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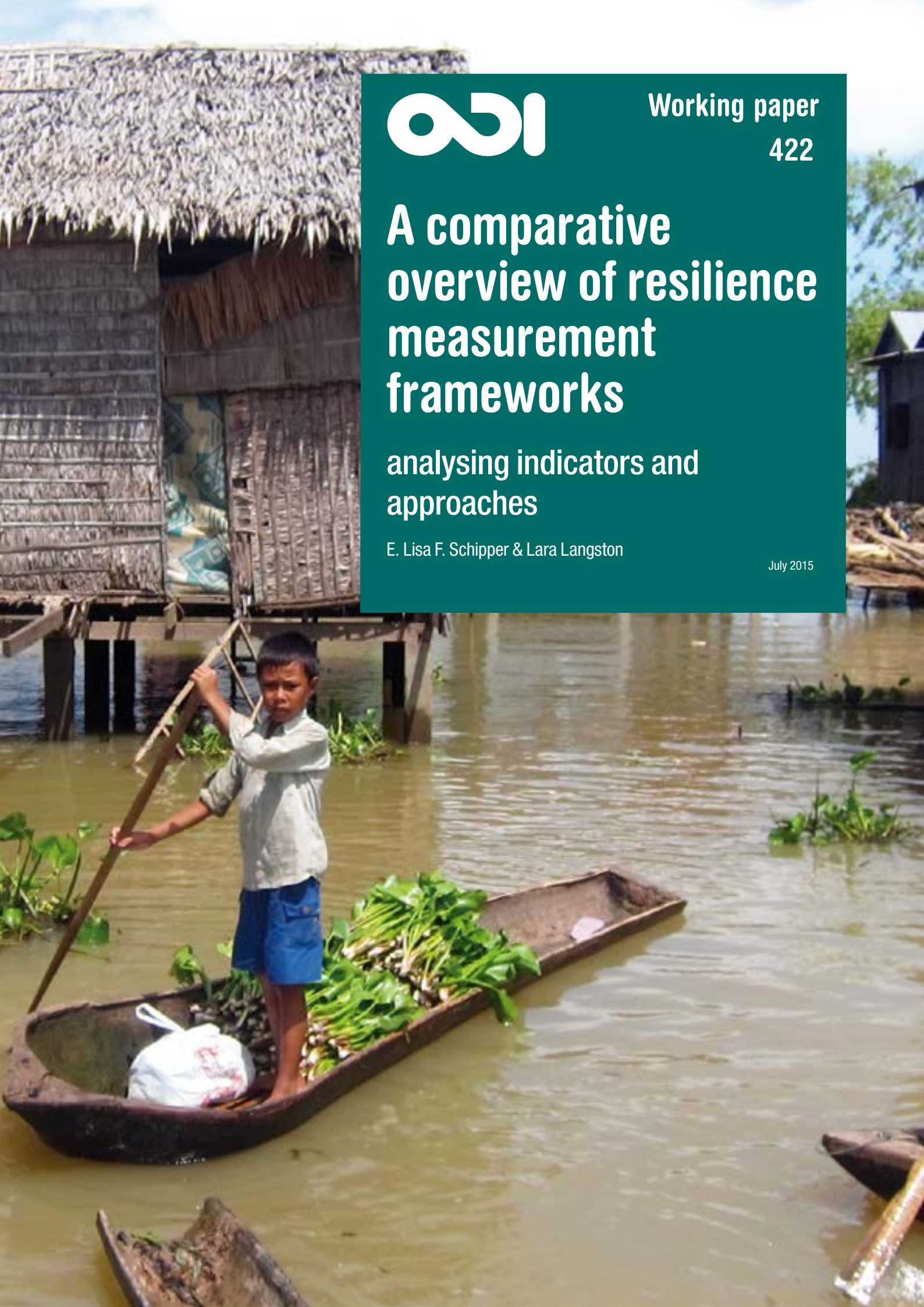
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# A comparative overview of resilience measurement frameworks

analysing indicators and  
approaches

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July 2015



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# List of Acronyms

<b>ACCCRN</b>	Rockefeller Foundation's Asian Cities Climate Change Resilience Network	<b>LAST</b>	Livelihood Assets Tracking System
<b>AIACC</b>	Assessments of Impacts and Adaptations to Climate Change	<b>NGO</b>	Non-Governmental Organisation
<b>ARC</b>	African Risk Capacity	<b>ODI</b>	Overseas Development Institute
<b>ARCAB</b>	Action Research for Community Based Adaptation	<b>OECD</b>	Organisation for Economic Co-operation and Development
<b>BRACED</b>	UK Department for International Development's Building resilience and adaptation to climate extremes and disasters framework	<b>PPCR</b>	Pilot Programme for Climate Resilience
<b>CoBRA</b>	Community-Based Resilience Analysis	<b>SHARP</b>	UN Food and Agriculture Self-evaluation and Holistic Assessment of Climate Resilience
<b>CRM</b>	Climate risk management	<b>TAMD</b>	Tracking Adaptation and Monitoring Development
<b>FAO</b>	UN Food and Agriculture Organisation	<b>UN</b>	United Nations
<b>HFA</b>	Hyogo Framework for Action	<b>USAID</b>	US Agency for International Development
<b>IFRC</b>	International Federation of Red Cross and Red Crescent Societies	<b>UNFCCC</b>	United Nations Framework Convention on Climate Change
<b>IISD</b>	International Institute for Sustainable Development	<b>UN/ISDR</b>	UN's International Strategy for Disaster Reduction
<b>IPCC</b>	Intergovernmental Panel on Climate Change	<b>V2R</b>	Practical Action's Vulnerability to Resilience
		<b>WFP</b>	United Nations World Food Programme

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## Executive Summary

*'Everyone is talking about resilience'*  
Mitchell (2013)

Over the last few years, resilience has emerged as the new preferred paradigm among development organisations, including both non-governmental organisations and donors, to meet a future world of uncertainty and change. The growth of the popularity of resilience within the development discourse, and the adoption of resilience widely across programmatic pillars within NGOs and donor agencies, has led to an explosion of resilience-focussed frameworks. The measurement of resilience is a new and rapidly developing area of research and practice (Bahadur et al., 2015; Winderl, 2014), and a growing number of NGOs and organisations have developed and highlighted resilience indicators as a key component of measuring programme success. This paper explores the theory and practice of measuring resilience in the context of climate change and natural hazards to provide lessons for this growing field of activity and highlight key challenges and suggest ways to improve understanding.

The growing number of targets under inter-governmental frameworks for sustainable development, which extends to disaster risk reduction and climate change, necessitates the ability to measure and assess progress. A set of seven global targets was agreed on at the

World Conference on Disaster Risk Reduction in Sendai in March 2015; the UN Sustainable Development Goals are expected to be adopted in September 2015 and new targets for the reduction of greenhouse gas emissions under the UNFCCC are expected to be adopted at the end of 2015.

We examined 17 sets of indicators of resilience found in internationally recognised resilience frameworks. The purpose was to understand what the indicators actually say about resilience, and this required a working definition of resilience against which to assess the indicators. Following a review of the literature, we identified three criteria (Learning, Options, Flexibility) that cover key dimensions of resilience that recur in the literature. We complemented the literature review with written interviews with eight key informants in the field. We then looked at the indicators to see whether they aligned with our criteria of resilience, and the nature of this alignment.

The analysis identified a number of issues that may contribute to the broad discussion on resilience and resilience indicators. We found that the criteria selected for the analysis were generally well aligned with the indicator sets. The analysis furthermore showed that: (1) each framework is strongly influenced by its conceptual entry point, making a comparison only partially possible and justifying the development of further frameworks; (2) there is a clear gap between the theory on resilience and the way in which the indicators focus on well-being and general development factors; and (3) indicators may not always provide a complete picture of resilience.



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## 1 Introduction

Over the last few years, resilience has emerged as a new preferred paradigm among development organisations, including both non-governmental organisations and donors, to meet a future world of uncertainty and change. The idea of resilience epitomises the need for flexibility on the one hand, and sturdiness on the other, as a formula for managing during and after natural hazards and permanent changes in climate. Resilience was voted the ‘development buzzword’ of 2012 according to devex.com (Wilderl, 2014) but has left many confused about what it means (Mitchell, 2013; Davoudi, 2012; Mayunga, 2007). Debate around the concept’s definition in the context of climate change and natural hazards and whether resilience is applicable in reality has been discussed for some time (e.g. Klein et al., 2003; Tobin, 1999; Handmer and Dovers, 1996). Regardless of disagreement, resilience appears to fill a conceptual gap that other discourses, namely on adaptation and vulnerability to climate change, appear not to have been able to satisfy. At the same time, a push for better quality and more impact evaluations among donor agencies has put greater emphasis on the process of developing evaluation and measurement frameworks (Garbarino and Holland, 2009). The serendipitous convergence of these two ideas has given birth to an overwhelmingly large number of frameworks for the evaluation, assessment and understanding of resilience.

This paper has been developed in the context of related thinking on resilience frameworks (Bahadur et al., 2015) and attempts to build on those analyses to help provide an overview of the field of resilience indicators, given its rapid advances, and gain in recognition among researchers, donors, NGOs and other practitioners. Bahadur et al. (2015) examine the degree to which resilience frameworks align with conceptual understandings of ‘resilience thinking’ to assess their internal coherence and rigour. Our analysis extends that line of exploration to the indicators described in the frameworks. This paper seeks to examine resilience indicators to see (1) how they have been developed; (2) how applicable they are and in what situations; and (3) the limits of using indicators.

