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# Determinants of community resilience to climate change and the contribution of water, sanitation and hygiene

UTS Institute for Sustainable Futures and  
UNICEF East Asia and Pacific Regional Office



Photo credit: Juliet Willetts, ISF

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## About the authors

The University of Technology Sydney - Institute for Sustainable Futures (UTS-ISF) conducts applied research to support water and sanitation policy and practice in Asia and the Pacific. UTS-ISF provide partners with technical expertise including climate change; planning, governance and decision-making; gender equality and inclusion; public health and water resources management; monitoring; and policy and practice advice. [www.isf.uts.edu.au](http://www.isf.uts.edu.au)

UNICEF East Asia and the Pacific Regional Office (EAPRO) works in 13 East Asian countries and 14 Pacific countries and territories to help provide access to clean water and reliable sanitation, and to promote basic hygiene practices that keep children safe from infectious diseases. UNICEF EAPRO partner with governments, civil society organizations and communities themselves to construct and rehabilitate WASH facilities, bringing climate-resilient services straight to children in need.

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# Executive Summary

Resilience across all development sectors, including water, sanitation and hygiene (WASH), must be strengthened to address the evolving risks of climate change and ensure people's basic needs are met. Approaching WASH interventions with a wider focus on community resilience can help ensure that all people have access to safe WASH services, whilst also enabling the overall resilience of rural communities in low- and middle-income countries (LMICs) by enhancing adaptive capacity and supporting climate-resilient development in other sectors and across other dimensions.

This study examined literature on the determinants of community resilience and considers opportunities and challenges for monitoring how WASH interventions contribute to enhancing those determinants. It was carried out by the University of Technology Sydney – Institute for Sustainable Futures (UTS-ISF) in partnership with the UNICEF East Asia and Pacific Regional Office (EAPRO).

The study examined: (i) academic review papers that canvas the breadth of proposed determinants of community resilience, (ii) aid and development organisational frameworks on community resilience, and (iii) critiques of the concept of community resilience. The study then collates the findings on determinants of community resilience and makes conclusions and recommendations for monitoring WASH contributions to community resilience.

Existing systematic and non-systematic review papers demonstrate that researchers and practitioners claim a wide breadth of determinants that contribute to or are essential for community resilience. These determinants can be organised into five broad domains of social, economic, institutional, infrastructural, and environmental determinants. The multiplicity of proposed determinants may arise, in part, due to differing definitions and epistemological approaches for measuring resilience and practical limitations of what can be measured. Few studies validate and provide any empirical evidence that their proposed determinants or indicators build community resilience, or even provide an operational definition of resilience that can be measured. Similarly, organisational frameworks for community resilience appear to reflect what the organisation aims to achieve as part of its existing mission and do not provide evidence that elements of their framework build a measurable definition of community resilience.

Researchers also raise several critiques of the concept of community resilience. These include criticisms that the concept overlooks the heterogeneity of and competition within communities, communities are not consistently defined, the complex and context-specific nature of communities makes it difficult to make a standardised characterisation of community resilience, and the concept of community resilience often neglects cross-scalar interactions between the community and other systems (e.g. government, ecosystems). However, thoughtful monitoring approaches can account for these concerns when attempting to measure community resilience.

The wide scope of claimed determinants of community resilience, limited evidence of what truly builds community resilience, availability of data that can be realistically collected in the context of rural communities in LMICs, and the context-specific nature and contested framing of communities makes it challenging to demonstrate the levels to which WASH contributions are building overall community resilience to climate change.

As a minimum, it is expected that WASH in most cases contributes to secure water and sanitation services, protects environments and supports health and well-being, alongside a breadth of other contributions that are possible depending on the orientation and scope of a given intervention. For instance, inclusive approaches to WASH are likely to increase empowerment, participation and equality, approaches incorporating risk analysis in WASH may build wider capacity to anticipate risks, and institutional WASH contributes to secure education and health services. In addition to monitoring such outcomes to assess their depth and value, there are other reasons to monitor the linkages between WASH contributions and claimed determinants of community resilience. These include strengthening cross-sectoral collaboration, demonstrating how WASH supports the achievement of resilience strategy and policy targets and goals, and supporting achievement of the desired outcomes of community members. Future work by UTS-ISF and UNICEF EAPRO will develop guidance for WASH stakeholders to define a theory of change and causal chains for WASH contributions to community resilience that would be useful to monitor. This guidance will also outline steps for the necessary planning and resourcing to make such monitoring fit-for-purpose based on the intervention context.

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# 1 Introduction

## 1.1 Background

This document outlines the determinants of community resilience and the potential contribution from water, sanitation and hygiene (WASH) initiatives in rural areas. It was developed through a literature review, as the first step in a wider effort. The broader aim is to inform and make recommendations for how WASH initiatives in rural areas implemented by UNICEF, its partners and other WASH sector actors can better plan for and monitor contributions to broader community resilience.

This work forms part of a partnership between UNICEF East Asia and Pacific Regional Office (UNICEF EAPRO) and the University of Technology Sydney's Institute for Sustainable Futures (UTS-ISF), as a contribution to regional knowledge and learning, and to support UNICEF country offices.

The rationale for a focus on monitoring the contribution of WASH interventions to community resilience has several dimensions. Monitoring this contribution has potential to:

- Optimise WASH interventions for wider impact
- Provide evidence for investment in WASH as part of climate change adaptation strategies
- Support intra-sectoral (e.g. WASH-WRM) and cross-sectoral (e.g. food and energy security) collaboration on climate change adaptation
- Demonstrate additionality of climate resilient WASH outcomes that go beyond conventional development objectives

Indeed, the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report makes several conclusions about the importance of WASH in responding to climate change:

- Adaptation options that are feasible and effective to the 3.4 billion people living in rural areas around the world and who are especially vulnerable to climate change must include the provision of basic services, such as water and sanitation (high confidence).
- In urban settings, infrastructure, including transportation, water, sanitation and energy systems have been compromised by extreme and slow-onset events, with resulting economic losses, disruptions of services and impacts to well-being (high confidence).
- The burden of diseases could be reduced, and resilience increased, through strengthening access to water and sanitation (high confidence).
- Weak governance, unequal access to safe water and sanitation services and a lack of infrastructure and financing all reduce adaptation capacity and deepen vulnerability (high confidence).
- The greatest gaps between policy and action are in failures to manage adaptation of social infrastructure (e.g., community facilities, services and networks) and failure to address complex interconnected risks for example in the food–energy–water–health nexus.
- Strengthened health, education and basic social services are vital for improving population well-being and supporting climate resilient development (high confidence).

Beyond supporting community resilience at local levels, articulating the links between WASH outcomes and resilience may support in establishing linkages between the global WASH sector and global climate change adaptation efforts such as the Global Goal on Adaptation. The IPCC Sixth Assessment Report asserts with high confidence that most adaptation efforts are fragmented and sector-specific and that greater attention is needed towards processes of transformative adaptation. Guidance on what transformative adaptation is in the context of WASH and how it is implemented is currently weak. However, literature on transformative adaptation developed in other fields suggests that transcendence of traditional development siloes and exchange of information across sectors is key (Bouwer et al., 2021; Mach and Siders, 2021; Shi and Moser, 2021).

## 1.2 Research questions

The literature review covered in this document was guided by the following question:

How is community resilience to climate change and its determinants **conceptualised and measured** in academic literature and highly cited development organisation frameworks?

The subsequent follow-up work is focused on those determinants most closely related to or potentially influenced by water, sanitation and hygiene interventions in rural areas.

## 1.3 Methods

The literature review was conducted in three parts, comprising the following:

1. Academic review of existing review papers: Many monitoring tools and frameworks have been developed in the field of community resilience highlighting a range of determinants that contribute to community resilience. With such a large body of research, it was not feasible to look at all individual models presented in the academic literature. This review therefore focused on compiling systematic reviews that examined multiple community resilience monitoring tools.
2. Review of academic papers critiquing the concept of community resilience: The concept of “community” has been critiqued by climate change academics and practitioners as problematic for understanding the capacity of people to respond to climate change and setting the scope and form of interventions intended to build people’s resilience. Hence, we reviewed the common problematisations and authors’ proposed solutions for overcoming the problems in order to consider the implications for this study.
3. Review of community resilience frameworks from major donors, UN agencies and development/humanitarian non-governmental organisations (NGOs) (and grey literature reviews of NGO frameworks) to provide insights on how practitioners and donors commonly frame and measure community resilience.

Drawing on this, a typology of determinants of community resilience was developed based on the above literature reviews. This typology was further evolved to form a conceptual framework (theory of change) for how water, sanitation and hygiene interventions could influence such determinants.

The details of the literature reviews and process to develop the conceptual framework are described below.



### 1.3.1 Collection of reviews on determinants of community resilience

We compiled recent systematic reviews and other reviews of resilience frameworks from academic literature to understand the commonalities and differences in approaches and to identify relevant critiques. The search terms in ProQuest and Google Scholar included: “resilience framework”, “measurement”, “systematic review”, and “community resilience”; and “vulnerability”, “indicators”, “measurement” and “systematic review”. The search period was 2015-2023. Inclusion criteria were a focus on resilience at a community level and papers that covered multiple tools, models or frameworks. Exclusion criteria were applied through review of abstracts as follows: Papers that focused on human-induced shocks, on resilience of physical and mental health, on resilience of businesses, organizations and policies, only on food or livelihood security, only on resource loss and management. We also excluded books, letters, theses and conference abstracts, studies focused on a single location or country, studies with a sole urban focus and studies examining a single resilience framework.

This approach identified 15 systematic reviews that each examined multiple community resilience, community vulnerability and community disaster preparedness measurement frameworks. These reviews included nine comparative reviews highlighting the key indicators, domains (i.e. higher-level categories of indicators) and methodologies and six validation reviews proposing methods to assess the appropriateness of measurement frameworks. The systematic reviews were primarily from the disaster risk reduction (DRR) field with six of the 15 reviews matching the inclusion/exclusion criteria found in DRR specific journals and a further three in publications focussed on natural hazards. A further four were found in environmental journals, and one each from agriculture and community health.

The papers were reviewed to examine how resilience (or other related concepts, for example, vulnerability) was defined, to determine trends in the evolution of frameworks and indicators over time, critiques of measurement approaches, validation and measurement methods, and the most cited frameworks, domains and indicators. A Miro board was used to inductively group the different indicators and categories of indicators proposed by authors of review papers to identify similarities in claimed determinants of resilience.

### 1.3.2 Critiques of community resilience concept

We made searches in ProQuest using varying search strings comprising the terms “communit\*”, “concept of communit\*”, “clima\*”, “disaster”, “critique”, “critici\*e”, “criticism”, “concept”, or “adapt”. We sought to include papers that critically discussed the concept of community in relation to climate change or disasters, even if resilience was not mentioned. However, these search terms yielded few relevant papers as authors generally do not use a common set of terms when critically discussing the concept of community, and the term “community” itself is widely used in other literature.

We then used a range of qualitative search strings in Google Scholar to identify relevant papers. These search strings were “criticisms of community concept in resilience”, “criticisms of community concept”, “criticisms of community-based adaptation”, “criticisms of community in resilience”, “criticisms of the concept of community in disaster and climate change”.<sup>1</sup>

Relevant studies from the ProQuest and Google Scholar searches were identified by reading the paper abstracts. Additional studies were added from our personal collection of literature. In total, 14 studies were retrieved and reviewed in full. The publishing date of the papers ranged from 2013 – 2021.

We read through each study and documented each time the authors described a problematisation of the concept of community that was distinct from any problematisation suggested by the previous studies read. Through this process we identified eight discrete problematisations of the concept of community with respect to climate change and disasters. For each problematisation, we documented the authors’ suggested solutions for overcoming the problems and added our own reflections on the implications of the problems and solutions for the remainder of this study.

