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Research paper

Monitoring and evaluation of climate resilience for agricultural development – A review of currently available tools

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ABSTRACT

Building climate resilience, defined as the ability to anticipate, absorb, accommodate, or recover from climate change in a timely and efficient manner, is becoming a major priority of development across multiple sectors. However, there is still no consensus on how resilience should be assessed despite the release of numerous theoretical papers on the topic. Various measurement frameworks and recommendations have emerged, but their applicability is yet to be critically assessed. Using a comprehensive review and a systematic selection approach, we review resilience assessment tools developed for the context of climate change and agricultural development, and their linkages to theoretical frameworks, with a particular focus on the choice of indicators and the scale and methods of measurement. Fifteen tools originating from diverse organizations were selected and evaluated according to a measurement framework. Our study finds that, while some of the tools remain embedded in classical approaches, by simply adding a resilience lens to previous tools and by recycling indicators, others demonstrate a true attempt to rethink in order to account for resilience dimensions. We conclude that for the use of resilience assessment tools, a major challenge is to ensure that simple and operational tools can address complexity. Full baseline should comprise both quantitative and qualitative data collection, and include more systemic indicators as well as indicators of stability and shocks. Changes should be tracked with regular monitoring and evaluation using simple tools based on key variables that capture short-term adaptive processes and changes in states, at the appropriate system level. Clear pathways to human well-being, including transformation, should be discussed through system-oriented approaches, to discard potential undesired resilient states. Finally, robust outcome and impact records from the use of these tools are needed to demonstrate whether the resilience concept is useful over time in driving development into more desirable paths.

1. Introduction

The interactions between climate change trends and smallholder farming systems vulnerability put increasing pressure on the livelihoods of the world's poor. To deal with these new and unpredictable risks, resilience has emerged as a key concept for policy and program development (Barrett & Constas, 2014), possibly – and controversially – replacing sustainability as the ultimate objective (Anderies, Folke, Walker, & Ostrom, 2013; Béné, Newsham, Davies, Ulrichs, & Godfrey-Wood, 2014; Chapin, 2009; Redman, 2014;). The European Union, for example, has announced that it intends to mobilize €1.5 billion for resilience programming in the Sahel between 2014 and 2020[1], the UK Department for International Development (DFID) recently committed £140 million, and USAID, the Rockefeller Foundation, and Swedish International Development Cooperation (SIDA) have jointly committed US$100 million through the Global Resilience Partnership (Béné, Frankenberger, & Nelson, 2015). Numerous countries and NGOs have made resilience one of their major programmatic priorities, and the resilience concept is frequently referred to in the formulation of the Sustainable Development Goals[2]. The African Union declared in June 2014 in Malabo its commitment to enhancing resilience of livelihoods and production systems to climate variability and other related risks[3].

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[1] http://europa.eu/rapid/press-release_IP-13-1013_en.htm.
[2] https://sustainabledevelopment.un.org/?menu=1300.
[3] http://pages.au.int/sites/default/files/Malabo%20Declaration%202014_11%2026-.pdf.

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2452-2929/

However, despite this growing interest in resilience and the release of numerous theoretical papers on the topic (Barrett & Constas, 2014; Desjardins, Barker, Lindo, Dieleman, & Dussault, 2015; Folke et al., 2010; Miller et al., 2010), there is still no consensus on how it should be defined or measured.

From an early definition of resilience, primarily for ecological systems by Holling (1973) as "the persistence of relationships within a system and measure of the ability of these systems to absorb changes of state variables, driving variables and parameters and still persist" the concept has been frequently redefined according to contexts and concept evolution. Though there is no consensus today on a precise definition of resilience, the working definition of the Intergovernmental Panel on Climate Change (IPCC) is widely used in the context of climate change: the 'ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner' (IPCC, 2012). The scientific community agrees that resilience derives from three critical capacities: *absorptive* (the amount of change that a system can undergo while still retaining its function and structure), *adaptive* (the amount of learning, combining experiences and knowledge, and adjustments to external drivers), and *transformative* (the creation of a new system when the initial state is not bearable anymore) (Folke, 2006; Folke et al., 2010; Miller et al., 2010; Walker, Holling, Carpenter, & Kinzig, 2004). The resilience of a system results therefore from the interactions (trade-offs and synergies) between these three features, as well as from the degree to which the system is capable of self-organization (Béné et al., 2014).

There are multiple epistemological entry points for studying resilience in the context of climate change, with the most established originating from the broad field of socio-ecological systems. The general concepts have been applied to various fields of study, including the field of international development, where resilience is, in addition, the capacity to avoid and escape from unacceptable standards of living over time and in the face of stressors and shocks (Barrett & Constas, 2014). Thus, the working definition of resilience that was used in our context of climate resilience for agricultural development is a combination of the IPCC's (2012) and of Barrett and Constas (2014) to define resilience as: 'the ability of a system and its component parts to anticipate, absorb, accommodate, or escape from unacceptable standards of living due to the effects of a hazardous event, in a timely and efficient manner'.