We found that the process of comparing indicators against criteria developed separately is challenging because of the tremendous discrepancies in conceptual frameworks and aims of the different indicator sets, coupled with the numerous existing perspectives on resilience. Nonetheless, the analysis suggested that although individual indicators may not appear relevant to resilience, if accompanied by qualitative information on context, they may be able to provide a sense of direction (built or reduced resilience). Furthermore, we found that resilience cannot be measured only through indicators of improved livelihoods and well-being, but that it also cannot be measured without such information.

## 2 Methodology

This paper set out to examine resilience indicators found in the various resilience frameworks, most of which have been developed since 2013. The purpose was to understand what the indicators actually say about resilience, and this required a working definition of resilience against which to assess the indicators. Following a review of the literature, we identified three criteria (Learning, Options, Flexibility) that cover key dimensions of resilience that recur in the literature and draw substantially on the Rockefeller Foundation’s understanding of resilience. We complemented the literature review with written interviews with key eight informants in the field (‘resilience measurement luminaries’). We then looked at the indicators to see whether they aligned with our criteria of resilience as well as the nature of this alignment.

We initially examined 25 sets of indicators from different frameworks for monitoring resilience, along with additional frameworks not containing indicators (Table 1). The frameworks were taken from Bahadur et al. (2015) and additional frameworks were identified through the key informant interviews and snowballing. Among the indicators, three of the frameworks focussed only on project management and not resilience per se (ARC, PPCR, IFRC), and some contained indicators that were project- and management-oriented, in addition to resilience-focussed indicators (BRACED). The project-oriented indicators were not included in the analysis, and therefore only 16 sets of indicators were examined, one of them partially. Brief descriptions of each framework are found in Annex I.

The process of examining each indicator, with sometimes very limited details or information, and assessing whether they were a match for the three criteria was challenging because the criteria were identified based on a combination of starting with existing characteristics and a literature review, meaning that they did not match the conceptual frameworks underpinning the indicators. Another challenge was that for some of the documents, only top-line indicators were available for analysis whilst sub-indicators were more difficult to access, or sub-indicators were example indicators only. Where this is the case, indicator analysis is based on the top-line indicators accessed from reports or logframes.

Importantly, the frameworks containing the indicators do not all deal only with resilience. Indeed, some indicators are aimed at measuring adaptation and others at poverty and capacity. In light of the discussion on resilience in Section 3, these three variations have been included in the analysis because of minor differences in the interpretation of resilience, adaptation and vulnerability reduction, leading to different approaches of learning, options and/or flexibility within resilience-focussed frameworks. Nevertheless, this is a point of discussion that is revisited in Section 5.

### 3 Resilience and indicators: two contested ideas combined

The emergence of resilience within the development discourse and the widespread adoption of resilience across programmatic pillars within NGOs and donor agencies has led to an explosion of resilience-focussed frameworks. The measurement of resilience is a new and rapidly developing area of research and practice (Bahadur et al., 2015; Winderl, 2014), and a growing number of NGOs and organisations have developed and highlighted resilience indicators as a key component of measuring programme success. The ability to measure resilience through consistent mechanisms is intended to enhance the accountability of funding for NGO programmes, which is necessary for budgeting and public investment decisions, as well as offering a way of assessing progress toward resilience, either as determined by a set of identified variables or as set out in global policy frameworks, such as in the Sendai Framework for Disaster Risk Reduction 2015-2030, or the UN Sustainable Development Goals.

However, the ability and methods to measure resilience are contested. Indeed, as this and other reviews of resilience frameworks have shown (Winderl, 2014; Mitchell, 2013), what counts as an indicator of resilience has been defined and redefined in semi-chaotic fashion according to different interpretations of what the concept means, as well

as how best to go about measuring it. Due to the need to be context-specific to be accurate and also rely on available data, universal indicators cannot exist, even though this review has found that universal principles of resilience are necessary to ensure that there is accountability and above all that it is truly resilience that is being measured. The irony is, of course, that both the use of indicators as well as resilience as a concept are debated. This section describes some of the relevant issues that the debates are built upon.

#### 3.1 Resilience

There is no shortage of literature reviews on resilience, nor any shortage of conceptual issues to discuss. The purpose here is to identify the key dimensions of resilience that are generally common across the different interpretations, by way of an exploration of why resilience is so attractive to current thinking about risk reduction. Stein has compiled a list of resilience definitions up to 2013 (Stein, 2013) and more recent compilations of definitions can be found in Winderl (2014).

The idea of resilience is not new and has been discussed in the context of disaster risk reduction (e.g. Dovers and Handmer, 1992; Handmer and Dovers, 1996; Tobin, 1999), but it was not used much in climate change policy language until more recently. Resilience was seen as an overarching concept, a goal for the process of adaption, although not without a certain degree of debate around its

**Table 1. Indicator frameworks included in analysis**

Name of framework
Rockefeller Foundation's Asian Cities Climate Change Resilience (ACCCRN)
Assessments of Impacts and Adaptations of Climate Change (AIACC) Sustainable livelihood approach
Action Research for Community Based Adaptation (ARCAB)
ARUP's City Resilience Framework (ARUP)
UK Department for International Development Building Resilience and Adaptation to Climate Extremes and Disasters framework (BRACED)
UNDP Community-Based Resilience Analysis (CoBRA) Framework
Constas and Barrett's Principles of Resilience Measurement for Food Insecurity (Constas and Barrett)
Mayunga's Capital-Based Approach to Community Disaster Resilience (Mayunga)
Feinstein International Center's Livelihood and Resilience Framework (Feinstein)
International Institute for Sustainable Development's Climate Resilience and Food Security (IISD)
UN Food and Agriculture Organisation's (FAO) Self-evaluation and Holistic Assessment of Climate Resilience of farmers and pastoralists framework (SHARP)
International Institute for Environment and Development's Tracking Adaptation and Monitoring Development (TAMD)
Technical Assistance to NGO's (TANGO) Livelihood Framework
Characteristics of a Disaster Resilient Community (Twigg, 2009) (Twigg)
UN/ISDR Disaster Resilience Scorecard for Cities (UN/ISDR)
USAID Measurement for Community Resilience (USAID 2013)
USAID Coastal Resilience (Indian Ocean Tsunami Warning System Program) (USAID 2007)

meaning and relation to both vulnerability and adaptive capacity (see Klein et al., 2003; Nelson et al., 2007). There was also a considerable amount of scepticism *vis-a-vis* the use of resilience in the context of climate change and even disaster risk reduction. Resilience was considered ‘a relatively poorly defined concept not yet operational for policy and management’ (Klein et al., 2003: 41). Manyena (2006: 435) similarly notes that ‘resilience has gained currency in the absence of philosophical dimensions and clarity of understanding, definition, substance, and most importantly, its applicability in disaster management and sustainable development theory and practice’. It has also been critiqued for being difficult to apply in practice (Martin-Breen and Anderies, 2011). Despite this, already 12 years ago, Klein et al (2003: 41) observed an ‘unrelenting devotion’ to the use of resilience as a concept, which has clearly blossomed.

### 3.1.1 Resilience vs. adaptation and vulnerability

There are multiple efforts to carve out spaces for each of the many concepts that come bundled with the climate change and disaster risk reduction discourse. Yet the numerous different entry points to which any given concept can be traced back means that overlaps and contradictions in definitions and uses exist. ‘Resilience’ can be traced to two origins, one rooted in ecology and the other in sustainable livelihoods. The two dimensions of resilience drawn from ecology, namely the ability to bounce back quickly and the ability to withstand disturbance, also have a history in engineering and risk preparedness (Alexander, 2013), so they are not new to thinking about disaster risk posed to humans. However, there is some discomfort surrounding the incorporation of ecological principles into social science studies of resilience (Olsson et al., 2015). Thus, resilience is unlike ‘adaptation’, which as used does not retain a strong theoretical connection to its originating cousin in evolutionary biology, or ‘vulnerability’, which has followed its lineage from the natural hazards field more faithfully.

Despite separate conceptual roots, resilience is often used as a synonym for adaptation and vulnerability reduction (which are usually seen as linked) when speaking about taking action to reduce risk, but several people have pointed out the differences between them (e.g. Bene et al., 2012). Others describe differences between resilience and vulnerability, including that the two stem from separate schools of thought with different groups of individuals involved (Miller et al., 2010; Manyena, 2006; Cannon and Müller-Mahn, 2010; WFP, 2014). Nelson et al., (2007) distinguish adaptation and resilience among other things on the basis that adaptation is about actors, policies and projects, while resilience is about systems thinking. Regardless of the arguments on why resilience is a separate idea and not a replacement for other concepts, there is also evidence that use of the term has been part of a conscious effort to move away from the ‘negative’ tone of

vulnerability toward the more ‘positive’ idea of resilience. The effort to provide a more constructive presentation of disaster risk reduction also boosted the use of resilience (see for example the language used in the IFRC’s *World Disasters Report* 2004; and also as a binary, as in resilience/vulnerability in Folke et al., 2002). Twigg makes the point that by emphasising resilience over vulnerability, there is greater emphasis on ‘what communities can do for themselves and how to strengthen their capacities’ (2009: 8), which is a way to move away from a ‘victim’ perspective. Yet that does not mean that there is universal agreement on the definition or how the term relates to adaptation and vulnerability.

