other hazard, both in terms of frequency of occurrence and in the number of deaths. The National Flood Protection Plan estimates that the average cost of flood damage is USD 4.2 million per site. Growing urbanization creates additional flood risks with regard to informal settlements.

Integrated water management

The construction of hydraulic infrastructure is central to Morocco's flood control policy. The 2009 National Water Strategy set the objective of building 60 large dams by 2030 with a total storage capacity of 7 billion m^3. These dams serve the dual needs of water demand and flood control. However, there is a growing realization that dam infrastructure needs to be complemented by non-structural measures. The 2002 National Flood Protection Plan aimed to reduce flood risk through "(1) a detailed diagnostic of flood events, (2) an analysis of current institutional framework and suggestions for improving it, and (3) proposal of an action plan" (Loudyi et al. 2022:52). While most of the money allocated to flood control (79 percent) still goes into structural measures, the plan also introduced several non-structural measures. The adoption of the new water law in 2016 is a good example of a legal instrument that improves integrated water management and flood early warning.

The new 2016 water law in Morocco dedicates an entire chapter to floods and provides guidance on the roles of different stakeholders for flood risk management. It calls on the Hydraulic Basin Agencies for preparing a flood risk prevention plan for medium and high flood-risk areas, which presents an opportunity for citizen engagement and participation. Similarly, in 2016, a new insurance law introduced a coverage scheme for disaster event consequences. This new law also established the Fund of Solidarity against Catastrophic Events to allow compensation for victims of disasters following both natural and man-made events. The establishment of Ourika Valley Flood Forecasting and Warning System played a successful role in the detection and warning of 10 floods from 2003 to 2012. Regulation of land use in flood-prone areas through delineation studies and raising public awareness can further reduce flood risks.

Proactive and anticipatory action

The early part of Morocco's response to floods was dominated by infrastructural measures and crisis interventions which proved inadequate. The introduction of new legal measures and strategies paved the way for protection, prevention and management that was previously missing. Even the funding mechanism has gradually evolved from emergency response and post-disaster reconstruction toward prevention financing. Overall, there is a paradigm shift occurring in Morocco from reactive to proactive approaches in flood risk management that is enhancing resilience.

Sources: Afilal 2017; Loudyi et al. 2022; OECD 2017.

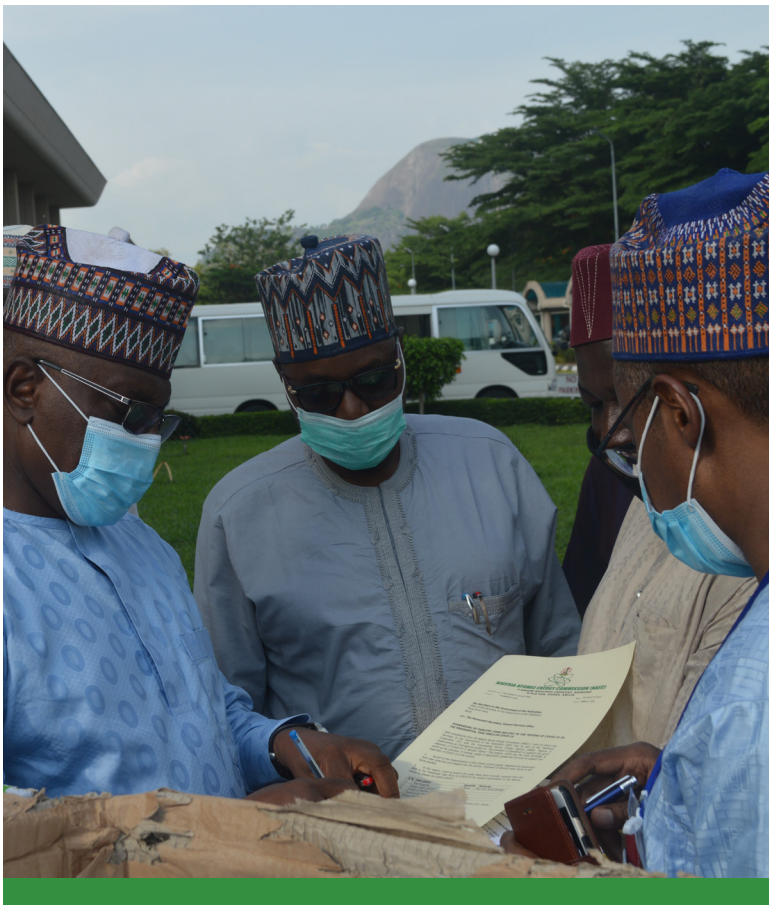
Using resilience enablers allows us to articulate some of the intangible or harder-to-define processes and contextual forces at play. It requires a subtle change of mindset from what a system currently has to what a system does/how it operates. They are a dynamic set of enablers that allow a system to anticipate risks, absorb and recover from or adapt to disruptions and transform in the face of change (see Folke 2006). Combined, they facilitate and act as an extension of resilience capacities. For example, the participation and inclusion of stakeholders in a meaningful and timely way is crucial to resilience efforts. The way each country undertakes this process, the actors involved, methods and emphasis will, of course, vary, but the core enablers remain universal. In practice, resilience enablers and capacities often go hand in hand. Morocco, for example, illustrated adaptive capacity based on leadership, learning and innovation when it introduced new legal instruments to shift from a reactive to a proactive approach in flood risk management (see case study 4).

USING RESILIENCE ENABLERS ALLOWS US TO ARTICULATE SOME OF THE INTANGIBLE OR HARDER-TO-DEFINE PROCESSES AND CONTEXTUAL FORCES AT PLAY.

The resilience enablers are closely linked to the principles for building resilience identified by Biggs et al. (2015) and resonate with common approaches in development practice such as the sustainable livelihoods framework which underpin the development of indicators and indices of resilience (Brooks et al. 2005; Dulal et al. 2010). For practitioners, resilience enablers serve as tangible or intangible proxies that a system can draw on in anticipation of or in response to a sudden shock or a recurrent stressor (Béné 2020).

Leadership, vision and coordination

Leadership refers to the capacity of individuals, institutions and groups within states to mobilize, communicate and take collective action toward a clear goal. Clear and purposeful leadership is known to confer resilience to systems (Fabricius et al. 2007; Carpenter et al. 2012) and is seen as "a key ingredient in encouraging individuals and communities to take action during challenging times" (Rockefeller Foundation and Arup 2016:25). A clear and shared vision for resilient development is necessary to foster social cohesion and mobilize support for new policies and programmes. Similarly, coordination is crucial to ensure that efforts undertaken in different sectors or by different stakeholders are compatible, mutually beneficial and contribute to overall risk reduction and resilience (see case study 5).



Leaders and policy makers can rise in situations to mobilize networks, shape management and practices, build shared visions, and unite individuals in a collaborative learning process for transformation (Olsson et al. 2004, 2008; Moore and Westley 2011). They can overcome barriers to change

spanning government scales and seizing opportunities (Olsson et al. 2004; SRC 2016). Leadership for resilience is demonstrated through active problem-solving, cohesion building and facilitated communication (Southwick et al. 2017). In South Africa, the presence of dedicated leaders was pivotal to the resilience of health systems to challenges of resource scarcity and staff shortages (Lembani et al. 2015). McKenzie et al. (2015) also found coordination with religious leadership crucial to public health resilience efforts in Nigeria.

Participation, inclusion and ownership

Participation and inclusion refer to the capacity of states to meaningfully and in a timely manner engage a broad group of stakeholders in policy-making processes. The mandates and obligations of different stakeholders may vary across states, but resilience requires key government ministries, civil society organizations, communities, media and other decision makers to play their part. Participatory and inclusive processes foster ownership and the shared assumption of responsibility for agreed upon policies and programmes. "While the enabling, guiding and coordinating role of national and federal State Governments remain essential, it is necessary to empower local authorities and local communities to reduce disaster risk, including through resources, incentives and decision-making responsibilities, as appropriate" (UN 2015:8). Science and local understanding are brought together paying due attention to the role of local culture, norms and values. It shapes our study to engage with differences while remaining conscious of power dynamics wherein different interests, needs, scales or definitions are prioritized (Harris et al. 2018; Hallegatte et al. 2017).

A range of benefits are accrued from broad and meaningful participation and shared ownership. For example, we can leverage insights and knowledge; find legitimacy and transparency; detect shortcomings; identify cultural sensitivities; build trust and shared understanding; and diversify knowledge (Anschell 2021; SRC 2015). The African Union's COVID-19 recovery framework calls community participation the "cornerstone of the recovery process" (African Union 2022a). The framework emphasizes inclusion and consultation throughout the recovery process in assessments, determining problems and needs, finding solutions, executing projects, and in feedback

mechanisms. Research and focus group discussions with youth in Mozambique found that greater dialogue and participation of youth in peace processes is critical for building resilience against violent extremism (Lucey and Patel 2022). Action Aid (2017) case studies also demonstrate how resilience efforts were bolstered by the participation of women health workers via house visits and demonstrations to address a typhoid outbreak in Nyanga, Zimbabwe. Similarly, women community mobilizers were able to raise awareness on Ebola prevention in Liberia and Sierra Leone through door-to-door campaigns.

Investment and finance

Investment and finance are prerequisites for building resilience. Resources are required not only for strategic investments in risk reduction activities such as early warning systems and resilient infrastructure, but also to support programmes and activities that reduce vulnerability and contribute to building strong roots of resilience in line with development priorities. This will likely require both new and additional funds for resilience activities and a careful review to align existing budget and investment plans with overarching resilience objectives.

The benefits of investing in resilience are clear: Not only does it save lives and avoid losses in case of disasters or crises, but it can also unlock economic potential and bring development co-benefits, thereby bringing a triple dividend (Tanner et al. 2015). A risk-sensitive budget review carried out for 16 African countries in 2018-2019 found that direct and indirect disaster risk reduction (DRR) investments accounted for 4 percent of national budgets on average, ranging from 0.3 percent to 8.8 percent (UNDRR 2020a). Beyond specific DRR investments, large-scale investments are required to foster system resilience in a comprehensive manner. Finance can be mobilized through a range of different instruments and mechanisms coming from both public and private

Case study 5. Cape Town: Whole-of-city approach to avoid "Day Zero"

Water distress

Cape Town had to contend with the possibility of acute water supply shortage and disruption as three years of inadequate rainfall from 2015 to 2018 caused water levels in its reservoirs to drop dramatically. Cape Town relies heavily on surface water and is vulnerable to droughts. In 2018, the city was anticipating a drop in dam water levels to 13.5 percent of capacity by April. At that critical point, municipal taps were expected to be shut off and water would only be supplied to hospitals and other critical services.

Supply-demand management

The city government contemplated the drastic step of cutting parts of Cape Town's water supply—a scenario they announced as Day Zero. The Day Zero disaster plan entailed the distribution of water to residents through a complex system of manual collection points. Day Zero would likely have brought economic and humanitarian catastrophe to the city. The city received negative press coverage and many media outlets referenced Cape Town as the first city to potentially run out of water.

In response, a consumption target of 500 megaliters of water per day was set, several new small-scale augmentation projects were implemented, and the Department of Water and Sanitation facilitated a water transfer from Groenland Water User Association to supplement the city's water supply. Water conservation campaigns lowered residents' demand through a variety of measures such as replacing lawns and water-sensitive plants with alternatives, installing water-saving devices, and adopting behavioural changes such as shortening showers and collecting grey water for use in toilet flushes. Residents with the financial means built rainwater harvesting tanks and drilled boreholes. A select few corporates went entirely off-grid and turned to groundwater or desalination. This period also saw the emergence of start-ups that offered water-saving solutions and public investments in smart water management solutions.

Partnerships and participation

The drought situation Cape Town faced was unprecedented and challenging. Reaching the ambitious water conservation target would not have been possible without commitment, collaboration and contributions from all stakeholders who came together for a common purpose. Using a combination of behavioural norms, technology and resources allowed the city to demonstrate resilience. Transparent communication, an open call for partnership and mutual support are important takeaways for the resilience effort.

Sources: City of Cape Town 2019; City of Cape Town, Arup, and 100 Resilient Cities 2020; Pascale et al. 2020; Ziervogel 2019.

sources. The public sector will play an important role in mobilizing funds and scaling up public finance steered toward resilience-building, both at the national and international levels (UNCCD 2023).

Innovation, learning and technology

Innovation and learning refer to the ability and willingness to think critically, adjust to change and learn from experiences. It is assumed that systems that have shown capacity and willingness to innovate and learn in the past are better placed to do so in the present and future (see case study 4). Resilient organizations foster creativity through resource allocation, incentives for innovation, tolerance for failure and by creating an atmosphere where employees feel safe to share ideas (Barasa et al. 2018:499). This is crucial for resilience-building as the dynamic and changing risk context requires continuous improvement of existing practices, policies and institutions and to reform or replace those that have not worked in the past. The recognition of indigenous knowledge systems plays a critical role for learning and innovation. This can relate to indigenous ways of life and food practices that are conducive to enhancing resilience, for example, but also to the critical reappropriation of indigenous forms of knowledge that can offer alternative development frameworks and pathways (see Mungwini 2013). Case study 6 on the Baraza Peace Committees illustrates how

THE RECOGNITION OF INDIGENOUS KNOWLEDGE SYSTEMS PLAYS A CRITICAL ROLE FOR LEARNING AND INNOVATION.

resilience can be enabled through local customs and informal practices that promote peace and security and help tackle the structural drivers of vulnerability. Effective structures and mechanisms for learning and innovation allow a system to operate with incomplete information, deal with uncertainties and surprises, and challenge existing structures (Bujones et al. 2013; Biggs et al. 2015). Technological innovation is increasingly seen as a means for economic, environmental and social resilience (Sakali 2021; UNFCCC 2021).

During our consultations, **technology** emerged as an important cross-cutting issue that can be seen both as a means and enabler underpinning resilience-building efforts and as a new type of risk stemming from a lack of regulations and guidelines for the use of new technologies which could increase vulnerabilities and reproduce patterns of inequality and exclusion. There was consensus; however, that technology cannot be ignored and needs to be considered in terms of both the positive and negative impact it can have on resilience-building efforts. When well managed and utilized, technology can facilitate new forms of learning and innovation, increase participation and inclusion, simplify communication, and implement redundancy in risk governance. The use of digital technology in rural Africa can supply insights that allow individuals to optimize their production, gain access to appropriate products and services, and explore new linkages with markets (Tsan et al. 2019). In Ghana, an electronic agricultural input distribution system with barcodes allows the government to detect problems like low-yield seeds and poor fertilizer more quickly. In Rwanda farmers are organized into cooperatives and subnational markets using digital technology (Tsan et al. 2019). Technology also plays an important role in improving the effectiveness of multi-hazard early warning systems (see case study 2) and underpins the majority of policy efforts that can be undertaken to build resilience. New technologies can also increase access to public services and be combined with traditional ecological knowledge to ensure that agropastoralists in African borderlands can complement their generations of experience while adapting to changed circumstances with forward-looking and new types of information (UNDP 2022a). However, an over-reliance on technology can create new vulnerabilities due to malfunction, interruption or outside manipulation (McChrystal and Butrico 2021).

Case study 6. Baraza Peace Committees

Fragility and violence risks
The eastern regions of the Democratic Republic of the Congo (DRC) are contending with significant security challenges; clashes between army, militia and other armed groups; and intercommunal violence that are triggering internal displacement. There are recurrent allegations of human rights abuses such as atrocities against civilian population and the tactical use of sexual and gender-based violence. Tensions related to land, identity, power and access to resources characterize the situation.

Dispute resolution
Foundation Chirezi, a civil society organization, has facilitated Barazas (Swahili word for "gatherings") as a local justice and dispute resolution mechanism based on restorative justice principles and values. These gatherings, or informal peace courts, aim to ensure accessible, fair and non-punitive justice where the formal legal system falls short and conflicts quickly turn violent. These are community-led initiatives that seek to provide successful resolution to conflicts through participatory processes of dialogue and reconciliation. In 2018, Foundation Chirezi were operational in nine villages and catered to 2,280 cases.

The disputes are brought to the Baraza consisting of a democratically elected main committee (five people), a youth group (around 10 people), a women's group (around 10 people) and a general group of remaining members from the community. Once the sides have been heard before the full Baraza, the committee deliberates in private before it announces a decision to resolve the conflict from a range of options such as private or public apology, work, payment, etc. Another interesting aspect of this mechanism is the creation of mixed-gender courts as well as female-only peace courts which allow sensitive issues such as marital rape to be discussed more openly without a male presence.

Hybrid justice
This case study illustrates that a western approach of retributive justice is not applicable in every context. A more participatory and reconciliatory hybrid idea of justice rooted in local customs and practices enables local peace and security—an important root of resilience. The Barazas and the Congolese criminal justice system are not mutually exclusive; they can play to their strengths and complement each other using the positives of both and minimizing or eliminating the negatives.

Sources: Murhula 2022; Peace Direct 2014, 2020; Poole 2013.

Policy entry points and indicators of resilience

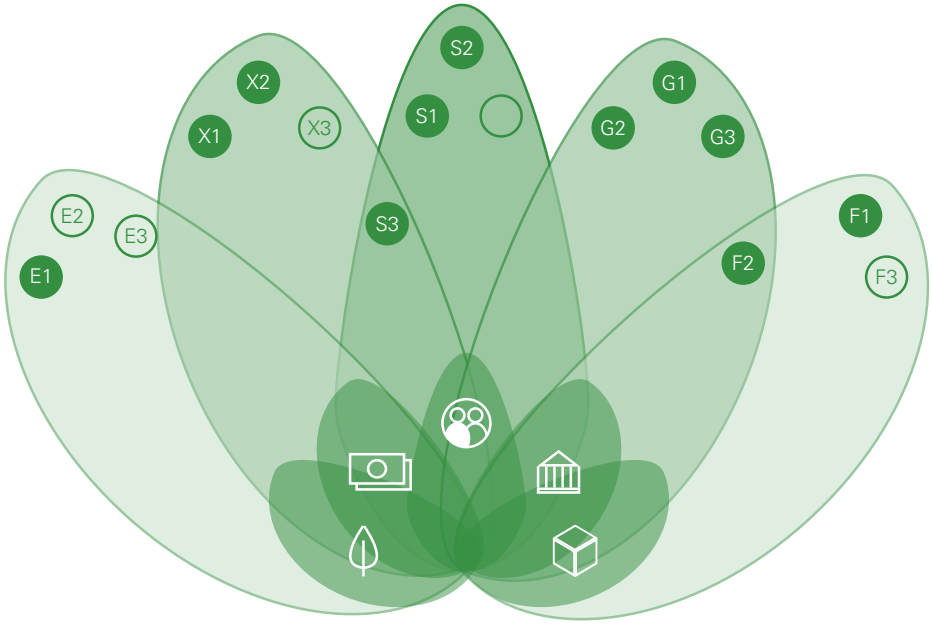
We identify social, economic, environmental, governance, and infrastructure (figure 5) as key dimensions—that is systems to focus on and policy entry points—for resilience-building based on an exhaustive literature review and as discussed and validated through stakeholders engagement (see annex 3). The policy entry points should correspond to the vision of desirable resilience identified in the roots and tackle drivers of vulnerability. They are displayed as petals joined at the base and overlap to stress their interlinked and interactive nature which means that effective resilience-building will require integrated and comprehensive approaches that are cognizant of complex system dynamics.

Figure 5. Resilience dimensions or policy and programme entry points

Indicators
A set of fixed general resilience indicators combined with a list of context-specific, customizable indicators to gauge the level of general resilience.

Policy entry points
These comprise five overlapping system dimensions and represent entry points for resilience-building efforts.

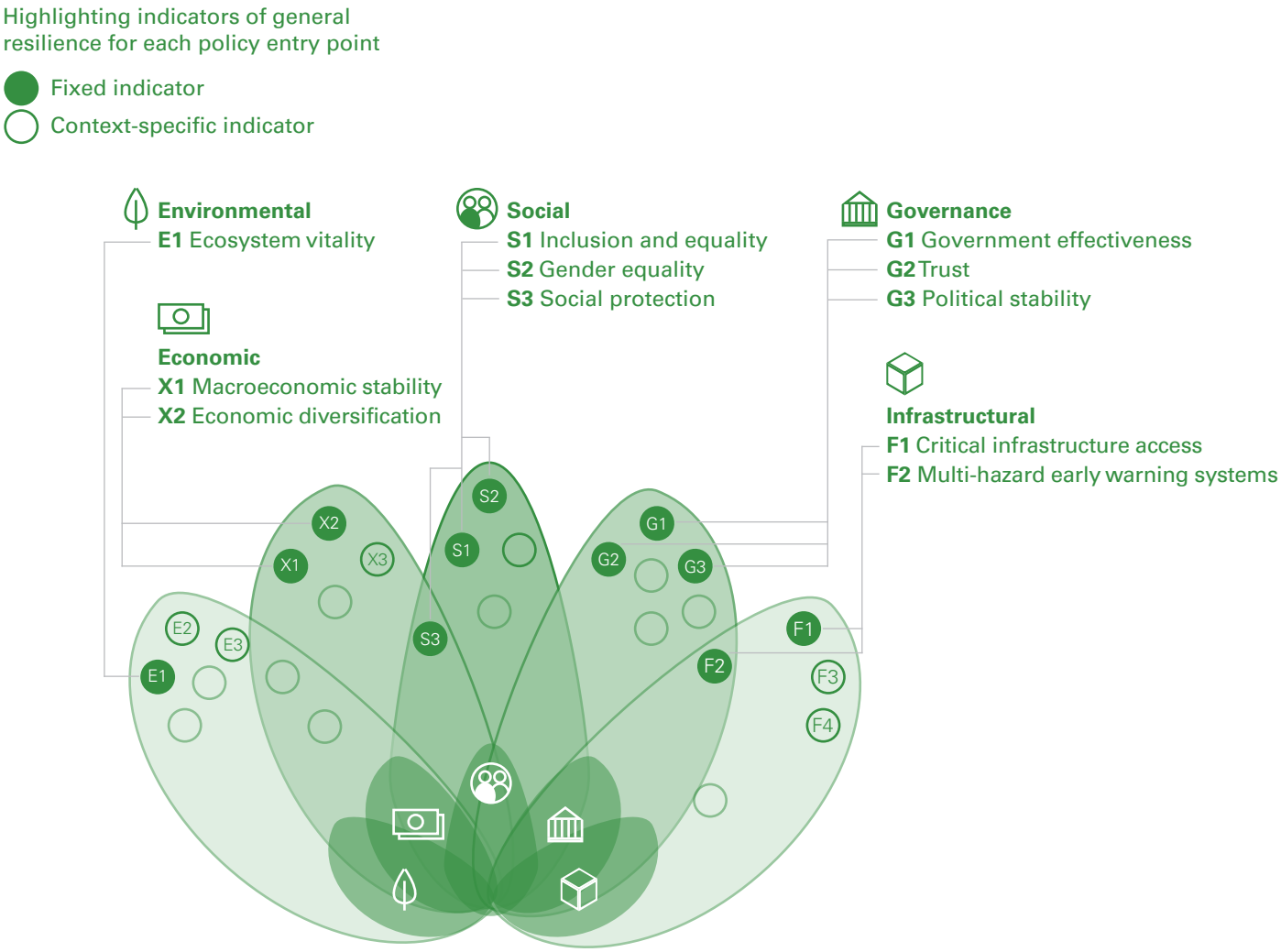
- Environmental
- Economic
- Social
- Governance
- Infrastructural



Each entry point covers several aspects that contribute to resilience and which, in turn, can be expressed via indicators (figure 6). Taken together with the resilience enablers and capacities, the policy entry points and indicators can be used to describe and gauge the general state of resilience of the overall system in question and identify resilience-building priorities. Since resilience is a theoretical construct, most indicator-based measuring attempts use process indicators or proxies (such as technical capacity, skills, education, health, civil society network or foreign reserves) as markers of specific resilience characteristics. Here, we propose a shortlist of fixed indicators that are available from public data sources and were selected based on a number of theoretical and practical considerations. Based on the

RoAR findings, we prioritized policy-relevant indicators that have strong explanatory power for general resilience to different kinds of shocks at the national level. Overall, data availability remains a challenge and can influence the choice of indicators used. In addition, many of the publicly available data sources combine multiple variables into a theory-derived indicator, so it is important to avoid duplications and overlaps when combining data from multiple sources.