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<sup>1</sup> These searches yielded relatively more relevant results because Google Scholar is able to search the contents of papers for similar phrase constructions without limiting itself to identical matches of the search strings.

### 1.3.3 Review of organisational community resilience frameworks

Our review of organisational frameworks included the following documents:

- Five community-focused resilience or adaptation frameworks from implementation agencies and one from a UN agency: CARE (CARE, 2022), International Federation of the Red Cross and Red Crescent Societies (IFRC) (IFRC, 2018), Plan International (Plan International, 2020), Oxfam (Jeans et al., 2016), Tearfund (Tearfund, n.d.), and the UNICEF EAPRO Over the tipping point (Joshi et al., 2023);
- Findings from two literature reviews of organisational and grey literature resilience frameworks that consolidated resilience characteristics of communities (Twigg, 2009; ARUP, 2011); and
- Descriptions of community resilience from five external support agencies: United Kingdom Foreign, Commonwealth & Development Office (FCDO), Asian Development Bank (ADB), United States Agency for International Development (USAID), Green Climate Fund (GCF), and the World Bank.

We also reviewed the websites of the following organisations, but did not find a current framework relating to community resilience at a global or regional level: SNV Netherlands Development Organisation, iDE, World Vision, Doctors Without Borders (MSF), International Rescue Committee (IRC), Catholic Relief Services (CRS), Save the Children, Action Against Hunger, United Nations High Commissioner for Refugees (UNHCR), United Nations Development Programme (UNDP), Direct Relief, United Nations Framework Convention on Climate Change (UNFCCC) Nairobi Work Programme, Mercy Corps, International Institute for Environment and Development (IIED), and the World Health Organisation (WHO).

Organisations generally do not explicate how they derived their lists of resilience characteristics, traits or indicators on their websites or outputs. Most organisational and grey literature frameworks of community resilience span a diverse range of domains. We synthesised the community resilience characteristics proposed by the six implementation agency frameworks and the two literature reviews into categories, and in turn, related these to the categories emerging from academic literature.



Organisations generally do not explicate how they derived their lists of resilience characteristics, traits or indicators.





## 2 Measuring community resilience

### 2.1 Definitions and conceptualisations of resilience and vulnerability

There are many definitions and conceptualisations of resilience to climate change and resilience in general. Below we describe the key theoretical perspectives observed in the climate change adaptation literature followed by the evolution of the definitions employed by the Intergovernmental Panel on Climate Change (IPCC), which are viewed as authoritative definitions that seek to bridge multiple perspectives.

#### 2.1.1 Resilience theory

Resilience and vulnerability definitions and conceptualisations tend to be informed by three broad perspectives that have, over the past few decades, emerged as bodies of theory-practice and formed a basis for policy-making. These three perspectives may be referred to as risk/hazard, vulnerability, and social-ecological system (SES) resilience approaches (Kohlitz et al., 2017):

- **A risk/hazard approach** emphasises the *prediction* of future hazards (such as floods and droughts) related to climate change, assessment of the *severity and likelihood* of hazard occurrence (i.e. the risks they create), and *adaptation actions* that will reduce or offset the impact of the anticipated hazards, or enable rapid recovery from impacts (Smit and Wandel, 2006). Taking a risk/hazard approach places importance on the skills and knowledge needed to anticipate future hazards and implement actions that are designed specifically for responding to the impacts of expected hazards. In some literature this approach is termed ‘outcome vulnerability’, as vulnerability is seen as the outcome of *exposure* and *sensitivity* to future hazards (O’Brien et al., 2007). Exposure is the degree or extent to which a system is subject to a disturbance. Sensitivity is the degree to which a system is affected by a disturbance (Gallopín, 2006).
- **A contextual vulnerability approach** is premised on the assumption that individuals and social groups who are empowered and have agency, and when supported by equitable and just institutions, will be in a better position to respond to climate risks and impacts (Ribot, 2014). It has origins in social and critical theory (Eakin and Luers, 2006). Under a vulnerability approach, it is not essential to predict future hazards because the susceptibility from harm to be addressed is viewed to come primarily from social processes and structures that produce inequality, discrimination and marginalisation (Nightingale, 2017). Hence, taking a vulnerability approach emphasises empowering and building agency of (disadvantaged) people through enhancing their access to and control of resources and redressing inequitable decision-making and resource allocation processes.
- **An SES resilience approach** emphasises that climate change creates uncertainty for systems and that many risks and future system responses are unknowable due to the complexity of the systems and limited knowledge about how the climate will change in the future (Walker and Salt, 2012; Folke et al., 2016). It has roots in the field of ecology, where ecological resilience concerns the amount of change or disturbance a system can experience without shifting to an alternative state that has different properties (Eakin and Luers, 2006). SES resilience concepts often centre on the ability of a system to change, reorganise or reconfigure itself to better accommodate changing environmental conditions as they emerge (Biggs et al., 2015). From this perspective, resilience is built through processes that enable rapid learning, adaptability, and access to diverse and redundant resources.

Theorists have also described resilience in terms of the magnitude of change that a person or system has the capacity to make in order to deal with disturbances. This is often categorised along **three capacities: absorptive, adaptive and transformative capacity** (Béné et al., 2012). *Absorptive capacity* refers to a system’s ability to cope with stressors or shocks in order to persist normal functions and maintain stability. *Adaptive capacity* is the ability of a system to incrementally adjust to change. Finally, *transformative capacity* refers to a system’s ability to fundamentally change its structure and/or function (Béné et al., 2012). In this line of thinking, resilience is “the paradoxical and elastic condition of staying the same while simultaneously changing in response to disturbances – either ‘**bouncing back**’ to a previous state, or ‘**bouncing forward**’

to a new and improved state with new system structures, functions and identity (also called a resilience regime)” (Grove, 2018; as cited in Fallon et al., 2022). This concept of **transformative adaptation** has been discussed in the literature since 2010, however with its adoption in the IPCC Sixth Assessment report, it is now more widely discussed and differentiated from **incremental adaptation**, with the key difference being an ‘expanded solution space’, ‘deep systemic change that requires reconfiguration of social and ecological systems’ and ‘actions aiming at adaptation to climate change resulting in significant changes in structure and function that go beyond adjusting existing practices’ (IPCC, 2023).

Adaptive capacity can be unpacked further into concepts of **specific adaptive capacity** and **generic adaptive capacity** (Eakin et al., 2014). Specific adaptive capacity refers to traits or processes that enable people and systems to specific climatic threats (e.g. flood management plans). Generic adaptive capacity refers to traits and processes that enable human development which in turn make people and systems better able to respond to climatic disturbances of all kinds (e.g. education, access to sanitation, etc.) (Eakin et al., 2014). Specific adaptive capacity aligns with a risk-hazard approach whereas generic adaptive capacity aligns with a contextual vulnerability approach.

Finally, resilience may be expressed as a **trait** (or set of traits), a **process** (or set of processes), or a desired **outcome** (Moser et al., 2019). Traits refer to characteristics of the individual or system (e.g. connectivity, capacity for learning). Processes refer to actions or interventions (e.g. embrace change and uncertainty, integrate local knowledge.). Outcomes refer to a desired state for the individual or system (e.g. equitable governance, maintained system functionality) (Moser et al., 2019). Hence, researchers and implementers may imply that resilience is built based on the extent to which an individual or system possesses certain traits, implements or is subject to certain processes, or experiences certain outcomes (or any combination of these three). Each of the three resilience approaches (risk/hazard, vulnerability, and SES resilience) tend to focus on different traits, processes and outcomes which can be seen in the variety of indicators proposed in the literature and by organisations.

Resilience, expressed in the various way outlined above, can then be measured **objectively** or **subjectively**. Objective modes of measurement involve experts making a priori assumptions about what characteristic(s) makes a person or system resilient then measuring that characteristic (Jones, 2019). Subjective modes of measurement rely on asking people to consider their own circumstances and self-assess their capabilities drawing on their own perceptions and judgements (Jones, 2019). Subjective measures, although less frequently used, have the benefit of drawing on people’s knowledge of their own context, aspirations and mental states (Jones and d’Errico, 2019). Objective and subjective measures are likely to be complementary (Jones, 2019). The frameworks covered in this literature review are primarily based on objective measures.



## 2.1.2 Evolution of IPCC definitions of resilience and vulnerability

The Assessment Reports of the IPCC have evolved over the years to reflect the contributions of these perspectives on resilience and vulnerability. Specifically, the 2001 report erred to a risk/hazard conception and focused primarily on vulnerability and not on resilience. Following this, the 2007 report maintained a risk/hazard framing of vulnerability but with strengthened attention to social processes and also provided an SES-related definition of resilience. The 2014 report recharacterized vulnerability in more complex ways accounting for multiple factors and defined resilience in line with and SES resilience perspective. Finally, the 2021 report retained the 2014 definition of vulnerability and included an SES-related definition as well as noting the circumstances in which resilience is a positive attribute. These evolutions are described in more detail below.

- **IPCC Third Assessment Report, 2001:** In this document, the IPCC scarcely refers to resilience and defines it as the “amount of change a system can undergo without changing state”. More emphasis is put on the concept of vulnerability which is characterised as “a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity”. Adaptive capacity here is defined as “the ability of a system to adjust to climate change (including climate variability and extremes)”. This definition reflects a tendency towards the risk/hazard perspective in which vulnerability is measured by its predicted exposure and sensitivity to climate hazards and the ability of the system to adjust to those hazards.
- **IPCC Fourth Assessment Report, 2007:** In the Fourth Assessment Report, the IPCC maintained its definition and conceptualisation of vulnerability as a function of exposure, sensitivity and adaptive capacity, although the influence of social processes and structures on exposure, sensitive and adaptive capacity are acknowledged and reported on (showing influence from the vulnerability approach). However, the definition of resilience was changed to “*The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change*”. This definition aligns with the SES resilience approach’s emphasis on the ability to reorganise to adapt climate change. Resilience in the Fourth Assessment Report is more often invoked in relation to ecosystems, consistent with SES resilience theory’s roots in the field of ecology.
- **IPCC Fifth Assessment Report, 2014:** The IPCC removed the framing of vulnerability as a function of exposure, sensitivity, and adaptive capacity in the 2014 Fifth Assessment Report. Vulnerability was recharacterized as encompassing “*a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt*”. Inequalities and uneven development are highlighted as key drivers of vulnerability which contrasts with prior reports’ emphases on exposure to biophysical hazards as a determinant of vulnerability. Resilience was redefined as: “*The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning and transformation*”. Resilience to climate change and specific hazards (e.g. droughts) is used in reference to a variety of systems including human, livelihoods, food production, and energy systems, not just ecosystems as the previous report focused on.
- **IPCC Sixth Assessment Report, 2022:** The Sixth Assessment Report retained the 2014 definition of vulnerability. The definition of resilience was slightly modified from the 2014 definition to be: “*The capacity of interconnected social, economic and ecological systems to cope with a hazardous event, trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure. Resilience is a positive attribute when it maintains capacity for adaptation, learning and/or transformation*”. The key changes from the 2014 definition are the addition of the word “interconnected” and distinguishing capacity for adaptation, learning and transformation as attributes of “positive resilience”. This reflects an evolution of thinking that natural and human systems are not separate and the IPCC taking a stance that resilience is not always positive (e.g. a corrupt governance system may resist being changed). The 2022 Report also introduced the IPCC’s Climate Resilient Development framework, which calls for simultaneously building resilience and mitigating greenhouse gas emissions through integrated actions across social and natural systems.

### 2.1.3 Other key resilience definitions

Another working definition of resilience commonly used in the disaster risk reduction sector is the UNDRR definition used in the Sendai Framework. This definition encompasses preparedness through risk management as well as community capacity to respond to stresses: “*The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management*” (United Nations Office for Disaster Risk Reduction, 2015).