Resilience is defined in different ways and reviews of definitions provide insights into these differences (Manyena, 2006; Bahadur et al., 2010; Béné et al., 2012; Frankenberger et al., 2014). A number of resilience scholars working on environmental change draw on Holling’s 1973 work on defining ecological resilience, but resilience is also linked to sustainable livelihoods. In the context of climate change, resilience has a particular meaning that overlaps significantly with adaptation, to the point that it is often used as a synonym or replacement for adaptation, while it is often used in place of vulnerability reduction in the disaster risk reduction context. But not everyone working on resilience is concerned about climate change or disaster risk reduction. In fact, it is understood and implemented in the development and humanitarian sectors (e.g. Oxfam, 2013), social protection, mental and physical health, war and conflict (Martin-Breen and Anderies, 2011), as well as for business. In all of these cases, resilience is used to mean the condition of being able to survive during an adverse situation (such as domestic abuse or an earthquake) and/or to refer to the ability to recover from such an event. These two dimensions are not the same, yet they are both common understandings of the term, and sometimes they are part of a single definition.

### 3.1.2 Resilience of ecosystems and social systems

There are multiple epistemological entry points for resilience as applied in the context of climate change and natural hazards. One of the more established is that championed by the Resilience Alliance (RA), a group of individuals who, following Holling’s ecological definition, define resilience as:

- The amount of change the system can undergo and still retain the same controls on function and structure;
- The degree to which the system is capable of self-organisation; and
- The ability to build and increase the capacity for learning and adaptation (Holling and Walker, 2003).

The RA has also been influential in defining the resilience perspective held by the Stockholm Resilience Centre, whose work focuses on socio-ecological systems,

and who define resilience as ‘the capacity to deal with change and continue to develop’. The notion of whether such development requires transformation into a new state is unclear in many engagements with resilience, especially in terms of what that process of transformation looks like and what conditions are required for it to take place. According to the Resilience Alliance, resilience is only something that a system can achieve within given limits (Walker et al., 2004). In their view therefore, once a threshold is reached, transformation is needed to obtain a new state of resilience. The notion of moving beyond a threshold is a necessary component in thinking about well-being with regard to environmental change, yet it seems most definitions consider only the existing system. Frankenberger et al. (2014: 4), for example, define resilience as ‘a capacity that enables households and communities to maintain a minimum threshold condition when exposed to shocks and stresses’. This becomes even more difficult to digest when we introduce the notion so present in the idea of transformation, namely of developing to improve livelihoods, and not just to maintain the status quo. This challenge is also partly the result of the translation of an understanding of resilience that is ecological into a social understanding (see Olsson et al., 2015).

Nelson et al. (2007: 399) point out that resilience means that ‘systems need to be managed for flexibility rather than for maintaining stability’, yet the distinction between flexibility and maintaining stability is in reality difficult to identify. For example, will providing certain agricultural skills that can improve sustainable land management provide flexibility or simply give people techniques for maintaining their status quo as farmers? These limits to resilience have been acknowledged, yet perhaps their importance for applying and understanding resilience should be more strongly emphasised. Indeed, one of the biggest conceptual issues is how to go from surviving to thriving, which is in line with sustainable development and well-being goals for the future.

### 3.1.3 Toward sustainable livelihoods

In discussions about the meaning of resilience, the idea of ‘bouncing back’ is frequently underscored as a pivotal dimension of resilience, which from a social perspective has been interpreted to mean returning to the previous state after a disturbance. The critique emphasises that the previous state may not have been a good state to be in anyway, and could be undesirable in the context of continuous and permanent climate change (Klein et al., 2003; Adger, 2000). Some early work even equated resilience with ‘entrenchment’ (Smithers and Smit, 1997), or ‘resistance’ (Handmer and Dovers, 1996), suggesting that by promoting resilience, one was encouraging the maintenance of the status quo, rather than moving

toward the type of change that adaptation was associated with. In an early paper on droughts, Riebsame describes possessing adaptive capacity as ‘the ability to change form and function markedly under new conditions’, whereas possessing resilience means that a system is ‘likely to maintain “normal” operations via disaster relief and other social maintenance schemes in future droughts’ (1991:133). Brooks also notes that, rather than focussing on building resilience of existing systems, in some cases it may be prudent to ‘replace’ the systems with others that are better suited to the climate.

Moving beyond a return to the previous state or the maintenance of the status quo even if it means high risk, Dodman et al. (2009) underscore the need for resilience to go beyond just coping and emphasise improvements in development. From this perspective, resilience can also be understood through a livelihoods lens (Chambers and Conway, 1992), in that improving livelihoods *per se* can be considered a way to improve resilience, although this may not be what is intended by the term ‘resilient development’, which is used frequently as a buzz word but not always in the context of climate and disaster risk. The discussion on resilience and livelihoods recalls a similar discussion on adaptation and development from the 2000s, which questioned the extent to which there is a tangible difference between activities labelled ‘adaptation’ and those labelled ‘development’ (e.g. Schipper, 2007; McGray et al., 2007)<sup>1</sup>. Both the academic and grey literature engage with the role of livelihoods in resilience building. A few of the frameworks examined are built around the sustainable livelihoods approach, using the five livelihood capitals/assets as entry points for the measurement of resilience. Frankenberger et al. (2014) suggest that resilience programming should have the goal of positive livelihood outcomes rather than resilience *per se*. In their Resilience Programming Framework, they suggest that resilience outcomes are measured by development indicators such as food security, nutrition and poverty (Frankenberger et al., 2014).

Conceptualisations of the components of resilience are a significant part of the ‘new’ wave of resilience thinking, which is linked to promoting resilience as a development agenda. The Rockefeller Foundation has in several iterations explored what resilience means (some in collaboration with Arup). Their City Resilience Framework is based on four dimensions of resilience (health and well-being, economy and society, leadership and strategy, infrastructure and environment), which are then sub-divided into 12 ‘drivers’ of resilience (3 per dimension). These include, for example, the need for leadership promotion and effective management within a city, and assurance of public health services, among others. The Rockefeller Foundation also presents seven ‘qualities’ of resilient cities: ability to learn (‘Reflective’); limit spread

1 The latter discussion was abandoned without full resolution, in all likelihood because the distinction between adaptation and development is sometimes visible and necessary, and at other times artificial and non-existent.

of failure ('Robust'); can easily repurposes resources ('Resourceful'); has alternative strategies ('Flexible'); has backup capacity ('Redundant'); includes broad consultation and communication ('Inclusive'); and has systems working together ('Integrated'). They are similar in function and purpose to the Stockholm Resilience Centre's seven principles of resilience (maintain diversity and redundancy; manage connectivity; manage slow variables and feedbacks; foster complex adaptive systems thinking; encourage learning; broaden participation; and promote polycentric governance systems) in that they provide guidance for how to achieve resilience. In other words, adherence to the 'qualities' or 'principles' of resilience should put one on the path toward resilience. This could then also provide a useful guide for measuring whether progress is being made toward resilience.

### 3.2 Indicators

Efforts to evaluate and develop targets for adaptation (e.g. Tellam et al., 2007) and indicators of vulnerability (e.g. Eriksen and Kelly, 2007) began several years ago. Indeed, it looked like monitoring and evaluation would be the 'next big thing' in adaptation practice and science (McKenzie-Hedger et al., 2008). But the outputs and initiative were met with lukewarm responses and significant critique (see Füssel, 2009), which put them mostly on indefinite hold, with only small pockets of activity continuing, mostly focussed on adaptive capacity (e.g. Jones et al., 2010). Yet the development of resilience frameworks and indicators to assess progress toward resilience are springing up left and right, as noted by Bahadur et al. (2015). Clearly, the demand for ways to measure interventions and progress has not waned, and in fact may be even stronger than ever. The growing number of targets under inter-governmental frameworks for sustainable development, which extends to disaster risk reduction and climate change, necessitates the ability to measure progress. A set of seven global targets was agreed on at the World Conference on Disaster Risk Reduction in Sendai in March 2015, the UN Sustainable Development Goals are expected to be adopted in September 2015 and new targets for reduction of greenhouse gas emissions under the UNFCCC are expected to be adopted at the end of 2015. Without a way to assess movement toward these targets, these global initiatives lose credibility, but more importantly, the actions necessary for human and ecosystem well-being may not be taken. Indicators are one of the most common forms of monitoring progress, yet they need to be used with care because they are unable to paint a complete picture of the situation.

The key to good indicators is credibility rather than volume of data or precision in measurement. Sandhu-Rojon (2003) argues that a quantitative observation is no more inherently objective than a qualitative observation, but suggests that large volumes of data can confuse rather than bring focus. It is more helpful to have approximate answers to a few important questions than to have exact

answers to many unimportant questions (Spearman and McGray, 2011). Underlying this is the important question of how many indicators are necessary to accurately tell a story of resilience. Furthermore, what can be done when no information is available for the most important indicators? These are major questions that need to be considered in the development of a monitoring framework.

The selection of indicators depends heavily on assumptions about what is being measured. Consequently, how resilience is defined matters. Interestingly, some believe that resilience and vulnerability cannot be directly observed or measured (Hinkel, 2011; Patt et al., 2008; Luers et al., 2003) and instead require the identification of measureable 'proxies' to represent the various ways in which resilience manifests. These can be taken from data-driven field studies, or induced from assumptions about social, environmental, economic and political circumstances. However, basing proxies on assumptions means that if the rationale behind the assumptions is incorrect, the proxies will not portray resilience accurately. The assumptions can be based on generalisations about certain groups of people based on gender, age, ethnicity, or infer implications about resilience from the proxies without any statistically proven relationship between the two (Mazvimavi and Rohrbach, 2006). Delineating what is meant by resilience is therefore necessary, and will determine what sort of indicators are selected.