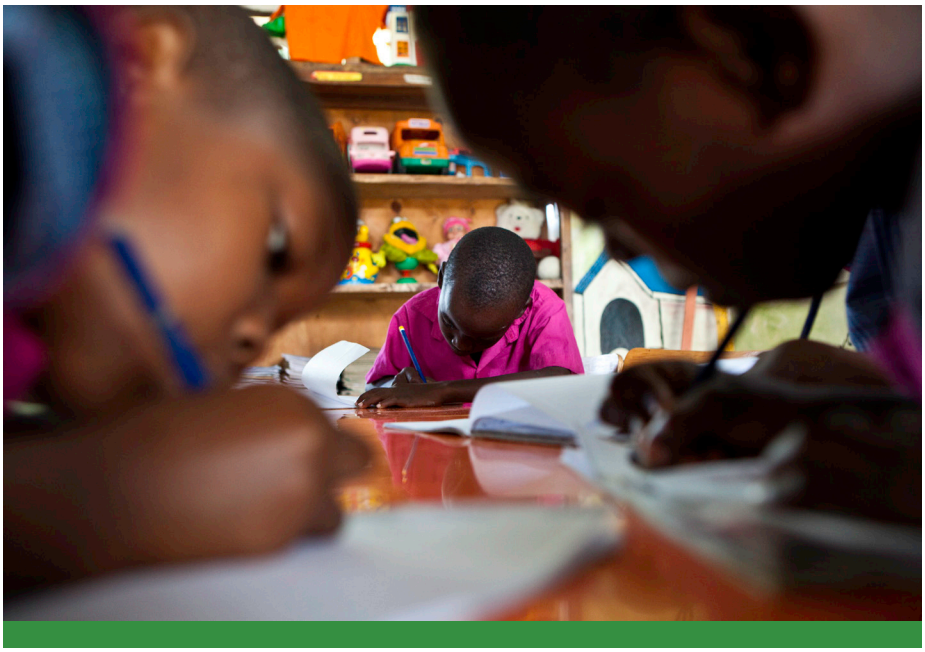
Figure 6. African Resilience Indicators



Given the interlinked nature of the policy entry points, not all indicators can be easily assigned to a single category as they contribute to different aspects of socioeconomic resilience. In the case of social protection, the unit of analysis changes the allocation to a specific category: For a community or household, social protection is quite clearly an indicator of economic absorptive capacity. When assessing resilience at the national level, investments in social protection and social protection coverage are more commonly used to describe levels of social welfare and subsumed under social resilience (see box 2).

Social dimension

Social resilience is understood as the ability of social entities to address risks emanating from a multitude of factors and can be fostered through social policy interventions. It is often assessed through a combination of sociodemographic characteristics and measures that seek to describe the web of interrelations that distinguish social from individual resilience. Common indicators include education level, literacy rate, age, inequality, health care access and medical capacity, insurance coverage, access to public services, community stakeholder organizations, social trust, social capital, social networks, social cohesion, and social equity (Magis 2010; Peacock 2010; Cassidy and Barnes 2012; Manyena et al. 2019; Ainuddin and Routray 2012; Aldrich and Meyer 2015; Tesso et al. 2012; Antwi et al. 2014; Dunbar et al. 2020; Tompkins and Adger 2004; Holladay and Powell 2013; Balaei et al. 2019; Figueiredo et al. 2018; Cai et al. 2018). Qualitative studies of resilience have emphasized the importance of factors that are hard to measure in building social resilience, such as informal social protection, cultural or behavioural norms and religious practices (Saja et al. 2018). Aspects of mindset such as community connectedness, hope and altruism were found to play an important role in youth resilience in South Africa (Mosavel et al. 2013). Spirituality and faith can contribute to resilience by offering meaning, community and social support but can also have negative effects, for example in cases where strict religious beliefs interfere with health-seeking behaviours such as immunizations (Mhaka-Mutepfa and Maundeni 2019).



Similarly, issues of psychological resilience can play a key role in resilience-building efforts, but can only be measured at the individual level. Psychological resilience is shaped by a combination of personal characteristics including intellectual and social skills and self-awareness and social context including relationships with others, traditions and values (Levine 2003). Strong social support systems and networks are important factors for fostering the resilience of individuals (see Machisa et al. 2018). “Feeling safe” has a direct effect on the resilience of adolescents in sub-Saharan Africa (Bandeira et al. 2023). Place attachment and self-efficacy, that is the belief in one’s ability to achieve a set goal or overcome a specific challenge, can influence levels of disaster preparedness and actions taken by individuals and thereby contribute to resilience (Wang et al. 2021; Grothmann

Box 2. Social protection—Linking social and economic resilience

Social protection programmes at the national scale have the potential to build adaptive, absorptive and anticipatory capacities toward resilience to shocks (Ulrichs et al. 2019). Social protection also plays an important, shock- and hazard-independent role in building resilience and contributes to overall social development and poverty reduction (Pino and Confalonieri 2014). Unemployment, lack of assets and financial exclusion hamper the resilience of individuals and households (Koomson et al. 2022).

Social safety nets such as cash transfers are a common social protection measure used in the African context (Bousquet et al. 2016; Bertelsmann Stiftung 2022; Jacinto et al. 2020; Tambo 2016; de Boer et al. 2016; Myeki and Bahta 2021). For example, in its National Strategic Resilience Framework (2019–2030), the Kingdom of Lesotho highlights the importance of social safety nets for building resilience to climate change. Social protection programmes such as the Sahel Adaptive Social Protection Program (SASPP) have targeted women as primary beneficiaries of cash transfers due to the recognition of the wider political economy that may exclude women's participation (World Bank 2020). Targeting the most vulnerable or those likely to be excluded comes with the challenge of requiring access to the right type of information (Pino and Confalonieri 2014) and has often proven difficult.

Many social development scholars thus argue in favour of universal social protection systems, in particular for contexts of widespread poverty (UNRISD 2022). While safety nets and informal sources of social protection provided through social networks can alleviate some of the impacts of shocks and stresses in times of crises, national social protection programmes were found to contribute the most to building adaptive, absorptive and anticipatory capacities for resilience-building (Ulrichs et al. 2019).

Hence, efforts to build resilience must consider the wider socioeconomic and political factors of vulnerabilities that may exclude certain groups of people (Rodina et al. 2017). Tackling the challenge of designing and implementing universal social protection programmes to reap their many developmental benefits (UNRISD 2022) provides a direct policy entry point for building socioeconomic resilience.

and Reusswig 2006). These and other psychosocial factors shape individual resilience outcomes but cannot be assessed at the aggregate level in the same way as other aspects of social resilience. It is important to keep the relevance of mindset and sociopsychological aspects of resilience in mind in each context and consider additional research to enhance the understanding of their impact on system resilience on a case-by-case basis.

Social indicators

To gauge the level of social resilience, we have selected three composite measures covering inclusion and equality and social protection based on the Ibrahim Index of African Governance as well as gender equality based on Goal 17 of Agenda 2063. These measures were selected based on the literature review (see annexes) and stakeholder consultations and aim to describe the

DESIGNING AND IMPLEMENTING UNIVERSAL SOCIAL PROTECTION PROGRAMMES TO REAP THEIR MANY DEVELOPMENTAL BENEFITS (UNRISD 2022) PROVIDES A DIRECT POLICY ENTRY POINT FOR BUILDING RESILIENCE.

social fabric and people's substantive freedoms that allow people to thrive and are deemed crucial for learning, innovation and transformation (Manyena et al. 2019) rather than sociodemographic characteristics. ***Inclusion and equality*** assesses equality in political power, political representation, civil liberties, socioeconomic opportunity and access to public services and is disaggregated into different social and socioeconomic groups (Mo Ibrahim Foundation 2023). ***Gender equality*** comprises women empowerment in terms of land tenure security, proportion of seats held in parliaments, regional and local bodies, and violence and discrimination against women and girls (AUDA-NEPAD 2021). ***Social protection*** addresses the different dimensions of welfare and assesses the extent of social safety nets and poverty reduction policies, income inequality, equity of public resource use, decent and affordable housing, and food security (Mo Ibrahim Foundation 2023). There is a strong argument to be made that social protection indicates absorptive capacity, "reduce[s] the use of negative coping strategies that undermine longer-term livelihood sustainability, and reduce[s] household risk adversity towards more profitable, yet more risky, activities" (Asfaw und Davis 2018:231). The measures of inclusion and (gender) equality serve as proxies for the social fabric and social interrelations, whereas social protection depicts socioeconomic characteristics that shape social resilience.

Governance dimension

Effective governance and formal and informal institutions are a prerequisite for resilience-building and underpin success in broader development efforts (see case studies 1 and 5 for an elaboration of the relevance of informal institutions). The **governance dimension** of resilience describes the ability of formal and informal institutions to leverage knowledge, rules and experience to navigate risks (Aligica and Tarko 2014; Barma et al. 2014; UN DESA 2020). It comprises aspects of leadership and the distribution of power as well as participation and people's empowerment. Peace and security and institutional resilience are important subdimensions. Institutional resilience is often expressed in terms of good and participatory governance, adaptive management, transparency, and legal and policy frameworks for disaster management and is therefore relatively well aligned with overall development aspirations enshrined in Agenda 2063 and the 2030 Agenda. Peace and security is particularly relevant in the African risk context and is a cross-cutting issue as fragility and

conflict can undermine any resilience-building effort. Governance is a prerequisite for social and other dimensions of resilience as aspects such as leadership and vision and participation play a crucial role across all policy dimensions. Indicators and proxies described in the literature are therefore closely linked to our resilience enablers (see Briguglio 2014; Bahadur et al. 2010; Holladay and Powell 2013; de Hoyos Guevara and Bertoncelo 2020; Allen and Giovannetti 2011; Sono et al. 2021; Gasser et al. 2020; Cai et al. 2018; Giovannetti 2010; Shah et al. 2018; Figueiredo et al. 2018).

GOVERNANCE IS A PREREQUISITE FOR RESILIENCE AS ASPECTS SUCH AS LEADERSHIP AND VISION AND PARTICIPATION PLAY A CRUCIAL ROLE ACROSS ALL POLICY DIMENSIONS.

Governance indicators

To gauge the governance dimension of resilience, we rely on a number of quantitative indicators as well as the assessment of resilience enablers and capacities outlined above. We have selected government effectiveness, public trust in institutions and political stability to capture different aspects of institutional resilience. Government effectiveness assesses the perceived quality of public services, independence from political pressure, and quality of policy formulation and is part of the World Bank's Worldwide Governance Indicators. Government effectiveness was a leading factor in some African countries, demonstrating overall higher resilience to the impacts of climate change compared to others (Sono et al. 2021). ***Trust in public institutions*** characterizes the relationship between state and local institutions and citizens. It is assessed by the Afrobarometer and encompasses trust in president, parliament, national and local government, police, army, courts of law as well as in traditional and religious leaders (Afrobarometer 2020). There is a trust deficit between local populations and state institutions in conflict-affected parts of Africa. Bridging this gap is found to strengthen resilience to hazards, increased stability and bring about durable peace (UNDP 2022b). ***Political stability*** is based on the African Peer Review Mechanism (APRM) thematic area of democracy and political governance which includes a list of indicators on the prevention and management of intra- and interstate conflicts. This reflects the security situation in a country that might impede resilience-building efforts.

Economic dimension

Economic resilience is understood as the ability of informal and formal economic and monetary systems to withstand or bounce back or transform from the negative effects of external shocks (Pendall et al. 2009; Martin 2012; Rose and Krausmann 2013; Briguglio 2014). It can be described in both micro- and macroeconomic terms and focuses on the continued functioning and health of the economy during crisis (Scherzer et al. 2019). Indicators of economic resilience therefore vary between (i) those that look at the national level and

include poverty rates; employment rates; GDP; foreign development assistance and aid; macroeconomic stability (debt level, currency reserves, inflation) and management; public spending on social assistance as percentage of GDP; access to credit and financial resources; economic diversification; income inequality; public-private partnerships; and female workforce participation; and (ii) those that look at the community or household level and include diversity of income sources; individual and community savings; house ownership; access to pensions; and access to financial resources and loans (Scherzer et al. 2019, Manyena et al. 2019; Briguglio 2014; Shah et al. 2018; Tesso et al. 2012; Morkūnas et al. 2018; Dunbar et al. 2020; Sono et al. 2021; Wang and Li 2022).

Economic indicators

Since the focus of this study is on the national level, we opted for macroeconomic indicators and use macroeconomic stability and economic diversification as proxies of economic resilience. These are vital for several reasons, including that they create fiscal space, which enable a country to respond to adverse external demand shocks by increasing government spending or cutting taxes (Schembri 2008). Contagion effects from financial and geopolitical crises can be avoided or reduced by prudent debt levels. ***Macroeconomic stability*** is based on Brigulio (2016) and includes (i) government debt as a percentage of GDP, (ii) inflation measured by the GDP deflator, and (iii) current account balance. There are multiple approaches and indicators for ***economic diversification***, but relatively few metrics that are readily available. We propose to use *manufacturing value added as percentage of GDP* as suggested in the Agenda 2063 Indicator Handbook (AUDA-NEPAD 2021). Alternatively, countries could use the *product concentration index* (UNCTAD Stat 2023) that measures the degree to which exports and imports are concentrated on a few products or the *percentage of exports of the product category with the largest share of total exports* (provided in AUC/OECD 2022) as proxies for export diversification.

Infrastructure dimension

The **infrastructure dimension of resilience** relates to the abilities and capacities of the built environment and infrastructural systems to absorb and recover from or adapt to shock events (Petrović

et al. 2018; Peacock 2010; Berkeley and Wallace 2010; Vugrin et al. 2010). Infrastructure is vital to societies (Shrier et al. 2016) and critical to attaining resilience and sustainable development. Infrastructure such as transportation networks, energy systems and communication systems are both vulnerable to climate-related shocks and enable people to respond to—and cope with—shock events. Infrastructure development, including housing, needs to be made resilient and based on integrated planning and robust standards and norms that are conducive to environmental resilience. Indicators for infrastructure resilience found in the literature include general measures for infrastructure access (for example, electricity, sanitation and health care), measures on the availability and robustness of critical infrastructure as well as measures for emergency management such as early warning systems, access to disaster risk information and the availability of emergency shelters (Peacock 2010; Sono et al. 2021; Fallah-Aliabadi et al. 2020; van der Merwe et al. 2018; Saurin et al. 2013; Fallah-Aliabadi et al. 2020; Cantelmi et al. 2021; Sathurshan et al. 2022; Meng et al. 2018).

INFRASTRUCTURE DEVELOPMENT NEEDS TO BE MADE RESILIENT AND BASED ON INTEGRATED PLANNING AND ROBUST STANDARDS AND NORMS THAT ARE CONDUCIVE TO ENVIRONMENTAL RESILIENCE.

Infrastructure indicators

Critical infrastructure access and (multi-hazard) early warning systems contribute to disaster risk management and serve as proxies for infrastructure resilience. Modern societies depend heavily on critical infrastructure such as transport networks, power, water supply, telecommunication and medical facilities. Early warning systems are integral to adaptive (Tambo 2016) and anticipatory (Boyd et al. 2013) capacities for resilience-building against shocks.

Critical infrastructure access is not a readily available measure but can be constructed from existing SDG indicators on energy, water, telecommunications and transport infrastructure access as well as medical capacity. It gives a measure of a country's capacity to absorb shocks and mitigate disaster impacts. The Sendai Framework indicators can be used to assess the availability and coverage of ***multi-hazard early warning systems***, although data availability remains a challenge (UNDRR and WMO 2022). Recent political commitments to improve early warning and the establishment of the Africa Multi-Hazard Early Warning and Early Action Programme (African Union 2022c) and the African Multi-Hazard Advisory Centre (UNDRR Regional Office for Africa 2022) may soon improve both the availability of multi-hazard early warning systems and data on early warning.

Environmental dimension

Environmental resilience is understood as the ability of natural stocks and ecosystems to absorb unforeseen changes and maintain essential functions and feedback (Seidl et al. 2016; Peacock 2010; Scheffer et al. 2015; Walker et al. 2004). These stocks can take the form of water, air, biodiversity, soil or food production (Scherzer et al. 2019). Measures of environmental resilience attempt to assess either the characteristics or status of a given ecosystem in view of assessing its resilience or the governance and management systems in place to protect ecosystems and foster their resilience. For

example, a nation's percentage of forest cover is often used as an indicator of environmental resilience due to the ecosystem and economic benefits derived from forests (Sono et al. 2021). Other measures look at the sustainable management of common resources (Dunbar et al. 2020) to make a more direct link to policy interventions that can build environmental resilience.

Environmental indicators

Measuring environmental resilience is a complex undertaking and is often limited by data availability. The focus here was put on measures that assess the sustainable management of environmental resources and, therefore, have a more direct policy entry point than those that assess ecosystems' status or health in general. We propose to use the composite measure of ***ecosystem vitality*** as a proxy for environmental resilience. It is a component of the Yale Environmental Performance Index and measures how well countries preserve, protect and enhance ecosystems and the services they provide. The component comprises 18 variables to assess biodiversity and habitat, ecosystem services, fisheries, acid rain, agriculture and water resources (Wolf et al. 2022). It allows us to gauge the health and functioning of ecosystems, which provide a range of regulating, provisioning, cultural and supporting services that can reduce vulnerability to climate- and weather-related shocks (Seddon et al. 2020).

For now, climate change is considered part of the risk context assessment but is not covered in our list of indicators because of the focus on national-level policy entry points. The Climate Change Performance Index (Burck et al. 2022) provides an advocacy tool and instrument to compare different countries' climate protection efforts that could be used to assess whether an individual country's current climate actions are compatible with international climate goals.

CLIMATE CHANGE IS CONSIDERED PART OF THE RISK CONTEXT BUT NOT COVERED BY OUR INDICATORS BECAUSE OF THE FOCUS ON NATIONAL-LEVEL POLICY ENTRY POINTS.

However, the Climate Change Performance Index currently only includes high-emitting countries, and of these, only four are in Africa.

Given the complexity and challenges associated with measuring resilience (see annex 2) as well as the need for contextualization, we suggest an approach that combines a set of fixed indicators with a longer list of flexible, context-specific indicators to gauge resilience across the five policy entry points/dimensions. The fixed indicators describe general characteristics of resilient development and can be measured with credible, periodically updated data generally available from public sources. The aim here was to come up with a shortlist of indicators that are most relevant for our policy entry points, and that can be used to create a rapid profile of general resilience. This snapshot of resilience can and should be complemented with a longer list of flexible indicators that are moulded and adjusted to the specific risk context and needs and the assessment should be tailored to a specific situation to provide a more granular picture. Table 3 contains a long list of indicators and a more detailed description of the proposed fixed indicators is included in the section on operationalization below.

Risks and risk drivers

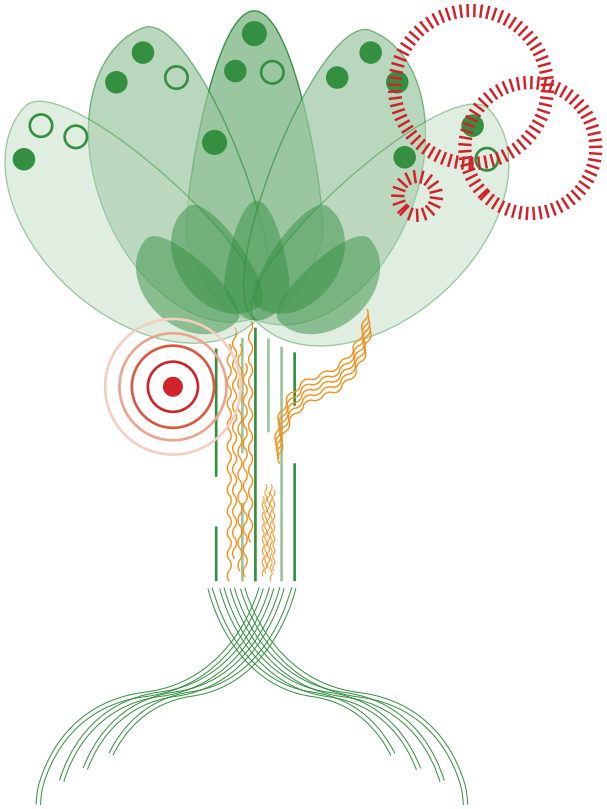
Finally, a variety of risks and risk drivers are represented in red and orange (figure 7). Risk is understood as a function of hazard, exposure and vulnerability/capacity (IPCC 2012) and can be both known and unknown. Risk drivers are conditions or processes that influence levels of risk by adding to exposure and vulnerability or reducing capacity (UCP Knowledge Network n.d.). Hazards can originate outside the system boundaries and, due to vulnerabilities and lack of capacities, manifest into risks. There are a number of examples for external risk drivers that need to be taken into account due to the high international connectivity of people and markets. For example, the war in Ukraine has cascading impacts on food security in Africa due to import dependency whereas international travel facilitated the rapid spread of COVID-19. More indirect external risk factors can emanate from international policy processes that have negative effects on African countries, for example agricultural subsidies that distort competitiveness but also international failure to act on the accelerating climate crisis that disproportionately impacts Africa and its people. Examples of internal risk drivers are environmental degradation, unsustainable forms of urbanization, high levels of (youth) unemployment and high levels of export concentration in the economy. In combination, internal and external risk drivers can lead to an accumulation of risk and significantly increase vulnerability, for example in the case of high levels of energy and food dependency.

Risks can relate to climate change, terrorism, economic downturn and epidemics. When materialized, they can lead to direct losses of lives, livelihoods and critical assets while impinging on people's capacities to cope and adapt. Furthermore, these risks threaten development gains since they can adversely affect peace and

socioeconomic development. Risks can be dynamic in nature; they can originate within one subsystem and transmit the risk to others in an increasingly interconnected, globalized world.

Figure 7. Risks and risk drivers

Risks and risk drivers
Risks and risk drivers are varied and a function of hazards (red) and vulnerabilities (orange). They can therefore be system-inherent or external and include climate change, terrorism, economic downturn etc.



Assessing the risk context is an important and complex part of the overall resilience assessment. It entails assessing hazard exposure to gauge the level of risk stemming from external shocks and identifying structural drivers of vulnerability to understand system-inherent risk creation processes. Drivers of vulnerability include inequality, the uneven distribution of power, governance, fragility and institutions but also broader development trends such as rapid, unplanned urbanization or migration. Left unaddressed, drivers of vulnerability can counteract resilience-building efforts and reproduce inequalities and processes of marginalization that often underpin disaster risk creation.

A recent UNDP ground-level study on resilience found that climate-induced rural-to-urban migration increases pressure on inadequate social service provisions in critical areas such as health, education and employment in pockets of Ethiopia, Kenya and Somalia (UNDP Resilience Hub for Africa 2023). Former pastoralists who settle on the fringes of urban areas hardly resume their previous way of life and are inadequately prepared for life in informal settlements. This can become a maladaptive practice, which reduces incentives to adapt within the pastoral context, hence undermining resilience. By focusing

BY FOCUSING ON SYSTEMIC RISK, WE EMPHASIZE THE DEVELOPMENTAL COMPONENTS OF RISKS THAT POLICY AND INTERVENTIONS SHOULD REMAIN VIGILANT TO.

RESILIENCE-BUILDING MUST EMBRACE FORESIGHT AND RISK ANTICIPATION SO THAT RESILIENCE INTERVENTIONS ARE READY TO TAKE ON THE CHALLENGES OF OUR DIFFERENT TOMORROWS.

UNDP RESILIENCE HUB FOR AFRICA 2023

on systemic risk, we emphasize the developmental components of risks that policy and interventions should remain vigilant to. Finally, as the future is full of complex uncertainty and unknown risk, resilience-building must embrace foresight and risk anticipation so that resilience interventions are ready to take on the challenges of our different tomorrows (UNDP Resilience Hub for Africa 2023).