## 2.2 Variation in and evolution of resilience assessment frameworks

The measurement of community resilience draws on several fields across a large number of frameworks, indicators and models. These fields include psychology, public health, environmental management, climate change adaptation, disaster risk reduction (DRR) and disaster preparedness. The frameworks are based on varied conceptualisations of resilience and vulnerability, including theoretical perspectives that relate to risk/hazard, contextual vulnerability and socio-ecological resilience approaches. Frameworks also include a focus on both specific hazards and overall resilience. As such, there is no single unified approach to monitoring community resilience (Asadzadeh et al., 2017). Below we describe the ways in which different definitions and conceptualisations underlie proposed frameworks, varied purposes of different frameworks and an overview of the evolution of measurement approaches over time.

### 2.2.1 How assessment frameworks defined resilience

The frameworks cover a wide range of **resilience and vulnerability definitions and conceptualisations** and at different scales. Specifically, risk/hazard approaches were common in hazard-specific and community preparedness models, which had a strong focus on physical aspects such as infrastructure and risk mitigation through systems such as early warning systems (Kusumastuti et al., 2022). Although there are significant commonalities in the indicators from DRR literature and other fields, there are some variations in the approach. Frameworks found in environmental journals were more likely to highlight the importance of strong ecosystem services and institutional policies in building resilience (Sharifi, 2016) aligned to an SES approach to resilience. Frameworks focused on community vulnerability rather than community resilience have fewer mentions of preparedness and hazard predictions, and more discussion of structural and developmental deficits and opportunities for social empowerment, and thus are more aligned to a contextual vulnerability approach, addressing community inequalities when assessing the ability to overcome stresses (Fatemi et al., 2017). The various IPCC definitions were used as working definitions in several of the systematic reviews. Aspects of the definitions were adapted as needed with Jurgilevich et al. (2017b) adopting the vulnerability definitions from the 2007 Fourth Assessment Report and ideas of climate risk drawn from the 2014 Fifth Assessment Report. The UNDRR was used as a working definition in the DRR resilience frameworks examined in Ostadtaghizadeh et al. (2015).

Often, a theory or conceptualisation of resilience, or how the proposed characteristics contribute to building resilience, is not provided in the resilience assessment frameworks. Yet, certain themes are recognisable. Authors implicitly draw on concepts found in risk/hazard, contextual vulnerability, and SES resilience thinking to assert that various characteristics are resilience-building. Examples from the organisational and academic literature that show characteristics asserted to determine or be associated with resilience, and how they are aligned with varying concepts, are shown in Table 1.



Authors implicitly draw on concepts found in risk/hazard, contextual vulnerability, and SES resilience thinking to assert that various characteristics are resilience-building.

Table 1. Examples of resilience characteristics from literature that align with varying risk/hazard, contextual vulnerability and socio-ecological resilience related concepts

Resilience as...	Description	Example characteristics from academic and organisational literature
<b>Reduction in exposure</b>	Characteristics that reduce the magnitude, frequency, and/or duration that systems or people are exposed to climate-related disturbances (IPCC, 2022).	<ul style="list-style-type: none"> <li>Assets and resources are located outside of high-risk areas (ARUP, 2011)</li> <li>Mobility to escape danger in event of climate hazards (IFRC, 2016)</li> </ul>
<b>Increased resistance</b>	Characteristics that enable systems or system components to resist change and persist in a stable state despite external pressure (Carpenter, 2001).	<ul style="list-style-type: none"> <li>Use of strong/robust infrastructure (ARUP, 2011)</li> <li>Presence of physical protections (Twigg, 2009)</li> <li>Housing built to withstand hazards (Cai et al., 2018)</li> </ul>
<b>Increased specific adaptive capacity</b>	Characteristics that enable people to anticipate, plan for, and recover from specific climate hazards (Eakin et al., 2014).	<ul style="list-style-type: none"> <li>Access to risk/hazard data and assessments (Twigg, 2009)</li> <li>Presence of disaster risk reduction, preparedness and recovery measures (Ostadtaghizadeh et al., 2015; UNICEF EAPRO, 2023)</li> <li>Presence of evacuation plans (Kusumastuti et al., 2022)</li> <li>Presence of early warning systems (Plan International, 2020)</li> </ul>
<b>Increased generic adaptive capacity</b>	Characteristics that enable people's agency and wellbeing, and develop the effectiveness, equity, efficiency, and legitimacy of institutions, such that they are better able to respond to any form of climate related disturbance (Eakin et al., 2014).	<ul style="list-style-type: none"> <li>Community can meet its basic food needs (IFRC, 2016)</li> <li>Extent to which youth and children are empowered to participate in planning and decision-making (UNICEF EAPRO, 2023)</li> <li>Gender justice and enhancing voice (Oxfam, 2016)</li> </ul>
<b>Increased general (SES) resilience</b>	Characteristics that enable entire systems to re-organise while undergoing change so as to still retain essentially the same function, structure and feedbacks in the face of all kinds of disturbances (Folke et al., 2010).	<ul style="list-style-type: none"> <li>Diversification of livelihoods (CARE, 2022)</li> <li>Collective, forward-looking and flexible decision-making (Oxfam, 2016)</li> <li>Presence of biodiversity (Cai et al., 2018)</li> </ul>
<b>An outcome</b>	Characteristics that are associated or correlated with positive or negative outcomes with regard to climate and/or disasters, but are not necessarily viewed as driving those outcomes (Moser et al., 2019)	<ul style="list-style-type: none"> <li>Ethnic makeup of population (Fatemi et al., 2017)</li> <li>Ratio of men to women (Assarkhaniki et al., 2020)</li> <li>Percentage of female-headed households (Fatemi et al., 2017)</li> </ul>

Similar to resilience, authors of frameworks propose a wide range of characteristics of vulnerability. Vulnerability is treated in the same ways as resilience is as described above and often the vulnerability characteristics are simply an inverse of the resilience characteristics. For example, community conflict may be viewed as a vulnerability characteristic while the ability to resolve conflicts may be viewed as a resilience characteristic. It should be noted that *in academic discourse, resilience and vulnerability are often not explained simply as opposites of each other*. The tendency of the literature and frameworks to treat them as such may be a result of limitations in the nuance of some authors' engagement with climate change

adaptation theory and their use of resilience and vulnerability as buzzwords. The systematic reviews also highlighted a different focus when frameworks referenced vulnerability rather than resilience: Frameworks emphasising vulnerability had a larger number of indicators at community level associated with individual and community capacity with fewer indicators at an institutional and policy level (Fatemi et al., 2017).

Many frameworks are **project specific** or focus on particular aspects of resilience and vulnerability such as **specific hazards** or specific people or groups. Cai et al., 2018's review of 174 DRR resilience monitoring frameworks found that 55% of the frameworks focussed on an individual category of hazard. The most common hazard categories were coastal disasters, earthquakes, social events, oil spills, drought, landslides and fires. By nature of their narrow application, these frameworks focus on *specific adaptive capacity* when measuring resilience, with a strong representation of indicators focussed on risk mitigation through early warning systems and disaster specific measures such as the use of coastal defence systems or understanding the extent of flood plains across the community (Cai et al., 2018).

## 2.2.2 Purpose of resilience assessment frameworks

The above variations in definition also stem from the **purpose of specific frameworks**, which could be divided into three main types. The models defining their framework as a *community vulnerability framework* focussed more on demographic indicators, such as gender and ethnicity (Fatemi et al., 2017). Frameworks described as *community preparedness frameworks* had a strong focus on government policies, community plans and early warning systems (Kusumastuti et al., 2022), whereas *community resilience frameworks* had a stronger consideration of social capital and infrastructure (Assarkhaniki et al., 2020).

The orientation of the frameworks also varied based on **the user and their perspective**. Hence whilst all related to community resilience, they differed depending on the primary user being national governments, provincial governments, universities or NGOs (Cai et al., 2018). Some frameworks were intended for use for national or provincial level planning whereas others were intended for community level intervention. Therefore, the boundary as to which frameworks can be considered as having a 'community' focus is challenging, particularly when it comes to urban versus rural communities. This point is highlighted by Cai et al., 2018 who notes that 60% of the reviewed models defined themselves as community frameworks, but these models still favoured indicators that would be most useful in national planning such as levels of infrastructure development and social demographics. Meanwhile, development and humanitarian organisational frameworks are primarily intended to provide guidance to the organisations' regional and country offices and programmes on building resilience that is consistent with the organisations' missions.



“

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### 2.2.3 Evolution of academic resilience assessment frameworks

Whilst the literature is expansive, in fact a **small number of frameworks** formed the core basis, with **subsequent frameworks derived from these**. For instance, Ostadtaghizadeh et al., 2015 found that of 17 examined frameworks, the indicators used could be tracked back to 5 models with the most prolific being the University of South Carolina's Baseline Resilience Index for Communities (BRIC) and the Climate Disaster Resilience Index (CDRI). These frameworks were also found to be the most cited by Assarkhaniki et al., 2020 whereas Ran et al., 2020 identified the Social Vulnerability Index (SoVI) and Disaster Resilience of Place (DROP) Models as the most cited.

This evolution, where previous models were adapted to create new models, means that **analysis of the most common indicators and domains** must be carefully done and can be problematic. In particular it can mean that indicators associated with earlier models are over-represented in the literature. Reviews such as Nguyen & Akerkar, 2020, Cai et al., 2018 and Zaman & Raihan, 2023 focus on the frequency of use certain indicators and domains, however this may not be an argument for the appropriateness of those indicators and is likely to be influenced by the common basis of many of the models.

The **majority of the frameworks were developed in high income countries** (HICs) and rely on censuses data collection. The commonly adapted tools mentioned above, including BRIC, SoVI and DROP are all frameworks developed in the United States (US) and US developed frameworks account for more than 40% of the observed frameworks in the largest systematic review (Cai et al., 2018). The focus on census data results in a more quantitative approach to data validation and a focus on demographics (Cai et al., 2018).

**Few frameworks have been developed in least-developed countries, and only minor adaptations have been made of HIC-based frameworks when they are applied in LMIC.** Review papers that excluded HICs such as Ran et al., 2020 did not have a strong representation of least developed countries. The results of this review found most frameworks were from upper-middle income countries (56%), lower-middle income countries (26%) a smaller proportion from least developed countries (9%) and with the remaining multi-country models (9%). Many of the HIC models have been adapted for use in low- and middle-income countries (LMICs), but the adaptations have only been minor and there are few tools in the academic literature that are appropriate for LMICs (Ran et al., 2020). This is particularly true because quality census data may not be readily available in many LMICs, and a focus on demographic data may not provide the breadth of indicators relevance to LMIC community resilience.

Another evolution of **recent models is a focus on participatory design**. Involving communities in the design of tools and indicators is important to ensure monitoring models are adapted to the context as the concept of resilience is bound to the culture and perspective of the community and the specific hazards they face (Ostadtaghizadeh et al., 2015). Despite this, a participatory approach was only present in under a quarter of the frameworks reviewed although this approach is becoming more prevalent (Assarkhaniki et al., 2020).

Despite many years of development and use of assessment frameworks, **validation is still at an early stage**, and can privilege quantitative over qualitative approaches. In a systematic review (Ran et al., 2020), of the frameworks examined only 10% claimed to have used a method to empirically validate their indicators. Requiring the validation of indicators can also influence the design of the frameworks. Validation is a simpler process for quantitative data collection methods so having validation as a prerequisite can favour a quantitative approach even if a qualitative or hybrid approach is more suitable (Ran et al., 2020). Assessments of framework indicators should have consideration of appropriateness as well as an empirical approach to validity (Asadzadeh et al., 2017).



Involving communities in the design of tools and indicators is important to ensure monitoring models are adapted to the context as the concept of resilience is bound to the culture and perspective of the community and the specific hazards they face.