Another important dimension of indicators is the type of indicators that are being collected. This is because indicators can measure inputs, processes, outcomes and outputs and the distinction matters. If we value Learning as a driver of resilience, for example, we may want to measure processes of training, information sharing and awareness raising (what do people know, etc.). This would then be a process indicator. At the same time, this type of activity may be considered an output if we are interested in measuring project success (how many training sessions, how many people trained, etc.). Therefore, the purpose for the indicator is a vital characteristic. Brooks (2015) cautions that many indicators that are labelled resilience indicators are in fact output indicators measuring project success. An interpretation of types of indicators in the context of resilience by the OECD can be found in Box 1. The distinction between the various types of indicators is able to bring to the attention of both developers and users of resilience frameworks what type of information can be extracted from different types of questions and indicators. This offers a more nuanced and informed approach because it makes it clear that there are different dimensions of resilience, and even if an output indicator is high, for example, if related process indicators are low, this suggests that the system in question may ultimately not be resilient at all.

The challenge posed by different types of indicators is that the information that they provide should not be ambiguous, putting even greater pressure on how resilience is defined. Hinkel (2011) cautions that an indicator must only have a single (monotonous) relationship



with whatever is being measured. For example, in the analysis done following recovery after the 2010 Haitian earthquake, it was noted that while access to credit could be seen as a way to build resilience, being burdened by debt was also a driver of vulnerability (Tulane University, 2012). Consequently, access to credit is not a useful indicator of resilience in that instance.

In addition, no single set of indicators will satisfy and inform all policy interventions, as noted by the analysis of indicators that follows. Indicators are intended to provide data that will help decision-makers make better decisions and ultimately build resilience, but will not provide answers alone. Despite this, a need for quantitative information on which to base decisions, especially about how to prioritise funding, is evident among donors. Interestingly, there is awareness among the framework developers of the risk that numerical information is used ‘improperly to guide funding’ (USAID, 2007: 4-8). Tyler (2015) suggests that indicators are not comparable between locations due to their specificity in contextual priorities and the relative nature of resilience. A lack of consensus regarding the usability and potential of numerical indicators to successfully measure resilience has led to debate. Levine (2014) proposes that numerically measuring resilience is impractical, highlighting that resilience cannot be measured as a singular entity due to the different degrees of threat or risk to which people are exposed.

### 3.3 Criteria for analysis

As the review of literature on resilience as well as indicators has shown, interpretations of resilience are multiple, and any understanding of how best to measure it is caught up in the challenges presented by the fuzziness of those many interpretations and the problems embedded in the measurement of qualitative information through indicators. The resilience frameworks that have been developed collectively offer a long list of

diverse dimensions that are necessary for resilience. In order to make sense of these, we drew on the literature to identify three areas of convergence in the crusade to define resilience. In this effort, it was necessary to navigate between the different types of characteristics, including those that guide external engagement in resilience building and those that actually represent resilience, the latter being the goal of the paper. We used Rodin’s (2013) five characteristics of resilience (Aware, Diverse, Self-Regulating, Integrated, and Adaptive) as a starting point for determining our criteria, because of the extensive work done by the Rockefeller Foundation on this topic

#### 3.3.1 Learning

Given that the entry point for this analysis is explicitly the resilience of social systems, the ability of humans to have information and act on it is clearly a necessary component of resilience. This broad category includes *Learning* processes (Bahadur et al., 2013), which ensure that a better understanding is gained from a hazard experience (Cutter et al., 2008; Pelling, 2003). Learning means gaining greater knowledge and awareness of risk or threats faced. This includes the ability to incorporate lessons into preparedness and recovery in order to recover and come out stronger than before (Djalante and Thomalla, 2010). It is not just about knowing how to get out when necessary (i.e. knowing the evacuation instructions), but having a far more profound awareness of what risk actually implies, and of attitudes towards risk within a community (Mayunga, 2006). Learning also includes the ability to share information with others (Cabell and Oelofse, 2012) and assess which sources of information are reliable and useful for the purposes of preparedness and recovery. *Learning* is crucial for people to be able to take action to reduce their exposure and sensitivity to climate change and natural hazards, including in the development of situational awareness (Rodin, 2013). This involves having access to and comprehending information about how the circumstances

#### Box 1. Different types of indicators

System resilience indicators look at the resilience of the main components of the system over time, including how the overall well-being of people and the system is affected when shocks actually occur, for example how political capital is affected by an actual earthquake, or how social capital is affected by new or escalating conflict. These indicators should be complemented by negative resilience indicators.

Negative resilience indicators look at whether people are using strategies to boost resilience that may have negative impacts on other areas of the system, for example turning to crime to deal with unemployment; or negative impacts on certain vulnerable people, for example by reducing the number of meals eaten a day, or taking children out of school.

Process indicators ensure that the resilience roadmap is being used in policy making and programming.

Output indicators show the results of implementing different parts of the resilience roadmap.

Proxy impact indicators help show the results of resilience programming. These must be used with caution, but can be necessary when other more nuanced measures (such as system resilience indicators) are difficult to create, or difficult to communicate to a specific target audience.

Source: OECD, 2014.

are changing on social, ecological, political and economic levels (as per Gaillard et al., 2010). Beyond being prepared for an emergency, this also requires an understanding of individual and collective strengths and weaknesses, coping options and their limitations (IFRC, 2011a).

### 3.3.2. Options

Awareness of weaknesses or limits does not necessarily imply that people have the power or skills necessary to address them, which may be mostly out of an individual's control (i.e. if certain groups are marginalised because of structural factors, historical biases or ideological disagreements). For this reason, people also need a large degree of *Options* in their lives, which allows them to circumvent drivers of vulnerability. Having a diversity of options ensures that there is a greater chance that people will cope and do well when an event occurs (Rockefeller Foundation, 2009; Rodin, 2013). The notion of diversity is also frequently found in the ecological resilience literature (Bahadur et al., 2013; Holling, 1973; Folke, 2006). Above all, this includes having choice and options to modify behaviour, with advantages such as being able to switch crops or seeds, finding new income sources or changing physical location, which are all identified as important resilience building options (CARE, 2014; Thornton and Herrero, 2014; McGray et al., 2007). These all require knowledge, entitlements, wealth and access, which are fundamental enabling characteristics, thus linking resilience to sustainable livelihoods, capacities and capabilities (e.g. Keck and Sakdapolrak, 2013). Other ways in which such options can be taken advantage of include with the help of support networks that are genuinely altruistic, and not just provide access to credit or loans, which can become an enormous burden, such as in the case of indebted farmers who commit suicide (Kennedy and King, 2014). It is also necessary for all relevant actors to be involved in preparedness and communication, with an implicit recognition of different groups, across different scales.

### 3.3.3. Flexibility

Flexibility is in some ways the most obvious part of resilience (Nelson et al., 2007). It implies the ability to withstand disruption without complete collapse, and to return to a functioning state as highlighted by the Resilience Alliance approach (Walker et al., 2006). Flexibility also implies the ability to recover from the disruption without the costs being too high, or taking too long (Obrist et al., 2010). But more importantly, flexibility signifies that there is a large degree of self-regulation (Rodin, 2013), meaning a low level of inter-dependence of different sensitive variables (e.g. Cutter et al., 2010). This means, for example, that if the roads become flooded, people should still be able to travel in and out of

the location (e.g. Berkes, 2007), and goods and services should not be interrupted, and also that crops produced in the location should not be lost because a natural hazard takes place (i.e. the workforce should not have to stop harvesting to take care of emergency operations). Flexibility also includes the need for sustainable livelihoods (Chambers and Conway, 1992), implying that livelihood strategies should not be dependent on at-risk resources or institutional arrangements. In addition, livelihood strategies themselves should not be the source of vulnerability or play a role in increasing the magnitude of hazards.

## 4. Results<sup>2</sup>

All of the frameworks include factors that indicate alignment with at least some, if not all, of our resilience criteria, as can be seen in Table 2. Most of the frameworks are focussed on a combination of different aspects of the resilience dimensions through different approaches. However, the frameworks differed in their depth and description, and as such, Table 2, whilst useful in providing a general overview against our criteria, masks some of the issues facing frameworks and indicators.

Although the purpose of the exercise was not to compare indicator sets *per se*, the analysis aimed to understand the current array of available resilience indicators, and therefore observations on how they differ from each other are important. There are significant discrepancies between the frameworks, for example the number of indicators they include: ARUP has 12 main indicators, whereas SHARP, UN/ISDR and Twigg have multiple themes with sub-questions, pushing the number of indicators to 50 or more. What Table 2 reflects is that at least one indicator in each set touched on an aspect of the three criteria, however it does not show that some frameworks were more tightly aligned with the three criteria selected (i.e. that almost all of the indicators fall into one of the three categories). For example, the ACCCRN indicators are mostly context setting (area flooded, number of organisations involved in water planning, etc.) with a few touching directly on our three criteria.