Assessing risks comprehensively in the context of climate change is a complex undertaking that requires a relatively large body of information and knowledge to describe hazards, exposure and vulnerability as well as underlying risk drivers and potential impacts (UNDRR 2022). Stakeholder involvement is needed to come to an agreed upon value-based system for assigning different risk levels and formulating priorities for action (UNDRR 2022). There is currently no ready-made typology that enables the prioritization of risks across the African continent, but a number of risk assessment tools and hazard profiles can facilitate the analysis of different threats and levels of exposure in each context. UNDRR and CIMA Research Foundation have, for example, developed a data catalogue and probabilistic disaster risk profiles for 16 African countries. Similarly, UNEP hosts a suite of geospatial data products, including natural hazard exposure information, on their new data and knowledge platform, *World Environment Situation Room*. In addition, there are a few publicly available global risk indices such as INFORM (EC-DRMKC 2020) or the World Risk Index (Weller 2022, based on Birkmann et al. 2011) that include country-level information on hazard exposure and risk. The INFORM Risk Index provided a basis for analysing Africa's disaster profile as part of the *Bi-ennial Report on the Programme of Action for the Implementation of the Sendai Framework for Disaster Risk Reduction 2015–2030 in Africa* (African Union 2020). It assesses hazard and exposure to a range of natural hazards and conflict and provides general measures for addressing vulnerability and lack of coping capacity. The AMHEWAS component on disaster risk knowledge will provide a more relevant and context-specific approach to risk mapping that may be utilized in the future.

Value Addition of the RoAR Approach

The RoAR extends traditional risk management into the arena of “unknown, uncertain and unexpected [challenges] at the scale of systems rather than individual components” (UNDRR 2021:35). It puts the spotlight on core systems that need to develop the means to respond, adapt and prevent breakdowns. Shifting the focus from risks and shocks alone to the roots that underpin resilience regardless of context, RoAR makes a contribution to inform a more developmental approach to resilience that allows us to identify common structural drivers of resilience (or vulnerability) and tackle contradictions in the development model that hinder resilience-building (such as the prioritization of speed and efficiency at the expense of redundancy and absorptive capacity). The implementation of the RoAR will affect development policies, plans, strategies, research and practices across the social, governance, economic, infrastructure and environmental dimensions and develop metrics with which to assess resilience.

The RoAR signals a shift from a single risk to a multi-risk paradigm, including a range of situations like compounding, cascading and simultaneous crises. This implies resilience with consideration

not only to hazards that have caused destruction historically but that may very well become part of our new reality. It entails building multi-hazard risk scenarios and assessments (UNDRR 2020b). The RoAR takes a flexible approach with an evolving databank of indicators as "[p]olicies and programs for recovery can be different in the short and medium to longer-term and need to be tailored to respond to whether African countries find themselves in a worst, median or best-case scenario" (African Union 2022a:18).

The systems approach entails reinforcing policies and considering linkages as opposed to operating in silos. The RoAR promotes intersectoral collaboration and identifying and harnessing synergies. Going beyond government, the inclusion of stakeholders from civil society and the private sector is underlined. It ties into a development-oriented thinking of resilience as opposed to a specific risk orientation. It places development goals and objectives at the heart of resilience.

Next Steps: Operationalizing the RoAR Approach

The operationalization of resilience is a multi-stakeholder effort that comes with differentiated responsibilities and requires strong public sector support and leadership. It also requires partnerships and coordination across different levels of governance as well as with international, bilateral and multilateral partners. A pilot exercise in Eswatini and Mozambique tests and demonstrates the utility, flexibility and ease of applicability of the RoAR in country-specific contexts. This will enable us to detect and address remaining weaknesses and bring in additional experience of programmers and development

practitioners grappling with questions of resilience in their day-to-day work.

We suggest using a three-step, consultative process for assessing resilience and identifying policy and programme entry points for resilience based on the RoAR approach. The first step entails a context analysis and systems mapping, which is followed by an analysis of the resilience enablers and capacities and ongoing resilience programme and policy priorities. Finally, a resilience synthesis based on the first two steps should lead to an evaluation of the current state of resilience and the identification of policy and programming priorities to enhance resilience in the short- and long-term.

We see this three-step process as a facilitated multi-stakeholder exercise that brings in representatives from different public sector institutions, relevant development partners, the private sector and civil society organizations. The RoAR foresees the use of different methods, tools and collaborative stakeholder exercises to arrive at a shared vision for desirable resilience and rigorous assessment of the status quo and possible trajectories. It is important to bring in qualitative and quantitative measures of resilience in order to understand feedback loops and interactions between different elements of our systems and risk factors. Including qualitative elements and different types of knowledge and perspectives further helps us grasp aspects of resilience that are not easily measured or assessed with existing data sets, for example the extent and role of traditional knowledge, cultural identity, social networks, and informal social protection mechanisms and issues of power and marginalization (Jones and Tanner 2017; Grothmann and Patt 2005; Adger et al. 2009; Clayton et al. 2015). Therefore, ensuring diverse representation and including all relevant stakeholders in a participatory exercise is important for the assessment to bear results that can guide inclusive and sustainable resilience-building.

WE SUGGEST USING A THREE-STEP, CONSULTATIVE PROCESS FOR ASSESSING RESILIENCE AND IDENTIFYING POLICY AND PROGRAMME ENTRY POINTS FOR RESILIENCE BASED ON THE ROAR APPROACH.

Country context analysis (roots)

The first step is a comprehensive context analysis, which speaks directly to the roots of resilience. The objective of this exercise is to determine what the desirable system to be made resilient is as well as identify its structural vulnerabilities and drivers of risk. This is gauged through systems mapping and an examination of a country's key policy documents and development goals, investments, vulnerability and risk assessments. Engaging with stakeholders' knowledge and historical records can fill gaps in this exercise where observational data is limited. It is pivotal to understand the needs of the population broadly and vulnerable groups in particular. This analysis brings about a systemic and deep understanding of a specific country's context, the state's interests and priorities and development trajectory, as well as key challenges and threats that need to be addressed.

For example, Côte d'Ivoire's Strategic Plan 2030 identifies governance challenges as one of the root causes of vulnerability that hinders the fight against poverty, inequality, marginalization and the lack of social cohesion (Republic of Côte d'Ivoire 2021). Furthermore, the document calls for the structural transformation of the economy, focusing on strengthening private sector participation. An in-depth evaluation of these variables provides us with an overarching and contextualized narrative and signposts of resilience. The primary tools for the analysis are desk-based research to collect and prepare all relevant information and a participatory stakeholder workshop to conduct the systems mapping and a visioning exercise on desirable resilience. Surveys and key informant interviews can complement the analysis and add depth where needed.

In summary, the country context analysis should answer questions such as:

- What are the key elements of a desirable system and how are they interconnected?
- What are the key development goals and vision?
- What are the structural, root causes of vulnerability?
- What shocks and threats have negatively impacted the system?
- What new and existing risks is the system facing and how are they spatially distributed?
- What are the key factors determining the exposure of people and assets?
- Which factors best explain the socioeconomic deficits and insecurities?
- How do culture, tradition, religious norms and beliefs influence the risk context?
- Which capacities need to be expanded or created in order to build resilience? Who needs to take on which responsibilities for resilience-building?

STARTING THE RESILIENCE ASSESSMENT WITH A SHORTLIST OF FIXED INDICATORS ALLOWS US TO GENERATE A SNAPSHOT PROFILE OF GENERAL RESILIENCE.

Resilience assessment (policy entry points and enablers)

The second step constitutes a resilience assessment based on the five policy entry points and resilience enablers, which speak to the trunk and crown of the RoAR tree. This exercise aims to assess the state of resilience within the system and understand which cross-cutting enablers and capacities can be leveraged or need to be built to strengthen resilience. The assessment again combines desk-based work to collect relevant information on available indicators at the national level and a consultative process and collective judgement on relevant, context-specific indicators for the qualitative assessment of resilience enablers and capacities. The mix of these indicators, evidence and collective judgment allows us to reach a deeper level of understanding of resilience and identify entry points of intervention to overcome resilience gaps.

Starting the exercise with a shortlist of fixed indicators allows us to generate a snapshot profile of general resilience. This can already highlight areas of concern and inform the discussion of additional context-specific indicators needed to better characterize resilience in the specific setting. We aimed to keep the number of indicators limited so as to keep the effort needed for creating the snapshot profile of resilience low. To capture the complexity of resilience thinking, we opted to include a number of composite measures based on various input variables readily available from public sources. This required careful consideration to avoid duplications when including additional indicators to contextualize the assessment. Table 3 at the end of this section gives a comprehensive overview of the long list of indicators that were identified as most relevant for our five policy entry points based on the literature review. They can be used to contextualize the assessment and, where available, be complemented and/or replaced by more appropriate data available from national statistical offices.

Resilience enablers and capacities can be gauged through process indicators, qualitative assessment and expert judgement. Here, the participatory stakeholder workshop can assess the current status and potential challenges related to leadership, vision and coordination, participation, inclusion and ownership, finance and investment, and learning, innovation, and technology. Participation could also be assessed by using a subcategory in the Ibrahim Index of African Governance that measures freedom of association and assembly, political pluralism, civil society space and integrity of elections. For the other enablers and capacities, a facilitated expert evaluation exercise can lead to a qualitative assessment of weak, medium or strong capacity accompanied by a short narrative explaining the score. Clear guidance, effective facilitation and process documentation are crucial for meaningful results, which can be visualized in the form of a traffic light chart and utilized to identify priority areas for intervention.

Resilience synthesis and recommendations

The final step is synthesizing and comparing the country context analysis and resilience assessment to form a judgement on the current state and possible resilience trajectories. The hazards, structural vulnerabilities and development goals garnered from the context analysis are mapped against resilience enablers and capacities to identify alignments, relative strengths and weaknesses across policy entry points, and highlight elements that make a system resilient. The following questions provide guidance:

- Is there alignment between the vision, available resources, and capacities?
- Which policy entry points need to be tackled to achieve desirable resilience? Where in the policy entry points are relative strengths and weaknesses?
- Are structural vulnerabilities being addressed?
- Do current investments, policies and capacities contribute to enhancing the whole system for short and long-term resilience?
- What are synergies across the dimensions, and how are trade-offs being addressed?
- Are resilience gaps between current conditions and what is needed to anticipate, absorb and recover, adapt, and transform being addressed?

The analysis concludes with an in-depth understanding of the entry points relative to resilience level and a set of policy recommendations. The main method is stakeholder deliberation using state-of-the-art evidence and data. A concise write-up and visualization of the results can identify any remaining contradictory information and build consensus among stakeholders before finalization and dissemination of the results. The stakeholder group can play an active role in the design and shape of the final results based on the respective situation and assessment process.

Using the RoAR approach effectively to assess resilience and inform the development of resilience-building strategies is complex. The RoAR pilots in Eswatini and Mozambique will elaborate on how to operationalize the RoAR approach in different contexts and provide a user-friendly tool that helps programmers and practitioners track progress and strengthen resilience-building while establishing partnerships with other stakeholders in the process.

Table 3. Bank of resilience indicators deemed most relevant for the five policy entry points

Category	Indicator	Economic	Social	Governance	Infrastructure	Environmental	Data Source
Access to information	Countries that adopt and implement constitutional, statutory and/or policy guarantees for public access to information			●			SDG indicator (16.10.2)
Access to information	Freedom of information, expression and press			●			Agenda 2063 indicator (3.11.1)
Access to information	Freedom of opinion and expression, access to information			●			APRM Objective 1.4 Protecting Human Rights
Accountability/ transparency	**Anti-corruption** Assesses anti-corruption mechanisms, absence of corruption in state institutions, the public and the private sector, and public procurement procedures			●			Ibrahim Index of African Governance (IIAG) Measured across 54 African countries calculated using data from 35 independent, external data sources
Accountability/ transparency	**Bribery incidence** Proportion of persons and of businesses who had at least one contact with a public official and who paid a bribe or were asked for a bribe during previous 12 months			●			SDG indicators (16.5.1 and 16.5.2)
Accountability/ transparency	Control of corruption			●			World Bank Worldwide Governance Indicators (WGI) Estimated annually for over 200 countries based on over 30 data sources by a variety of survey institutes, think tanks, non-governmental organizations, international organizations and private sector firms
Accountability/ transparency	**Corruption Perception Index** Estimates perceived levels of public sector corruption according to experts and business people			●			Transparency International Annual assessment in 180 countries, based on 13 independent data sources, using a 0–100 scale
Adjusted market flexibility	Composite measure constructed from data on labour-market regulations and business regulations and data on financial prudence	●					Briguglio 2016, data from Economic Freedom of the World Index, Global Competitiveness Index
Age structure	Age dependency ratio (percentage of working-age population)	●	●				World Bank World Development Indicators
Democracy and political governance	**Democracy, constitutionalism and the rule of law** List of indicators on free and fair competition for power and adherence to Constitution and law			●			APRM Thematic Area of Democracy and Political Governance
Democracy and political governance	Effective public participation in governance			●			APRM Thematic Area of Democracy and Political Governance
Democracy and political governance	Effective public service delivery			●			APRM Thematic Area of Democracy and Political Governance
Democracy and political governance	**Good governance futures** Set of indicators suggested to track governance outcomes in multiple dimensions: - Africa-led solutions - Collaboration/cooperation and communication - Elections - Environment - Institutions - Peace and security - Policy - Political economy - Political leadership - Rule of law - Universal rights - Women -Youth			●			African Governance Architecture Africa Governance Report 2021
Democracy and political governance	**Human rights** List of indicators regarding the protection of civil and political as well as social, economic and cultural rights			●			APRM Thematic Area of Democracy and Political Governance

Table 3. Bank of resilience indicators deemed most relevant for the five policy entry points

Category	Indicator	Economic	Social	Governance	Infrastructure	Environmental	Data Source
Democracy and political governance	**Political stability** Prevent and manage intra and interstate conflicts			●			APRM Thematic Area of Democracy and Political Governance
Democracy and political governance	Separation, checks and balance of powers			●			APRM Thematic Area of Democracy and Political Governance
Domestic resource mobilization	Proportion of public sector budget funded by national capital markets	●					Agenda 2063 indicator (7.20.1)
Domestic resource mobilization	Resources raised through innovative financing mechanisms as percentage of national budget	●					Agenda 2063 indicator (7.20.3)
Domestic resource mobilization	Total tax revenue as percentage of GDP	●					Agenda 2063 indicator (7.20.2)
Economic development	**Economic decline and poverty** Considers factors related to economic decline within a country	●	●				Fragile State Index Carries annual ranking of 178 countries using quantitative, qualitative and expert validation
Economic development	**Human flight and brain drain** Considers the economic impact of human displacement for economic or political reasons and the consequences this may have on a country's development	●	●				Fragile State Index Carries annual ranking of 178 countries using quantitative, qualitative and expert validation
Economic development	**Uneven economic development** Considers inequality within the economy, irrespective of the actual performance of an economy	●	●				Fragile State Index Carries annual ranking of 178 countries using quantitative, qualitative and expert validation
Economic diversification	**Export concentration** Product category with largest share of total exports, 2020 (percentage of exports)	●					AUC/OECD 2022
Economic diversification	Manufacturing value added as percentage of GDP	●					Agenda 2063 indicator Data is available from the World Bank based on World Bank national accounts data and OECD National Accounts data files
Economic diversification	**Product Concentration Index** Degree to which exports and imports of economies are concentrated on a few products rather than being distributed in a more homogeneous manner among several products	●					UNCTADstat
Ecosystem vitality	Component of the Environmental Performance Index, composed of 18 variables that assess biodiversity and habitat, ecosystem services, fisheries, acid rain, agriculture and water resources			●		●	EPI/Yale Estimates for 180 countries from variety of sources
Education	**Government expenditure on education as percentage of GDP** General government expenditure on education (current, capital and transfers) is expressed as a percentage of GDP		●				UNESCO Institute of Statistics Administrative data and financial data from ministries of finance or education
Education	**Literacy rate, adult total** Adult literacy rate is the percentage of people ages 15 and above who can both read and write with understanding a short simple statement about their everyday life		●				UNESCO Institute of Statistics National population census and household and/or labour force surveys
Education	**Pupil-teacher ratio** Average number of pupils per qualified teacher at each level of education (pre-primary, primary, lower and upper secondary education) in a given academic year		●				UNESCO Institute of Statistics Administrative data from schools and other organized learning centres
Education	**Technical and vocational education and training (TVET)** Participation rate in technical and vocational programmes (15-to 24 year-olds), by sex		●				UNESCO Institute of Statistics Continental Education Strategy for Africa (CESA 16–25) Indicators Manual

Table 3. Bank of resilience indicators deemed most relevant for the five policy entry points

Category	Indicator	Economic	Social	Governance	Infrastructure	Environmental	Data Source
Emergency funds	**Currency reserves (percentage of total external debt)** International reserves to total external debt stocks	●					World Bank
Emergency preparedness	Availability of (and distance to) emergency shelters			●	●		N/A
Emergency preparedness	Damage to critical infrastructure, number of disruptions to basic services, attributed to disasters			●	●		SDG indicator (11.5.2)
Emergency preparedness	**Early warning system in place** Number of countries that have multi-hazard early warning systems			●	●		UNDRR Sendai Monitor; AMHEWAS
Emergency preparedness	Number of countries that adopt and implement DRR strategies in line with Sendai Framework			●	●		SDG indicator (13.1.2)
Emergency preparedness	Operational spares and contingency planning for critical infrastructure in place			●	●		N/A
Energy	Acess to clean fuels for cooking		●		●		World Bank World Development Indicators
Energy	**Composition of energy mix** Renewable energy share in the total final energy consumption				●	●	SDG indicator 7.2.1
Energy	Electricity access and power outage infrastructure, disaggregated by rural/urban and fuel type				●		SDG indicator
Energy	**Energy dependency** Proportion of net energy imports (percentage of energy use)	●			●		IEA Statistics
Energy	Energy efficiency				●	●	SDG indicator 7.3.1
Environmental performance	Composite index (EPI) that uses 40 performance indicators in 11 categories that are grouped into three main components: Climate change, environmental health (including water and sanitation) and ecosystem vitality					●	EPI/Yale Estimates for 180 countries come from international organizations, research institutions, academia and government agencies
Equity	Financial inclusion and access to finance	●	●				IMF Financial Access Survey IMF International Financial Statistics
GDP	**GDP per capita** GDP per capita is the sum of gross value added by all resident producers in the economy plus any product taxes (less subsidies) not included in the valuation of output, divided by midyear population	●					World Bank
Gender equality	Financial and economic inclusion of women	●	●				African Union Annual Gender Scorecard
Gender equality	**Gender Inequality Index** A composite metric of gender inequality using three dimensions: Reproductive health, empowerment and the labour market		●				UNDP Estimated for 162 countries based on data from major publicly available international databases
Gender equality	Proportion of births registered in first year		●				Agenda 2063 indicator (6.17.2)
Gender equality	Proportion of women in parliament		●	●			Agenda 2063 indicator (6.17.1) International Parliamentary Union
Gender equality	Proportion of women subject to sexual and physical violence		●				Agenda 2063 indicator (6.17.2)
Gender equality	Proportion of women who have undergone female genital mutilation		●				Agenda 2063 indicator (6.17.2)
Gender equality	Proportion of women with tenure security/land ownership; Equal landownership for women						Agenda 2063 indicator (6.17.1); SDG indicator (5.a.2)

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Category	Indicator	Economic	Social	Governance	Infrastructure	Environmental	Data Source
Gender equality	Share of households with women/marginalized groups involved in planning processes		●	●			N/A
Government effectiveness	Perceived quality of public services, independence from political pressure and quality of policy formulation			●			World Bank WGI Estimated annually for 214 countries based on over 30 individual data sources produced by survey institutes, think tanks, non-governmental organizations, international organizations and private sector firms
Green economy	**Environmental and resource productivity** Emissions per GDP	●				●	Climate Watch Data
Green economy	Environmental taxes (percentage of GDP)	●				●	Member states
Green economy	Green economy/green recovery strategy in place	●				●	Member states
Green economy	**Green Growth Index** Composite index with four dimensions (Efficient and Sustainable Resource Use, Natural Capital Protection, Green Economic Opportunities and Social Inclusion)	●					Global Green Growth Institute
Health/medical capacity	**Community health workers** Number of community health workers per 1,000 population		●		●		World Health Organization (WHO) Estimated annually from population censuses, labour force and employment surveys, health facility assessments, and routine administrative information systems
Health/medical capacity	**Coverage of essential health services** based on tracer interventions that include reproductive, maternal, newborn and child health, infectious diseases, non-communicable diseases, and service capacity and access, among the general and the most disadvantaged population		●				WHO Based on Ministries of Health and National Statistical Offices that oversee data collection and reporting for health service coverage
Health/medical capacity	**Health expenditure as percentage of GDP** Level of current health expenditure expressed as a percentage of GDP		●		●		WHO Estimated annually in collaboration with member states
Health/medical capacity	**Hospital beds** Number of hospital beds available per every 10,000 inhabitants in a population		●		●		WHO Estimated annually from WHO regional offices
Health/medical capacity	**Physician, nurses, midwives** Total number of physicians, nurses and midwives per 10,000 inhabitants		●		●		WHO Estimated annually through Global Health Workforce Statistics and OECD, supplemented by country data
Inclusion and equality	Distribution of political power in political representation, in civil liberties, in socioeconomic opportunity and in access to public services across different strata of society		●	●			IIAG Measured across 54 African countries calculated using data from 35 independent, external data sources
Income inequality	**Gini** Gini index measures the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution	●	●				World Bank Estimated based on primary household survey data obtained from government statistical agencies and World Bank country departments.
Insurance coverage	Share of (exposed/vulnerable) households with property and/or climate insurance	●	●				N/A
Leadership/vision	Level of long-term vision implementation			●			Midterm reports, Agenda 2063 Progress Report, 5-year progress report, country policies and national budget allocation for implementation

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Leadership/vision	Openness to innovation			●			N/A
Leadership/vision	Setting of long-term vision			●			Member States Development Plans
Livelihoods	**Employment to population ratio** Modelled ILO estimate of the proportion of a country's population aged 15 or older that is employed	●	●				International Labour Organization (ILO) Estimated annually drawn from labour force surveys and household surveys, supplemented by official estimates and censuses for a small group of countries
Livelihoods	**Unemployment, percentage of labour-force** Unemployment refers to the share of the labour force that is without work but available for and seeking employment	●	●				ILO Estimated annually generally derived for 189 countries and territories, disaggregated by sex and age as appropriate
Macroeconomic stability	**Current account balance** Current account balance is the sum of net exports of goods and services, net primary income and net secondary income	●					Briguglio 2016, data from International Monetary Fun (IMF) Estimates annually using government publications, and databases compiled by researchers and international organizations
Macroeconomic stability	**Debt-to-GDP ratio** Total stock of debt liabilities issued by the central government as a share of GDP	●					Briguglio 2016, data from IMF Estimates annually using government publications, and databases compiled by researchers and international organizations
Macroeconomic stability	**Inflation (GDP deflator)** Inflation as measured by the annual growth rate of the GDP implicit deflator shows the rate of price change in the economy as a whole; the GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency	●					Briguglio 2016, data from IMF Estimates annually using government publications, and databases compiled by researchers and international organizations
Mobility	Internal (rural-urban) migration	●	●				N/A
Mobility	International migrant stock	●	●				UN DESA 2021
Mobility	Number of internally displaced people	●	●	●			Global Internal Displacement Database
Mobility	**Personal remittances, received (percentage of GDP)** Personal transfers and compensation of employees; personal transfers include all current transfers (in cash or kind) between resident and non-resident individuals	●	●				World Bank, African Union for continental level, Ministries at member states levels
Participation	Freedom of association and assembly, political pluralism, civil society space and the integrity of elections			●			IIAG Measured across 54 African countries calculated using data from 35 independent, external data sources
Partnerships	Effective multi-stakeholder partnerships for resilience-building			●			N/A
Partnerships	**Encourage and promote effective public, public-private and civil society partnerships** Amount in USD committed to PPPs for infrastructure			●			SDG indicator (17.17.1)
Partnerships	Number of countries reporting progress in multi-stakeholder development effectiveness monitoring frameworks that support achievement of the SDGs			●			SDG indicator (17.16.1)