## 2.2.4 Application of organisational frameworks

Our review included community-centric resilience frameworks from six international development and humanitarian organisations (CARE, IFRC, Plan International, Oxfam, Tearfund, and UNICEF), two literature review syntheses of organisational and program-based community resilience frameworks (Twigg, 2009; ARUP, 2011), and resilience metrics from five external support agencies (FCDO, ADB, USAID, GCF, and the World Bank).

Relative to the academic frameworks, the resilience characteristics found in the development and humanitarian organisational frameworks **tend to be more qualitative and measurable at a community level**. For example, characteristics include “community is connected” (IFRC, 2016), “people manage risk by investing for the future” (CARE, 2022), “collective, forward and flexible decision-making” (Oxfam, 2016) and “extent to which children and youth are empowered to participate in planning and decision making” (UNICEF EAPRO, 2023). These frameworks also **tend to include concepts of inclusion, social justice and the role of the State** more strongly than the academic frameworks, for example including characteristics such as “gender justice and enhancing voice” (Oxfam, 2016), “social protection schemes” (Plan International, 2021), and “women and marginalized groups have equal rights and access to critical livelihoods resources” (CARE, 2022). The differences between the development/humanitarian organisation frameworks and the academic frameworks could be due to the human development and community-centric focus of the organisations working in low- and middle-income country contexts versus academics that make use of readily available data that is abundant in high-income country contexts.

The resilience characteristics put forth by development and humanitarian organisations **tend to be framed in alignment with the mission of the organisation**. The Plan International and UNICEF frameworks identify characteristics with respect to children, consistent with their missions to protect and advance the rights of children. The characteristics of the IFRC framework centre on the ability of the community to meet its most basic needs (e.g. basic food, WASH, and shelter needs), which reflects IFRC’s mission to meet the needs of vulnerable people during and after disasters. Many of the characteristics of the CARE framework relate to livelihoods and agricultural practices in alignment with CARE’s mission to end poverty, particularly in low- and middle-income countries where subsistence farming is common in rural areas. This finding suggests that **organisations choose resilience characteristics that reflect the objectives of their mission rather than attempting to comprehensively determine the factors that will make a community most resilient overall**.

Descriptions of community resilience by donor agencies tend to be general in nature and rely on program and project managers to define specific resilience indicators that suit the program/project context. For example, an ADB framework indicator for strengthening the resilience of poor and vulnerable people to impacts of climate change is “Number of poor people (men and women) in high-climate-risk areas that have directly or indirectly benefited from the program.” Measurements of this indicator are done at an individual project level. Some donors describe resilience in terms of abstract concepts. For example, the World Bank framework refers to resilience attributes such as “preparedness”, “robustness”, and “rapidity”, and the FCDO framework conceptualises resilience as comprising of absorptive, adaptive, and anticipatory capacities, but neither of these frameworks operationalise the concepts into measurable terms.

## 2.3 Key domains in measuring community resilience

Grouping indicators into domains and subdomains was an almost universal approach amongst academic frameworks covered in the systematic reviews. This was presented as an important aspect of a framework to provide ease of visualisation (Assarkhaniki et al., 2020, Fielke, Kaye-Blake, et al., 2017) and to provide results that can be easily conceptualised and remembered (Nguyen & Akerkar, 2020). Nguyen & Akerkar, 2020 found that almost all frameworks used between three and seven domains and proposed that this range is easiest for users to visualise. The systematic reviews commonly focussed on consolidating indicators into high level domains with over 40 categories proposed amongst the models (Nguyen & Akerkar, 2020). The organisational frameworks similarly tend to group resilience characteristics into four to six domains, although two (IFRC and TearFund) do not group characteristics into domains.

Across the literature, there is convergence around five domains of indicators, namely: **social, economic, institutional, infrastructural and environmental**. These domains were proposed in consolidated



frameworks in Assarkhaniki et al., 2020, Ostadtaghizadeh et al., 2015 and Sharifi, 2016 and highlighted as the most common domains in Cai et al., 2018 and Nguyen & Akerkar, 2020.

The **relative emphasis of these five domains varied**, depending on the framework type. Frameworks focussed on community vulnerability had a stronger focus on the social and infrastructural indicators as well as economic indicators at a household level (Fatemi et al., 2017). Community preparedness frameworks favoured indicators within the infrastructural and institutional domains (Kusumastuti et al., 2022).

Authors observed the potential for **trade-offs and tensions between domains and how they are weighted**. Efforts to expand infrastructural or economic resources can compromise ecosystem services, so if there are relatively few environmental indicators considered the detrimental impacts of reduced ecosystem services may not be captured in the monitoring framework (Fielke et al., 2017). How implementing agencies prioritise their indicators within these monitoring frameworks can shape the priorities of how the community and government policy evolves (Fielke et al., 2017).

The domains and indicators used was also influenced by **the availability of the data and the geographic focus** of the project. National level projects which have available census data will have a higher number of indicators in the social demographic space (Cai et al., 2018) however in a lot of contexts this data is either unavailable, unreliable or incomplete and for models focussed on specific, projects, programs or communities census data is often not as significant as primary data sources (Zaman & Raihan, 2023).

The resilience characteristics proposed by organisational frameworks can also be consolidated into these five domains. However, the 'economic' characteristics tend to be more in relation to household and community management of and access to money than the behaviour or health of markets.



### 2.3.1 Social

In **academic literature**, the social domain was the most commonly used domain among the 17 resilience frameworks reviewed by Assarkhaniki et al., (2020) and represented the second highest proportion of indicators used under all of the domains in the 36 frameworks in Sharifi (2016). This domain of resilience was predominately used to cover categories of indicators relating to demographics and the capacities of individuals in the community and the community as a whole (Assarkhaniki et al., 2020). The focus on census data in many of the models has meant that demographic indicators are the most prevalent in this domain with the five most commonly used indicators being (Cai et al., 2018): (i) education; (ii) age; (iii) previous disaster experience; (iv) place attachment (i.e. Population born in state of current residence); and (v) civic involvement. The subdomains of individual and collective capacity are more complex and multidimensional than demographic data and are more difficult to measure requiring often requiring a more qualitative research approach (Sharifi, 2016).

- **Demographics:** Demographic data highlights quantitative population-level data on dimensions that could contribute to vulnerability and is prevalent in frameworks that are used to influence government policy at a national or provincial level (Cai et al., 2018) . Common demographic indicators include community age distribution(Assarkhaniki et al., 2020; Cai et al., 2018; Fatemi et al., 2017; Ostadtaghizadeh et al., 2015), gender distribution (Assarkhaniki et al., 2020; Fatemi et al., 2017), population density (Cai et al., 2018; Fatemi et al., 2017), ethnicity (where the community lies on a multi-cultural/monocultural spectrum)(Fatemi et al., 2017; Sharifi, 2016), workforce demographics (Assarkhaniki et al., 2020; Fatemi et al., 2017; Ostadtaghizadeh et al., 2015; Sharifi, 2016) and relative equality (Assarkhaniki et al., 2020; Sharifi, 2016). As mentioned previously these are often not specifically determinants of resilience but can impact determinants of resilience due to existing social inequalities. Demographic indicators were common in community vulnerability frameworks (Fatemi et al., 2017), but were not present in community preparedness frameworks (Kusumastuti et al., 2022) and were found in most but not all community resilience frameworks.
- **Individual capacity:** Individual capacity refers to indicators that measure factors that determine individuals' ability to respond to hazards. This includes common indicators such as education(Assarkhaniki et al., 2020; Cai et al., 2018; Fatemi et al., 2017; Fielke et al., 2017; Nguyen & Akerkar, 2020; Ostadtaghizadeh et al., 2015; Sharifi, 2016), previous disaster experience (Cai et al., 2018; Sharifi, 2016), wellbeing (Fielke et al., 2017; Sharifi, 2016), traditional knowledge (Assarkhaniki et al., 2020; Sharifi, 2016) and place attachment (Assarkhaniki et al., 2020; Cai et al., 2018) which were common across the range of frameworks.
- **Collective capacity:** Collective capacity refers to the connectedness of people to their communities and the social organisations that build such connectedness. This group includes common indicators such as community trust (Fielke et al., 2017), community cohesion (Cai et al., 2018; Fatemi et al., 2017), health services (Assarkhaniki et al., 2020; Cai et al., 2018; Nguyen & Akerkar, 2020; Ostadtaghizadeh et al., 2015), conflict management (Fielke et al., 2017), CBO participation and religious organisation participation (Assarkhaniki et al., 2020; Fielke et al., 2017; Ostadtaghizadeh et al., 2015; Sharifi, 2016) which were common across the range of frameworks.

In **development organisation resilience frameworks**, the social domain was mainly covered with respect to individual capacity and collective capacity. In relation to **individual capacity**, education and knowledge were often included. This comprised both general awareness, knowledge and training (for example (Twigg, 2009)), as well as climate education (UNICEF EAPRO, 2023). In some frameworks a related area of human assets (ARUP, 2011) or human capital (Oxfam, 2016; Plan International, 2020) was included. **Collective capacity** was included in some frameworks in the form of social cohesion (CARE, 2022; IFRC, 2018; Oxfam, 2016) and social capital (ARUP, 2011; Oxfam, 2016; Plan International, 2020; Tearfund, n.d.).

An extension of individual and collective capacity included in development organisation frameworks were dimensions of **empowerment, participation and inclusion**. Empowerment included equity and political assets (ARUP, 2011), gender and marginalisation in relation to access to information, skills, services and access to and control over livelihoods (Tearfund, n.d.), involvement of youth in decision-making (UNICEF EAPRO, 2023) and gender justice and voice (Oxfam, 2016). Participation and inclusion (IFRC, 2018; Plan International, 2020) also related to consideration of needs of most vulnerable (UNICEF EAPRO, 2023), empowerment and participation (Oxfam, 2016), diversity (ARUP, 2011)

### 2.3.2 Economic

In frameworks in the **academic literature**, economic determinants address the financial resources that can be utilised to support the community during stresses. Assarkhaniki et al., 2020 defines this as operating in two categories, with financial resources available **at individual or household level** and at various levels of **government**. Examination of the frameworks within the Cai et al., 2018 and Ostadtaghizadeh et al., 2015 reviews revealed additional indicators related to the private sector. The most common indicators under this domain as noted by the Cai et al., (2018) review were: (i) income; (ii) employment; (iii) housing capital; and (iv) business size. The three main categories of indicators include:

- **Financial resources at household or individual level:** At a household level this covers indicators such as household assets (Assarkhaniki et al., 2020; Ostadtaghizadeh et al., 2015), income (Assarkhaniki et al., 2020; Cai et al., 2018; Fatemi et al., 2017; Fielke et al., 2017; Ostadtaghizadeh et al., 2015; Sharifi, 2016) and level of employment (Assarkhaniki et al., 2020; Cai et al., 2018; Fielke et al., 2017; Ostadtaghizadeh et al., 2015).
- **Government financial resources:** Government economic indicators focus on levels of funding to disaster response agencies and services and the availability of these funds during an event (Assarkhaniki et al., 2020; Fatemi et al., 2017).
- **Private sector:** Private sector indicators highlight the level of investment in the community through indicators pertaining to business activity and also the resources that the private sector provides that can contribute to recovery such as indicators associated with food production (Assarkhaniki et al., 2020), security (Sharifi, 2016) and availability and utilisation of finance or private insurance (Assarkhaniki et al., 2020; Fatemi et al., 2017; Ostadtaghizadeh et al., 2015).

In **development organisation frameworks**, economic factors included a variety of dimensions, such as asset ownership, liquidity and disposable income (UNICEF EAPRO, 2023), economic assets (ARUP, 2011), financial services (CARE, 2022; Plan International, 2020) savings (Plan International, 2020), community economic opportunities (IFRC, 2018) and financial instruments (Twigg, 2009).