### 4.1. Alignment with criteria

In general, **learning** has been interpreted widely. Learning is implied as an outcome of trainings attended, positioning of educated people in key institutions and access to information. This is probably because it may be relatively easy to measure it and ask people if they know what the hazards are to which they might be exposed, what their evacuation routes are and whether they consider themselves to have options for coping. Naturally, some of this information is based on perception and with the

2 The indicator sets are referred to here by a single name, for simplicity. The full name can be found in Table 1 and details on each of the frameworks can be found in Annex I. Complete references for the documents from which the indicators were extracted can be found in the Reference section.

added complexity of cognitive dissonance, the results may not be an accurate reflection of what is actually true. Whether giving training or providing access to information will actually result in greater knowledge is also not guaranteed. **Flexibility** is also a recurrent theme, often linked to **options**, because it is the multiple options that give people flexibility, and as such the two may not really be distinguishable on the ground.

Interestingly, there is wide variation in the ways in which **learning** is directly or indirectly addressed across the frameworks. The TAMD framework addresses the knowledge of decision-makers, the SHARP framework emphasises access to markets and group membership, which require or result in knowledge. BRACED emphasises the use of climate information in decision-making as an indicator of resilience. ARUP addresses the need to educate communities and businesses of the importance of ecosystem services to urban populations to prevent undermining actions. Twigg asks about public awareness, knowledge and skills; information management and sharing; education and training; cultures, attitudes, motivation; and learning and research. The UN/ISDR (2014) scorecard places emphasis on knowledge of exposure and vulnerability and understanding relevant hazards. TAMD, BRACED and ACCCRN also ask about

participation of people in groups and in planning, which is a way to understand whether people influence decision-making, but on the larger scale (community or even household) does not disaggregate who has an influence on the process. This would require understanding which voices in a community matter most and why, possibly something that could be obtained by CoBRA under the category ‘Social’, which examines ‘local kinship, number, scale and functionality of community organisations, participation in the above groups, community ability to plan, mobilise resources and implement, fair and transparent access to resources’. Drawing on dimensions of learning, ARUP also stresses effective leadership and management, particularly outlining education as critical for stakeholder empowerment and the subsequent prevention of harmful decision making to ecosystem services. This is a crucial step beyond just having people in place who possess knowledge about climate change, because more context is needed to understand what role such individuals play in influencing the underlying drivers of vulnerability to climate change.

Options appear in different ways, but not as extensively as expected. SHARP includes indicators looking at choice in seeds and diversity in livestock, for example, while TAMD combines the awareness dimension to ask whether

**Table 2. Indicator alignment with criteria (X =alignment)**

Framework/Criteria	Awareness	Options	Flexibility
ACCCRN	x	X	X
AIACC	x	X	X
ARCAB	x	X	X
ARUP	x	X	X
BRACED	x		
CoBRA	x	X	X
Constas and Barrett			X
Mayunga	x	X	X
Feinstein		X	
IISD	x	X	X
SHARP	x	X	X
TAMD	x	X	
TANGO		X	X
Twigg	x	X	X
UN/ISDR Disaster Resilience Scorecard for Cities	x	X	X
USAID Measurement Framework for Community Resilience (USAID 2013)	x	X	X
USAID Coastal Resilience (USAID 2007)	x		X



people are familiar with options in responding to an extreme event. IISD includes a question about whether services have options for delivery during extreme events, whilst ARUP's City Resilience Framework includes developing livelihood and employment diversity through a range of options (financial, skill training, social welfare etc). The existence of funding to support various activities to reduce risk could also be considered part of options, because financing opens up doors and thus creates opportunities that would otherwise not be available. UN/ISDR (2014), TAMD, ACCCRN, ARUP, CoBRA, AIACC, SHARP, all mention different types of financing, e.g. for households, for plans and activities. The existence of contingency funds (ARUP) is one way to ensure options, but of course also flexibility (see below). CoBRA specifically mentions financial capital as a way to enable people to adopt different livelihood strategies. Mayunga talks about insurance.

In terms of flexibility, a few frameworks explicitly address what happens after an extreme climate event: the UN/ISDR, Twigg and USAID (2007) are all specifically designed with recovery processes in mind. In addition, the three frameworks that are built around the sustainable livelihoods framework (AIACC, CoBRA, Mayunga and USAID [2013]) address this dimension of flexibility implicitly. The USAID (2013: 10) framework explicitly talks about flexibility as part of the 'community social dimensions', which are necessary for resilience: '[community social dimensions are] the dynamic qualities possessed by a community that enables it to manage community-based assets in an equitable and sustainable way. They include preparedness, responsiveness, connectivity, learning and innovation, self-organization, diversity, inclusion, social cohesion, and aspirations'. ACCCRN mentions road and air traffic disruption due to an extreme event (as it relates to tourism) and ARUP includes a mention of continuity of services, including transport networks.

The focus of the different aspects and dimensions of the criteria derives from each of the indicator frameworks emerging from different conceptual and epistemological roots. For example, ARCAB is focussed on community-based adaptation and aims to monitor 'Practice', 'Outcomes' and 'Context' of specific initiatives (ARCAB, 2012a), while the UN/ISDR HFA indicators are tightly linked to the globally-agreed Hyogo Framework for Action from 2005, which set goals for reduction of disaster risk, and the UN/ISDR (2014) scorecard is focussed on city resilience. SHARP focuses specifically on agriculture and sustainable land management.

## 4.2 Other findings

The findings from the literature review about the **wide range of interpretations of resilience** came through strongly in the analysis of the indicators. In particular, the lack of agreement in the literature on whether traditional

development indicators or improvements in well-being and livelihoods can also be indicators of resilience became an important issue. Examining individual resilience indicators does not give an accurate resilience reading because, in isolation, many are not applicable to resilience, or resilience challenges and trends may be missed. In order to understand the value of indicators, the wider framework themes or the broader characteristics are fundamental to providing relevant context. From the indicators examined, SHARP was a strong example of this. Individual examination of the indicators generally led to low resonance with the three criteria. For instance, questions about agricultural input (e.g. fertilizer) seemed only relevant if it was known that agricultural input was either good or bad for resilience, and then only in combination with other factors. However, examining the thirteen wider themes in the SHARP framework highlighted that the individual indicators all collectively contributed to the overriding resilience criteria (learning, options and flexibility; see analysis in Table 3). Examining the indicators in isolation from the themes would have led to a different conclusion on the ability to measure resilience.

In closer examination of the frameworks, several are rooted in a **sustainable livelihoods approach**, such as the CoBRA, AIACC and Mayunga, which are arranged according to the five capitals, or inspired by it in identifying their various top-line indicators. The USAID framework (2013) is also based on capitals, including political capital. Some of the frameworks emphasise one or two of the criteria over the others. CoBRA, for example, is primarily about flexibility, focussing on ensuring that services could continue in the face of shock, such as through physical accessibility through all-weather roads and infrastructure, or through applying services, such as reforestation of storm protection, that would reduce disruption to resource-based activities (UNDP, 2013). This aligns more directly with the older definitions of resilience, which emphasise flexibility above all of the other criteria, including those found in SRC (n.d) and Walker et al. (2006).

Moving away from the three main criteria, the issues of **regulation, policies, institutions and governance** have been placed as a separate category of analysis, because they have important roles to play both in supporting and in potentially preventing resilient development. TAMD has a strong emphasis on enabling policy environments, including asking about whether actors are in place to forward the resilience agenda, or whether necessary planning documents/plans in place. Of course, policies and institutions, and even actors, do not guarantee action, but in some cases may be the only avenue to allow necessary change to take place. The TAMD and UN/ISDR frameworks also touch on the issue of funding to support action, and given that funding can at times be a limit to making necessary changes, this is important. As noted, BRACED also draws on TAMD for this purpose. ACCCRN also emphasises city-wide plans for disaster

**Table 3. SHARP themes against resilience criteria**

SHARP Themes	Resilience Criteria
Socially self-organised	Flexibility, Options
Ecologically self-regulated	Flexibility
Appropriately connected	Learning
Functional and response diversity	Options
Optimally redundant	Options
Spatial and temporal heterogeneity	Flexibility, Options
Exposed to disturbance	Flexibility
Coupled with local natural capital	Flexibility
Reflective and shared learning	Learning
Globally autonomous and locally interdependent	Options
Honours legacy	Options
Builds human capital	Flexibility
Reasonably profitable	Flexibility, Options

management, funding for community disaster risk reduction, flood maps, and other institutions. Similarly, the UN/ISDR scorecard emphasises co-ordination, participation and engagement. USAID (2007, 2013) includes strong governance and institutions as one of their goals for resilience. ARUP outlines the need for inclusive governments, particularly drawing on learning and knowledge from grassroots levels in order to forge cross-sector relationships that benefit decision-making.

There are also many indicators that focus on well-being, such as questions about vaccinations or tourism (ACCCRN), about social stability and crime (ARUP), financial management (ARUP). Food security is an overarching theme in many of the frameworks (IISD, SHARP, ARUP, Feinstein), with access to food and nutrition-related issues being presented as part of resilience. Health, which is a vital component of well-being, receives significant attention from the frameworks (ARUP, ACCCRN, USAID, UN/ISDR, CoBRA, TANGO, Constan and Barrett, Mayunga, IISD, SHARP, Feinstein). Clearly, good health and access to healthcare allow people to even have choice and flexibility, but rather than being a direct driver of resilience, both seem like they would be part of the enabling conditions. This distinction is of course fuzzy, in the sense that enabling conditions may need to be present in order for resilience to occur.

Evidently, assumptions limit the analysis. We do not know the context behind some of the characteristics, and in places the additional information that suggests why such dimensions were focussed on is absent. This implies that some of the analysis is subjective with the need to consider the impact of assumptions.

