



An Indicator Framework for Measuring Pastoralists' Resilience to Drought in the Horn of Africa

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Abstract

Globally, there is considerable interest in measuring the effectiveness of investment in resilience building. Yet the identification of appropriate indicators remains a challenge. This article defines an indicator framework for comprehensive resilience capacities measurement and analysis based on an extensive theoretical literature review, a series of workshop discussions and the authors' own experiences. Results indicate three dimensions and attributes of resilience capacities - absorptive, adaptive and transformative - on the basis of which indicators were constructed. Building on the premise that resilience as a concept is too complex for measurement indicators to be easily identified; the paper delineates outcome and composite indicators to assess pastoralist systems. This information could be used as a starting point to evaluate whether pastoralists have become more or less resilient to drought, and could also be used to assess the factors that have contributed to these outcomes. Although the proposed indicator framework has not been systematically tested, the potential benefits are discussed with reference to the literature on (agro)-pastoralist systems. Conceptually, there is still a considerable amount of work to be done in terms of the indicators' sensitivity to shocks and stresses. We conclude that determining appropriate resilience indicators is not an end in itself; they are simply tools that can be used to define or point to more significant issues.

Keywords: Adaptive capacity, climate variability and change, disaster resilience, indicators, and pastoralism

1. Introduction

The measurement of resilience to disaster is increasingly being identified by researchers and practitioners as a key component in assessing programme success (O'Connell et al., 2015; Schipper and Langston, 2015). The growth of resilience within the development discourse, and the adoption of the concept across sectors has led to an explosion of resilience-focused frameworks. Currently, there is no shortage of literature reviews on resilience (Adger, 2000; Obrist, Pfeiffer and Henley, 2010; IPCC, 2012; Béné et al., 2012; Stein, 2013; Frankenberger et al., 2014; Winderl, 2014), nor any shortage of conceptual issues to discuss. Although there has been much documentation about definitions of resilience (Holling, 1973; Carpenter, Bennett and Peterson, 2001; Berkes and Ross, 2013; Bennett, Cumming and Peterson, 2005; Folke 2006; Obrist, Pfeiffer and Henley, 2010), the question of whether meaningful methods and indicators for measuring resilience exist remains contested. The few studies analysing resilience measurements in relation to disasters (Winderl, 2014) do so from different perspectives. The identification of indices, metrics and standards for measuring disaster resilience remains a significant challenge on a spatial scale (Tanner et al., 2015). There is also a clear gap between the theory of resilience, which is largely informed by ecological concepts, and the way in which indicators focusing on social-ecological resilience to disasters are conceptualized (Folke 2006; Ifejika, Wiesmann and Rist, 2014). Whether there is a single "correct" or "best" meta-indicator of disaster resilience is a debate that has been ongoing for the last decade and is likely to continue in the years to come. The tensions among various disciplines on what exactly constitutes resilience when it is achieved make it difficult even to reach consensus on the identification of appropriate indicators through which to assess outcomes or the impacts of investments.

A review of both the theoretical and empirical literature suggests that many of resilience indices proposed reflect diversity of disciplines and sectors that have appropriated the concept. However, there is a paucity of information on a comprehensive indicator framework within which pastoralists' or agro pastoralists' resilience to drought can be assessed. Studies by Ifejika, Wiesmann and Rist (2014) identified a framework that can be used for empirical analysis of livelihood resilience to social-ecological dynamics. Cabell and Oelofse (2012) identified an index of behaviour-based indicators that, when identified in an agro-ecosystem, suggest that it is resilient and endowed with a capacity for adaptation and transformation. Similarly, Marschke and Berkes (2006) identified resilience-building strategies and used local-level perspectives of well-being as a surrogate for resilience. Opiyo, Wasonga and Nyangito (2014) recently used interview data and principal component analysis to determine households' resilience to climate-induced stresses, based on biophysical and socio-economic variables. Darnhofer, Fairweather and Moller (2010) assert that developing sets of surrogates or indicators, as suggested by Bennett, Cumming and Peterson (2005) and Carpenter, Bennett and Peterson (2006) is a more useful approach to assessing resilience than trying to measure resilience itself. According to Schipper and Langston (2015) though, there is widespread agreement on the need to advocate for a broader indicator framework for assessing resilience in farming systems which are perceived to be complex. Considering that a pastoralists' livelihood has various dimensions at the household or individual level in the form of capacities (assets and strategies) and at the structural level in the form of transforming structures and processes, these dimensions need to be captured when conceptually and empirically integrating system and resilience to drought. However, there is a lack of such a multi-dimensional framework with which such systems can be assessed for resilience.

Within the Horn of Africa, pastoralist systems are known to be tightly coupled human-environment systems, in which human livelihoods are derived substantially or wholly from livestock keeping that forage on extensive rangeland as common resources (Ellis, 1998; Martin et al., 2014). In this article, the Horn of Africa refers to the region encompassing Somalia, Djibouti, Ethiopia, Eritrea, South Sudan, northern Uganda and Kenya, although it lacks "precise geographical boundaries". The pastoralists in the region have diverse cultures, yet they tend to share institutional and cultural adaptation and coping strategies that promote resilience in environments characterized by high resource variability (Kaye-Zwiebel and King, 2014; Opiyo et al., 2015b). Indeed, today many

pastoralist systems are failing to meet households' livelihood requirements as a result of complex social and ecological drivers that undermine their long-term "resilience" to frequent drought in sub-Saharan Africa (Sallu, Twyman and Stringer, 2010). It cannot simply be assumed, however, that resilience building interventions will in fact succeed in sustaining pastoralists' livelihoods and the ecological processes on which they rely without effective measurement and analysis.