In addition, several frameworks included a focus on **livelihoods**. Several of these concerned diversified livelihoods (CARE, 2022; UNICEF EAPRO, 2023; Plan International, 2020; Tearfund, n.d.), and also use of climate resilient agricultural practices (CARE, 2022) or sustainable livelihoods (Twigg, 2009).

### 2.3.3 Institutional

Institutional determinants of resilience include those related to the performance of government in terms of good governance, as well as actions to the prepare for, respond to, or recover from stresses (Assarkhaniki et al., 2020). This domain can include municipal services involved in preparation, response and recovery. In addition, there are close linkages with some infrastructural indicators, for instance infrastructure associated with early warning systems, with some authors categorising these as institutional and others as infrastructural. An overlap between the two domains also occurs regarding indicators for operations and maintenance where infrastructure is reliant on institutional frameworks to be effective (Assarkhaniki et al., 2020). The most frequently used indicators included (Cai et al., 2018): (i) availability of municipal relief service; (ii) availability of community mitigation plan; (iii) availability of community recovery plan; (iv) availability of evacuation plan; and (v) political fragmentation.

- **Good governance and government performance:** The majority of indicators under this domain relate to aspects of good governance, suggesting that the existence of mitigation and response plans in themselves and the existing capacity of the community is not sufficient without a stable system of support from different levels of government (Fielke et al., 2017). Indicators in this subdomain focus on the level of political fragmentation (Cai et al., 2018; Fielke et al., 2017; Ostadtaghizadeh et al., 2015), proximity of government offices to the community (Assarkhaniki et al., 2020), distribution of decision making power (Fielke et al., 2017), community participation in decision making (Fielke et al., 2017; Ostadtaghizadeh et al., 2015), institutional collaboration (Ostadtaghizadeh et al., 2015; Sharifi, 2016) and existing legal structures (Kusumastuti et al., 2022).
- **Preparedness:** Different frameworks highlighted different planning documents as important in community preparation depending on the focus and definitions of the framework. The community

preparedness frameworks focussed on risk mapping, evacuation plans and training of the community (Kusumastuti et al., 2022b) whereas community resilience frameworks had a stronger infrastructure focus with O&M plans as well as mitigation plans (Assarkhaniki et al., 2020; Cai et al., 2018).

- **Response and recovery:** The frameworks did not differentiate between preparation, response and recovery with some planning actions likely to be common to all, but institutional indicators listed in the frameworks that fit well in to this category include availability of municipal services, use of early warning systems (Kusumastuti et al., 2022), availability of recovery plans and availability of evacuation plans (Cai et al., 2018).

In **development organisation resilience frameworks**, various groups of indicators and categories align with the institutional domain, including aspects of good governance, preparedness, response and recovery. In terms of good governance, areas included legal and regulatory systems (Twigg, 2009), transparency of operations (UNICEF EAPRO, 2023), institutional mechanisms, capacities and structures (Twigg, 2009) environmental protection laws (Plan International, 2020) and integration with development policies (Twigg, 2009). For preparedness, response and recovery, organisational frameworks included risk reduction policies and guidelines (Plan International, 2020), risk informed sectoral plans (Plan International, 2020), integration with emergency response and recovery (Twigg, 2009).

In addition, organisational frameworks also included **state provided social protection**, such as social safety nets and protection (CARE, 2022; Plan International, 2020; Twigg, 2009) and legal frameworks for children to claim environmental rights (UNICEF EAPRO, 2023), protection of children during migration (UNICEF EAPRO, 2023). Organisational frameworks also included aspects related to the **relationship between government and communities**, such as accountability (Oxfam, 2016; Twigg, 2009), community participation (Twigg, 2009) and responsiveness to community needs (UNICEF EAPRO, 2023).



Across the literature, there is convergence around five domains of indicators, namely: social, economic, institutional, infrastructural and environmental.



### 2.3.4 Infrastructural

In **academic frameworks**, the infrastructural domain focuses on **physical assets** in the community and their availability, quality and functionality when a community experiences stresses. Assarkhaniki et al., (2020) breaks this grouping down into 9 subdomains, namely housing, communication, transportation, energy, water, and sanitation, health infrastructure, economic infrastructure, education, emergency response and community services.

These categories are generally consistent with the other frameworks with common elements including:

- **Transport and communication** were almost universally covered in frameworks (Assarkhaniki et al., 2020; Fatemi et al., 2017; Kusumastuti et al., 2022; Ostadtaghizadeh et al., 2015) across community vulnerability frameworks, community preparedness, community resilience and all journal types. These two sets of infrastructure provide basic services and are essential in disaster response, and hence their inclusion across multiple different frameworks.
- **Energy, water and sanitation and medical infrastructure** are similarly common and multi-disciplinary (Assarkhaniki et al., 2020; Fatemi et al., 2017; Kusumastuti et al., 2022; Ostadtaghizadeh et al., 2015).

Meanwhile a smaller number of frameworks focussed on meeting points, shelter points, housing type and fire stations which could be categorised under **response infrastructure** (Cai et al., 2018; Fatemi et al., 2017; Kusumastuti et al., 2022; Ostadtaghizadeh et al., 2015). These indicators are more common in hazard specific frameworks. The most commonly used indicators in the infrastructural domain in a review by Cai et al., (2018) were: (i) shelter capacity; (ii) communication capacity; (iii) transport access; (iv) medical capacity; and (v) housing type.

In **development organisation frameworks** often included physical assets and basic services. For physical assets, this included shelter (CARE, 2022; IFRC, 2018) and included the robustness, secureness or safe location of physical assets (ARUP, 2011; CARE, 2022; Twigg, 2009). Amongst basic services, energy, drinking water and sanitation were included in (UNICEF EAPRO, 2023), and meeting WASH needs in (IFRC, 2018).

### 2.3.5 Environmental

Many **academic frameworks** include environment domain, noting that this was the last common and often with least indicators. Assarkhaniki et al., 2020 categorises relevant indicators into the **environmental services** provided to the community through agricultural activities and ecosystem function such as air quality and water availability, and **impacts on the environment**, including human impacts on the environment through environmental policy and social impacts on the environment through measures such as population density. Other frameworks tend to include environmental policy within the institutional domain and social indicators impacting the environment in the social domain with (Ostadtaghizadeh et al., 2015). Yet others (Cai et al., 2018; Fielke et al., 2017 and Sharifi, 2016) limit this domain to the resources the environment provides and environment damage through factors such as erosion.

Despite the support services provided by the environment to enhance community resilience, this domain was given less consideration than the other four major domains. The environmental domain had the lowest proportion of indicators among the frameworks reviewed by Sharifi (2016) and is not considered in the community vulnerability frameworks in the review by Fatemi et al., (2017). The most commonly used indicators under the environmental domain focus on damage to the environment and therefore it's contribution to hazard risks, they are (Cai et al., 2018): (i) land use that causes environmental degradation; (ii) erosion rate; (iii) biodiversity loss; and (iv) land loss.

In **development organisation frameworks**, several frameworks included indicators related to the environment and ecosystems. These included both a positive focus on environmental assets, sustainable natural resource management (ARUP, 2011; Plan International, 2020; Tearfund, n.d.; Twigg, 2009) as well as in a negative sense, in terms of reliance on vulnerable ecosystems (UNICEF EAPRO, 2023). One framework mentioned ecosystem-based disaster risk reduction and climate change adaptation (Plan International, 2020).

## 2.4 Measurement considerations, methods and validation

Several of the systematic reviews of community resilience frameworks focussed on ways to measure the appropriateness and effectiveness of existing monitoring frameworks. This included analysis of the use of different **data collection and analysis** approaches across the frameworks with the use of qualitative, quantitative and hybrid analyses and primary and secondary data collection varying depending on the intent of the framework. The reviews also focussed on the inclusion several aspects of resilience as indicators of the appropriateness of the framework, namely **dynamic resilience** including scenario planning, a **comprehensive definition** of resilience, **appropriate indicators** for the desired outcomes and contextualisation to local context. The reviews also propose statistical approaches to **empirical validation** to assess the effectiveness of the frameworks. These aspects of frameworks provide a systematic approach to reviewing their appropriateness and effectiveness, however the all of these monitoring approaches have been criticised as they may not account for the variations and complexities within different communities.

### 2.4.1 Types of data sources

The reviewed models used a variety of data collection methods and data sources often driven by the intended use of the framework. The breakdown of the measurement approach within the reviews showed support for both quantitative and qualitative data but less common use of hybrid approaches. Cai et al., 2018 found 39.7% of the frameworks used a qualitative methodology, 39.1% quantitative and 12.6% hybrid. This split changed dramatically when looking at general community resilience or resilience to a specific shock, with a strongly qualitative focus for general resilience, (45.2% qualitative/28.8% quantitative) and quantitative for specific hazards (29.9% qualitative/53.7% quantitative). Zaman & Raihan, 2023 conflicted with the conclusion from Cai et al., 2018 that general resilience models tended qualitative, finding 43% of models used a quantitative approach, 34% qualitative and 23% mixed methods. This is despite the fact that most of the models in this review used a primary data collection method that could be adapted to hybrid or qualitative approaches with the most common data collection methods being face-to-face surveys, focus group discussions and key-informant interviews.



## 2.4.2 Resilience as a dynamic versus static concept

An important consideration in the frameworks is that communities and the shocks they face will change over time and resilience to these shocks does not necessarily involve bouncing-back to their current state. Communities can undergo transformational change and maintain their resilience or may be resilient to certain hazards but not others (Copeland et al., 2020).

It is important for monitoring of resilience to consider the future risks communities are likely to face rather than focus on a single hazard or event. This can be accomplished through scenario planning through tools such as climate projections, land-use planning, demographic projections, impact thresholds and simulation of adaptation measures (Jurgilevich et al., 2017). Jurgilevich et al. (2017) found that just over half of the frameworks they examined considered changes over time in their indicators and definitions, however this consideration of dynamics mostly addressed exposure to bio-physical factors despite the importance of the dynamics of vulnerability and socio-economic factors:

“Although the role of socio-economic factors in climate change risk formation is largely recognised in the literature (Räsänen et al 2016), the biophysical factors still prevail in the future-oriented sub-national assessments. More methodological developments are needed in addressing future socio-economic change and projections at the sub-national level, which can be used along with the climatic projections of that region” (Jurgilevich et al., 2017)

This is an evolving field in resilience monitoring as the number of models involving dynamic indicators is growing (Assarkhaniki et al., 2020).

As well as being dynamic in time communities are dynamic spatially with itinerant populations and changing community boundaries during shocks. The ability to migrate is sometimes seen as an indicator of resilience so it is difficult to maintain a geographic boundary for a community. It is also important to note there is interaction outside of the geographic community as resilience at national level will impact community resilience. Some of the reviewed models measure indicators at national, community and individual level to account for these interactions (Fielke et al., 2017).

## 2.4.3 Methods to assess validity

A number of the systematic reviews propose methodologies to assess the appropriateness and effectiveness of the frameworks. This involves determining whether the selected indicators and methodologies are measuring a clear and appropriate definition of community resilience, whether they are suitable for the context in which they are used, including incorporating community perspectives, whether the data can be verified to have a measurable impact on their definition of community resilience and whether the outputs from this are presented in a way that is useful to the sector that is using the framework.

### Theoretical basis and definition

To effectively measure community resilience any model requires a clear definition of the concept backed by indicators that are comprehensive in addressing that definition. Assessment of the theoretical comprehensiveness of resilience definitions and the robustness and comprehensiveness of indicators were proposed by Asadzadeh et al., 2017; Ran et al., 2020 and Sharifi, 2016 as important in defining appropriate frameworks.