## 5. Discussion

Given that ‘no consensus exists currently on how to measure resilience’ (Winderl, 2014), it is no surprise that the results from the analysis have shown that the indicators are not fully aligned with the resilience criteria and that they are highly diverse. Our analysis has identified a number of issues that may contribute to the broad discussion on resilience and resilience indicators.

There are three main findings: (1) each framework is strongly influenced by its conceptual entry point and a comparison is only partially possible; (2) resilience to climate change and disaster risk cannot be measured only through indicators of improved livelihoods and well-being, but it cannot be measured without such information, because resilience requires well-being and sustainable livelihoods; and (3) indicators need to be used with caution and in some cases their use may be incompatible with the desire to measure resilience. The following section expands further on these points and discusses additional issues.

### 5.1 Differing epistemic roots and definitions

Even experts are feeling swamped by the multitude of resilience frameworks that are emerging on a regular basis (Twigg, 2015; Tyler, 2015). Many are developed in isolation, with few links to earlier frameworks (if any). Lack of agreement on what resilience means has left the field ‘messy’, as described by Moser (2015). This does not refer to variations in how the definition is worded or framed, but to the multitude of ‘principles’, ‘qualities’, ‘dimensions’ and ‘characteristics’ that go beyond a simple definition and aim to describe what resilience is about. For example, for SHARP, the practice of sustainably managing

agricultural land is a clear indicator of resilience, and for others resilience is driven by governance and institutional changes (e.g. TAMD). These different entry points for analysis make the task of comparing frameworks uneven and this presumably makes each framework distinct enough to warrant the investment of time and finances into developing additional frameworks. The process of thinking through the indicators requires profound contemplation on what resilience is and what it is not, but on the positive side this means that the more work that goes into developing the frameworks, the better. Building on this, the importance of defining what resilience means for cities and for urban dwellers, has been outlined by ARUP. The City Resilience Framework, and the themes and indicators selected, will provide the foundation for the City Resilience Index and besides indicators, ARUP have considered a wide number of other factors that are important in defining city resilience. The careful development of the framework is intended to allow the Index to offer critical guidance and information for ‘robust’ and ‘holistic’ decision making (ARUP, 2014).

Attempting to measure resilience through quantitative measures highlights the complex and historically intertwined relationship between vulnerability, adaptation and resilience. The BRACED indicators, for example, include indicators that focus on vulnerability, particularly physical vulnerability (how sensitive and exposed infrastructure or environments are), and the measurement of impact rather than resilience, such as through the reduction in the number of deaths caused by climate extremes and disasters. These indicators focus on mortality or malnourishment, as do several of the IISD and ACCCRN indicators. The inclusion of vulnerability indicators highlights that various definitions and conceptual understandings of resilience, and vulnerability, underpin the development of indicators. Yet there is still significant confusion about how resilience and vulnerability relate to each other.

From the perspective of being able to monitor both vulnerability and resilience, it is clearly easier to both identify and monitor the drivers of vulnerability. This is because resilience is the objective, which means that the trajectory to reach it is in the future and therefore uncertain and conditional, whereas the drivers of vulnerability can be identified since they are in the past or present. Indeed, some of the frameworks mix both positive and negative indicators (i.e. ‘Loss of teaching time’ and ‘Structural safety of educational facilities’ within the same framework), suggesting that looking at certain aspects from a vulnerability perspective is more helpful than seeing them from a resilience perspective.

Only a few of the frameworks actually mention the need for a vulnerability assessment before beginning to measure the resilience (e.g. USAID, 2013). Clearly, one cannot embark on a journey to build resilience if one does not address the factors that are causing the lack of resilience in the first place. Having the right decision-makers in

place, equipping people with multiple climate-independent livelihood options and securing infrastructure is potentially irrelevant if people are denied access to vital resources because of their identity (gender, ethnicity, political affiliation, etc.).

Another aspect of the analysis on entry points is that, rather than only two distinct schools of thought on resilience, there are at least three evident in the frameworks: the socio-ecological approach with its roots in ecology; the sustainable livelihoods approach; and a disaster risk-focussed approach. The latter is not described in the literature review (Section 2) in part because a disaster risk reduction perspective is implicit in efforts to build resilience, yet indicator analysis shows that disaster risk reduction is actually not considered explicitly in most of the frameworks. Pelling (2011) and Alexander (2013) note the crucial role of disaster risk reduction in the current theory on resilience, and this implicit integration of a risk reduction perspective into some of the resilience frameworks explains why some operate in the context of particular hazards. Many frameworks are therefore driven by the question “resilience of whom and to what?” (e.g. UN/ISDR; USAID, 2007; 2013). Fewer frameworks consider resilience to be the general capacity of a system to engage with a range of dynamic shocks and stresses (e.g. ARUP).

The intangibility of resilience is likely the reason for its muddled conceptual existence, and this also contributes to uncertainty about how it will move from something that can be measured to something that can actually be applied when needed. Just because capacities, knowledge or networks exist does not mean that they will be accessible or useful in a given crisis situation. Numbers of people receiving training, of rescue vehicles or of people employing a new technology suggests more about project effectiveness than about resilience. Because of the lack of artificial counterfactuals, the resilience-building process can in reality only be tested when a rapid-onset natural hazard or major change in climate occurs. This is because we cannot measure resilience directly, and instead need to rely on proxies, which are based on assumptions and past lessons learned about what makes people resilient. Since each natural hazard is unique, it can only be hoped that the same drivers of resilience will work for each event. This is not so for slow-onset hazards, where there is sufficient time to collect evidence of change and the way in which it affects people and ecosystems to be able to identify relevant adjustments that will contribute to resilience. This justifies the perspective that there may be other, more effective but indirect ways of speaking about resilience (Mitchell and Harris, 2012).

## 5.2 Development (well-being) and resilience to risk

We found that there were a number of additional indicators that fell outside our three criteria and we question whether these really belong in a resilience assessment. The complex distinction between what is

resilience and what is part of the enabling conditions was a recurring theme. This differentiation matters for the discussion on whether or not improved well-being is an underlying requirement for building resilience and whether efforts to build resilience without emphasising well-being are unlikely to be as successful.

One of the most significant findings in the analysis is that resilience cannot be measured only through indicators of improved livelihoods and well-being, but that in order to measure it, information about livelihoods and well-being is necessary. Numerous indicators that touch on health and general development factors provide a useful context for understanding how successful resilience building is likely to be, but good health alone (not in the context of extreme events or climate change) will not be able to say anything about whether or to what extent the person in question is resilient to extreme events or climate change. This begs the question of whether resilience really is just another way to package development, similar to the many discussions on the relationship between adaptation and development that took place in the 2000s (e.g. Tanner and Mitchell, 2008; Schipper, 2007). That the relationship between resilience and development has not been adequately addressed in building most of the resilience frameworks suggests that there is still some way to go in integrating the two (Barrett and Conostas, 2014).

### 5.3 Limits to indicators

Indicators themselves are of course also problematic, and bring that baggage with them to the resilience frameworks. Indicators are only able to indicate, and not to provide scientific ‘proof’ or detailed explanations of change (Sandhu-Rojon, 2003), partly because they are based on assumptions about how systems work, albeit informed assumptions. Béné (2013) offers an excellent hypothetical example of how livelihood diversification is misunderstood as evidence of resilience when indicators are derived based on a set of assumptions about the system.

Tyler (2015) and Graub and Choptiany (2015) say that indicators can provide insights into relative resilience. There is a degree of conditionality with a number of the indicators. In other words, they may be useful for saying something about resilience, but only in certain cases, and the indicators themselves do not specify the cases. For example: Which types of crops offer the greatest resilience in an unknown situation of drought, flood or heatwave? Should farmers be planting all their fields or is it best to leave some fallow? Are more formal institutions better or worse than less formal ones in the case of extreme events, given any number of other factors that influence vulnerability?

Interestingly, most of the indicators examined are focussed on a snapshot in time, rather than a look ahead. Tyler comments that the idea of a snapshot of a number of factors cannot fairly represent resilience, which is an ‘*emergent property* of complex systems – it is only manifest through the interaction of the system over time’ (2015).

This may also explain why only the UN/ISDR, USAID (2007, 2013) and IISD indicators deal directly with options for recovery, reconstruction and rehabilitation. This could also mean that most of the frameworks are making assumptions about the way in which recovery is affected by the possession of different types of characteristics and capacities, which are covered in the indicators.

### 5.4 Additional issues

Several of the experts interviewed for this paper agree that one of the biggest weaknesses of resilience frameworks is how challenging and complex they are to implement (Brooks, 2015; Twigg, 2015; Tyler, 2015). This complexity is evident in how much information is necessary to be able to complete the measurements, but also appears in other aspects. Some of the frameworks are self-assessments (SHARP, UN/ISDR 2014) but several others are explicitly targeted at external evaluators (BRACED, TAMD). The different audiences and expected users of the frameworks mean that the types of indicators are different. For example, indicators for self-assessment might include knowledge of how well-prepared neighbouring households are, which might have an impact if a village experiences an extreme event, while an indicator for external evaluators would explore attitudes and knowledge of risk in general.

Another important issue is that resilience, like vulnerability, is a relative term (Twigg, 2009; DFID, 2011), meaning that it should be specified what hazard or change to which someone or something is resilient. The frameworks mostly lump all natural hazards and changes together, making it unclear how the data would be disaggregated (if at all). It is possible that people can become more resilient to droughts but not to floods (or even become more vulnerable to them as a result of resilience to droughts). It is unclear how the indicators would reflect these distinctions, or whether there was any effort to attempt such a disaggregation.