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Category	Indicator	Economic	Social	Governance	Infrastructure	Environmental	Data Source
Peace and security	**Prevention and reduction of intra- and interstate conflicts** List of indicators on conflict, escalation of violence			●			Continental Early Warning System Indicators Module
Political, social and environmental governance	Composite measure constructed from World Bank Worldwide Governance Indicators, HDI health and education scores and Environmental Performance Index (EPI)	●		●			Briguglio 2016, data from World Bank, UNDP and Yale
Population concentration	Population density in economic zones	●					N/A
Poverty	**Multidimensional Poverty Index** Identifies acute deprivations in health, education and standard of living by interrogating 10 indicators: Nutrition, child mortality, years of schooling, school attendance, access to cooking fuel, sanitation, drinking water, electricity housing and ownership of assets	●	●				UNDP HDR Estimated for 111 countries using surveys and national level data
Poverty	**Proportion of population living below international poverty line (disaggregated)** Proportion of population below the international poverty line is defined as the percentage of the population living on less than $1.90 a day at 2011 international prices	●	●				SDG indicator (1.1.1)
Public services	**Proportion of total government spending on essential services (education, health and social protection)** Total general (local, regional and central) government expenditure on education (current, capital and transfers), expressed as a percentage of total general government expenditure on all sectors	●	●				SDG indicator (1.a.2) Estimated annually using government sources for 191 UN member states; metadata currently only refers to expenditure on education
Public trust	Trust in public institutions; for example, president, parliament, police, court of law, traditional leaders or information from public media		●	●			Afrobarometer 34 countries in last merged data set (round 7, 2019); round 8 reports available for 21 countries
Regional economic integration	**Regional and cross border trade** Percentage change in value of intra-African trade per annum	●					Percentage change in value of intra-African trade per annum
Risk-proof infrastructure	Proportion of urban population living in slums, informal settlements or inadequate housing(including insecure tenure, overcrowding)				●		SDG indicator (11.1.1)
Risk-proof infrastructure	**Proportion of building stock according to code** Extent to which building codes are developed and implemented				●		N/A
Risk-proof infrastructure	**Quality of built environment** Share of storm-resistant housing		●		●	●	N/A
Risk-sensitive planning and investment	**Quality of spatial planning for the built environment** Extent to which design, materials and location consider all risks			●	●		N/A
Risk-sensitive planning and investment	**Risk-informed investment appraisal** Extent to which infrastructure planning and financing incorporates management of risks			●	●		Risk-sensitive budget review
Social capital	**Informal social protection** Participation in saving groups, mutual support group, church/faith-based organization, local social and solidarity economy organization		●				N/A
Social capital	Sense of involvement/belonging		●				N/A

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Social capital	**Social Cohesion Indicators** **Security apparatus** considers the security threats to a state, such as bombings, attacks and battle-related deaths, rebel movements, mutinies, coups, or terrorism **Factionalized elites** considers the fragmentation of state institutions along ethnic, class, clan, racial or religious lines, as well as brinksmanship and gridlock between ruling elites **Group grievance** considers divisions and schisms between different groups in society, particularly divisions based on social or political characteristics, and their role in access to services or resources, and inclusion in the political process		●	●			Fragile State Index Carries annual ranking of 179 countries using quantitative, qualitative and expert validation
Social capital	**Social network** Citizens networks/membership in community groups		●				N/A
Social protection	Proportion of population covered by at least one social protection mechanism	●	●				ILO
Social protection	Proportion of population covered by social assistance/ social insurance	●	●				SDG indicator (1.3.1)
Social protection	Proportion of unemployed persons receiving unemployment benefits	●	●				SDG indicator (1.3.1)
Social protection	Public spending on social assistance as percentage of GDP	●	●				World Bank (ASPIRE) Atlas of Social Protection
Social protection	Share of population covered by health insurance	●	●				ILO Social Protection Dashboard
Social protection	**Social protection (composite indicator)** Social safety nets, poverty reduction, labour and welfare policies, socioeconomic inequality mitigation, access to housing and the absence of undernourishment	●	●				IIAG Measured across 54 African countries calculated using data from 35 independent, external data sources
State of environment	Availability and quality of water for different uses					●	Aquastat/Food and Agriculture Organization of the UN (FAO) Estimates at different frequency for 150 countries
State of environment	**Availability of arable land** Includes land defined by the FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow					●	FAO Estimates through questionnaires are supplemented with information from official secondary data sources from national ministries, publications and data reported by international organizations
State of environment	**Biocapacity** Biocapacity is the area of productive land available to produce resources or absorb carbon dioxide waste, given current management practices					●	Global Footprint Network National Footprint and Biocapacity Accounts provide the core data for 200 countries
State of environment	Forest area as percentage of land area					●	SDG indicator (15.1.1)
State of environment	Land degradation/access to water critical for livelihoods	●				●	N/A
State of environment	Level of water stress; freshwater withdrawal as a proportion of available freshwater resources					●	SDG indicator (6.4.2)
State of environment	**Living Planet Index** Measure of the state of global biological diversity based on population trends of vertebrate species from around the world					●	World Wildlife Fund (WWF) Estimates using population time series data from a variety of sources such as journals, online databases and government reports

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State of environment	Projected or actual change in ecosystems					●	N/A
State of environment	Proportion of land that is degraded					●	SDG indicator (15.3.1)
State of environment	**Red List Index** Shows trends in overall extinction risk for species					●	International Union for Conservation of Nature (IUCN) Assessments for species prepared by SSC Specialist Groups, RLAs, Red List Partners or IUCN-led assessment projects using IUCN Species Information Service
State of environment	Share of important biodiversity sites that are protected					●	SDG indicator (15.1.2)
Sustainable entrepreneurship	Enabling environment for private sector development	●					N/A
Transport/ telecommunications	Access to public transport		●		●		SDG indicator (11.2.1)
Transport/ telecommunications	Connectivity in relation to railways, maritime and air transport				●		N/A
Transport/ telecommunications	Proportion of paved roads				●		N/A
Transport/ telecommunications	Proportion of population covered by mobile network		●		●		SDG indicator (9.c.1)
Transport/ telecommunications	Proportion of rural population who live within 2km of an all-season road		●		●		SDG indicator (9.1.1)
Transport/ telecommunications	**Road network density** Road density is the ratio of the length of the country's total road network to the country's land area				●		International Road Federation Estimated annually through survey for 200 countries
Transport/ telecommunications	**Telecommunication access** Access to internet, televisions, radio, mobile cellular		●		●		ITU
WASH	Access to (improved) drainage system		●		●	●	N/A
WASH	**Access to sanitation** Proportion of population using safely managed sanitation services; proportion of wastewater safely treated		●		●	●	SDG indicators (6.2.1 and 6.3.1)
WASH	**Access to waste management infrastructure** Proportion of urban solid waste regularly collected		●		●	●	SDG indicator (11.6.1)
WASH	**Access to water** Proportion of population using safely managed drinking water services		●		●	●	SDG indicator (6.1.1)
WASH	Percentage of population with access to improved water sources		●		●	●	WHO/UNICEF Joint Monitoring Programme (JMP)
WASH	Percentage of population using improved sanitation facilities		●		●	●	WHO/UNICEF Joint Monitoring Programme (JMP)

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ANNEX 1

Resilience —A Conceptual State of the Art

The rise and rise of resilience

The resilience concept has made its way from early theoretical work in ecology (Holling 1973) to a much broader field of research related to human-environment interactions and international development (see Folke 2016 for an in-depth review of the history of resilience research). The seminal work of Holling (1973) paved the way for resilience thinking that challenges the way we think of social-ecological systems. He showed that resilience is not limited to ideas of resistance and stability (what he called engineering resilience), but instead can describe the ability of a system to absorb changes and persist (see table A.1).

Table A.1 Definitions and different understandings of resilience

Type of resilience	Definition	Reference
Ecological	Resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist	Holling 1973:17
Engineering (ecology)	Resistance to disturbance and speed of return to the equilibrium	Holling 1996, based on O'Neill et al. 1986; Pimm 1984; Tilman and Downing 1994
Engineering (construction)	Property of a system which has: (i) Reduced failure probabilities; (ii) reduced consequences from failures, in terms of lives lost, damage, and negative economic and social consequences; and (iii) reduced time to recovery	Bruneau and Reinhorn 2006
Social	The ability of groups or communities to cope with external stresses and disturbances as a result of social, political and environmental change	Adger 2000:347
Psychological	The ability to cope with adversity and to adapt to stressful life events	Afek et al. 2021
Community	Ability of a community to absorb stress; capacity to manage or maintain certain basic functions and structures during disastrous events and the bounce backability of a community after a disaster	Twigg 2007
Economic	Policy-induced ability of an economy to withstand or recover from the effects of exogenous shocks	Briguglio et al. 2009
Social-ecological	The ability of people, communities, societies, and cultures to live and develop with change and with ever-changing environments and to cultivate the capacity to sustain development in the face of change, incremental and abrupt, expected and surprising	Folke 2016

Since then, the notion of resilience has been applied in relation to engineering and construction (for example, building for earthquake and storm safety), social groups and communities emphasizing the role of risk and burden sharing as well as mutual support, psychology, economics and social-ecological systems. Owing to the broad fields and perspectives from which resilience is being used and addressed, definition and approaches can vary significantly (see table A.1). While psychological resilience focuses on individual coping behaviours, a common notion among the other approaches is the adoption of a system's perspective and the attempt to understand how different elements of a system relate to one another in ways that can increase or decrease resilience.

Owing to its popularity, there are many different conceptualizations and ways of describing the characteristics of a resilient system. Handmer and Dovers (1996) proposed a three-way classification of (i) resistance and maintenance, (ii) change at the margins, and (iii) openness and adaptability. The notion of resistance and maintenance is close to the original definition of resilience as "a measure of the persistence of systems and of their ability to absorb

change and disturbance and still maintain the same relationships between populations or state variables" (Holling 1973:14). Change at the margins implies that adaptations are "undertaken, but limited to those that do not threaten core attributes of the dominant system. They respond to symptoms not the root causes" (Pelling 2011:43). The third characteristic of openness and adaptability means that social systems "tackle the root causes of risk, are flexible and prepared to change direction rather than resist change in the face of uncertainty" (Pelling 2011:44).

In the arena of preventing and countering violent extremism, resilience entails efforts to develop cognitive skills such as critical thinking, character traits such as empathy, and promoting values like tolerance, dialogues, legal recourse and social-bonding, social-bridging, and social-liking (Stephens and Sieckelinck 2021). Resilience is seen "as a shield" that stands between individuals and extremism and harbour social connections to keep divisive forces at bay (Stephens and Sieckelinck 2019). Lucey and Patel's (2022) focus group discussion with youth in Mozambique found that greater dialogue and participation of youth in peace processes is critical for building resilience to violent extremism.

In the context of natural hazards and disaster risk, resilience definitions have stressed the system's capacity to withstand external shocks and stresses (Birkmann 2013). Work that focuses on resilience of social systems has underscored aspects of inclusive governance and learning processes that are essential for the continuation of desired system functions under changing stress (Pelling 2011). Studies on inclusive governance promote the decentralization of power and "inclusion of local and lay voices and of diverse stakeholders in shaping agendas for resilience through adaptation and adaptive management" (Pelling 2011:44). This is needed to address issues of distributional and procedural justice and fairness. Adaptation of social systems always requires a negotiation of goals and functions that are desirable and serve the resilience of the system. Pelling finds that "achieving resilience may require change in values and institutions within managing organisations, and this can include the challenging of established priorities and power" (2011:56), which—in case it was upscaled or replicated—could ease the way for more transformative changes in society.

A distinction emerges between the narrower, engineering, robustness, and stability focused approaches to resilience and those that adopt a humans-in-ecosystems perspective. The latter see social-ecological systems as complex adaptive systems, which means they have many interconnected working parts and are constantly changing and operate over a range of different scales. This is a crucial difference in thinking about system behaviours and has inspired a wealth of research analysing and theorizing on social-ecological systems. In this line of work, resilience has most often been studied in the context of natural resource governance and environmental hazards.

A DISTINCTION EMERGES BETWEEN THE NARROWER, ENGINEERING, ROBUSTNESS, AND STABILITY FOCUSED APPROACHES TO RESILIENCE AND THOSE THAT ADOPT A HUMANS-IN-ECOSYSTEMS PERSPECTIVE.

Resilience and development

Economic growth has been front and centre of current development thinking (Romero-Lankao et al. 2016) dominated by market mechanisms and technological innovation (Time for Transformation 2022). Sustainability theory stands in contrast, if not in opposition, to this idea of growth and development. It uses terms such as “triple bottom line”, “three Es” and “three-legged stool” to understand the interlinkages between interdependencies among the economy, the environment and social equity. There is inherent tension between the timespans and scale at which sustainable development is conceptualized vis-à-vis development thinking. Development thinking, for instance, perceives the environment as a tool to be used for human economic activity while the concept of sustainability brings forth balance between protecting the environment and the social implications of such decisions (Walker et al. 2020).

Sustainable development is understood as “the development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (UN 1987). In 2015, all UN member states adopted 17 Sustainable Development Goals (SDGs) which encompass 169 targets to stimulate action for humanity and the planet. Sustainable development must now contend with the more dynamic, uncertain and complex systemic context of the Anthropocene (Reyers and Selig 2020). The concept of resilience is increasingly used by scholars and development practitioners alike to develop traits that can address the inevitable occurrence of disturbances and to find ways of shock-proofing development gains, most notably in the context of climate-related extreme events. In the international development arena, resilience has gained a positive connotation whereby any given system is able to adapt to shocks and withstand harm in the face of crisis. Resilience is therefore often expressed as an aspiration to secure progress in sustainable development. Resilience is embedded across the SDGs (Bahadur et al. 2015) and is referred to explicitly in five of them, including target 1.5 of SDG 1 (end poverty in all its forms everywhere): “By 2030 build the resilience of the poor and those in vulnerable situations, and reduce their exposure and vulnerability to climate-related extreme events and other economic, social, and environmental shocks and disasters” (UN General Assembly 2017).

The explicit mention of resilience across the SDGs demonstrates their strong linkages and mutual reinforcing mechanisms. Higher levels of resilience can foster the achievement of the SDGs and vice versa. Shocks and stresses can reverse years of development gains and efforts to eradicate poverty by 2030 (UN 2015). The SDG vision— through partnerships and for people, planet, prosperity and peace—will suffer if these challenges are not addressed. Resilience characteristics to absorb, persist, adapt and transform are enablers for sustainable development and achieving the SDGs (Metaxas and Psarropoulou 2021; Rockström et al. 2009; UN 2015). A focus on resilience can protect development gains and

ensure people have the resources and capacities to better reduce, prevent, anticipate, absorb and adapt to a range of shocks, stresses, risks and uncertainties. Thinking beyond shocks, it also provides the thrust needed to build stronger foundations able to leverage opportunities. Resilience can, however, work against the SDGs by perpetuating inequalities and other undesirable systems. It requires careful consideration and in some cases removal of undesirable forms of resilience (Rockström et al. 2009).

Resilience has been taken up in global policy documents for sustainable development, with the need for building resilience recognized in the 2030 Agenda for Sustainable Development, the Addis Ababa Action Agenda, the Paris Agreement on climate change, the Sendai Framework for Disaster Risk Reduction, and the New Urban Agenda. At face value, both sustainable development and resilience aspire for long-term health and the continuity of systems. The Intergovernmental Panel on Climate Chante (IPCC) states that transformations in economic, social, technological, and political decisions and actions facilitate climate-resilient pathways.

> A climate-resilient pathway for development is a continuing process for managing changes in the climate and other driving forces affecting development, combining flexibility, innovativeness, and participative problem solving with effectiveness in mitigating and adapting to climate change. If effects of climate change are severe, this process is likely to require considerations of transformational changes in threatened systems if development is to be sustained without major disruptions (IPCC 2014:1106).

Resilience and sustainability also share a common emphasis on the importance of social, economic and environmental systems (Espiner et al. 2017). They touch upon diverse ways of knowing, values, motivations and power dynamics across spatial and temporal domains (Romero-Lankao et al. 2016). In the New Urban Agenda, resilience and sustainability are mentioned in the same sentence eight times, reflecting a common assumption that sustainability and resilience, even if interpreted as distinctly different, often are viewed as positively correlated (Elmqvist 2014). Several scholars posit that resilience is integral to achieving sustainable development (see Espiner et al. 2017; Linkov et al. 2014; Bahadur et al. 2015; Reyers et al. 2022). The Stockholm Resilience Centre (2009:7) goes on to call resilience “the missing link of sustainable development”. Anderies et al. (2013) highlight the strengths of resilience, sustainability and robustness to address global policy challenges. Espiner et al. (2017) link sustainability and resilience in three potential states: Emergent, developing and mature. Herein, mature systems occupy both a high level of resilience and sustainability from perturbations. Metaxas and Psarropoulou (2021) have similarly found them to be complimentary. Indeed, Suárez et al. (2016) claim that resilience has replaced sustainability in urban planning.

Meanwhile, Swanstrom (2008:6) argues that "applying the framework of ecological resilience to human institutions and governance processes generates paths to greater understanding, as well as dead ends". Davoudi (2012) states that resilience can be a useful bridging concept between the natural and social sciences and foster dialogue. Nevertheless, the meanings and implications of sustainability and resilience are contested and often emerge from deliberations among actors with unequal levels of power about the desirability of alternate futures, the necessary means of attaining them and the trade-offs that will be accepted along the way.

The links between risk, resilience and vulnerability

Resilience and vulnerability are often understood as antonyms to describe an undesirable starting point (vulnerability) where an effective intervention seeks to tackle and turn into a desirable situation (resilience) (Béné et al. 2012; Moss et al. 2016; Cassidy and Barnes 2012). It is for this reason that many development interventions begin with vulnerability analysis and aim to move toward a state of resilience. Academic literature highlights differences between resilience and vulnerability.

While some scholars have argued that "[r]esilience increases the capacity to cope with stress and is hence a loose antonym for vulnerability" (Adger 2000:348), others insist that resilience is not a flipside of vulnerability since the concepts have emerged in scholarly traditions rooted in different epistemologies (for example, Gallopín 2006, Miller et al. 2010). Resilience, with its roots in ecology, follows a more positivist approach and emphasizes (social-)ecological and biophysical components whereas vulnerability tends to follow the constructivist tradition which emphasizes human agency, the social and the political (Miller et al. 2010). The policy implication being that while vulnerability offers a greater range to deal with issues of power, politics and equity, resilience hones in on issues of ecology and systems effects (Gallopín 2006). Despite these differences, there is some agreement on the usefulness of both resilience and vulnerability as complementary concepts to solve complex real-world challenges and crises. Levina and Tirpack (2006:16) sum up the relation as "'vulnerability' seems largely to imply an inability to cope, and 'resilience' seems to broadly imply an ability to cope".

WHILE VULNERABILITY OFFERS A GREATER RANGE TO DEAL WITH ISSUES OF POWER, POLITICS AND EQUITY, RESILIENCE HONES IN ON ISSUES OF ECOLOGY AND SYSTEMS EFFECTS.

GALLOPÍN 2006

In the context of natural hazards, disaster risk research builds on Gilbert White's early recognition that risk outcomes are not a mere consequence of hazard magnitude, but rather shaped by the characteristics of the society exposed to such hazard (White 1945). Since then, a wide range of scholars have emphasized that risk can be seen as a function of both hazard and vulnerability (Blaikie et al. 1994; Birkmann 2013). Using a vulnerability-centred lens on risk emphasizes the role of the societal component in risk as "hazards are, at least to some extent, known and constant, [so that] vulnerability appears to be

the main factor that distinguishes between those who suffer loss and those who escape it" (O'Brien et al. 2006:70).

Nevertheless, different perspectives can be taken to assess vulnerability. While Oliver-Smith (1999:29) refers to vulnerability as adaptive failure, that is the outcome of past action, it is also possible to view it as a starting point to understand limits and barriers that inhibit adaptation and transformation (see O'Brien et al. 2004). In both perspectives, human agency is a key element to vulnerability and resilience.

Coping and adaptation in resilience

A distinction between coping and adaptation is useful to grasp the variety of actions undertaken to address external stressors. These stressors may be treated either as single events (coping) or as manifestations of continuous change (adaptation). Accordingly, Birkmann (2011:1117) posits that "coping encompasses immediate measures that might help to deal with an actual hazard event (impact), [whereas] adaptation measures should allow for a longer-term adjustment (change)". Similarly, Pelling (2011:21) defines adaptation as "the process through which an actor is able to reflect upon and enact change in those practices and underlying institutions that generate root and proximate causes of risk, frame capacity to cope and further rounds of adaptation to climate change".

While this distinction seems relevant at the level of the actual process, a distinction is less useful in practice as most capacities can be used in multiple ways so that the distinction would depend on the situation and context against which the capacities are assessed. On the ground, coping and adaptation are often closely interlinked: "The key adaptations are less often those related to changes in long-term average temperature and more often related to the frequency and magnitude of extremes such as droughts or floods" (Smit and Pilifosova 2003:11).

Based on this insight, Smit and Wandel (2006) have introduced the idea of a coping range that defines up to which level of hazard magnitude people are able to cope and mitigate potential impacts. In their understanding, adaptive capacity can be directed at broadening this coping range to increase the magnitude of events people are able to cope with. It can also be used to counteract a reduction of coping range that may occur due to the "cumulative effects of increased frequency of events near the limit of the coping range" (Smit and Wandel 2006:287). Such reduction would occur if the strategies employed are primarily "erosive", that is they deplete an actor's resource base. On the other hand, repeated hazard occurrence and successful coping may bring about daily routine improvements and thus a learning effect (see Inderberg and Eikeland 2009).

Coping strategies usually build on experience with past disasters "based on the assumption that what has happened in the past is likely to repeat itself following a familiar pattern" (Bankoff

2004:32). Wisner et al. (2004:105) similarly argue that coping strategies "grow out of a recognition of the risk of an event occurring and of established patterns of response". There are limits to adaptation beyond which measures to adapt become unfeasible. Dow et al. (2013:306) define an adaptation limit "as a point at which an actor can no longer secure valued objectives from intolerable risk through adaptive action". The notion of risk recognition in this description of coping may hint at learning processes that take place to improve coping based on prior experiences and expectations. Recent resilience literature that seeks to contribute to understanding and building resilience and transformability seems to emphasize the key role of learning and social innovation (Fiksel et al. 2015; Pahl-Wostl and Patterson 2021; Tschakert and Shaffer 2014).

Critiques and limitations of resilience

Resilience has as many critics as it has proponents (Cannon and Müller-Mahn 2010; Cote and Nightingale 2012; MacKinnon and Derickson 2013; Harris et al. 2018; Mikulewicz 2019). Notwithstanding the proliferation of policies and programmes seeking to tackle climate change and bring about sustainable and resilient development, many responses fall short of their stated objectives or apply a narrow framing that undermines resilience in the long term (Adger et al. 2011; Funder et al. 2015). In the social sciences, critiques of resilience highlight that the concept does not engage with power relations—a perspective that is key to attaining social and environmental justice (Walsh-Dilley et al. 2015; Fallon et al. 2022). This can be partly attributable to applying ecological principles to social dynamics without adequate consideration of social dimensions.

Resilience has been problematized as techno-managerial, apolitical and conceptually ambiguous (Bahadur and Tanner 2014; Kuhlicke 2013; Mikulewicz 2019; Fallon et al. 2022). The positivist assumption attached to resilience is also not grounded in empirical reality. For example, fascism or slavery (Berkhout 2008; Cinner and Barnes 2019) may be resilient, but are certainly not desirable within agreed upon norms and the international human rights framework. Furthermore, resilience can hide spatio-temporal trade-offs (Anguelovski et al. 2016): What may be resilient in the short term may deter resilience in the long term. Similarly, resilience in one location can impinge resilience in another. The winners and losers of resilience efforts are determined by a fundamentally political value-laden process (Anguelovski et al. 2016).

A critical examination of climate adaptation and vulnerability reduction interventions articulated three mechanisms leading to negative outcomes: ***Retrofitting, accumulation by adaptation and coercive transformation*** (Eriksen et al. 2021):

- Through **retrofitting**, adaptation funding supports existing development agendas and vested interests such as

privatization of resources, environmental conservation or different forms of ecological modernization.

- **Accumulation by adaptation** occurs when powerful members of a community "capture" and monopolize project resources, capitalizing on their own privileged access and in so doing, further marginalize those who are most vulnerable (Eriksen et al. 2021).
- **Coercive transformation** is the worrying prospect that social transformations become tools of oppression by imposing livelihood transformations on marginalized groups.

The danger of resilience becoming a buzzword and catch-all phrase has been widely stated in development and climate adaptation literature (Oxfam 2013; Tanner and Horn-Phathanothai 2014). Béné et al. (2014:605) suggest that it is because "the term is used…in a relatively indistinctive and all-embracing sense, reflecting the intuitive and universal meaning of resilience ('the capacity to absorb shocks'), that this new policy discourse around resilience has emerged". There is also criticism about vagueness, contradiction, and inconsistency in its usage and application (Aldunce et al. 2015; Fainstein 2015; Carmen et al. 2022). In addition, concepts underpinning resilience scholarship, such as panarchy and creative destruction are neither easily communicated nor easily translated into policy discourse (Boyd et al. 2008). Carpenter et al. (2012) talk about resilience being narrowly framed to counter singular risks like natural disasters at the cost of a broader range of disturbances. The case studies from Mercy Corps and FAO (see boxes A.2 and A.3 in annex 2) lay bare different definitions, understandings, methods and applications of resilience thinking in development interventions across Africa.