The theoretical comprehensiveness of the definition is defined by review paper authors in varied ways:

- Whether the definition address multiple dimensions of resilience, particularly the five common domains addressed proposed in section 3.5 (Sharifi, 2016).
- Whether the definition is measuring adaptive resilience, that is whether it is measuring how efficiently communities recover, their ability to withstand shocks or their ability to absorb and transform (Asadzadeh et al., 2017).
- Whether the definition accounts for changes and interactions across temporal and spatial scales. Are community level relationships linked to those at regional level and are past, current and future events included (Copeland et al., 2020; Ran et al., 2020; Sharifi, 2016).
- Whether the model accounts for uncertainties and uses scenario planning (Sharifi, 2016)

## **Appropriateness of indicators**

The definition and appropriateness of the indicators are often assessed on (Asadzadeh et al., 2017):

- Robustness, are they the best representation each aspect of resilience?
- Coverage, do the indicators cover all aspects of the resilience definition?
- Level of measurement, do they only measure inputs and outputs or do they draw outcome and impact level data?
- Consistency, is there a method to check the accuracy of the data?

Other authors have mentioned alternative criteria for indicator selection, including validity, sensitivity, robustness, reproducibility, scope, availability, affordability, simplicity, and relevance (Ran et al., 2020). In addition, some of the variables may be interdependent, which could result in redundancy in measuring a dependent variable (Ostadtaghizadeh et al., 2015)

## **Contextualisation for local context**

Frameworks can be assessed on whether they have taken steps to adapt to fit the context in which they are being used. This is particularly relevant in community resilience frameworks due to the proportion of frameworks developed in high-income countries (Ran et al., 2020).

A common way to adapt frameworks is through participatory design of indicators, involving the community in the selection of indicators, data collection methodology and weighting of results through a bottom-up design process (Sharifi, 2016). Participatory approaches are uncommon among existing models in the reviewed literature, but are becoming more common in recent frameworks (Asadzadeh et al., 2017).

## **Empirical validation**

It is important to have a defensible method to validate any framework or indicators. This can be accomplished through different statistical validation approaches, however the majority of frameworks do not employ empirical validation. Validation methods have been used in only 10% of the frameworks analysed (Cai et al., 2018; Zaman & Raihan, 2023), although these approaches are becoming more common (Asadzadeh et al., 2017). Four common validation approaches within the reviewed frameworks are:

- Comparing the results from the model to composite indices: Composite indices for this model can be created in different ways with some models generating indices through factor analysis (Ran et al., 2020).
- Comparing the results with estimates from independent sources: Some frameworks have drawn upon expert judgements of vulnerability from previous work as a basis to assess correlation with their indicators (Ran et al., 2020).
- Comparing the results with quantitative recovery variables such as mortality, morbidity, and rebuilding timescales (Ran et al., 2020). This approach requires measurement after an event and is generally used within the DRR literature.
- Comparing measurements of community resilience to perceived community resilience. Leykin et al., 2013 conducts this process by creating a model of perceived resilience defined by surveying a sample of the community and asking them to rank their individual and community resilience using a clearly articulated definition. This perceived resilience is then correlated with the different indicators in the framework using methods such as exploratory and confirmatory factor analysis.

These validation techniques can prove problematic as many models do not have quantitative and testable predictions. Forcing a validation methodology that uses predictive accuracy or fit to a data set through statistical methods such as factor analysis onto some of the qualitative frameworks is unfeasible (Ran et al., 2020). In these cases, a robust defence of the underlying definitions and assumptions in the methodology is essential to account for the lack of empirical verification.



When considering the verification of the indicators against other measures of community resilience it is also important to address weighting and scaling and scaling of the results. The varying impacts of indicators needs to be accounted for and can be considered using a data driven or knowledge driven approach to determining the relative impacts of indicators. However the majority of frameworks use an equal-weighting approach to indicators (Asadzadeh et al., 2017).

Indicators also ideally should be expressed on a common scale by standardising data, mathematically sound approaches to this include recalling using a normal distribution or normalising minimum and maximum data to a 0-1 range, but both of these approaches were uncommon in the frameworks (Asadzadeh et al., 2017) and are difficult to achieve in practice.

### **Useability**

A community resilience framework will be ineffective if it does not result in information that is able to be operationalised in the sector applying the framework. Asadzadeh et al., 2017 proposes that frameworks be assessed on whether results are easy to understand, enhance conceptual clarity and are in a format that is can be put to use by implementing organisations. Under this assessment framework they highlight the Baseline Resilience Indicators for Communities (BRIC) model as the most effective model against these criteria, although it should be noted that visualisation measures will be predominantly subjective. Sharifi, 2016 expanded on this assessment of the impact of frameworks by including an assessment measure of whether the application of the framework resulted in an action plan to improve community resilience.



## 2.4.4 Critiques of measurement of resilience at community level

The concept of “community” has been critiqued by climate change academics and practitioners as being problematic for understanding the capacity of people to respond to climate change and setting the scope and form of interventions intended to build people’s resilience. In this section, we review the common problematisations, describe authors’ proposed solutions for overcoming the problems (or our own where no references are provided), and consider the implications for this study.

### **Intra-community power dynamics**

Social division and conflict often exist within groups of people, but uncritical use of the concept of community runs the risk of framing people as harmonious and unified (Cannon, 2008). Such divisions and conflict are linked to power relations within the community that can be a source of poverty and vulnerability (IFRC, 2014). Interventions intended to build community resilience can unintentionally maintain a status quo of power asymmetry that reproduces vulnerability or even worsens unequal power relations (Ribot, 2011; Buggy & McNamara, 2016).

Researchers recommend that implementers of community-based adaptation interventions should analyse local power dynamics and address socio-political causes of vulnerability (Buggy & McNamara, 2016; McNamara et al., 2020). Indeed, our review of resilience characteristics points to the importance of equality in decision-making and resource access and control. Hence, monitoring indicators relating to power dynamics within communities and households may be important for tracking resilience.

### **Elite capture**

Elite capture refers to instances where powerful people within the community expropriate funds or the benefits of projects intended for a wider range of people, thus reinforcing their positions of power (Eriksen et al., 2021). Elite capture often results from the tendency of implementers to rely privileged insiders to start new adaptation projects which gives opportunities for influential community members to manipulate project inputs for their own benefit (IFRC, 2014; Eriksen et al., 2021).

Targeting individuals or groups with specific characteristics may be more effective at ensuring project benefits reach the intended people than going through the “community” (Titz et al., 2018). However, power relations and elite capture can exist within sub-groups (e.g. women, people with disabilities, etc.) as well, so methods for giving opportunities for anyone to participate in decision-making remain important. Data collection methods for monitoring community resilience should take proactively seek to take inputs from a diverse range people outside of traditional leaders and influential people.

### **Heterogeneity within communities**

Communities are heterogeneous with respect to their values, worldviews, priorities, power, livelihoods and more (Eriksen et al., 2021). Hence, people are likely to have differing capacities with respect to responding to climate hazards and differing aspirations for building their resilience.

Adaptation interventions could seek to assess resilience amongst specific social groups, then tailor interventions to meet the needs and desires of those specific groups, rather than applying the same treatment for everyone in the community. Likewise, indicators for monitoring resilience may need to be disaggregated and tailored to specific social groups.

### **Complexity of communities**

Communities are complex, diverse, and multi-faceted (Cannon, 2008). Hence, processes that seek to monitor and evaluate changes in resilience require social and process-oriented indicators that are context-specific and resource-intensive to define and measure (Eriksen et al., 2021). It is difficult to come up with generic indicators for community resilience because indicators of success are not universal (Moser & Boykoff, 2013) and community members will value aspects of resilience in different ways.

Programs can invest more in monitoring and evaluation of community resilience to account for this complexity. However, realistically, a balance must be struck between accounting for the nuance of resilience in specific places and what can be pragmatically implemented at scale.

## **Responsibility for building resilience**

There is a risk that community-based adaptation approaches can be seen as a ploy to offload the responsibility and costs of building resilience onto communities (Galvin, 2019; Davis et al., 2021). That is, government or other actors may use the concept of community resilience to advance an agenda that views communities as self-sufficient without a need for external services.

Climate resilience project implementers should seek to advocate to governments that ongoing external support is often crucial for success. Implementers could also seek to support communities to create representative structures that can engage with power structures at higher levels (Dodman & Mitlin, 2013). Monitoring approaches to community resilience could also include indicators relating to the level of ongoing government support to communities.

## **Resilience across scales**

Vulnerability and resilience at a community level are influenced by regional and national inequalities, trends in investments and state policies, and global flows of capital (Forsyth, 2013; Robinson & Carson, 2015). Hence, it cannot be expected that the resilience of communities can be secured only through local-level interventions.

Although climate resilience project implementers may have limited influence on broader forces, it is important for them to consider the risks and priorities people have with wider processes of social, economic, or political change (Forsyth, 2013). For monitoring community resilience, establishing common and clear boundaries of what can be monitored to account for such broader forces will be needed to acknowledge their influence while managing the complexity of interlinked scales.

## **Scoping of communities**

Communities are often ill-defined by project implementers and can be scoped in numerous ways (IFRC, 2014; Ntontis et al., 2019). Ways of defining or scoping communities includes along the lines of groups of people with similar affiliations, groups of people sharing an experience of a common adverse event, existing familial or social identity, or – most commonly – physical geography or location (Cannon et al., 2014; Buggy & McNamara, 2016; Ntontis et al., 2019). However, uncritical scoping of the community can lead to grouping people with dissimilar experiences, inflaming internal disputes, or excluding certain groups (McNamara et al., 2020).

A review of community-based adaptation initiatives in Pacific island countries found that initiatives that moved away from archetypal parameters of community, usually based on geography, tended to perform better (McNamara et al., 2020). Questioning whether community, or alternatively some other grouping of people, is the most logical way to frame the beneficiaries of an intervention may lead to better outcomes (Cannon et al., 2014; Titz et al., 2018). For the purposes of monitoring, bottom-up, participatory approaches to defining groups to monitor may be used where feasible. This may result in indicators that are disaggregated or aggregated along different lines than which the intervention was implemented.

## **Dynamic communities**

Communities undergo continuous processes of formation and reformation, and social division and inequalities change over time (Titz et al., 2018; Räsänen et al., 2020). Individual interventions are often too short in duration to measure adaptation success in terms of longer-term outcomes with respect to these changes (Eriksen et al., 2021).

Sustained engagement and reassessment of the context over time is required to ensure that community resilience support remains relevant and appropriate (Buggy & McNamara, 2016). With respect to monitoring, indicators may lose their validity over time and need to be periodically revised to suit the changing nature of communities.

The critiques of the concept of community in relation to climate and disaster resilience, opportunities to overcome the identified issues, and implications for this monitoring WASH contributions to community resilience are summarised in Table 2.

Table 2. Summary of community critiques, solutions, and project implications

<b>Problem</b>	<b>Possible solution</b>	<b>Implications for monitoring WASH contributions to community resilience</b>
<b>Intra-community power dynamics as an internal source of vulnerability</b>	Interventions should seek to understand and address intra-community sources of vulnerability such as unequal power	Indicators that seek to measure intra-community/household power dynamics may be useful.
<b>Elite capture of the benefits from a community resilience intervention</b>	Design solutions with and for specific groups of disadvantaged people.	Data collection methods for measuring indicators should seek input not just from elites and traditional leaders
<b>Heterogeneity within communities means people have differing levels of resilience</b>	Assess, and build resilience in ways that account for this diversity instead of a common approach for everyone at the community level	Indicators may need to be disaggregated across social groups
<b>The complex nature of community resilience makes it difficult to monitor and evaluate</b>	Programs must invest more in thoughtful monitoring and evaluation	Balance needs between capturing nuance and complexity of resilience while being practical for country offices to implement
<b>Governments may use the concept of community resilience to absolve themselves of responsibility</b>	Advocate to government that community resilience is not about leaving communities to fend for themselves	Careful messaging to government partners about community resilience and their responsibilities; Include indicators on government support to communities
<b>Community resilience is linked to/influenced by the resilience of systems at larger scales</b>	Community resilience-building must consider factors beyond the community scale	Establish common and clear boundaries or expand scope
<b>Scoping of community is often poorly defined by programs and lack of consensus on what is a community</b>	Define and operationalize the concept of community before the intervention; Consider alternatives to community based on geographic parameters	Indicators may be disaggregated (or aggregated) along different lines than how the intervention was implemented; Potentially bottom-up approaches to defining some indicators
<b>Communities are dynamic, so levels of resilience change over time</b>	Take a long-term, evolutionary perspective to resilience building through re-doing assessments and adjusting interventions over time	The indicators may need to be framed as losing validity over time, so need to re-measured or the indicators updated

“ The concept of “community” has been critiqued by climate change academics and practitioners as being problematic for understanding the capacity of people to respond to climate change and setting the scope and form of interventions intended to build people’s resilience.