For users of the indicators, it is not always clear whether the individual indicators refer to individual or group resilience, or whether individual resilience is dependent on group resilience (or group vulnerability). For example, in SHARP, the indicator of the existence of groups is unclear. Is this supposed to be an advantage to the individual or the group? One might assume that only if groups serve a specific purpose (such as to share information on weather forecasts or employment opportunities) that they would be beneficial for resilience.

Furthermore, few of the frameworks actually speak to who they are focussed on, as in whose resilience is to be built. The TAMD framework shows how enabling factors need to be present at several different levels. Their emphasis of actors, institutions, policies and funding at governing levels differs from the community focus found in ARCAD and Twigg’s characteristics of resilience or the individual farmer level in the SHARP approach. Related to this is the scant reference to gender or how different

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groups of people, or even individuals with different levels of vulnerability, can be disaggregated. BRACED and SHARP are the only two that mention it<sup>3</sup>. Speaking about ‘community’ resilience suggests that some sort of collective resilience can be assessed, but does this come from an average, from a judgement made by the users of the frameworks, or is it determined by whoever is providing the information (i.e. interviewees)? It is clear that some of the indicator sets are more appropriate for a rural community in a developing country, and others are more appropriate for urban or more developed areas. Frameworks that focus on decision-makers, policies and institutions may not be entirely appropriate for the community level, who may have little say or influence in those factors. Assessing their status may provide a good context for understanding the other indicators, but because external factors are influencing them, measuring changes in policies or institutions before and after interventions in communities again only says something about the greater context, not about the community’s changes.

The analysis suggests that sector-specific indicators may be the most effective (e.g. SHARP), because they can provide enough context by asking detailed questions. This partly manages to avoid questions about whether the indicators are about general well-being rather than more focussed on resilience, as well as the question of whose resilience and to what (relative nature of resilience), which is not present in most of the frameworks. Conversely, indicator sets that verge on being too general, containing too much ‘background’ information that provides no or unrelated information about resilience, are likely to produce results that are too general for making decisions.

While those developing resilience metrics may be fully aware of their limitations, design of the frameworks needs to oblige users to also consider the short-comings of measuring resilience. This includes details like the impossibility of capturing a dynamic characteristic such as resilience in a static (one-time) measurement. In the absence of such a process of reflection, indicator data is likely to be misunderstood and potentially misused.

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3 BRACED mentions it in project-specific indicators that refer to management and success, rather than resilience. IFRC also mentions it, but we did not consider the indicators in the analysis as they are aimed at project and management effectiveness.

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## 6. Conclusions

The way in which the challenges posed by global environmental change are framed and solutions identified has shifted over time as research has identified new conceptual frameworks and tools for their analyses. Researchers, policy makers, humanitarian and development organisations have also recognised a need to assess the effectiveness of these approaches by monitoring progress of initiatives for risk reduction on the ground, as well as evaluating this progress. One of the ways in which this is to be done is through the application of indicators, tracked over several years. Resilience indicators are currently taking centre-stage, giving way to a vast body of work on resilience frameworks.

The growth of popularity and availability of resilience indicators is significant in many ways. The need for resilience as part of development both in developing and developed countries is urgent. That the concept has such broad uptake across development organisations of all sorts, both public and private, is encouraging. Just like sustainability, resilience is an idea that is necessary for inter- and intra-generational survival. The fact that organisations are increasingly relying on monitoring and evaluation (including through indicators) shows concern with how resources are used, and interest in making sure that goals are attained without maladaptation. Of course, both resilience as a concept and the use of indicators are contested in certain forums. On the one hand, resilience, like sustainability and many other important concepts, runs the risk of being used and abused to the point that it becomes meaningless. Indicators, on the other hand, can only tell part of the story (in some cases a very small part), so further reflection is necessary to identify how to develop indicators that can say more about resilience without the risk that the information is misunderstood or misused.

Indicators are likely to be more effective if they are able to capture greater detail. Particularly from a disaster risk reduction and hazards perspective, indicators need to be clear about the hazard type to which the resilience is being built and measured, and whether they measure individual or group resilience and how the frameworks relate the two. The nuances that more in-depth indicator frameworks use, such as SHARP or Twigg, mean that more of the socio-cultural and political context that serves to qualify binary or numerical responses can be collected. Additional conversations between teams who are involved in indicator development could be a good way to strengthen resilience indicators across the board. Further improvements could come from acknowledging and detailing the role played by, and delineating the relative importance of, the various selected indicators in the greater development picture for a given situation. It is also necessary to be aware of the limits that come with taking snapshot measurements in time.

While indicators have their short-comings, their development requires a process of reflection and deliberation on what is truly required for resilience that is unlike the disconnected eruptions of knowledge on adaptation. Thus, even if the indicators themselves fail to be useful, the path toward their development, involving countless meetings, documents, presentations and debates provides a robust theoretical platform on which to build more knowledge. Despite disagreements over how to define or delineate the concept, it is hoped that there will be some sort of general convergence on the characteristics of resilience, in order to ensure that rather than tearing each other down because we don't agree on how the concept is used, we can actually use this energy to help reduce the risk posed by climate change and natural hazards.



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## Annex I

### Description of indicator sets

This section describes the indicator sets in each of the frameworks examined. More detailed discussion of some of the analysed frameworks (and others) can be found in Bahadur et al. (2015), Brooks et al. (2014a) Frankenberg et al. (2014) and WFP (2014). Here, we focussed on the extent to which the individual indicators aligned with our three criteria: Learning, Options, and Flexibility. They are presented here in alphabetical order.

#### ACCCRN (Tyler et al., 2014)

The ACCCRN framework was developed to be used for local planning and monitoring changes in climate resilience in the urban context of the Network. The approach acknowledges that neither adaptation nor resilience can be measured directly, and that indicators are only proxies. The development of ACCCRN indicators and matrices are structured around key vulnerability issues within specific cities, placing emphasis on the connection between local city-level partners in participating cities, and the collaboration with national-level local programme coordinators in order to implement climate resilient interventions. Specifically, as resilience policies were poorly defined in the case study cities, the indicators were constructed in parallel with the clarification of goals and targets. The indicators are based on conceptual frameworks, with empirical assessment of local vulnerabilities. With the difference in priorities, the eight ACCCRN cities developed a total of 152 indicators across 10 different sectors.

#### AIACC: Sustainable livelihood approach for assessing community resilience to climate change (Elasha et al., 2005)

Within the development of the AIACC indicators, resilience is captured by ‘measuring the improvement of quality of life without compromising livelihood options for others’, alongside measuring the ‘capability of people to make a sustainable living’ (Elasha et al., 2005). This framework uses the LAST system approach within indicator development, and focusses on measuring community coping and adaptive capacities towards climatic variability and extremes. This is used as a proxy to determine levels of coping and adaptive capacity for future climate change. The approach focuses specifically on observing a communities’ ability to recover from, and cope with, shocks and stresses, income stability and economic efficiency.

#### ARCAB

The ARCAB monitoring and evaluation framework is focussed on community-based adaptation projects and as

such emphasises adaptive capacity rather than resilience. The indicators also focus on transformed resilience through knowledge and capacity, as identified in the theory of change, and the strengthening of the long-term adaptive capacity of the climate vulnerable poor. The objective is to also strengthen the enabling environment in which adaptation occurs. The framework revolves around the understanding that ‘good development that improves people’s access to assets and strengthens and diversifies livelihoods, is at the heart of enabling people to adapt’ (ARCAB, 2012b). The literature which discusses the development of ARCAB indicators addresses how indicators for adaptive capacity often stem from development indicators as proxies (e.g. food security, livelihood, poverty indicators, see Section 2), alongside disaster risk reduction indicators (ARCAB, 2012b). Therefore, the underlying basis of their indicators is development, with downstream indicators assessing knowledge, climate information availability and trend information in order to identify changes in adaptive capacity for the most vulnerable to climate change. Upstream indicators focus on institutional capacity to manage climate change risks, scaling up resilience, and delivery of adaptation benefits.

#### ARUP

ARUP’s City Resilience Framework was developed in collaboration with the Rockefeller Foundation. The indicators are based on four categories, 12 indicators and 48 sub-indicators, observing assets, systems, behaviours and practices. The aim is to provide ‘a holistic articulation of resilience which equates to the elements of a city’s immune system’ (ARUP, 2014). The majority of indicators are outcome indicators, focussing on performance rather than specific actions themselves (ibid).

#### BRACED

The definition upon which the BRACED indicators are developed is the ‘ability to anticipate, avoid, plan for, cope with, recover from and adapt to climate related shocks and stresses’ (DFID, 2014). The indicators selected for BRACED are related to the key performance indicator that measures the number of people with improved resilience due to a project intervention, focussing on changes in those attributes of resilience affected by the project in question. It identifies the change in resilience attributes that have been affected by the project (DFID, 2014). Due to the way that the methodology is applied, the majority of BRACED indicators are project-specific outcome indicators (see Box 1), consisting of top-line<sup>4</sup> indicators and sub-indicators. The purpose is to use outcome indicators to measure the improvement in beneficiaries, which can lead to impact indicators that measure improved well-being. BRACED

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4 Topline indicators are the main categories of indicators, sometimes broken down into sub-indicators.