According to Garcia et al. (2022), resilience tends to relegate local communities to perpetual victimhood when power is conceptualized as "power over". Adger (2006:277) finds that "adaptive actions often reduce the vulnerability of those best placed to take advantage of governance institutions, rather than reduce the vulnerability of the marginalized, or the undervalued parts of the social-ecological system". In practice, resilience of a population or community can emerge as part of a survival strategy where the public sector does not deliver. This has been illustrated and showcased in the informal sector, especially in urban settings where marginalized populations have demonstrated immense creativity and ingenuity in building resilience in the absence of public support (for example, Dodman et al. 2019; Leck et al. 2018). In short, the political and social aspects are often glossed over to make way for technocratic solutions (Kuhlicke 2013).

Mikulewicz (2019) argues that the systemic lens reduces a complex social reality into predictable parts rendering the process apolitical and techno-centric. He uses the case study of a São Tomé and Principe intervention in which climate resilience is sought through livelihood diversification, changes in food habits and market

THE DANGER OF RESILIENCE BECOMING A BUZZWORD AND CATCH-ALL PHRASE HAS BEEN WIDELY STATED IN DEVELOPMENT AND CLIMATE ADAPTATION LITERATURE.

OXFAM 2013; TANNER AND HORN-PHATHANOTHAI 2014

access. The main argument being a neoliberal technical solution devoid of political economy. Resilience does not go far enough in exploring how the process is shaped by the interaction of resources, actions and learning (Kruse et al. 2017). Bahadur and Tanner found the friction between system thinking and siloed policy structure in city governments of India and a process that failed to adequately provide space for a low-caste Harijan community. There are also calls for climate action to shift away from system-centred to human-centred approaches (Mikulewicz 2019). Many others make a case for transformation, equity and rights to fill this gap. Dolšak and Prakash (2018:334) state that "[m]any scholars call for climate proofing of development policies; we suggest serious attention to political proofing of climate adaptation".

From resilience to resilience thinking

Compared to earlier and more narrow approaches, resilience thinking is a rich concept that brings together the more positivist and ecosystem-oriented approaches with human capacity and agency. It can be seen as a response or counternarrative to linear thinking and command-and-control approaches to risk management and nature as it sees inextricable links between social and ecological systems—which are complex and non-linear—characterized by feedback loops and uncertainty (Berkes et al. 2003). Resilience thinking acknowledges that changes in ecological systems will impact social systems and vice versa. It accounts for the dynamic nature of social-ecological systems and searches for ways to navigate them in ways that safeguard or improve social development and well-being within planetary boundaries (see Rockström et al. 2009). It enables us to acknowledge the unpredictability inherent in socio-environmental change and provides a way to prepare for shocks that are both unavoidable and unanticipated (Tyler and Moench 2012).

Resilience thinking goes beyond the framing of resilience as the ability to withstand shocks. It looks at both the adaptability and the transformability of social-ecological systems as properties that influence resilience at different scales and levels of governance (from the local community to the national, regional and global) (Folke et al. 2010). Resilience thinking thus enables the distinction between the capacity to maintain a system in its current state (adaptability) and the capacity to deliberately create a new and more desirable system (transformability) (Walker et al. 2004). This distinction can help identify parts of a particular social-ecological system where transformation is preferable to the status quo (or resilience in the narrow sense). Resilience in this line of thinking is intrinsically neither good or bad, but rather a system property that needs to be assessed and understood within its context.

Strengthening adaptability is a dominant focus of many policies that seek to protect communities, ecosystems and the built environment against external shocks such as natural hazards and

climate change. In the case of climate change, however, adaptability alone will not suffice to ensure social-ecological resilience at the global scale. Preventing the global climate system from tipping into a catastrophic state will require fundamental changes in systems of production and consumption at the regional, national and local levels (Schellnhuber 2009; Otto et al. 2020; Wiedmann et al. 2020). Transformability at one scale may thus be needed in order to build resilience at another. This holds true not only for ensuring ecological resilience, but also for overcoming the economic systems that reproduce untenable conditions of poverty and social inequalities. In the case of climate change, profound and fundamental change will occur inevitably. The degree of systems' transformability, however, will determine whether it is deliberate transformative change geared toward a desirable outcome, or the imposed result of a collapsing climate system.

Policy makers and development practitioners would do well to take more from resilience thinking than simply the need to strengthen social-ecological systems' adaptability in the face of shocks. Indeed, the systems perspective of resilience thinking is helpful for analysing interactions between society and the environment, and for better understanding the interlinkages between different levels of governance—both of which are key for achieving the 2030 Agenda.

So, what can bridge the gap between the analytical advances in resilience thinking and the narrow way the term is used normatively in policies and practice? Building blocks include the notion of transformability in resilience thinking, the vision and aspiration of continental transformation expressed in Agenda 2063, and a definition of transformation that is specific about desirable outcomes (such as sustainability, inclusion and empowerment) as well as processes to achieve them. Transformative approaches present a chance to change undesirable situations and tackle issues of injustice and power distributions. According to Pelling (2011:69), "[t]here is the potential for bottom-up, aggregate transformational change through, for example the promotion of stakeholder participation in decision-making, leading to the inclusion of new perspectives and values in emerging policy". Transformation is often framed in a normative way, starting from critique of the existing structures and modalities that shape patterns of risk and vulnerability. Disasters that reveal distributional inequalities of vulnerability and risk can spark "reactive motivation [which] can lead to a proactive adaptation" (Pelling 2011:47). Outside of disasters, transformation often faces a central dilemma: "[T]he comfort zone for adaptive action is relatively small because those with power and the marginalised are wary of the instability they fear from significant social change" (Pelling 2011:44).

Resilience as a means of transformation

There is a growing consensus that the speed and scale of climate change, environmental injustices, biodiversity loss and income inequalities necessitates transformational change in almost every domain of human life (Steffen et al. 2015; McPhearson et al. 2021; Time for Transformation 2022; Olsson 2018, UNRISD 2022; box A.1). Human activity is threatening the long-term health of Earth's systems (Seddon et al. 2016) and nothing short of radical departure from status quo will enable us to remain within planetary boundaries. This entails reconfiguration of our knowledge, technology, institutions and modes of doing business as well as personal and sociocultural behaviours and meanings (Godfrey-Wood and Naess 2016, McPhearson et al. 2021; Uitto 2022).

The diffusion of transformation and transformative change is increasingly reflected in climate funding mechanisms and climate and development literature. For the Green Climate Fund (GCF), a 'paradigm shift' toward low-carbon and climate-resilient development is a foundational tenet (Harmeling and Grießhaber 2013). The Adaptation Fund seeks projects with transformational potential. Several studies debate transformation and adaptation (Tanner and Bahadur 2013; Denton et al. 2014; Fazey et al. 2017; Few et al. 2017; McPhearson et al. 2021) and development organizations call for transformative approaches (World Bank Climate Change Action Plan 2021; GCA 2021). There is guidance available on wider characteristics of transformation but no agreements yet on definition and measurement.

Transformation is typically known to involve changes in features like power relations, institutional arrangements, resource flows, meaning and values, technology, management regimes, and roles and routines—and the interactions between them (Olsson et al. 2017). In other words, "[t]ransformation or transformability in social-ecological systems is defined as the capacity to create untried beginnings from which to evolve a fundamentally new way of living

Box A.1 UNRISD definition of transformative change

Transformative change tackles the root causes of poverty, inequality and environmental destruction. It means changes to social structures and relations, to the power of elites and to those patterns of stratification—class, race, ethnicity, religion, location or SOGIESC—that are locking many millions into disadvantage and deprivation. It requires transformative social policies that are universal and rights-based, and changes to economic structures so as to favour employment-intensive growth patterns and a fairer distribution of the benefits of economic activity. It necessarily includes shifting to sustainable production and consumption patterns that halt environmental destruction.

Our approach to transformative change is grounded in the vision and aspiration set out in the 2030 Agenda for Sustainable Development. Front and centre are the goals of sustainable economies, environmental and climate justice, and reduced inequalities in power and wealth. To that end UNRISD's work scrutinizes the many issues associated with aspirations, values and norms, institutions and policies, actors and collective actions which shape social, economic, environmental and political outcomes.

Source: UNRISD 2021

when existing ecological, economic, and social conditions make the current system untenable" (SRC 2016, based on Gunderson and Holling 2002; Walker et al. 2004; Folke et al. 2010). The IPCC defines transformation in the context of climate change as "the altering of [the] fundamental attributes of a system (including value systems; regulatory, legislative or bureaucratic regimes; financial institutions; and technological biological systems)" (IPCC 2012:564). Cinner and Barnes (2019) emphasize that the concepts of resilience and transformation are related but not synonymous.

The critical difference between the two types of resilience capacities is that transformability looks more in-depth at current inequalities and injustices and can account for non-climatic drivers of change that need to be addressed in order to ensure sustainability (see table A.2). It takes resilience thinking as an opportunity that may create the political will for change despite uncertainty (Pelling 2011). This does not mean that the approaches are mutually exclusive, but rather complementary in the sense that strengthening adaptability and existing coping mechanisms or reducing disaster risk will contribute significantly to resilience but may not be enough to deal with all the challenges arising with climatic and non-climatic shocks and stressors, especially when it comes to novel hazards or tipping points beyond which existing mechanisms will no longer suffice (Magnan et al. 2020, see Schipper and Langston 2015).

Table A.2 Adaptability and transformability

Aspect	Adaptability	Transformability
Key distinctive characteristic	Governance system stays in place, performance is improved (broadening the coping range)	Governance system is altered, move toward "adaptive governance" (gradual change toward alternative management or livelihood strategies)
Underlying assumption	Shock and risks will change the known, for example, increasing frequency or magnitude of hazards. Altering current response mechanisms within the given modus operandi will suffice to deal with climate change impacts	Status quo is not desirable, and shocks and risks will go beyond the known, that is, novel hazards will occur so that more profound change to current response mechanisms and the alteration of rules and decision-making become necessary
Goal	Improving the existing system's functions in a changing context, realizing full potential through alteration of rules within established regime Disaster risk reduction/management	Move to alternative, more desirable regime Adaptiveness—adjusting workflows and mechanisms
Pitfalls	May reduce the potential for transformation at a later stage by increasing the system's resistance; may amplify existing inequalities and lead to persistence of unsustainable system attributes	Difficult to achieve as both decision makers and local population may be reluctant to initiate change in face of uncertainty; perceived transaction costs are high

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ANNEX 2

Measuring and Tracking Progress Toward Resilience

The evolution of resilience thinking has led to a proliferation of uses of the concept both across academic disciplines and communities of (development) practice. The manifold approaches and divergent meanings associated with resilience in different contexts and with regard to different shocks and stresses render the assessment and measurement of resilience challenging at best (Cummings et al. 2005; Zhou et al. 2010; Béné et al. 2012; Béné 2020).

In addition to the many co-existing definitions and conceptualizations, resilience lacks concrete, empirically verifiable examples which is a barrier to operationalizing resilience in practice (Collier et al. 2013). Early research has pointed out that it is not clear where resilience resides in a given system and how it can be enhanced or lost (Walker et al. 2002). Adding to the difficulty, resilience needs to be understood in a particular context, at a particular spatio-temporal scale and from a variety of perspectives (Carpenter et al. 2001). What may enhance resilience in the short term, may weaken it over time. Similarly, building resilience in one location or for one particular group may weaken resilience at or for another if interlinkages and feedback mechanisms are not taken into account.

Despite the growing body of work and projects and programmes aiming to build resilience, questions of how diverse interpretations of resilience influence assessment and resilience-strategies remain relatively scarce. Bahadur et al. (2010) stress that this is significant and shapes what is judged to be a success as "different understandings lead to different notions of the components, characteristics and indicators of resilient systems" (Bahadur et al. 2010: 5). Studying the same situation based on different assessment frameworks can therefore lead to markedly different results as Upton et al. (2022) illustrate by applying three different measures of household resilience to data from the Living Standards Measurement Survey—Integrated Surveys on Agriculture in Ethiopia and Niger. They conclude that the performance of the measure is mediocre at best and point out that "even though these three main resilience measures all attempt to reflect the same latent variable, they clearly reflect different underlying concepts and correspond differently with established wellbeing indicators" (Upton et al. 2022:3).

Clarity about defining resilience, the unit of analysis and the system boundaries (What kind of resilience? Resilience of what? Resilience to what?) is therefore an important prerequisite for any meaningful resilience assessment. The question "Resilience of what?" defines the unit of analysis which can be household, community, nation or continent, for example, but also infrastructure, agricultural landscapes, development or climate interventions. Identifying "Resilience to what?" requires thought into the type of shocks and stressors against which resilience is being developed. These can refer to climate-related shocks as well as a pandemics and its cascading effects or conflict, fragility and violence. Each resilience assessment project must choose the concept of resilience according to its objectives and carefully identify appropriate metrics for measuring and tracking progress. Importantly, "there is a need to be clear about how resilience is conceptualized and defined in relation to the approach by explicitly acknowledging what is being measured along with any underlying assumptions and known trade-offs" (Quinlan et al. 2016:685).

Looking at resilience more broadly, Bahadur et al. (2010:14) identify 10 main characteristics of resilient systems: A high level of diversity; effective governance and institutions; acceptance of

uncertainty; community involvement and use of local knowledge; preparedness for change and redundancy; high degree of social and economic equity; importance of social value and structures acknowledged; non-equilibrium dynamics acknowledged; continuous and effective learning; and adopting of a cross-scalar perspective.

Researchers at Stockholm Resilience Centre (SRC) have similarly identified a set of seven principles or building blocks for applying resilience thinking in practice. They highlight three crucial social-ecological system properties (maintain diversity and redundancy, manage connectivity, and manage slowly changing variables and feedbacks) as well as four governance system properties (foster complex adaptive systems thinking, encourage learning through monitoring and experimentation, broaden participation and promote polycentric governance system) for enhancing resilience (Biggs et al. 2012). These principles have been recognized by leading resilience scholars and experts and illustrate that a comprehensive approach is needed to understand the interlinkages between different system components and their respective properties. Having these principles in mind when assessing resilience of what, to what and for whom can contribute to a more nuanced understanding of who benefits and who loses from a specific intervention, whether resilience entrenches or exacerbates existing inequalities, and how human well-being and critical ecosystem services can be enhanced despite shocks and stresses (Biggs et al. 2012).

Challenges of embracing complexity in assessment frameworks

Embracing complexity in resilience measurement is challenging because it is difficult to operationalize and translate underlying theoretical concepts into practice. At all scales, our current predicament reflects a lack of adaptive governance (Folke et al. 2005, Chaffin and Gunderson 2016; Arora et al. 2019), in particular polycentric governance (Ostrom 2010), in which disturbances are addressed at the scale of the problem with vertical connections across scales and horizontally to allow for learning and experimentation. In a crisis, top-down governance responses can exacerbate some problems (for example, authoritarianism or ineffective, one-size-fits-all policies) and purely bottom-up approaches are also ineffective. It is unclear, however, how polycentric governance could be implemented and progress tracked at a global scale (Walker et al. 2020).

Adopting resilience thinking, including the notion of transformability and managing for fundamental change rather than adaptation or robustness, presents another challenge as value judgements might diverge, requiring inclusive deliberation processes to identify which pathways and ways forward are desirable. Tracking progress toward transformation is difficult as both baselines and goal posts may shift over time while a system undergoes transformation.

TRACKING PROGRESS TOWARD TRANSFORMATION IS DIFFICULT AS BOTH BASELINES AND GOAL POSTS MAY SHIFT OVER TIME WHILE A SYSTEM UNDERGOES TRANSFORMATION.

While resilience thinking literature is relatively clear on the importance of adopting complex adaptive systems thinking in order to better understand such interlinkages and trade-offs that can occur across temporal and spatial scales, relatively few empirical studies and practical examples manage to operationalize the concept (see, for example, Jagustović et al. 2019, 2021). On the ground, resilience interventions tend to adopt a narrower framing than most conceptual approaches aspire to (see Cumming et al. 2005). Only a select few tools demonstrate a true attempt to rethink resilience assessment, informed by academic theories developed in recent years (Douxchamps 2017).

The gap between resilience theory and practice is likely the result of a combination of factors, including challenges associated with adopting and expressing a complex conceptual framework in practical terms and finding ways to describe resilience characteristics in quantifiable terms, the burden of identifying, collecting and analysing data to assess different aspects and dimensions of resilience where metrics have been agreed as well as a certain path dependency within larger development operations. But these difficulties in monitoring and measuring resilience also stem from a definition that is “somewhat subjective and dependent on value judgement and preferences” (Hallegatte and Engle 2019:2) and difficult to test or verify in practice unless a shock occurs.

Assessing capacities and characteristics of resilient systems at different levels

Existing assessment frameworks and metrics most often use indicators trying to describe resilience, which is expressed either as different capacities and assets, as processes (of learning, for example, Schipper and Langston 2015) or outputs/outcomes of a specific intervention. Assets and capacities to absorb, adapt and transform are most commonly used when assessing resilience in the context of disaster risk reduction, climate change adaptation and food security, as well as when assessing community resilience. Most frameworks focus on the local level and assess resilience at household or community scale (Bahadur et al. 2016). Here, a distinction is often made where a household’s or community’s tangible and intangible assets are used to describe absorptive capacity and livelihood diversification and ability to learn describe adaptive capacity whereas transformative capacity looks at governance mechanisms, policies and regulations, infrastructure, community networks, and formal social protection mechanisms that are part of the wider system in which communities are embedded (Bahadur et al. 2016).

Assessing and operationalizing resilience at the local level has the advantage that the specific case study context, causes, and effects between different types of risks and shocks and resilience and vulnerability are relatively clear. There is a rich body of literature

as well as an international policy framework for vulnerability and resilience in relation to natural hazards and risk management (see table A.4 with African examples, Sendai Framework). Vulnerability and resilience in the context of food security is also comparatively well understood and underpins much of the work of WFP, FAO and bi- and multilateral development agencies, especially in drought-prone regions (see Box A.2 with a case study based on FAO's RIMA). A common unit of analysis is at the community level in both rural and urban contexts with a plethora of frameworks, indicator systems and reviews available (see National Academies of Sciences, Engineering, and Medicine 2019; Mochizuki et al. 2018; Beccari 2016). The field of urban resilience is most advanced when it comes to studying the role of informal sectors (in relation to housing, work as well as social protection and mutual support in disaster relief) in building resilience (Dodman et al. 2019; Satterthwaite et al. 2018).

There is much less clarity on concepts that would allow the assessment of resilience to multiple shocks at the national level. Theory as well as the experience of past disasters and crises show that we are dealing with complex systems where feedback loops between different system components can lead to cascading risks across scales and regions (UNDRR 2022). Conceptually, there is consensus that building specified resilience to one type of risk or in one location does not necessarily lead to greater resilience overall (Carpenter et al. 2012; Biggs et al. 2015). Instead, a narrow focus on specified resilience can reduce flexibility and resilience to other types of unexpected shocks. Similarly, a good level of general resilience may be helpful overall, but insufficient to cope with specific large-scale events.

The challenge of finding the appropriate metric

Lawson et al. (2020) posit that quantitative metrics are often unable to accurately portray the dynamic and adaptive nature of sociotechnical systems that is central to the resilient performance of complex systems with interdependencies and connections. It is not sufficient to assess individual system properties in isolation. Instead, the focus should be shifted to how individual functions are connected and mutually interdependent, with the focus being on how the system performs as a whole (Lawson et al. 2020). Resilience should not be tracked through a single indicator (IFAD 2015) which can prove to be misleading as improved resilience in one domain can lead to greater vulnerability in another. The International Fund for Agriculture Development (2015) highlights that crop productivity is often used as main indicator of household resilience based on the assumption that greater income automatically leads to greater resilience. This ignores important factors such as income distribution across household needs or expenditures made that do not reduce vulnerability to shocks (IFAD 2015).

With users requiring different types of evidence, the search for resilience metrics and indicators has proliferated in development practice (Lawson et al. 2020; Datola et al. 2022; Global Resilience Partnership 2022). There is scrutiny on the impacts of resilience programming and what contributes to resilience. For projects aiming to build resilience, it is especially important to consider a mix of quantitative and qualitative methods, to use objective and subjective longitudinal indicators, along with novel data collection approaches (Global Resilience Partnership 2022).

There have been many attempts to measure resilience in different contexts, including psychometric models of individual resilience (see Sarkar and Fletcher 2014), conceptual frameworks to describe social-ecological resilience (Resilience Alliance 2010), participatory assessments of household and community resilience (Bergamini et al. 2013; Mercy Corps, see box A.3), as well as composite indices and models to estimate resilience at national or sectoral levels. Survey questionnaire, in-depth interview, and focus group discussion were the three major qualitative resilience measurement methods (Cai et al. 2018). Shah et al. (2018) use expert judgement to assign scores to different variables of resilience. Quantitative studies often involve statistical and data mining methods, with correlation and multivariate regression analyses being most frequently used (Tesso et al. 2012).

Because resilience is a theoretical construct, most indicator-based measuring attempts use proxies (such as technical capacity, skills, education, health, civil society network, foreign reserves) as markers of specific resilience characteristics. Data availability is a challenge and can influence the choice of indicators used. Sono et al. (2021) highlight, for example, that health and property insurance coverage are important indicators for disaster resilience, but data is not available at the national level in most sub-Saharan African countries. Similarly, more recent climate insurance mechanisms are difficult to measure comparatively, despite their positive effect on resilience. For example, “index-based livestock insurance increases the household resilience to drought in terms of household livestock holdings. Insurance is also associated will substantially higher nutritional resilience in the children of drought-affected households” (Cissé and Ikegami 2016:1). Another common challenge in indicator-based assessments is the time lag between when evidence is needed and when it becomes available. This is particularly the case for assessing environmental resilience where ecological indicators are often not available or updated infrequently.

BECAUSE RESILIENCE IS A THEORETICAL CONSTRUCT, MOST INDICATOR-BASED MEASURING ATTEMPTS USE PROXIES AS MARKERS OF SPECIFIC RESILIENCE CHARACTERISTICS.

Birkmann et al. (2022) assess the internal and external validity of two global indices measuring human vulnerability to natural hazards (World Risk Index/Birkmann et al. 2011) and to natural hazards, epidemics, and conflict (INFORM, EC-DRMKC 2020) and find that they do have explanatory power for disaster outcomes as they correlate with disaster mortality. Both indices include dimensions of vulnerability that are also used to assess resilience as they assess the

lack of coping (and adaptive) capacity. But validation remains scarce. In a systematic review of frameworks that measure social vulnerability and resilience, Ran et al. (2020: 13) find that “few papers measured changes in vulnerability or resilience over time, which limits our understanding of the extent to which they co-evolve with exogenous factors (e.g., policy interventions, hazardous events)”. They further note that validation efforts were lacking in most cases and suggest that more systematic evaluations of the quality of a given model is needed since we cannot test the models’ predictions.

Sectoral approaches to measuring resilience

Several resilience assessment frameworks take a comprehensive approach, but focus on a specific sector and risk context. In Africa, two sectors that were studied quite extensively are food and health. While resilience to food insecurity is often assessed at the household or community level, food system resilience often relies on data-heavy, time and resource-intensive case study approaches that aim to better understand different dimensions and capacities of resilience in the food sector as a whole. Jacobi et al. (2018), for example, used a mixed-method approach and conducted household surveys and focus group discussions as well as participatory observation and mapping exercises in order to gain a comprehensive understanding of food system resilience in Kenya and Bolivia. Seekell et al. (2017) developed an indicator-based analysis of food systems resilience at the national level comprising of socioeconomic, biophysical and production diversity.