## 2.5 Summary and conclusions

Our review concurs with other similar reviews that attempts to characterise, measure, and assess resilience (of communities or other systems) produce highly variable results, owing to the complex nature of resilience and contestations over the core definition of resilience (Quinlan et al., 2016; Sharifi, 2016). As discussed earlier in this document, this includes differences in thinking with respect to:

- theoretical perspective: risk-hazard (disaster and engineering fields), contextual vulnerability (social and political sciences) and socio-ecological systems (ecology)
- type capacities to deal with disturbances: absorptive, adaptive and transformative capacities
- types of adaptive capacities: generic adaptive capacity and specific adaptive capacities
- resilience as a trait, a process or an outcome
- resilience as a reduction in exposure, as increased resistance, as increased specific adaptive capacity, as increased generic adaptive capacity, and as increased socio-ecological systems resilience
- objective and subjective measures of resilience

Consequently, researchers and organisations alike have collectively proposed a wide range of resilience characteristics that span most common development objectives. Table 3 summarises the key areas described in academic literature and organisational frameworks reviewed in this document. Yet, this table does not necessarily cover all aspects of community resilience as other outcomes (e.g. adaptive governance) could be included.

Table 3: Summary of key categories and areas of measurement of community resilience based on review

Domain	Community resilience outcome
<b>SOCIAL</b>	<ul style="list-style-type: none"> <li>• Health and well-being: Improved physical and/or mental health and overall happiness and well-being</li> <li>• Food security: A secure and reliable supply of safe, nutritious and affordable foods that meets dietary needs and preferences</li> <li>• Basic needs met: Shelter, clothing and other basic needs for survival (Note: needs beyond water and sanitation, which is covered in a different category below).</li> </ul>
	<ul style="list-style-type: none"> <li>• Capacity to anticipate risks: Individual, household or community access to information and knowledge on climate risks; technical skills and knowledge to interpret climate information; knowledge on how to prepare for climate risks; traditional ecological and social knowledge pertaining to climate risks</li> <li>• Capacity to innovate: Individuals, household or communities taking on a forward-thinking mindset towards the long-term; Openness to experimentation and innovation; Adaptiveness and flexibility</li> </ul>
	<ul style="list-style-type: none"> <li>• Individual attitudes and motivations: People’s individually held beliefs, risk perceptions, perceptions of self-efficacy, and opinions in relation to climate change that motivate them to act.</li> </ul>
	<ul style="list-style-type: none"> <li>• Collective capacity: Community cohesion, trust, conflict management, and caring for one another; social capital</li> </ul>
	<ul style="list-style-type: none"> <li>• Social justice and equality: Empowerment and meaningful participation of disadvantaged groups including women; Inclusive decision-making; Equitable resource allocation; gender equality</li> </ul>
<b>ECONOMIC</b>	<ul style="list-style-type: none"> <li>• Financial resources at household level: Household access to cash, remittances, membership to formal or informal savings accounts, liquid assets, formal or informal lending and borrowing, cash and non-cash transfers</li> </ul>
	<ul style="list-style-type: none"> <li>• Government financial resources: Local or central government access to revenue, cash, credit, liquid assets, formal lending and borrowing, cash and non-cash transfers</li> </ul>
	<ul style="list-style-type: none"> <li>• Private sector/businesses: Establishment of new businesses or enterprises; Increased profitability, revenue growth, growth margin, net income, cash flow, customer satisfaction, customer retention, brand recognition, return on investment, employee satisfaction and retention, or operational efficiency of businesses</li> </ul>

	<ul style="list-style-type: none"> <li>• Sustainable, diverse and secure livelihoods: Ability of households or individuals to earn income and “make a living” in diverse ways that are secure and viable over the long-term</li> </ul>
<b>INSTITUTIONAL</b>	<ul style="list-style-type: none"> <li>• Good governance at community level: Transparent, accountable, participatory, responsive and non-discriminatory decision-making at the community level; Good financial management; Adaptive governance</li> <li>• Good governance at the state level: Transparent, accountable, participatory, non-discriminatory, responsive and lawful decision-making; Good fiscal management; Strong legal and regulatory systems; Making data and information available; Planning for equity and sustainability; Adaptive governance</li> </ul>
	<ul style="list-style-type: none"> <li>• Climate/disaster preparedness planning: Provision and use of early warning systems; dissemination of weather and climate information; Development of disaster and climate risk preparedness plans; Evacuation plans; Vulnerability and risk mapping</li> </ul>
	<ul style="list-style-type: none"> <li>• Climate/disaster response and recovery: Financial mechanisms for supporting disaster response or recovery; Coordination during disaster response or recovery; Emergency response resources</li> </ul>
	<ul style="list-style-type: none"> <li>• Social protection: Social safety nets; Social insurance; Labour market protection; Legal frameworks and mechanisms for citizens to claim rights</li> </ul>
	<ul style="list-style-type: none"> <li>• Inter- and intra- sectoral collaboration and networking: Collaboration and networking between agencies/departments/individuals responsible for water, sanitation and hygiene with those from intra-sectoral areas (e.g. water resources management) and inter-sectoral areas (e.g. energy, agriculture).</li> </ul>
<b>INFRASTRUCTURAL</b>	<ul style="list-style-type: none"> <li>• Secure water and sanitation infrastructure and services: Access to safely managed water and/or sanitation services</li> </ul>
	<ul style="list-style-type: none"> <li>• Secure energy infrastructure and services: Access to reliable sources of energy</li> </ul>
	<ul style="list-style-type: none"> <li>• Secure transport infrastructure and services: Access to reliable and safe transportation</li> </ul>
	<ul style="list-style-type: none"> <li>• Secure telecommunications and ICT infrastructure and services: Access to reliable telecommunications and information and communication technologies</li> </ul>
	<ul style="list-style-type: none"> <li>• Secure healthcare infrastructure and services: Access to preventive, promotive, curative, rehabilitative and palliative health services delivered through health care facilities.</li> </ul>
	<ul style="list-style-type: none"> <li>• Secure education infrastructure and services: Access to reliable education services delivered through education institutions</li> </ul>
	<ul style="list-style-type: none"> <li>• Secure community services: Access to other community services not mentioned elsewhere such as policing, homelessness services, nutrition and food services, domestic violence and suicide prevention services, legal services, recycling services, and arts and cultural services.</li> </ul>
	<ul style="list-style-type: none"> <li>• Emergency response infrastructure: Evacuation facilities and shelter points; Emergency response vehicles and technologies</li> </ul>
<b>ENVIRONMENTAL</b>	<ul style="list-style-type: none"> <li>• Environmental quality: Environmentally safe water, soil and air quality; Biodiversity; Healthy ecosystems</li> </ul>
	<ul style="list-style-type: none"> <li>• Environmental protections: Land use and pollution regulations; Erosion management; Biodiversity loss prevention; Sustainable natural resource management practices; Ecosystems regeneration and restoration; Establishment of conservation and protected areas; Wildlife protection and anti-poaching</li> </ul>

Despite the widespread interest globally in assessing resilience, few studies have collected empirical evidence of which characteristics determine resilience in communities and other systems. Further complicating matters, the concept of community resilience has been called into question itself, for masking nuance and power dynamics related to how people handle adverse climate and other environmental effects. Clearly, no consensus on the determinants of community resilience has been reached. Given the pluralistic understandings of resilience worldwide, it is unlikely consensus will ever be reached.

# 3 Water, sanitation and hygiene interventions' contribution to community resilience

## 3.1 Defining climate-resilient WASH interventions

For WASH to have a contribution to community resilience, it is first critical that WASH interventions themselves are 'climate resilient'. This section defines key characteristics of 'climate resilience WASH interventions' and differentiates them from previous WASH interventions before the advent of climate change. Our focus here is specifically on 'interventions' and not a description of a 'climate resilient WASH system', which is the subject of current discussion in the WASH sector at the time of writing this document, and is aligned with other recent work.

As described earlier, there are multitude of definitions of resilience. The Intergovernmental Panel on Climate Change (IPCC) in 2022 defined resilience as: *"The capacity of interconnected social, economic and ecological systems to cope with a hazardous event, trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure. Resilience is a positive attribute when it maintains capacity for adaptation, learning and/or transformation."*

The IPCC (2022) definition of resilience is appropriate to use because the IPCC attempts to provide definitions that are encompassing of a wide range of perspectives, which reflects how we have treated the resilience concept in our literature review. The following table draws on this definition of resilience to interpret the definition for climate resilient WASH interventions (see Table 4).

Table 4: Explanation of climate resilient WASH using IPCC 2022 definition of resilience

Resilience definition fragment	Our interpretation to inform climate resilient WASH (CR WASH) interventions
<b>"The capacity of interconnected social, economic and ecological systems..."</b>	WASH systems comprise complex and dynamic social systems (e.g. WASH users, governance systems), economic systems (e.g. the production and distribution of WASH infrastructure, products and services) and ecological systems (e.g. water-related ecosystems). These systems are all interconnected with one another, as well as with systems outside of WASH (e.g. farming livelihoods). As a result, CR WASH interventions can aim to focus more narrowly on immediate WASH systems, or also explicitly seek to influence wider change that supports community or societal resilience to climate change
<b>"...to cope with..."</b>	As a minimum, CR WASH interventions should ensure coping mechanisms are present to access a minimum level of service (e.g., through back-up systems etc.). However, coping mechanisms may be inadequate in the long-run, hence a need for adaptation or transformation. Therefore, as needs, CR WASH interventions should aim to support relevant adaptation actions by users, service providers, local governments and national governments, or even wider transformations, should that be required to maintain the availability of the service and its contribution to wider community resilience.
<b>"... a hazardous event, trend or disturbance..."</b>	For WASH, these include shocks (e.g. cyclones, flash floods), slow onset events (e.g. drought, sea level rise), trends (e.g. changes in annual average rainfall or annual average temperature), and unpredictability and uncertainty (e.g. seasons not starting at the usual times, overall uncertainty about how climate and weather will change in the future). For CR WASH, each shock, event or trend may require different specific adaptive capacities, since, for example flooding, drought and sea-level rise all demand different adjustments in WASH infrastructure, services and planning.
<b>"...responding or reorganising..."</b>	There are many ways that WASH systems can respond to climate hazards. Responding can involve building the capacity of WASH systems to withstand or resist the force of climate hazards in order to continue working as always. But WASH systems can also reorganise, meaning that one or more components of the WASH system adjusts to a disturbance or change in conditions, which may result in designing in flexibility to technologies, operational procedures etc, reconfiguring how services are provided. and the relevant evolution in

governance and regulatory systems in forms of adaptive governance that support these changes.

“...in ways that maintain essential function, identity and structure.”

Ultimately, WASH systems should continue to meet all people’s human rights to water and sanitation and provide other benefits as expected by society. For CR WASH interventions then, it does not matter so much if the WASH system stays the same or reorganises, as long as it meets the needs of everyone now and over the long-term.

“Resilience is a positive attribute when it maintains capacity for adaptation, learning and/or transformation.”