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draws on the TAMD framework for assessing ‘improved policies integrating DRR and climate change adaptation are in place at local, national, regional and international levels’.

BRACED recognises that indicators are not a means of measuring the absolute level of resilience, and so the indicators focus on measuring resilience built by project intervention, and the number of people affected by change.

### **CoBRA (2013)**

CoBRA’s conceptual model is adapted from the work of the FAO, and uses a composite measure of five resilience components and an overall universal measure. The model identifies capital (skills, assets, services) and capacities (ability to respond to stress or change) as critical to building resilience. CoBRA is implemented through a series of steps to develop indicators. Indicators are formed dependent on identified non-resilient populations, and identifying which factors from the five dimensions of the sustainable livelihood frameworks (physical capital, human capital, financial capital, natural capital and social capital) should be measured and tracked. The framework focusses on encouraging local level participation, and uses evidence gathered at the community level to determine direction. Therefore, there is no set list of indicators to use, as they are generated dependent on the community, household or individual for which they are relevant.

### **Constas and Barrett Resilience Measurement for Food Security (2013).**

Constas and Barrett offer a theoretically-based set of measurement principles, focussing on food security and drawing on the FAO’s four components of food security as a starting point (availability, access, utilisation, and stability). Measurement is separated into three main categories. Indicators that measure household food security are identified as basic conditions, including the measurement of food security index, assets index, social capital index, access to services index, ecological and health. Indicators measuring covariate and idiosyncratic shocks and stresses are included in the measurement of disturbance. Finally, mitigation, coping and adaptation capacities are identified as response measures. As this is a theoretical discussion, the indicators are broad.

### **Feinstein International Center (2012)**

Feinstein focuses on agriculture and food security, measuring resilience with a ‘livelihoods change’ approach, mapping change over time within harvest cycles and using a ‘livelihoods cycle framework’. Drawing on livelihood concepts (such as DFID), the approach considers how assets are utilised in various income producing activities, and assessing choices by individuals and households in terms of income or asset allocation.

The Center focusses on seven indicators of livelihood outcomes and household well-being. Three focus on food security, one of well-being through illness and human

capital measurements, and three on economic and asset management or change. The focus here is flexibility and robustness, lacking awareness building.

### **Climate Resilience and Food Security: A framework for planning and monitoring (IISD) (Tyler, 2013)**

This working paper by the International Institute for Sustainable Development presents approaches to understanding and monitoring food system resilience to climate change. It describes an emerging conceptual tool designed to support analysis of community-level food security and resilience of food systems, based on a project in Central America. The guidance tools are expected to help communities develop resilience indicators relevant to their food security context and provide information for policy-makers and planners at regional and national levels for developing system-level indicators of climate resilience. The framework is explored through food utilisation resilience analysis, food access resilience analysis, food availability resilience analysis, resilience analysis of support resources and services, and resilience analysis of support organisations and policies.

### **Mayunga’s Capital-based approach (Mayunga, 2007)**

Mayunga’s paper proposes a capital-based approach to measure the concept of community disaster resilience. Five major forms of capital are identified; social, economic, physical, human and natural. Acknowledged as a widely applied concept in sustainable development and poverty alleviation programmes, capital is viewed as a necessity to build a sustainable community economy. There is a broad expanse of indicators proposed across the five capital forms, including public affairs, informal sociability, household income, employment, and housing. Indicators surveying health, education and infrastructure/ transport are also proposed. The paper acknowledges that measuring the dimensions of capital is complex, and specific aspects can be difficult to quantify, and the associated weighting that is needed to measure resilience is recognised as a technique with challenges that need to be addressed in order to measure resilience successfully.

### **SHARP**

The SHARP indicator set is sector-specific, focussing on thirteen precise agriculture-related themes, building on the agro-ecological resilience indicators developed by Cabell and Oelofse (2012). In order to consider the different epistemological origins of resilience, FAO has narrowed the focus of its indicators ‘to climate resilience of farming systems’. They draw on the definition of resilience by ACCCRN, relating to the ‘resilience of a system or part of a system to climate-related shocks and stresses’ (Dixon and Stringer, 2015). Notions of change and transformation are central to the definition, defining resilience as ‘the ability of a system to recover, reorganise and evolve following external stresses and disturbances’ (Choptiany et al., 2015). The

indicators reflect that SHARP conceptualises resilience as both a process, with the inherent ability to adapt, and as an outcome, and so indicators consist of a mixture of outcome and output indicators. Unlike the other frameworks, SHARP is intended as a guide for self-assessment, which means that the users of the indicators include the farmers. This approach is expected to empower farmers to strengthen their own resilience through being able to measure their own progress, with support provided to evaluate, analyse and link indicators to tools (Choptiany et al., 2015).

## TAMD

TAMD indicators are adaptation-focussed, rather than resilience-focussed, however the terms are used interchangeably in the documentation. The framework relates adaptation, vulnerability and resilience in the following way: 'The ultimate goals of adaptation and CRM are to reduce people's vulnerability to climate-related risks (i.e. enhance their resilience) and to secure development outcomes (at a range of scales) in the face of climate change that might otherwise undermine development progress' (Brooks et al., 2013: 18). The indicators are intended to assist in 'evaluating outputs, outcomes and impacts of adaptation-relevant development interventions' across two tracks, but are intended to be complemented by other approaches, such as the use of a theory of change (Brooks et al., 2014b). The framework uses indicators that address the global, national, municipal and local levels, and focusses on climate specificity alongside livelihoods improvements and other development focuses. Track 1 indicators 'show the extent and efficiency of climate risk management (CRM) systems, mechanisms and practices'. Track 2 indicators focus on development and adaptation outcomes at different levels (ibid). Alongside Track 1, 8 national level indicators are identified, and are similar to those proposed under the PPCR.

## TANGO (2012)

TANGO's conceptual framework for resilience is used as a basis for several of the conceptual frameworks, and particularly used by the Department for International Development (DFID). The framework aims to address underlying causes of vulnerability, integrating a livelihoods framework, a disaster risk reduction framework, and climate change elements. Additionally, the framework integrates long-term trends, such as institutional, economic, socio-political or environmental factors into the examination of critical influences on livelihoods security and exposure.

## Characteristics of a Disaster Resilient Community (Twigg, 2009)

*Characteristics of a Disaster-Resilient Community* is a guidance note for government and civil society organisations working on disaster risk reduction and climate change adaptation initiatives at community level in vulnerable communities. It contains multiple

dimensions for analysis, guided by five Thematic Areas: governance, risk assessment, knowledge and education, risk management and vulnerability reduction, and disaster preparedness and response. Each of these is explored through three sub-dimensions: components of resilience; characteristics of a disaster-resilient community; and characteristics of an enabling environment.

## UN/ISDR Disaster Resilience Scorecard for Cities (UN/ISDR, 2014)

The disaster resilience scorecard is a tool for cities to assess their baseline level of 'disaster resilience', defined as the ability of a city to mitigate and recover from an extreme event. This is further described as 'the ability of a city to understand the disaster risks it may face; to mitigate those risks; and to respond to disasters that may occur, in such a way as to minimise loss of or damage to life, livelihoods, property, infrastructure, economic activity and the environment' (UN/ISDR, 2014). It includes 85 evaluation criteria, which are grouped in the following categories: **research**, including evidence-based compilation and communication of threats and needed responses; **organisation**, including policy, planning, coordination and financing; **infrastructure**, including critical and social infrastructure and systems and appropriate development; **response capability**, including information provision and enhancing capacity; **environment**, including maintaining and enhancing ecosystem services; and **recovery**, including triage, support services and scenario planning. It is unlike most of the other frameworks reviewed here in that its primary audience is the cities themselves.

## USAID Measurement Framework for Community Resilience (USAID, 2013)

USAID defines resilience as 'the ability of people, households, communities, countries and systems to mitigate, adapt to, and recover from shocks and stresses in a manner that reduces chronic vulnerability' (USAID, 2013). The USAID Measurement Framework for Community Resilience is based on a five-step process that begins with an initial vulnerability assessment to identify Baseline, Wellbeing and Basic Conditions. This is broken down into six indices based on food security/nutrition, health, social capital, assets, ecosystem health and poverty. The next step involves measuring disturbance (shocks, stressors) and identifying the frequency, duration and intensity of covariate shocks and stressors and idiosyncratic shocks and stressors. The next step looks at community capacities to measure resilience, and assesses adaptive, absorptive and transformative capacity. Then the framework looks at areas of collective action, which are categorised under disaster risk reduction, conflict management, social protection, natural resource management and management of public goods and services. The final step is to reassess against initial baseline indices.

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### **USAID Coastal Resilience (USAID, 2007)**

The coastal resilience framework is among the older sets of guidelines for assessing resilience. It is based on a rating system of 6 conditions from 'Excellent' to 'Condition absent' of eight Resilience Elements (Governance; Society and Economy; Coastal Resource Management; Land Use and Structural Design; Risk Knowledge; Warning and Evacuation; Emergency Response; and Disaster Recovery) based on four benchmark Core Capacity (Policy and Planning Capacity; Physical and Natural Capacity; Social and Cultural Capacity;

and Technical and Financial Capacity). This approach leaves a significant amount of judgment to the user of the framework, because there is an underlying assessment that guides the identification of the ratings.

The method uses sets of qualitative questions to evaluate these characteristics against benchmarks focussing on; policy and planning capacity, physical and natural resource capacity, social and cultural capacity and technical and financial capacity.



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