The health sector and questions of health system resilience have come under scrutiny since the Ebola outbreak in West Africa in 2013. More recently, assessments also include studies of COVID-19 impacts to highlight the importance of a functioning health system for resilience to shocks (see Agozie 2022; Bhandari and Alonge 2020; Biddle et al. 2020; Mustafa et al. 2022). Olu (2017) presents a conceptual framework for a resilient health system for public health disaster risk management that consists of six building blocks: Leadership/governance; health financing; medicines, vaccines and technologies; health information; health workforce; and health service delivery. Others suggest the construction of an index to assess health system resilience (Kruk et al. 2017) or the use of a checklist to identify priority areas for health system resilience (Meyer et al. 2020).

Resilience of electricity supply (and critical infrastructures more generally) is also assessed, but often using a more engineering definition of resilience and aiming at redundancy of critical elements and reducing the time needed to return to operations after a disturbance. Mujjuni et al. (2021) measure resilience of the electricity supply industry in relation to development commitments and proposes a catalogue of 303 indicators.

Household resilience

At the level of household resilience, studies often rely on primary data collection through surveys and/or interviews (Bottazi et al. 2018; Myeki and Bhata 2021). One of the most prominent approaches to measure household resilience is the Resilience Index Measurement and Analysis (RIMA II) approach of the FAO (see box A.2) which is most commonly used to assess household resilience in the context of food insecurity and is also often the subject of several academic studies (see Muricho et al. 2018; Ngesa et al. 2020; Upton et al. 2022).

Some studies combine assessments of household resilience with those of national systems: Ulrichs et al. (2019) obtained data from a desk review and interviews with key informants at the macro scale and focus group discussions with beneficiaries of social protection programmes at the micro level to evaluate how social protection contributes to resilience.

Murendo et al. (2020) assess households' resilience capacity in relation to nutrition based on panel data in Malawi and find that "resilience capacity was positively associated with household dietary diversity and food consumption". Their choice of resilience pillars was based on the availability of variables in the data set and focused on livelihood assets, access to safety nets and basic services. Ajonina et al. (2021) develops a flood vulnerability index for Limbe, Cameroon based on household survey data that includes five resilience indicators (perception of flood severity, success of flood control measures, long-term residence, access to hospital, community group membership).

The majority of studies assessing household resilience adopt the logic of the sustainable livelihoods framework and measures different types of capitals that households can employ to absorb or adapt to shocks, including relatively new trends. Mfossa (2019:10) analyses mobile money-driven financial inclusion and resilience in Cameroon and finds that access to mobile money contributes to households' financial resilience which he defines as "the ability to maintain spending and living standard during an economic emergency". This may be the result of own savings/microsavings as well as increased access to support from people's social network both of which can increase absorptive capacity. The transformative capacity is assessed to a lesser extent.

Community resilience

There is a plethora of frameworks for assessing community resilience in different contexts. Many frameworks aim to assess a community's disaster resilience where much of the conceptual framework development has taken place based using US-based case studies (see Cutter et al. 2008, 2010) and then applied elsewhere. Community resilience has also gained traction in the international development discourse, where it is often assessed in participatory exercises by bi- and multilateral development partners as well as NGOs and/or civil society organizations. Mercy Corps developed

Box A.2. Resilience Index Measurement and Analysis (RIMA II) of refugees and host communities in Uganda

The Food and Agricultural Organization of the United Nations (FAO) conducted an assessment on food security and resilience of refugee and host community households in Kamwenge and Kyegewa districts of southwest Uganda in 2019. The analysis sheds light on the current socioeconomic and gender situation of refugees and host communities, to help identify key programme needs for the target areas and provide contextual evidence for programme strategy development.

The resilience analysis was conducted based on the RIMA II approach that estimates household resilience to food insecurity and expresses resilience capacity quantitively by using the Resilience Capacity Index (RCI). RIMA defines resilience as "the capacity of a household to bounce back to a previous level of well-being (for instance food security) after a shock" (FAO 2016b). Resilience is composed of four components (termed pillars) and RIMA II measures household resilience through multiple variables. The resilience pillars are as follows:

a) **Access to basic services:** Ability of a household to meet basic needs by accessing and effectively using basic services such as sending children to school; accessing water, electricity and sanitation; and selling products at the market
b) **Assets:** Assets, both productive and non-productive, are the key elements of a livelihood, since they enable households to produce and consume goods
c) **Social safety nets:** Capacity of the household to access formal and informal assistance from institutions, as well as from relatives and friends
d) **Adaptive capacity:** Ability to adapt to a new situation and develop new livelihood strategies

The study applied a quantitative method using a survey questionnaire to understand food security and resilience in the target populations. A survey was conducted in 705 households from refugee and host communities. It identified droughts, water shortages, and crop pests and diseases as the top three shocks that affect target households. The refugee households scored an average RCI of 40, compared with an average RCI of 53 for host community households. Low levels of resilience among refugee households is linked to limited access to physical assets (for example, land or livestock). Refugee households have high levels of food insecurity, which negatively affects their RCI scores. Host households with male adults only have a lower RCI than those with only female adults, or with both male and female adults. Meanwhile, refugee households with female adults were found to have the lowest RCI.

Temporally, refugee households' resilience is low upon arrival but increases after 3 to 12 years into their stay. The main sources of income of refugee households are similar to those of host households with the same RCI; 67 percent of the households included in the survey engage in crop farming, while 29 percent are engaged in agropastoral activities. Households that sell surplus agricultural crops have a higher resilience than households that produce exclusively for their own consumption, in both refugee and host communities. The illness of household members affects the resilience of both refugee and host communities. Access to social and credit networks was an important determinant of resilience; such networks are conducive to consumption smoothing when households suffer shocks.

These findings lend themselves to numerous resilience-building and policy implications such as progressively guiding refugees from relying on humanitarian assistance to self-reliance; greater information-sharing projects to enable refugees to re-establish their household livelihood strategy within the first six months after settling; and access to credit facilities for both refugee and host community households to strengthen livelihoods.

Overall, RIMA is a context-specific approach to resilience-building whereby scores for FAO's four pillars of resilience are calculated by using statistical techniques to infer the value of latent variables. The unit of measurement is household and the survey questionnaire identifies risks through subjective perceptions of respondents and covers sociodemographic characteristics of households; food security; well-being; shocks; assistance; perceived resilience capacity; coping strategies and aspirations; access to basic services; employment; and agricultural and livestock production. This tool is well-suited to inform, target and rank households on resilience across temporal scales (Bahadur and Pichon 2016). Its strength lies in its ability to identify households most at risk and to isolate the specific areas of resilience weakness that lie behind the increasing vulnerability. RIMA has been validated over time as a good predictor of food security (Ciani and Romano, 2011; d'Errico et al. 2016) and has been employed in many case studies. It allows FAO to monitor progress during the project cycle and adapt interventions; assess food security and resilience changes over time; and to improve programme design and to inform policy decisions.

Sources: FAO 2019, 2016b.

a methodology for Strategic Resilience Assessment (STRESS) in order to bring resilience thinking into humanitarian and development practice (see box A.3). Wilkin et al. (2019) critically assess research using social network analysis to assess community disaster resilience and find that a robust methodology is emerging that can be used for bottom-up mappings.

There are also several comprehensive reviews of different assessment frameworks that specifically look at those measuring community resilience (see Sharifi 2016; Mochizuki et al. 2018; National Academies of Sciences, Engineering, and Medicine 2019; Zamboni 2017; Mayer 2019; Walpole et al. 2021). Tariq et al. (2021) review 36 existing resilience frameworks and build a library of 86 indicators of community resilience grouped into six dimensions (physical, health, economic, environmental, social, governance). Bhandari and Alonge (2020) suggest that community resilience (in the context of low- and middle-income countries' health systems) consists of six elements: local knowledge, community networks and relationships, communication (including risk and crisis communication), health, governance, and resources. Despite the many approaches and frameworks available for measuring community resilience, most reviews still find major shortcomings. In their critical review of 36 community resilience measurement tools, Sharifi (2016) finds that they "have failed to adequately reflect the dynamic nature of resilience by addressing interactions of forces operating over various geographic and temporal scales. Cross-scale relationships are largely neglected and communities are often being assessed as stand-alone and isolated entities. Also, tools need to better acknowledge the fact that resilience building is a dynamic process" (Sharifi 2016:644).

Even when assessments are limited to the issue of community resilience to natural hazards in the context of a data-rich environment (the United States), significant challenges persist:

> The current state of resilience measurement is not developed enough to reveal a single best measurement approach, scientifically or in practice. … Existing efforts assess capacity, are capital- or sector-specific, and do not address policy or programmatic needs such as targeting for resource allocation, investments, or disaster relief. Many are theoretical or conceptual exercises, and relatively few have been implemented, replicated, or adapted for application (National Academies of Sciences, Engineering, and Medicine 2019:44).

Urban resilience

Urban resilience has been studied and assessed extensively, in particular since the establishment of international city resilience networks such as ICLEI or the Resilient Cities Network that emerged from the Rockefeller Foundation's 100 Resilient Cities programme. It can be defined as "the capacity of cities to function, so that the people living and working in cities—particularly the poor and vulnerable—

Box A.3. Karamoja Strategic Resilience Assessment (STRESS)

Karamoja (Uganda) is recovering from conflict and undergoing rapid social, ecological and economical shifts. Pastoral livelihoods are in decline—estimated at 70 percent loss in livestock and government policies favouring agriculture. Urban and rural households experience pressures associated with price shocks, which result from poor regional harvests and market fragmentation, flood impacts on poor road infrastructure, and possible price manipulation by traders. Livestock diseases and pests impact pastoral and other livestock-based livelihoods.

Crop producers are affected by shocks associated with erratic rainfall and dry spells. Wage farm labourers, more likely to be poor and/or single women, are doubly vulnerable to rainfall variability, since they depend on income earned after initial rainfall to buy inputs for their own plots. Women—particularly girls between the ages of 9 and 18 and single, abandoned or widowed women—face the most serious impacts of shocks and stresses because of their heavy productive responsibilities. In this context, Mercy Corps undertook a Strategic Resilience Assessment (STRESS) from February–April 2016 to deepen its understanding of vulnerability and resilience in Karamoja and identify a set of resilience capacities.

The STRESS assessment, beginning with a scoping workshop, developed a systems map for achieving development outcomes, identified key shocks and stresses through hazard mapping, and crafted an initial assessment of key resilience capacities and constraints. It was followed by secondary research, key informant and expert interviews, and community data collection. A workshop in April 2016 reviewed findings and refined key resilience pathways to respond to specific shocks and stresses. The findings show friction between a new set of development policies that encourage agricultural market development and a pressing need to limit increasing expansion on marginal lands. It identified critical shocks and stressors such as drought and rainfall variability, natural resource conflict, alcoholism, under-nutrition and HIV. The analysis revealed differentiated vulnerability across livelihood, social and wealth groups.

Mercy Corps identified a set of six capacities required for households and communities to absorb, adapt and transform in the face of these disruptions. These include: (i) Increased capacity to manage natural resources equitably and transparently; (ii) increased access to products and services that reduce risk; (iii) increased access to appropriate financial services; (iv) increased access to information and early warning systems; (v) improved mechanisms for disaster risk management and response; (vi) increased access to water management and water, sanitation, and hygiene (WASH) services.

Overall, STRESS assessment lays emphasis on socioecological context and leverages a mix-method approach whereby resilience is gauged through a set of key questions (resilience of what, resilience to what, resilience for whom, resilience through what) (Bahadur and Pichon 2016). The assessment is conducted in four phases:

1. Scope
The team builds a contextual understanding of the system based on the guiding resilience questions, establishes the research focus, and prepares research plans and activities.

2. Inform
The team employs a mixed-methods approach to collecting the quantitative and qualitative information needed for an informed analysis.

3. Analyse
The team evaluates and synthesizes collected information.

4. Strategize
The team develops a theory of change, which includes the key elements required to build resilience.

Data is collected through literature review, multi-stakeholder workshops, expert interviews and community-based data collection that covers social, ecological and economic systems leading to a theory of change. Its strength lies in its ability to identify vulnerable groups across socioeconomic categories, create vulnerability profiles and narratives, and to devise capacities to foster resilience. A resilience theory of change based on this analysis enables targeted interventions aimed at supporting communities in achieving long-term well-being outcomes and transformational change.

Sources: Mercy Corps 2016, 2017, 2019.

FEW SCHOLARS EXAMINE WHETHER AND HOW THE RESILIENCE CONCEPT EMANATING FROM THE GLOBAL NORTH IS APPLICABLE IN THE GLOBAL SOUTH AND AFRICA IN PARTICULAR.

survive and thrive no matter what stresses or shocks they encounter" (Rockefeller Foundation and Arup 2016:11). The City Resilience Index that was developed for the Resilient Cities Network takes a comprehensive approach and uses 52 indicators grouped into four main components (health and well-being, economy and society, infrastructure and ecosystems, and leadership and strategy) that are meant to guide cities in assessing their resilience against 12 goals and comes with a range of guidance documents and evaluation tools (Rockefeller Foundation and Arup 2015).

In South Africa, Kotzee and Reyers (2016) use Biggs et al. (2012)'s principles of resilience to construct an index of social-ecological resilience to floods for three municipalities in South Africa based on data from the South African census, government documents, municipal planning documents and a biodiversity database (see table A.4 for additional examples of urban resilience assessments in Africa). Many academic reviews and assessments often hone in on one or a select few aspects of resilience rather than aiming for a city-level assessment. Common themes addressed often relate to questions of climate-resilient urban planning and development (see Zuniga-Teran et al. 2020; Chitengi 2015); both formal and informal mapping exercises to inform urban planning (see Chitengi 2015; Msilanga 2018; Cariolet et al. 2019); adaptation strategies to recurrent hazards (Broto et al. 2015; Owusu and Obour 2020;); and questions of urban climate justice, participation and community engagement (Ziervogel et al. 2017; Anguelovski et al. 2016; Broto et al. 2015; Sellberg et al. 2015; Kanonhuhwa et al. 2021).

In the development context, resilience of informal settlements and economies and justice implications of urban upgrading programmes are also prominently featured in both literature and practice (Kiunsi 2013; Amoako 2018; Chitengi 2015; Satterthwaite et al. 2020; Hambati and Yengoh 2018). For example, the World Bank has supported a project of participatory community mapping to identify flood-prone areas in informal settlements and find ways to protect areas from flooding (Msilanga 2018). While many scholars present case studies of urban resilience in developing countries, relatively few have engaged in questions of whether and how the resilience concept and discourse emanating from the global North is applicable in the global South and Africa in particular (Ziervogel et al. 2017; also see Meyer and Auriacombe 2019).

Disaster resilience and risk assessment

Cai et al. (2018) systematically review disaster resilience measurement scholarship that was published between 2005 and 2017 stressing that empirical validation remains a major challenge both in qualitative and quantitative approaches and is only done in approximately 10 percent of cases. The majority, 101 out of 174 articles reviewed, use indicators to measure resilience. The authors

group them into seven categories (social, economic, institutional, infrastructural, environmental/ecological, community, other). The most frequently used indicators are:

- **Economic:** Income, employment, housing capital
- **Social:** Education, age, communication capacity
- **Institutional:** Previous disaster experience, social connectivity, public services, mitigation
- **Infrastructure:** Shelter capacity, transportation access, medical capacity, recovery
- **Community:** Place attachment, civic involvement

None of the environmental or other indicators were used more than 20 times and therefore not listed (Cai et al. 2018). Mavhura et al. (2021) adapt the disaster resilience of place model by Cutter et al. (2008) to build a composite index of inherent, hazard-independent resilience in Zimbabwe. They use 26 variables in five dimensions (community capital, economic, infrastructure, social, health) based on data from public sources and census data to construct an index at the district level.

Many case studies assess disaster risk and look at social and/or community or household vulnerability to different natural hazards, often referring to resilience-building as an overarching goal, but do not analyse factors or variables that contribute to resilience in more detail (Mdungela et al. 2017; Muyambo et al. 2017; Mohammed et al. 2018; Adzawla et al. 2020; Kamanga et al. 2020; Ghebreselassie et al. 2020; Ballesteros and Esteves 2021; Dumenu and Takam Tiamgne 2020; Tessema et al. 2021; Tano et al. 2018).

Indicators and approaches for measuring resilience at the national level

There are several resilience measurement frameworks that define and assess resilience at the national level. Serfilippi and Ramnath (2018) provide a set of 76 resilience indicators which they narrow down into a core set of 27 social, environmental and economic indicators by using SMART criteria (specificity, measurability, actionability, realism, trackability). They incorporate institutional and infrastructural indicators into the social component and tag each indicator according to the resilience capacity it depicts (absorptive, adaptive, transformative). Opiyo et al. (2018) develop an indicator framework for measuring social-ecological resilience to droughts in pastoralist systems in the Horn of Africa and organize the indicators by absorptive, adaptive and transformative capacity:

- **Absorptive:** Assets ownership and access, coping strategies, safety nets, social cohesion
- **Adaptive:** Livelihood diversity, human, social, physical and financial capital
- **Transformative:** Institutions, network structures, governance mechanism, policies and regulation

Taking a broader approach to assess resilience to a range of shocks related to climate, conflict, and economy, IGAD developed a Protocol for Resilience Measurement based on nine overarching indicators (early warning, planning and preparedness, adaptation to climate variability, food security readiness, food and feed balance sheet, food and feed reserve, natural resource management, women empowerment, and literacy (ICPAC/IGAD 2023; IGAD 2020). The protocol uses 25 criteria and 28 subcriteria to build a resilience index (ICPAC/IGAD 2023). Bujones et al. (2013) measure resilience in fragile and conflict-affected countries. They identify the resilience gaps vis-à-vis shocks and stressors and consider institutions, resources and adaptive facilitators as the main analytical category.

In their systematic review of studies that operationalize and measure social-ecological resilience, Gonzalez-Quintero and Avila-Foucat (2019) present an overview of variables used to assess the seven principles of enhancing resilience. The EMBRACE project assessed 32 frameworks including ecological, sociological, psychological, critical infrastructure and organizational resilience (Beccari 2016). Others have reviewed more specific aspects such as tools for measuring urban vulnerability and risk (Pelling 2006) or indicator methodologies that focus on natural hazards (Balica 2012) and specific threats related to climate change (Schauser et al. 2010).

Estoque and Murayama (2017) assess social-ecological status at the country level for 144 countries by combining a social-ecological resilience component with a component of social-ecological pressure. Their resilience component uses the dimensions of socioeconomic integrity (measured by Human Development Index), governance integrity (World Bank government effectiveness measure) and ecological integrity (WWF biocapacity and GEF benefits index for biodiversity). Sub-Saharan African countries fare comparatively well with regard to social-ecological pressure (hazard exposure, population density, protected area density, ecological footprint and CO_2 emissions), but demonstrate low resilience in this study.

At the national scale, data from sources such as the World Bank Catalog; International Monetary Fund; Africa Information Highway from the African Development Bank; Climate Watch; and Notre-Dame Global Adaptation Initiative (ND-GAIN) have been used (Sono et al. 2021). Table A.3 gives an overview of several indices that can inform resilience measurement at the national level. In the context of this project, the GIZ and UNU-EHS (2014) climate resilience indicators, Briguglio's (2016) Economic Resilience Index and Assarkhaniki et al.'s (2020) list of indicators are considered the most relevant entry points for identifying appropriate indicators.

Gaps and critical challenges in measuring resilience

The abstract and multidimensional nature of resilience makes operationalization and measurement difficult (Zhou et al. 2010; Béné et al. 2012). There are several gaps and critical challenges despite

numerous attempts to measure resilience. First and foremost, while theoretical analyses and conceptual papers have increasingly picked up on the importance of considering difficult to measure indicators and incorporating qualitative research findings, more progress is needed to advance metrics for such "softer" components like social network, power and equity (Rodina et al. 2017; Béné 2020). Furthermore, there is need for contextualization of historical, social, economic and biophysical characteristics.

This poses a particular challenge for a transformative approach to resilience as "insights on transformation and transformative capacity highlight that these depend on altering existing power relations, which involves recognizing the social and political processes that both undermine and constrain resilience" (Bahadur and Pichon 2016:32). The suite of indicators needs to account for processes and outcomes across spatiotemporal scales. Conversely, Olsson and Galaz (2012) suggest that a stronger focus on factors that can reduce resilience of undesired regimes is needed: "Disaster resilience is as much about enhancing the desirable resilience of 'bouncing back' as it is about 'breaking down' the undesirable resilience that undermines the objectives of sustainable and equitable development" (Mochizuki et al. 2018:380).

The methodological angles of how to examine and overcome power asymmetries in daily resilience-building remain ambiguous and the harnessing of scholarly advances for practical achievements challenging (Garcia et al. 2022). One gap in particular relates to equity indicators that can help empirically track the relationship between equity and resilience (Rodina et al. 2017). Rodina et al. (2017) expand the concept of social resilience and focus more prominently on notions of agency, gender, justice, equity and more equal relations of power as key factors that enable societies not only to cope with, but also to thrive in, the face of change. It is argued that "more equitable societies are more likely to be able cope and adapt in the face of change, as the capacities to learn, self-organize, innovate, and transform are more evenly distributed among different groups, as opposed to concentrated in the hands of a few" (Rodina et al. 2017:7). A recent UNDP ground-level study on resilience highlights the importance of leaving no one behind in resilience thinking. In Somalia's Gabiley region, a farmer indicated that he had spent upward of 65,000 USD to extract underground water. This adaptive practice of water extraction is beyond the reach of many farmers and consequently comes at a high opportunity cost locking out potential users.

Jones and Tanner (2017) offer a subjective resilience approach to capture the perception of marginalization, power dynamics, risk, sense of place, social norms, social cohesion and cultural identity. According to them, structured surveys comprising of a fixed list of questions and answers is a practical tool for collecting information. Bergamini et al. (2013) propose indicators like women's involvement in decision-making and access to resources, education and information using a likert scale (1–5). Dewulf et al. (2019) pose five questions to turn resilience from a value neutral into a politically explicit concept: (i)

Resilience of what; (ii) resilience at what scale; (iii) resilience to what; (iv) resilience for what purpose; and (v) resilience for whom?

The dangers of measuring the wrong thing

Risk management and resilience-building is embedded in a global political economy that prioritizes quantitative metrics and "hard sciences" over qualitative analysis and social sciences and is often guided by the idea that only what gets counted counts. It has been recognized by scholars and practitioners alike that this can miss important aspects that play a critical role in development and resilience (see UNDRR 2022; Hallegatte and Engle 2019) but relatively little progress has been made to overcome this quantitative bias.

At times, the quantitative focus does not only mislead but can cause direct harm as illustrated by the example of doctors who avoid taking on difficult surgeries with high mortality risk after mortality statistics were made publicly available (Hallegatte and Engle 2019:2). However, less drastic consequences can also cause problems when the reliance on indicators not only gives a simplified overview of the situation but distorts agendas and diverts policy attention away from more complex issues (Fukuda-Parr et al. 2014).

There is relatively strong agreement on the need for better metrics as scholars point to the shortcomings of existing approaches as outlined above. It has been argued that the field of climate resilience metrics "lacks a reliable body of research necessary to understand interactions between climate-development, learn from past performance, and systematically build knowledge through iterative replication of evaluation design" (Barrett et al. 2020:2). Data availability and lack of data disaggregation continues to undermine the usefulness of sustainable development data: "Far too many people remain excluded from or invisible in data while others are harmed by their inclusion in it" (Barbero et al. 2022). The strong focus on data-driven decision-making can in and of itself be problematic if we value what we measure rather than measure what we value.

In order to use resilience assessment to guide development policy and programming efforts, more work is needed to develop approaches that avoid quick-fix solutions and take questions of values, justice and power into full consideration.

THE STRONG FOCUS ON DATA-DRIVEN DECISION-MAKING CAN IN AND OF ITSELF BE PROBLEMATIC IF WE VALUE WHAT WE MEASURE RATHER THAN MEASURE WHAT WE VALUE.