Measuring resilience implies the need to embrace complex adaptive systems and their components in a dynamic way, which complicates the choice of indicators (Resilience Alliance, 2010). This is further challenged by the fact that resilience can only really be assessed *a posteriori*, i.e., after the system has successfully coped, adapt or collapsed (Dodman, Ayers, & Huq, 2009; Redman, 2005). Although ten years ago the concept of resilience was classified as "operationally weak" with limited scope for measurement (Klein, Nicholls, & Thomalla, 2003), numerous frameworks have emerged in the last few years that attempt to bridge the gap by interpreting resilience as the sum of a range of characteristics (Twigg, 2009). The Resilience Measurement Technical Working Group has developed a measurement framework (Constas et al., 2014b) as well as measurement principles (Constas, Frankenberger, & Hoddinott, 2014a). Other frameworks and recommendations for measurement, indicators or proxies have been proposed (Cabell & Oelofse, 2012; Carpenter, Walker, Anderies, & Abel, 2001; Carpenter, Westley, & Turner, 2005; Dixon & Stringer, 2015; Frazier, Thompson, Dezzani, & Butsick, 2013; Twigg, 2009). How this measurement guidance translates into practical tools for development activities and helps manage towards better outcomes is yet to be critically studied (Dixon & Stringer, 2015).

As donors and development actors call for a community of practice to incorporate resilience dimensions into development actions, there is a need to evaluate resilience assessment tools and their linkages to theoretical frameworks in order to understand commonalities and discrepancies that can inform users in the selection of an appropriate tool for an application. To fill that gap, the objectives of this paper are to: (i) review how existing tools align with resilience measurement frameworks and (ii) assess the breadth in various tool types, with a particular focus on resilience indicators structures. The findings provide important insights on the essential elements of decision-support to increase resilience to climate change in the context of agricultural development.

2. Materials and methods

2.1. Tool identification and selection process

A comprehensive review of resilience assessment tools was undertaken, using the key words "resilience", "tool" or "assessment", "climate" and "smallholder" in various search engines (Google, Scopus and Web of Sciences). As tools are not as well indexed as scientific papers, the review included the identification of relevant actors to access tools (Fig. 1). More than 160 documents were consulted, from peer-reviewed publications to technical notes, toolkits guides and workshop reports. Care was taken to access the more recent information from the most complete panel of recognized international organizations working on the topic: scientific community, United Nations offices, national development agencies, donors and NGOs.

Resilience assessment tools for non-agricultural and or climate change context such as health, education, ecosystem services, and/or disaster applications, were discarded. Also excluded were tools, which were narrowly applied, lacked detailed documentation, or were not yet ready for application (Fig. 1). This process led to the selection of 15 tools included in the review.

The final set of 15 resilience assessment tools was classified according to 1) the time needed to carry out the assessment and 2) the nature of study, i.e., the two primary distinguishing characteristics of the tools. The tools varied widely in terms of the timeframe required to carry out the assessment: from one day to more than 6 months. Similarly, the tools varied in nature from being desk-based, relying on secondary data, to field-based studies, drawing from both qualitative and quantitative data.

The dominant focuses were recorded for each tool, representing how resilience was defined: i) the opposite of vulnerability, ii) as a desired characteristic to preempt risk, iii) as a stepping stone for improved well-being, iv) as the equivalent of adaptation, v) as a route to transformation, or vi) as a combination of these definitions. An extensive body of literature is available for definitions and discussions about each of these terms. In brief, *vulnerability* to climate change is the degree to which geophysical, biological and socio-economic systems are susceptible to, and unable to cope with, adverse impacts of climate change (Adger et al., 2007). In other words, vulnerability has been defined as the exposure to risk plus the resilience to this risk[4] (Alinovi, Mane, & Romano, 2010). *Risk* is the possibility of loss, or unwelcome circumstances (climate adverse conditions, disasters, etc.). This includes uncertainty as to how the system will be affected, which is absent in adaptation or vulnerability approaches, but nonetheless crucial (Barnett, 2001). *Well-being* is a broad development objective, and is measured with a variety of indicators including income and food security (OECD, 2013). *Adaptation* encompasses the modification of exposure to risk, the absorption and recovery from losses, and the exploitation of new opportunities (Adger & Vincent, 2005). If the changes required to

[4] More details on the differences between resilience and vulnerability can be found in Manyena (2006) and Füssel (2007), among others.