Resilience can be a negative attribute when it maintains a status quo which is not beneficial or is maladaptive, and for this reason the IPCC definition notes three characteristics of resilience when it is a positive attribute.

Resilience determinants to be cultivated by CR WASH interventions (both within and where relevant, beyond WASH systems) should therefore include:

**Adaptation:** The process of adjustment to actual or expected climate and its effects, with subsequent results that are sustained and provide benefits over the long-term as opposed to only coping to meet immediate, short-term needs.

**Learning:** Enabling people to learn from mistakes, anticipate future risks, accumulate memory about adaptation and transformation, and make informed decisions, such as through monitoring, evaluation and learning practices; or

**Transformation:** A deeper, more fundamental change than is usually achieved by adaptation. One example of transformation is the redistribution and sharing of power and control over decision-making, resources and benefits across marginalised and more powerful social groups.

GWP and UNICEF (2022) define resilience as “the ability of people and systems to anticipate, adapt to and recover from the negative effects of shocks and stresses (including natural disasters and climate change) in a manner that reduces vulnerability, protects livelihoods, accelerates and sustains recovery, and supports economic and social development, while preserving cultural integrity.” This definition aligns with the IPCC definition, but adds on desirable outcomes that one may consider as the value or purpose of resilience-building. As noted in Table 4 above, CR WASH interventions may be more narrowly framed to contribute to secure WASH services (since these services themselves are a determinant of community or societal resilience to climate change) or also purposefully take a broader, intersectoral focus that links WASH to other relevant dimensions of societal or community resilience.

“ For WASH to have a contribution to community resilience, it is first critical that WASH interventions themselves are ‘climate resilient’.





### 3.2 Monitoring the WASH contribution to community resilience to climate change

Due to the complexity and breadth of the claimed determinant of community resilience noted in this report and summarised in Table 3, it will be unworkable for implementation projects or research studies to claim to comprehensively monitor or measure community resilience. Hence, there projects and studies need to find balance between responding to the multi-faceted nature of resilience and feasibility.

To develop an approach to monitoring how WASH interventions contribute to community resilience, it is pertinent to define measurable characteristics of community resilience to which WASH can contribute and a rationale for focusing on these characteristics. While it is not possible to empirically show which characteristics are the “right” ones, or the most impactful for resilience, one can choose characteristics based on other criteria. For example, relevant dimensions could be selected in terms of:

- Where climate resilient WASH programming is most likely to have a direct link and there is evidence to support this link
- Resilience priorities as set out in national strategies and policies or by community members
- Country-specific opportunities to collaborate within the wider water sector, including water resources management (intra-sectoral collaboration) and across other inter-connected sectors such as agriculture and livelihoods (inter-sectoral collaboration) to strengthen ties between WASH and other sectors’ efforts to build resilience
- Priorities of major climate financiers and donors, particularly in relation to their results and performance assessment processes

A monitoring approach also ideally would account for the challenges identified in this review, including issues pertaining to data availability, validity, the dynamic and context-specific nature of resilience, the appropriateness and usability of indicators, and power dynamics and heterogeneity within and across communities. This is difficult to achieve in practice, so projects or studies must consider what they want to achieve with monitoring contributions to community resilience and what can realistically be accomplished.

A key aspect to consider in selecting areas to monitor, is the scope of a given CR WASH intervention. Engagement with UNICEF country offices and the advisory groups for this research project pointed to three key determinants of community resilience where any CR WASH intervention would normally be expected to contribute ((i) health and well-being, (ii) secure water and sanitation infrastructure and services; and, when including sanitation, (iii) environmental quality). This engagement also pointed to a set of areas where a climate resilient WASH intervention *could feasibly contribute* (depending on its scope and design), for instance, towards food security, or climate and disaster preparedness planning. Finally, there is a range of determinants towards which a climate resilient WASH intervention would be expected to have limited or no contribution (see Figure 1).

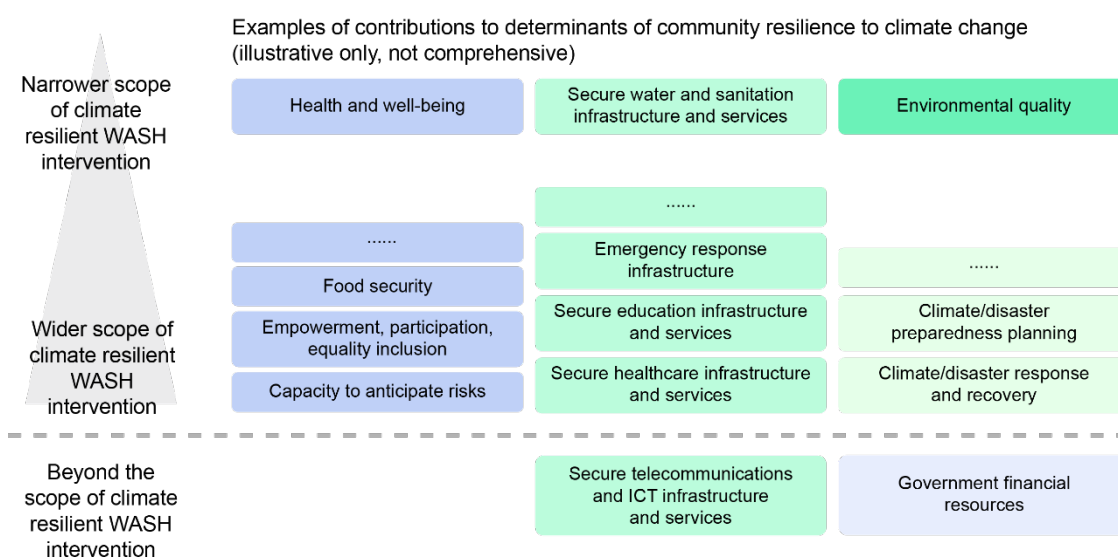


Figure 1: Potential contribution of climate resilient WASH programming to elements of community resilience

To monitor the contributions of a CR WASH intervention to broader community resilience to climate change, ideally evidence of a causal chain would be produced. Figure 2 outlines this causal chain. First, the CR WASH intervention would generate its intended outputs or outcomes which may include, for example, strengthened systems, improved services or trained personnel. Next, linkages between those outputs and outcomes and the community resilience outcomes listed in Table 3 (or derived from elsewhere) would be established. Finally, there should be reason to believe that the community resilience outcomes actually do contribute to overall community resilience although, as this document has shown, empirical evidence on determinants of community resilience is weak.

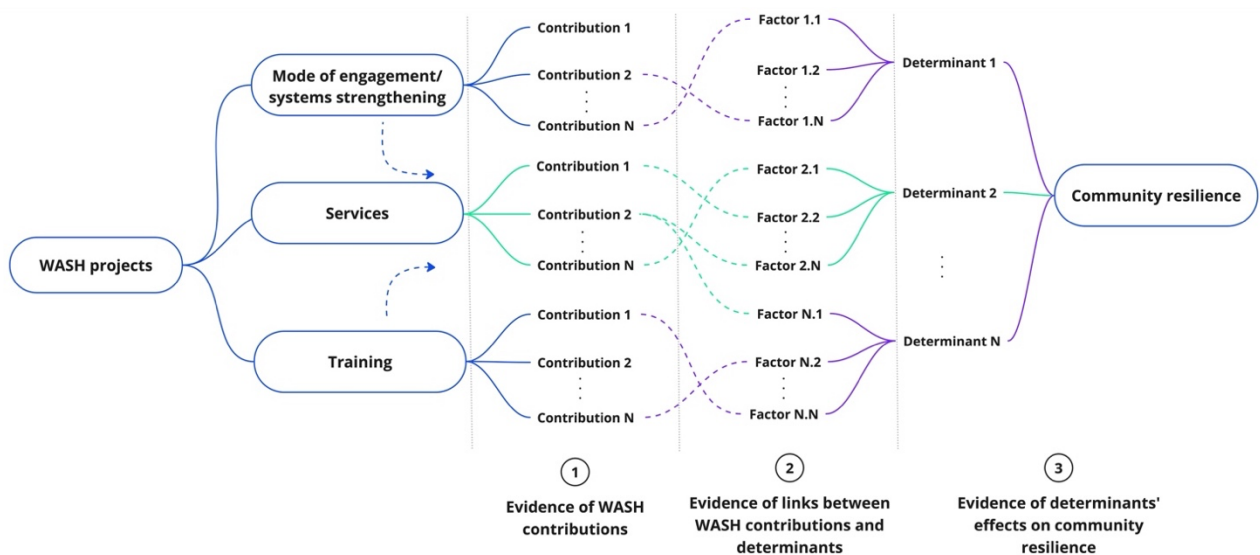


Figure 2: Flowchart of assumed causal chain between WASH projects and community resilience

Figure 3 shows a worked example of the causal chain. A CR WASH intervention may improve rural water services that, in addition to providing safe drinking water that is secure in the face of climate disturbances, may also provide sufficient water to improve gardening activities. Improved gardening activities may increase local food production and support local food security. Food security was identified in this review as a claimed determinant of community resilience to climate change. However, food security alone may be insufficient for achieving desirable levels of community resilience, food production is only one element of food security, and other factors are relevant for significant food production aside from gardening. But if evidence of each link of the causal chain exists, a case can be made that the CR WASH intervention is making some contribution to community resilience beyond just WASH service outcomes.

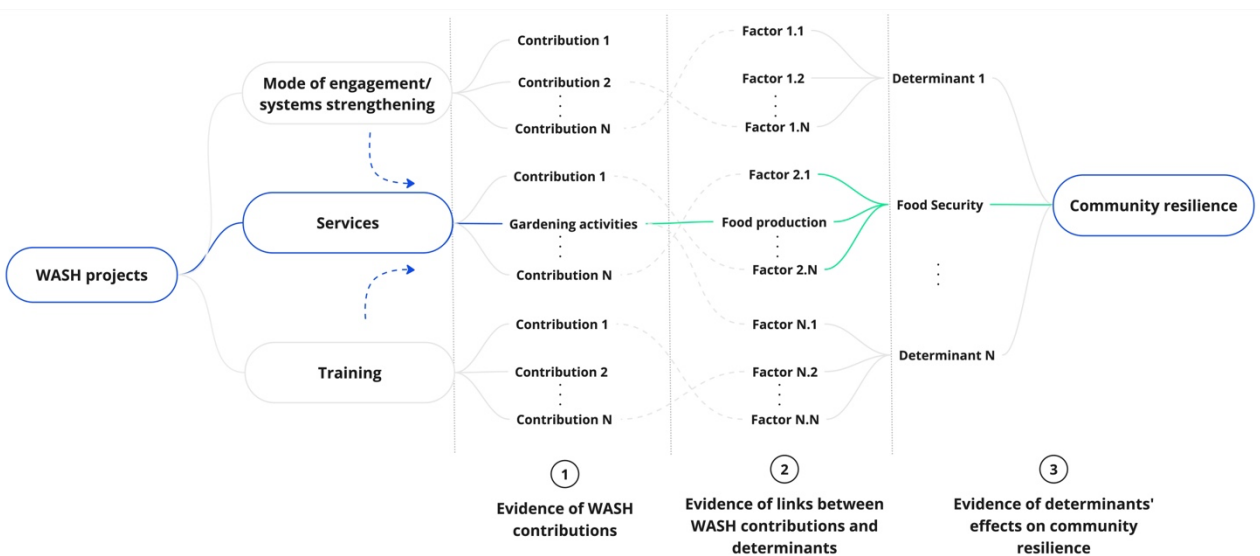


Figure 3: A worked example of the causal chain between WASH projects and community resilience: a climate-resilient WASH intervention that leads to more gardening activities can support local food production, improve local food security and strengthen community resilience.

Future work by UTS-ISF and UNICEF EAPRO will develop guidance for WASH actors on choosing a causal chain from CR WASH contributions to community resilience to monitor and how to plan and resource for monitoring that is fit-for-purpose.

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