Table A.3. Existing indicators and indices that could inform resilience at the national level

Name	Publisher	Components/indicators	Coverage and data sources
Sigma Resilience Index Global macroeconomic resilience index	SwissRe Institute	10 indicators, most weight on fiscal space (35 percent), monetary policy space (15 percent), banking industry backdrop (18 percent)	Mostly advanced economies, South Africa only African country covered, data from SwissRe, World Bank, WEF, IMF, WID, Maplecroft
Climate Resilience Indicators	GIZ and UNU- EHS (2014)	Range of exemplary indicators from global databases to assess and monitor climate resilience at the national level	Nearly global, uses mostly World Bank and UN data
INFORM Risk Index The INFORM Risk Index is a global, open-source risk assessment for humanitarian crises and disasters. It can support decisions about prevention, preparedness and response.	Disaster Risk Management Knowledge Centre/European Commission	Composite index similar to World Risk Index	Global
Resilience Index (not calculated)	Assarkhaniki et al. (2020)	Lists 318 indicators across five key resilience dimensions (social, economic, institutional, infrastructural, environmental)	Each indicator justified with a reference, but no data source given
Economic Resilience Index	Briguglio (2016)	Composite index of three equally weighted components: Macroeconomic stability index, adjusted market flexibility index and governance index	183 countries (imputed missing data); Sources: IMF database; Economic Freedom of the World Index; World Economic Forum data; Worldwide Governance Indicators; HDI, EPI
COVID-19 Economic Vulnerability and Resilience Indexes	Diop et al. (2021)	Nine indicators for resilience, not grouped into categories	150 countries based on publicly available data (World Bank and UNDP)
Global Resilience Index Initiative Aims to provide a globally consistent model for assessing resilience across all sectors and geographies. Will be a curated, open-source resource offering high-level metrics.	Multi-partner initiative	Potentially very hazard focused Still in an early phase, risk viewer is available online illustrating hazards, exposure, vulnerability and risk in open street map	The GRII will provide reference data on climate and natural hazard risks to inform and protect populations and economies, particularly in emerging and developing countries
Global Climate Risk Index 2021 Analyses to what extent countries and regions have been affected by weather-related loss events (storms, floods, heat waves) in terms of fatalities and direct economic losses.	Germanwatch	Fatalities/100,000 inhabitants Absolute losses in million USD purchasing power parity (PPP) Losses per unit GDP in percentage	Global (180 countries in 2021) MunichRe NatCatSERVICE, with economic and population data provided by IMF
Repository of Adaptation Indicators Intended to illustrate possible adaptation indicators and their application context, supporting the selection and context-specific formulation of indicators.	GIZ and IISD (2014)	Long list of indicators grouped into four focus areas: Climate parameters, climate impacts, adaptation action and adaptation result	Meta level indicators with few concrete examples and suggestions for data sources and collection methods
Global Multidimensional Poverty Index The global MPI is an international measure of acute multidimensional poverty covering over 100 developing countries. It complements traditional monetary poverty measures by capturing the acute deprivations in health, education and living standards that a person faces simultaneously.	Oxford Poverty and Human Development Initiative	10 indicators, grouped in three equally weighted dimensions: **Health** (nutrition, child mortality) **Education** (years of schooling, school attendance) **Living standards** (cooking fuel, sanitation, drinking water, electricity, housing, assets)	109 developing countries, based on Demographic and Health Surveys (DHS); Multiple Indicator Cluster Surveys, national surveys
Fragile States Index Analyses vulnerabilities that contribute to the risk of state fragility.	Fund for Peace	Comprehensive social science methodology to assess fragility in five dimensions (cohesion, economic, political, social, cross-cutting)	Nearly global, 178 countries

Table A.4. Examples of resilience assessments in Africa

Article	Scale	Methods	Data source	Stress/ context	Develop indicator/ index	Dimensions
Ajonina et al. (2021)	Urban, household	Mixed methods (includes FGD)	Household survey/own data collection	Flood	Flood vulnerability index	Three vulnerability components: susceptibility, exposure, resilience
Asmamaw et al. (2019)	Rural, household	Mixed methods, but quantitatively Heavy	Household survey/own data collection	Food insecurity, climate-induced shocks	Climate resilience index based on FAO (2016a)	11 components grouped into absorptive, adaptive and transformative capacity
Ballesteros and Esteves (2021)	General district level, East Africa	Quantitative	National census data	Coastal change	Social vulnerability to coastal change index	Exposure index and SVI; SVI uses eight socioeonomic variables (susceptibility, not so much capacity)
Bottazi et al. (2018)	Household, Dakar	Subjective resilience indicator framework	Surveys	Floods	Flood resilience index	Indicators are contextual: 24 indicators measure social dimensions of resilience
Dintwa et al. (2019)	General, district level Botswana	Quantitative	Population and housing census	Food insecurity	Social vulnerability index (based on Cutter 1996)	Complements original SVI by three additional variables to contextualize it
IGAD (2020)	National, IGAD region	Mixed methods, indicator-based	Combination of public data sources and data collection in member states	Climate, conflict, economic	State of resilience composite index	Combines 13 equally weighted indicators (weights flexible), no mention but can map onto the five key dimensions
Koomson et al. (2022)	National, 10 countries in sub-Sahara Africa	Alkire-Foster Methodology	Demographic and Health Surveys (DHS)	Disease	Disease outbreak resilience index (DORI)	Dimensions: Water/hygiene, physical distancing, energy and communication, and socioeconomic resilience. Each dimension has a subset of indicators.
Kotzee and Reyers (2016)	Household, South Africa	Quantitative, PCA	Census, official documents, biodiversity database	Flooding	Socioecological composite index	24 flood resilience indicators: Social, economic, ecological, institutional (stand-alone)
Mavhura et al. (2021)	District level, Zimbabwe	Quantitative	Publicly available data collected from National Statistics Agency and Food and Nutrition Council	Not specified/ inherent resilience to disasters	Composite resilience indices based on 26 variables	Five subdomains of resilience: Community capital, economic, infrastructure, social, health (based on DROP model)
Murendo et al. (2020)	Rural household, Malawi	Quantitative	Malawi Integrated Household Panel Survey (IHPS) 2013–2016	Drought, High input costs	Regression model	Use resilience pillars "adaptive capacities; assets; access to basic services"
Mutabazi et al. (2015)	Rural household, Tanzania	Quantitative	Own household survey	Changing climatic conditions	Composite index	11 variables, four subindices of resilience-building strategies (intensification, diversification, alteration, migration)
Myeki and Bhata (2021)	Individual household, South Africa	Mixed methods: Surveys and Interviews, Structural Equation Approach (Analysis)	Primary data	Food security	Drought resilience index	Assets, social safety nets, adaptive capacity, climate change

Table A.4. Examples of resilience assessments in Africa

Article	Scale	Methods	Data source	Stress/ context	Develop indicator/ index	Dimensions
Opiyo et al. (2018)	Household pastoralist system/ regional, Horn of Africa	Quantitative	Not specified	Drought	Indicator framework for social-ecological resilience to drought	Divided into absorptive, adaptive and transformative capacity
Rasch et al. (2017)	Household, South Africa	Agent-based modelling	Living standard and measurement survey	Rangeland	N/A	Social-ecological systems
Sono et al. (2021)	Regional, SSA National	Quantitative	World Bank Catalog, IMF, AfDB—Africa Information Highway, Climate Watch, Notre-Dame Global Adaptation Initiative (ND-GAIN)	Climate change	Composite national climate resilience index, vulnerability and readiness metric	Social, economic, infrastructure, environment, institution
Tambo (2016)	Household, Ghana	FAO resilience tool (2010) plus additional climate change contextual indicators to the adaptive capacity component	Surveys	Climate change	District-level climate resilience index (CRI)	Components: Income and food access; access to basic services; safety nets; assets; adaptive capacity; and stability—each component has indicators (23 total indicators)
Ulrichs et al. (2019)	Ethiopia, Kenya, Uganda	3a's model of resilience applied to social protection	Desk-based reviews, key informant and in-depth interviews, focus groups	Climate change	N/A	Social protection, cash transfers

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ANNEX 3

Unpacking Dimensions and Measures of African Resilience

This chapter critically engages with a wide array of literature to give a more in-depth overview of key components and indicators of resilience. It reflects on the definition of resilience across each of these components, its utility and evolution over time, application in the African context, and builds a table of potential resilience indicators and useful data sets for measurement. The key dimensions were identified as part of the literature review of the resilience concept and metrics that were discussed in annex 1 and 2.

The dimensions identified as most relevant are: social, economic, governance, infrastructural and environmental. This was confirmed in the high-level dialogue in Nairobi where experts agreed on the key dimensions although some questioned whether infrastructure merits its own dimension while others suggested security as an additional dimension. After an additional literature review and reflection, we kept the five dimensions which are in line with the literature. In a systematic review, Assarkhaniki et al. (2020) identify a total of 21 resilience dimensions and recognize our five subsystems as the ones that are most frequently used in existing literature. Security or fragility are rarely described as dimensions of resilience, but are an important risk factor captured either in stand-alone assessments such as the Global Conflict Risk Index (Halkia et al. 2020) or as part of broader risk assessment frameworks: The INFORM index for risk management uses current and project conflict intensity indicators to assess human hazard and exposure (in addition to exposure to natural hazards) (Marin-Ferrer et al. 2017).

We reviewed available metrics of conflict risk and fragility and suggested incorporating them in the governance dimension. In the following, we present key aspects and indicators for each of the five dimensions that make up the crown of the RoAR tree. Not all variables can be clearly assigned to one dimension as they contribute to different aspects of socioeconomic resilience. This is, for example, the case for variables related to health care that are used as indicators of social resilience by some authors and of (critical) infrastructure resilience by others. For some variables, the unit of analysis also changes the allocation to a specific dimension which can be the case for social protection: For a community or household, social protection is quite clearly an indicator of economic absorptive capacity. When assessing resilience at the national level, investments in social protection and social protection coverage are more commonly used to describe levels of social welfare and subsumed under social resilience.

Social dimensions of resilience

Social resilience is understood as the ability of social entities to address risks emanating from multitude of factors. Adger (2000:361) was one of the first scholars to give social resilience a definition and summarized it as “the ability of communities to withstand external shocks to their social infrastructure”. Using the (more recent) complex adaptive systems frame, social resilience can be defined “as the adaptive and learning capacity of individuals, groups and institutions to self-organize in a way that maintains system function in the face of change or in response to a disturbance” (Maclean et al. 2014: 145). Although abundant in literature, social resilience is still a contested topic especially in the context of climate shocks and disasters (Jacinto et al. 2020; Saja et al. 2019; Keck and Sakdapolrak 2013).

The focus here is on social entities such as individuals, families or households, communities, organizations, and specific social groups

(Saja et al. 2019). These social entities and markers are known to influence the level of resilience and vulnerability making it important to specify social components of resilience. Furthermore, social resilience "focuses on the attributes and processes that assist people, and the SES they participate in and influence, to manage through crises and to make successful transformations" (Maclean et al. 2014:146). Hence, learning and adapting are significant elements of building social resilience to shocks (Darnhofer 2010; Maclean et al. 2014; Saja et al. 2019). Here, we try to measure factors such as sense of involvement in community and associational networks and connection to the community (Peacock 2010).

Indicators of social resilience

A range of indicators of social resilience can be drawn from literature that usually combine sociodemographic characteristics with measures that seek to describe the web of interrelations that distinguish social resilience from individual resilience. Common indicators include education level, literacy rate, age, critical reflection and skill building, inequality, health care access (physicians, nurses and midwives per 10,000 population, medical capacity) and insurance coverage, knowledge of climate shocks, access to information, access to support services, community stakeholder organizations, social trust, social capital, social networks, social cohesion, and social equity (Magis 2010; Peacock 2010; Cassidy and Barnes 2012; Manyena et al. 2019; Ainuddin and Routray 2012; Aldrich and Meyer 2015; Tesso et al. 2012; Antwi et al. 2014; Dunbar et al. 2020; Tompkins and Adger 2004; Holladay and Powell 2013; Balaei et al. 2019; Figueiredo et al. 2018; Cai et al. 2018).

Measurements of social resilience are often complex because of the difficulties involved in measuring some of its factors (Saja et al. 2019). Researchers rely on proxies in cases where direct measurements or data are unavailable (Saja et al. 2019; de Boer et al. 2016). Sono et al. (2021) show that health, education and communication are factors that make up the social dimensions of resilience to climate change in Africa. Jacinto (2020) finds that educated households are more resilient to food insecurity than those with low education whereby training support for farmers is likely to increase their resilience. Similarly, the health status of a given society is often assessed by proxies such as the number of physicians per 10,000 people (Chandra et al. 2011, in Sono et al. 2021). Attributes of social resilience are also contextual; for example, migration is considered as an indicator of social resilience (Saja et al. 2019; Adger et al. 2002, Arora 2020) although mobility may also be thought of as a failure to adapt to shocks like the impacts of climate change (Islam and Shamsuddoha 2017).

Manyena et al. (2019) draw light on the human capabilities or substantive freedoms people value, giving primacy to the ideas of freedom and opportunity rather than the distribution of material goods.

Resilience in such conceptualization stems from more equitable societies. The argument being that such societies have higher capacity to learn, self-organize, innovate and transform. Social capital is an indicator of social resilience, especially in the African context (see Giovannetti 2010). According to Saja et al. (2019) social capital makes up one of the five key frameworks for assessing social resilience. It deals with organization among individuals and households through a network that offers solutions or helps people cope with challenges imposed on them from crisis situations (O'Connell et al. 2015; Boer et al. 2016; Saja et al. 2019; Alizadeh and Sharifi 2021). In Cape Town, South Africa, for example, households and businesses implemented water conservation strategies and applied behaviour changes in response to the water crisis between 2015 and 2018 that helped avoid the projected Day Zero intervention (City of Cape Town 2019; see case study 6).

These networks of support can be built through participation in civic organizations or volunteerism (see de Boer et al. 2016; Saja et al. 2019, Pfefferbaum et al. 2014) and are particularly relevant in contexts where formal social protection mechanisms are lacking. "The predominant view from the literature is that social protection, including cash transfer programmes, may protect beneficiaries from shocks, reduce use of negative coping strategies that undermine longer-term livelihood sustainability, and reduce household risk adversity towards more profitable, yet more risky, activities" (Asfaw und Davis 2018:231). Social capital and networks can serve as informal social protection systems and facilitate people's access to resources in times of crises. This can take many forms including saving and self-help groups, local social and solidarity organizations as well as more recent technology innovations such as mobile money that lowers the administrative burden of sending and receiving money to distant family or other social network members (see Mfossa 2019). Social cohesion can help households and communities work together to respond to shocks (City of Cape Town 2019; Cinner and Barnes 2019; Alizadeh and Sharifi 2021). Racism and discriminatory behaviours, on the other hand, are some of the manifestations of lack of social cohesion.

Qualitative studies of resilience have emphasized the importance of factors that are hard to measure in building community and social resilience, for example cultural and behavioural norms as well as religious practices (Saja et al. 2018). A study of community resilience in addressing the Ebola virus outbreak in Liberia highlights the critical role of "strong leadership, tight bonds and sense of kinship at the community level; trusted communication channels; and trust among various health system stakeholders" (Alonge et al. 2019).

Maru et al. (2014) identify traditional ecological knowledge as vital part of resilience in remote regions of Botswana, especially when food resources dwindle. Indigenous knowledge has recently gained traction as an important element of social-ecological resilience but is difficult to capture in the form of a quantifiable indicator (see Hambati 2021; Ebhuoma 2022; Kamara et al. 2018; Dube and Munsaka 2018).

Magis (2010) points out that equity ensures open access and equal opportunity which enables resources usage for the benefit of the entire community, enhancing resilience. In Mauritania, gender, tribal and caste differentiations plays a role in who has access to social safety nets (Bertelsmann Stiftung 2022). Women engaged in pastoral and agricultural activities in East and West Africa face several obstacles that impede their participation in economic activity (UNDP 2022). The gender-sensitive nature of resilience comes through in the example of early marriages in a recent UNDP ground-level study on resilience conducted in the Horn of Africa. Communities facing droughts undertake the early marriage of young girls in exchange for livestock as dowry payment. This often results in school dropouts which has detrimental effects on the rights, education and future opportunities of young women and girls. Some scholars therefore argue that a reframing of resilience around the notion of a just society is needed which would "focus more prominently on notions of agency, gender, justice, equity and more equal relations of power as key factors that enable societies not only to cope, but also to thrive in the face of change" (Rodina et al. 2017:7).

Governance dimensions of resilience

Governance dimensions of resilience are understood as the ability of formal and informal institutions to leverage knowledge, rules and experience to navigate risks (Aligica and Tarko 2014; Barma et al. 2014; UNDESA 2020). Institutional resilience is often described as a prerequisite for social and other dimensions of resilience and has been defined as "the ability of a social system (society, community, organization) to absorb and recover from external shocks, while positively adapting and transforming to address long-term changes and uncertainty" (OECD 2013).

Osbahr et al. (2010) found that formal institutions developed to respond to climate change and variability helps provide continuity in poverty reduction strategies and food security. They facilitate collective action and overcome the limitations of acting in isolation. They emphasize the need for social networks to link multiple institutional scales. Carpenter et al. (2001:778) posit the importance of learning as a form of adaptive management linked to resilience:

> Among the key elements of this idea are the needs to consider a range of plausible hypotheses about future changes in the system; to weigh a range of possible strategies against this wide set of potential futures; and to favour actions that are robust to uncertainties, reversible, and likely to reveal crucial new information about system function. Learning is advanced by institutions that can experiment in safe ways, monitor results, update assessments, and modify policy as new knowledge is gained.

According to Aligica and Tarko (2014), institutional design with flexibility and adaptability can usher resilience. The role of institutional aspects of resilience were buoyed by Ostrom's seminal

work on governance in 2009. She argued that institutional diversity and polycentric governance consisting of multiple decision makers operating at different scales can help solve common resource problem.

The overall resilience of social-ecological systems is dependent on the nature of governance mechanisms in place, which relates to institutional and political dimensions of resilience (Carabine and Wilkinson 2016; de Hoyos Guevara and Bertoncelo 2020). Thus, measuring resilient governance seeks to capture a complex and interwoven set of legal norms, policies, and the role of formal and informal institutions, all of which guide human operations and behaviour (Herrfahrdt-Pähle and Pahl-Wostl 2012). Institutions, governments, civil society and the private sector are all part of this institutional mechanism (Figueiredo et al. 2018).

The application of institutional resilience is widespread. At the national level, flood resilience measures emphasize the institutional or governance dimension of resilience (McClymont et al. 2020). Similarly, Sono et al. (2021) assert that apart from institutions, national-scale resilience assessments focus on systems and policies that enable national governments to address climate shocks. This thinking is applicable to other types of shocks. For example, responses to sociopolitical shocks may spur changes within institutional structures, systems and policies that result in transformative outcomes within a system, although these changes may take time (Herrfahrdt-Pähle et al. 2020).

Being able to respond quickly to shocks and changes in the system can be an important indicator of resilience to sudden-onset shocks (Walker 2020) and is often described in terms of emergency preparedness procedures and systems. Here, it is also important to consider speed/response time when designing institutional frameworks as having too many steps in a reporting and approval procedure significantly slows response time. The widespread trend of more and more checks and approval processes to promote safe operating procedures (including legal safety) does not promote resilience, it reduces it (Walker 2020).

Governance indicators

Commonly cited indicators of institutional resilience or governance in view of diverse types of shocks include leadership, long-term vision, adaptive management, participation, good governance, disaster experience, transparency, existence of a national emergency preparedness and response plan, specific disaster legislation, political stability, access to information, control of corruption and fraud, accountability, participation and engagement, capacity-building/training programmes, and early warning information (Briguglio 2014; Bahadur et al. 2010; Holladay and Powell 2013; de Hoyos Guevara and Bertoncelo 2020; Allen and Giovannetti 2011; Sono et al., 2021; Gasser et al. 2020; Cai et al. 2018; Giovanneti 2010; Shah et al. 2018; Figueiredo et al. 2018).

Some indicators are visible at the local city level of resilience assessment. For example, Accra's resilience strategy report emphasizes aspects of transparency and accountability which enable institutional resilience to potential shocks and current stresses on the city (Accra Metropolitan Assembly 2019). On the other hand, Kotzee and Reyers (2015) emphasize interventions that support "proaction, preparation, response & recovery". These may include mechanisms in place that facilitate public engagement, partnerships, risk assessments, early warning systems, data management, financing and others (Kotzee and Reyers 2015).

In the area of partnerships, resilience to COVID-19 in Nigeria benefited from public-private partnerships that supported the acquisition of medical supplies like protective gear for health workers (Blanton et al. 2020). DRC has faced 12 outbreaks of Ebola virus (Nachega et al. 2020) over the past 40 years. It was able to utilize coordination teams, community-based screening, testing, contact tracing, risk communication and case management developed in the past to address COVID-19. For health systems, partnerships are essential because they enable trust building across actors, which is necessary for institutional resilience against shocks (Blanchet et al., 2017). In urban water systems, legitimacy and authority are considered important indicators of resilience (Polonenko et al. 2020; Herrfahrdt-Pähle and Pahl-Wostl 2012). Briguglio et al. (2006) emphasize that without good governance it would be more likely that adverse shocks lead to economic and social chaos and unrest, thereby exacerbating the effects of economic vulnerability. Good governance, in turn, is deemed to strengthen economic resilience "because external shocks would be better absorbed and counteracted in an atmosphere of predictable laws and credible policies" (Briguglio 2014: 20).

Sono et al. (2021) present an assessment of resilience to climate change in sub-Saharan Africa that shows high levels of institutional resilience for Botswana, Mauritius and Cape Verde on account of government effectiveness, control over corruption, and a high level of accountability to implementing climate programmes and policies, demonstrating overall higher resilience to the impacts of climate change when compared to other countries.

Economic dimensions of resilience

Economic resilience is understood as the ability of economic and monetary systems to withstand or bounce back or transform from the negative effects of external shocks (Pendall et al. 2009; Martin 2012; Rose and Krausmann 2013; Briguglio 2014). It can be described in both micro- and macroeconomic terms. Hallegate (2014) suggests that microeconomic resilience has two dimensions: Instantaneous resilience, which is the ability to limit the magnitude of immediate production losses for a given amount of asset losses, and dynamic resilience, which is the ability to reconstruct and recover.

Macroeconomic resilience can be defined as the "ability of an economy to resist a shock and maintain existing levels of economic activity, in this case employment levels, or to recover to the pre-shock peak within a given period of time" (Bristow and Healy 2018:273). Rose and Krausmann (2013) describe economic resilience as taking two forms—inherent and adaptive. Inherent resilience is based on characteristics built into the system, whereas "[a]daptive resilience arises out of ingenuity under stress" (Rose and Krausmann 2013:74).

The focus of resilience here is on a functioning and healthy economy for a community in crisis (Scherzer et al. 2019). This leads to debates around the role of financial capacities and raises questions about the availability of and access to individual and public assets, and about the distribution of wealth across social collectives (Kruse et al. 2017). Economic resilience manifests itself in the ability of economic systems to recover from shocks and return to growth trajectories and the capacity to address threats by leveraging economic power, internal dynamics, number of external connections, and possession of resources (Martin 2012).

Indicators of economic resilience

Indicators of the economic dimensions of resilience vary between those that look at the national level and include poverty rates, employment rates, GDP, foreign development assistance and aids, macroeconomic stability (debt level, currency reserves, inflation), macroeconomic management, public spending on social assistance as percentage of GDP, access to credit and financial resources, economic diversification, income inequality, public-private partnerships, female workforce participation; and those that look at the community or household level and include diversity of income sources, individual and community savings, house ownership, access to pensions, access to financial resources and loans (Scherzer et al. 2019, Manyena et al. 2019; Briguglio 2014; Shah et al. 2018; Tesso et al. 2012; Morkūnas et al. 2018; Dunbar et al. 2020; Sono et al. 2021; Wang and Li 2022). International financial institutions have put in place instruments to ensure countries' financial liquidity in the aftermath of disasters that can support an economy's absorptive capacity. The World Bank's contingent credit line, Catastrophe Deferred Draw Down Option (Cat DDO), is one such measure providing contingent loans for countries that have a disaster risk management programme in place (World Bank 2018).

The global resilience programme BRACED (Building Resilience and Adaptation to Climate Extremes and Disasters) creates a typology of risks for 12 BRACED countries in the Sahel, East Africa and Asia that can be used to inform approaches to building resilience (Simonet et al. 2017). Analysing the effects of disaster occurrence on economic growth, the authors highlight that drought has a disproportionate impact compared to other disasters and finds that the share of population affected by disasters has a significant negative effect on

economic growth. They conclude that "[e]conomic diversification and trade openness, or insurance coverage could be important determinants of national capacity to absorb external shocks" (Simonet et al. 2017:50).

Briguglio (2009, 2016) has developed a widely used composite index of economic resilience where he combines three equally weighted components of macroeconomic stability (debt-to-GDP ratio, current account balance, inflation), adjusted market flexibility (constructed from data on labour market and business regulations and adjusted for financial prudence) and governance (public, social, environmental) to comparatively assess countries' resilience to external shocks.

Social protection—linking social and economic resilience

Social protection programmes at the national scale have the potential to build adaptive, absorptive and anticipatory capacities toward resilience to shocks (Ulrichs et al. 2019). Social protection also plays an important, shock- and hazard-independent role in building resilience and contributes to overall social development and poverty reduction (Pino and Confalonieri 2014). Unemployment, lack of assets and financial exclusion hamper the resilience of individuals and households (Koomson et al. 2022).

Social safety nets such as cash transfers are a common social protection measure used in the African context (Bousquet et al. 2016; Bertelsmann Stiftung 2022; Jacinto et al. 2020; Tambo 2016; de Boer et al. 2016; Myeki and Bahta 2021). For example, in its National Strategic Resilience Framework (2019–2030), the Kingdom of Lesotho highlights the importance of social safety nets for building resilience to climate change. In South Africa, safety nets in the form of cash provisions, farm inputs and training aid in building the resilience of livestock farmers to food insecurity (Jacinto et al. 2020). Social protection programmes such as the Sahel Adaptive Social Protection Program (SASPP) have targeted women as primary beneficiaries of cash transfers due to the recognition of the wider political economy that may exclude participation from women (World Bank 2020). In a study of northeast Ghana, Tambo (2016) found that male-headed households were more resilient to climate change than female-headed households, indicated by the number of safety net programmes a person belonged to. Targeting the most vulnerable or those likely to be excluded comes with the challenge of requiring access to the right type of information (Pino and Confalonieri 2014) and has often proven difficult.

Many social development scholars thus argue in favour of universal social protection systems, in particular for contexts of widespread poverty (UNRISD 2022; Mkandawire 2005). While safety nets as well as informal sources of social protection provided through social networks can alleviate the impacts of shocks and stresses in times of crises, national social protection programmes have been

found to contribute the most to building adaptive, absorptive and anticipatory capacities for resilience-building (Ulrichs et al. 2019).

Hence, efforts to build resilience must consider the wider socioeconomic and political factors of vulnerabilities that may exclude certain groups of people (Rodina et al. 2017). Tackling the challenge of designing and implementing universal social protection programmes to reap their many developmental benefits (UNRISD 2022) provides a direct policy entry point for building socioeconomic resilience.

Infrastructure dimensions of resilience

Infrastructure is vital to societies (Shrier et al. 2016) and critical to attaining sustainable development. The UN's SDG 9 specifically aims to "build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation". Infrastructure such as transportation networks, energy systems and communication systems are vulnerable to climate-related shocks. At the same time, these are systems that enable people to respond to and cope with shock events. For example, communication systems enable people to share information to mitigate and respond to disease threats (Koomson et al. 2022).

The infrastructural dimension of resilience relates to the abilities and capacities of the built environment and infrastructural systems to absorb, adapt or recover from shock events (Petrović 2018; Peacock 2010, Berkeley and Wallace 2010; Vugrin et al. 2010). It is often expressed in terms of "the ability to reduce the magnitude and/or duration of disruptive events" (Berkely and Wallace 2010:5) or the capacity "to minimise performance loss due to disruption, and to recover a specified performance level within acceptable predefined time and cost limits" (Gay and Sinha 2013:340).

Most studies focus on critical infrastructure and/or early warning systems as illustrated below, but some authors also point to the importance of 'regular' infrastructure development for resilience to shocks. Nakamura et al. (2020:1838) analyse two panel data sets in Ethiopia—on rural households and transport networks—to show that rural road development contributes to household welfare outcomes, suggesting that "by connecting remote communities to markets and the main road network, rural roads have substantially supported the welfare and resilience of rural households in shock-prone Ethiopia". Small-scale infrastructure in sectors such as agropastoral storage, energy and water can support the economy in African borderlands and in strengthening value chains (UNDP 2022).

Critical infrastructure resilience

Modern society is built and increasingly reliant on the smooth functioning of a set of complex and interconnected, critical infrastructures (Commes and Walle 2014; Chopra 2016). These include goods and services such as transport network, power, water

supply, telecommunication and health care. They have grown larger, more complex and interlinked over time. The fundamental obligation of infrastructure is to ensure critical service to people (Hallegatte et al. 2019; Commes and Walle 2014). This can be compromised by a variety of factors like system failure, vandalism, cyberattacks or natural hazards (Hallegatte et al. 2019). The interruption of critical infrastructure in times of crisis has many negative consequences including loss of life, impacts on health and well-being as well as economic disruption and supply chain issues. Such interruptions are on the rise due to both human and natural hazards (Tsavdaroglou et al. 2018).

The implications of damage to infrastructure can be significant. One study from the World Bank reported how investments in climate-resilient hydropower infrastructures in Africa could lead to an increase in revenues of 20 to 140 percent; on the other hand, inadequate planning could result in revenue losses ranging from 5 to 60 percent (Cervigni et al. 2015). In low- and middle-income countries, direct damage to infrastructure assets within transport and energy systems by natural hazards is estimated at about USD 18 billion per year (Hallegatte et al. 2019). Several recent systematic reviews of literature on resilience and (critical) infrastructures offer useful insights for resilience assessment (Guo et al. 2021) and frameworks have been developed using both quantitative and qualitative methods (see, for example, Donovan and Work 2017; Panteli et al. 2017; Argyroudis et al. 2019).

Multi-hazard early warning systems

Early warning systems aid in adaptive (Tambo 2016) and anticipatory capacities (Boyd et al. 2013) for resilience-building against shocks. Access to information is relevant to build resilience to shocks, and specifically contributes toward the anticipatory capacity of households (Bottazi et al. 2018). However, early warning systems may be more applicable to shocks that are predictable (Karamagi 2022). It is uncertain whether this may vary by the nature of a shock event. In Niger, Rainwatch, a weather monitoring system, was found to be successful for building resilience to food insecurity and drought caused by the monsoon event that occurred in West Africa between 2011 and 2012 (Boyd et al. 2013). Lesotho in its National Strategic Resilience Framework highlights the importance of early warning systems for multiple hazards to avoid and attenuate the effects of shock events (Government of Lesotho 2019).

In East Africa, early warning test kits have been developed to support health screenings (RAN 2017). In Southern Africa, a mobile web-based tool called Mobile Solutions for Marginalised Communities (MOSAC) was developed to provide information enabling access to markets (RAN 2017). Interventions like this can foster response to trade-related shocks. Many challenges related to infrastructure remain, which hampers resilience. In Kenya, for example, “[s]ome of the challenges relate to financing of urban infrastructure projects, and

include strain on central and local government funding due largely to insufficient public funds and misappropriation by relevant authorities" (Chirisa et al. 2016:121). Poor town planning, bad governance and corruption among other factors seem to be conspiring against the building of resilient urban infrastructure in Abuja (Usman and Tunde 2010), highlighting the interlinkages of the different dimensions of resilience.

Indicators for infrastructure resilience found in the literature include exposed infrastructure, building codes, sanitation access, electricity access, hospitals network, emergency shelters, early warning systems (coverage of early warning information per 100,000 people, access to disaster risk information at national and local levels, emergency evacuation plans), repair cost, design loads, power outage infrastructure, operational spares, contingency arrangement infrastructure, response plans and contingency arrangement infrastructure density (Peacock 2010; Sono et al. 2021; Fallah-Aliabadi et al. 2020, van der Merwe et al. 2018; Saurin et al. 2013;Cantelmi et al. 2021; Sathurshan et al. 2022; Meng et al. 2018).

Environmental dimensions of resilience

The environmental measure of resilience is understood as the ability of natural stocks and ecosystems to absorb unforeseen changes and maintain essential functions and feedbacks (Seidl et al. 2016; Peacock 2010; Scheffer et al. 2015; Walker et al. 2004). These stocks can take the form of water, biodiversity, soil or food production (Scherzer et al. 2019). Holling (1996) identified ecological resilience as the magnitude of disturbance that a system can absorb before shifting to an alternate regime or system state. SANBI (2014:3), in the South African context, defined ecological infrastructure as "naturally functioning ecosystems that deliver valuable services to people, such as healthy mountain catchments, rivers, wetlands, coastal dunes, and nodes and corridors of natural habitat, which together form a network of interconnected structural elements in the landscape".

An important feature of ecological resilience is that it views systems as having multiple alternate equilibria that differ in processes, structures, functions and feedback. Examples include eutrophication of lakes and coastal oceans, shifts among grassy and woody cover types in rangelands, degradation of coral reefs, and regional climate change (Scheffer et al. 2001; Folke et al. 2004; Sasaki et al. 2015). Environmental dimensions are important for resilience as life on earth depends on healthy, functioning ecosystems which provide a range of regulating, provisioning, cultural and supporting services (see MEA 2005) and can reduce vulnerability to climate- and weather-related shocks (Seddon et al. 2020). Additionally, "[a]n important regulating service of forests also related to water is the protection of society and human infrastructure against natural hazards such as flooding and snow avalanches" (Seidl et al. 2016:123).

According to the State of Biodiversity in Africa report, ecosystem and biodiversity loss are increasing at alarming rates (UNEP-WCMC 2016; IPBES 2018). According to Dewees et al. (2011:51), "[t]he most degraded areas are the southern margin of the Sahara Desert and a patchwork of areas throughout West Africa; scattered pockets in all the East African nations; much of Madagascar; and a distinct band along the west coast of southern Africa, including coastal areas of Namibia". Remotely sensed data indicated negative patterns of change in ecosystem health across sub-Saharan Africa (Dixon et al. 2003; Rouget et al. 2003; Ojoyi et al. 2015) and the Global Forest Resources Assessment shows that Africa was the world region with the highest rate of net forest loss in the period 2010–2020 (FAO 2020). The prevention of species loss and extinction and the maintenance of key ecosystem services and of biocultural identities all contribute to enhancing resilience (De Groot et al. 2013, see box A.4).

Box A.4. A narrative of environmental resilience

The Maradi and Zinder regions of Niger witnessed seriously degraded ecological integrity during 1930–1970 on account of tree clearance, land cultivation and tree monoculture. These trends were further exacerbated during the drought of the 1970s with tree clearance, migration and livestock culling, and population pressure. In the early 1980s onward, the re-establishment of local control and tree cultivation was initiated. These efforts saw farmers experiment with new techniques such as novel silvicultural practices where they would carefully prune "shrubs" in such a way that enabled them to grow to full-sized trees. The resulting tree growth increased tree density and further reinforced the sense of ownership and other variables in the chain of feedbacks. Resilience increased as a wave of innovation based on farmer-managed natural regeneration progressively reestablished woodland tree cover over 5 million hectares and local communities relearned-by-doing how to successfully manage their own people and landscapes.

After the drought of 2005, governance and local tree cover rapidly recovered at local levels; this recovery was reinforced by healthy links across the region mediated by herders, NGOs and even the national government. Several interventions at different scales and at different times combined to foster successful woodland regeneration and the reforestation of over 5 million hectares. These ranged from the intentional, NGO-supported discovery and propagation of farmer-managed natural regeneration to the unintentional decrease of national oversight of forestry practices in the Maradi/Zinder region. It entailed new governance mechanism improvements in farmer-herder relationships, NGO interventions and local ownership.

Source: Sendzimir et al. 2011.

The livelihood dependence on natural resources and significant contributions to GDP is one of the reasons environmental resilience has gained importance in Africa. Agriculture contributed 19.4 percent to the GDP of sub-Saharan Africa in 2020 (FAOSTAT 2022) and accounted for 53 percent of employment in 2019 (World Bank Data 2022). Furthermore, many African communities have a strong sense

of place attachment, and their well-being is inextricably attached to nature. A case in point is Lilongwe (Malawi) where 70 percent of community members rely on natural resources for their livelihoods (Allan Kwanjana, Director of the Parks, Recreation and Environment Directorate, Lilongwe City Council, personal communication, 2016 in O' Farrell et al. 2019).

Indicators of environmental resilience

Measures of environmental resilience attempt to assess either the characteristics or status of a given ecosystem in view of assessing its resilience or the governance and management systems in place to protect ecosystems and foster their resilience. For example, a nation's percentage of forest cover is often used as an indicator of environmental resilience due to the ecosystem and economic benefits derived from forests (Sono et al. 2021). Similarly, the percentage of protected marine and terrestrial areas can indicate environmental resilience at the national level (Sono et al. 2021). Other measures look at the sustainable management of common resources (Dunbar et al. 2020).

Some indicators aim to assess the state of ecological resilience in terms of species diversity; water quantity and quality; percentage of forest to total land area; percentage of availability of quality agricultural land and forests; occurrence and severity of wildfire buffers; livestock grazing; and health of local ecosystems, whereas others focus on resource governance and the process of fostering environmental resilience by measuring ecological footprints, the soundness of natural resource management practices and environmental performance (Seidl et al. 2016; Mori et al. 2013; Hessburg et al. 2016; Chambers et al. 2019; Manyena et al. 2019; Serfillipi and Ramnath 2018; Oxfam 2013).

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ANNEX 4

Material and Method

We applied qualitative methods to answer the research questions. Our effort was grounded by the question: What leads to resilience in Africa? Through this question, we learned about constitutive factors of resilience and its measurement. The main research questions are:

1. How do African stakeholders, including civil society and communities, understand and define resilience?
2. How do we conceptualize and assess resilience in Africa in a participatory and deliberative manner?
3. How can resilience address structural vulnerabilities in Africa?

We agree with Darnhofer et al. (2010), Schipper and Langston (2015), Spearman and McGray (2011), and Carpenter et al. (2001) that resilience value add is best served by identifying more general “rules of thumb”. We are better served by seeing resilience as a guiding phenomenon that is applicable across scales of time and space. We find no one or even set of indicators to be an accurate reflection of resilience and the exercise of quantitative numbering does not provide an accurate reflection at this scale. A qualitative description, while more generic, allows a wider group of stakeholders to understand and use this approach to steer the systems toward a desirable trajectory without being over prescriptive.

Our study includes five main methodological steps that are closely connected: (i) A comprehensive analysis of academic and grey literature for key theories related to resilience; (ii) semi-structured interviews with experts engaged in resilience efforts in Africa; (iii) case studies that span geography, risk profile and stakeholder groups in Africa; (iv) high-level deliberations; and (v) the development of the RoAR approach. We draw upon findings from the extensive cross-disciplinary literature review, field case studies, workshops, semi-structured interviews with various stakeholders and observations to develop a matrix for assessing the different categories of resilience in Africa. Here, we take inspiration from the work of many researchers who have identified characteristics of resilience in diverse contexts and apply that body of knowledge. We present the RoAR tree composed of dimensions/policy entry points and indicators (crown), resilience enablers and capacities (trunk), and roots that describe characteristics

of a desirable system. We began by searching for a wide set of academic and grey literature, media reports, books, conference papers, working papers on resilience and blogs to systematize resilience into thematic criteria and similarities and differences. We chose documents based on their alignment with our research questions as well as contextual depth. We used a combination of keywords in Google Scholar, including 'resilience Africa', 'resilience index', 'resilience indicator', 'social resilience', 'institutional resilience metrics', 'infrastructural resilience', 'ecological resilience', 'economic resilience', 'institutional resilience Africa indicators', 'social resilience Africa indicators' and 'economic resilience Africa indicators'. The time duration of the search was between 2000 and 2022 and the language of study was English given the familiarity of the research team.

The abstracts of these papers were screened and those related to the research questions were selected for further analysis. We undertook several rounds of reading of the texts to identify themes, concepts and patterns. Moreover, they had to justify the factors, indicators, variables, models or instruments that affect the resilience of systems. These offered a reference for the development of our approach. We leveraged a snowballing method and personal recommendations to add other relevant studies. In snowballing, we added relevant studies that were mentioned in the bibliography section of the reviewed studies. We filtered relevant studies based on the reading of the title and abstract. The studies that made the cut were read through and formed the basis of the analysis.

We strived to leverage lessons from a critical mass of literature as well as a richness of disciplines, geographic location of studies and spatio-temporal distribution, among others. Our approach was iterative as opposed to systematic review as we wanted to reach "theoretical saturation"—a point at which additional studies would not contribute substantially to our findings (Saunders et al. 2018; Hennink and Kaiser 2020). The objective was to use literature as a springboard for discussion of how to understand and define resilience in practice. The multi-dimensionality of resilience and focus on practical application informs this choice. As the project continued, a more targeted literature review focused on different aspects of the RoAR approach and examination of recent publications. This included social, economic, institutional, ecological and infrastructural and other relevant data of interest.

Despite the overall broad approach to the review, we excluded literature that focuses too narrowly on one specific sector or topic and does not lend itself for assessing resilience at a broader, systemic level. For example, we did not look at resilience in the context of psychology and child development, engineering resilience, resilience of IT systems/cybersecurity or purely ecological resilience studies/ studies in forestry.

Semi-structured interviews

Semi-structured interviews were carried out with practitioners between April and September 2022. The selection of practitioners was based on two factors: Long-standing work in Africa and expertise in resilience-building. The interviews were conducted online, and the duration ranged between 20 and 90 minutes. The questions were centred on understandings of resilience from different perspectives and the application of resilience-building efforts in Africa. Moving from general questions regarding interviewees' views on resilience and the particularities of using resilience in Africa, the interviews transitioned to more specific questions regarding gaps in current approaches or uses of resilience and gave respondents' time and space to expand on their observations and offer insights into how resilience-building can be made more effective. The interviews helped situate findings from the literature review and complemented the academic articles with practical views and examples of resilience-building projects as well as particularities and challenges in Africa.

Case studies

An active search for case studies that demonstrate lessons, good practices and successes in resilience and risk management efforts in Africa was carried out through the examination of academic and grey literature between December 2022 and February 2023. The selection process of case studies was based on three factors: (i) Geographic spread across Africa; (ii) different risk profile; and (iii) stakeholder group. We used a combination of keywords in Google Scholar including 'conflict and violence Africa', 'resilience stories', 'COVID-19 lessons Africa', 'Ebola learnings Africa', 'drought resilience Africa', 'leadership and resilience', 'pastoral resilience', 'urban resilience Africa', 'anticipatory resilience' and 'institutional resilience'. The focus was on understanding factors that proved useful in addressing risks and the lessons that could be drawn from these. Eight studies that met the criterion were selected and the merits of each study was discussed by the research team leading to the selection of six. The studies were corroborated and supplemented with other resources to ensure accuracy.

Stakeholder deliberations

The research process included multiple rounds of stakeholder deliberations. In May 2022, a high-level dialogue titled "Re-examining Resilience in the African Context: The Concept, Dimensions, Measuring, and Way Forward" was held in Nairobi, Kenya. Participants included civil society, government institutions, academia, and international bilateral and multilateral organizations. The discussions focused on different aspects of risks in the African context as well as approaches to resilience measurement and analysis. Here, we tried

to grasp the resilience context of Africa. What made it unique? How to customize resilience for its uniqueness? What opportunities and challenges lie in its wake? The participants were selected based on their long-standing experience working on development, humanitarian, and resilience and disaster risk reduction efforts in Africa and elsewhere. The sessions included multiple presentations and group discussions on the most pertinent elements of a resilience concept tailored to Africa. It concluded with three groups of participants presenting their own iteration of a resilience schematic.

Subsequently, two online review meetings on “Testing the Waters: State of Resilience in Africa Framework” were held on 13 September and 7 November 2022. The participants from the earlier stakeholder deliberation in Nairobi, UNDP country office teams and other field experts, were presented with the early findings and iterations of this study followed by open deliberations for approximately two hours. The discussion entailed several elements including on-the-ground findings, contextualization of the RoAR approach for Africa, suitability of indicators and challenges to keep in mind for operationalization, among others.

In December 2022, a follow-up multi-stakeholder deliberation titled “The Roots of African Resilience Approach and Framework Stakeholders Pre-validation Workshop” was held in Naivasha, Kenya. Participants included experts from African Union member states, Regional Economic Communities, the African Union, UN agencies, development partners, academics, civil society actors and think tanks. The RoAR tree and refined research findings were presented. Each aspect of the RoAR tree, including the name and use of the

tree analogy itself, was then critically analysed in breakout groups. Deliberations were led by session facilitators with expert input from participating representatives. Here, we tried to grasp the logic of resilience in Africa, risk profiles, indicators selection, and operational and measurement challenges. The sessions entailed group work and plenary discussions. The feedback and ideas presented in these deliberations were used to revise the work and enhance the analysis.

Following the Naivasha workshop, a round of deliberations between the AUC DRR unit, UNDP Resilience Hub for Africa and UNRISD guided the substantive revision and contextualization of the report, including the development of the case studies and the expansion of the indicator list. In October 2023, the AUC Interdepartmental Roundtable on Roots of African Resilience (RoAR) took place in Bishoftu, Ethiopia and brought together 15 experts from AUC departments with UNDP and UNRISD to review the definition and key components of resilience as proposed by the RoAR report. The Roundtable provided the opportunity to elaborate on African specificities and the relevance of the proposed definition and approach for the continent. The AUC experts confirmed the need for an Africa-specific resilience approach and welcomed the RoAR as a critical tool for building resilience and enabling a harmonized approach. They provided detailed feedback and comments on the different elements of the RoAR approach in order to strengthen the research findings. This feedback provided the basis for the final revision and adjustments of the present report.

Data analysis

The data collected through the literature review, interviews and multi-stakeholder deliberations was assigned descriptive codes. The purpose of conducting the literature review was to deductively understand what leads to resilience and through this learn about constitutive factors of resilience. An active search for resilience metrics and indicators was carried out, which entailed multiple rounds of careful reading of the texts to identify themes and patterns to inform and shape the conceptual framework as well as our analysis. Our analysis selected thematic categories that were prominent and widespread across the literature. We also considered differences and similarities across different sets of literature. We selected the most salient factors addressed in the literature with a focus on those we deemed most relevant for our study.

The deliberations were more inductive in nature to arrive at context-specific and empirically rich results. They allowed us to connect resilience theory with practice, particularly in the context of Africa. It brought to the fore the emphasis on structural factors that build resilience and subjective understanding. The preliminary categories were refined and recalibrated through the course of the analysis. The compiled data helped us build a comprehensive understanding inclusive of a vision of resilience, structural drivers

of vulnerability, and a set of components and indicators of general resilience. Overall, we iteratively used these five different strands to present a compelling, evidence-based approach to enhance the understanding of resilience.

Indicator selection criteria

We based the selection of indicators on relevance, reliability and accessibility:

1. **Relevance:** We selected indicators linked directly to resilience based on the literature review and deliberations. Thus, the indicator had to provide a high level and strong rationale of links to resilience in general, or its specific dimensions.
2. **Reliability:** We selected indicators where data sets were provided or compiled by recognized and credible international and national institutions with some measure of reliability and wide applicability (for example, WHO). This is not to say other data sources do not enjoy credibility but that this criterion is fit for the practical purpose of this study.
3. **Accessibility:** We selected indicators where data was available for most, if not all, African countries in the public domain. The objective of resilience efforts cannot succeed unless the indicators can be replicated over time and in different locations.

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Acronyms	
ABES	Africa Blue Economy Strategy
AMHEWAS	Africa Multi-Hazard Early Warning and Early Action System
APRM	African Peer Review Mechanism
AWV	Africa Water Vision
AUC	African Union Commission
CAADP	Comprehensive African Agricultural Development Programme
GDP	Gross Domestic Product
INFORM	Index for Risk Management
MS	member state
PIDA	Programme for Infrastructure Development in Africa
PoA	Programme of Action
REC	Regional Economic Communities
RoAR	Roots of African Resilience
SASPP	Sahel Adaptive Social Protection Program
SDG	Sustainable Development Goal
SSE	Social and Solidarity Economy
UN	United Nations
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNEP	United Nations Environment Programme

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ROOTS OF AFRICAN RESILIENCE

A Transformative Approach

The Roots of African Resilience (RoAR)—A Transformative Approach offers a holistic and flexible approach to resilience, tailored to the unique challenges and opportunities of the African context. The report was developed through extensive stakeholder engagement and rigorous research, RoAR underscores the importance of integrating local knowledge with scientific insights.

RoAR introduces a comprehensive approach—a tree of resilience—that connects structural drivers, enablers, and policy entry points to build resilient systems across various scales. This tool guides stakeholders in exploring the interconnections between risks and resilience, offering a flexible approach to assessment and strategy development. RoAR's strength lies in its adaptability to specific geographic, social, and political contexts while fostering a shared sense of understanding of resilience across Africa.

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