Whereas the questions "what constitutes pastoralists' resilience?", and "resilient to what?", have been the subject of ongoing debate for some time, the concept of an indicators framework for resilience measurement has not been effectively examined. This article, therefore, presents a framework that can be used in addressing the question of what set of possible indicators could provide the best comparative assessment of drought resilience among pastoralist communities. The information generated in this research can serve as tool for monitoring the effectiveness of programmes and policies aimed at building drought resilience in pastoralist systems.

2. Evolution of the concept of resilience since the 1970s

The concept of resilience is used loosely in many different contexts, from disaster risk reduction, climate change to the poverty and sustainable development, and has a variety of conceptualizations. In many research studies, the concept of resilience is derived from the social-ecological sciences (Carpenter et al., 2001; Holling, 2001; Folke, 2006; Béné et al. 2012). Since the 1970s, many competing notions and definitions of resilience as a concept have been offered, some of which are shown in Table 1. Holling (1973) was the first to define resilience as the ability to absorb change and disturbance and still maintain the relationships that control a system's behavior. In the social-ecological systems strand, resilience is considered as the capacity of the system to continually change and adapt and yet remain within critical thresholds. Resilience may also be defined as the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks (Walker et al., 2004). Adger, (2000) and Obrist, Pfeiffer and Henley, (2010) described resilience as the ability of groups or communities to cope with external stresses or shocks and disturbances as a result of social, political, and environmental change. Other definitions of resilience include those that focus on the return to equilibrium after a disturbance, in contrast to Holling's concept of resilience (Holling, 1973) that says nothing about returning to the original state, as it assumes constant change (Folke et al., 2010). Pickett et al. (2004) on the other hand propose a typology of definitions of resilience based on their degree of normativity, showing that resilience can be conceptualized as a descriptive or a normative concept, or a hybrid of both. This article defines resilience as the capacity to manage, adapt to, cope with or recover from stresses, shocks and disasters; or the ability of a system to remain stable or adapt to new situations without undergoing catastrophic changes in its basic functioning.

Today, an increasing multiplicity of global challenges of which climate variability and change is one and the difficulties of finding sustainable solutions to extreme climatic challenges has raised interest in using the concept of resilience concept in many social and ecological studies. In several regions in sub-Saharan Africa, substantial climate change is expected in the form of decreasing mean annual precipitation accompanied by increasing precipitation variability (IPCC, 2012), which may limit the ability of pastoralists to secure their livelihood sustainably. Resilience, which is defined by Carpenter et al. (2001) as the capacity of individuals, social groups or pastoralists to accommodate stresses (such as climate change) and disturbances (shocks), to self-organize, and to improve essential basic structures and ways of functioning, is argued to be a panacea for these global challenges. As Marschke and Berkes (2006) suggest, "resilience offers a lens with which to explore stresses and shocks and to understand livelihood dynamics", and "is used to characterize a system's ability to deal with change". That notwithstanding, most of these definitions are consistent in their focus on the adaptive capacity of a system (whether individuals, communities, larger societies, corporations, social-ecological systems, or ecosystems) that enables functioning to occur under adverse conditions. Hence, the need for relevant resilience frameworks that can capture this capacity in an environment characterized by change.

Table 1: Definitions of resilience from the 1970s to the present

Years	Discipline (sources)	Definitions	Implication
1970s	Ecological resilience (Holling, 1973)	Resilience as the ability to absorb change and disturbance and still maintain the same relationships that control a system's behavior.	Cited as the first to describe the concept in ecology.
1980s	Disaster resilience (Timmerman, 1981)	Resilience as the measure of the capacity of a system, or part of a system, to absorb or recover from a damaging event.	Discussed as probably the first to coin the term within natural hazards and disasters research.
	Engineering resilience (Pimm 1984)	Resilience as the speed with which a system returns to its original state following a perturbation.	
1990s	Coastal resilience (Klein et al., 1998)	Resilience as the self-organizing capacity of the coast to preserve actual and potential functions under changing hydraulic and morphological conditions.	
2000s	Social science (Adger, 2000)	Social resilience as the ability of groups or communities to cope with external stresses and disturbances as a result of social, political and environmental change.	
	Economic value of resilience (Walker et al., 2004; Bennett, Cumming and Peterson, 2005)	Resilience as the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity and feedbacks.	The three related attributes of social-ecological systems, determine their future trajectories: resilience, adaptability and transformability.
	(Berke and Campanella 2006; Marschke and Berkes 2006; Tierney and Bruneau 2007; Cutter, Christopher and Christopher, 2008)	Resilience as the ability to survive and cope with a disaster with minimum impacts and damage.	This encompasses the capacity of populations to reduce risk, to avoid losses, and to recover from damaging events with little or no social disruptions.
	Social-ecological (Carpenter et al., 2001; Folke, 2006)	Resilience refers to the magnitude of disturbance that can be absorbed before a system changes to a radically different state as well as the capacity to self-organize and the capacity for adaptation to emerging circumstances.	Social-ecological systems
2010	Social Resilience (Obriest, Pfeiffer and Henley, 2010)	Resilience as the ability of groups or communities to cope with external stresses or shocks and disturbances as a result of social, political, and environmental change.	
	Spatial resilience (Cumming, 2011)	Resilience as maintaining identity over time: "maintenance of key components and relationships and the continuity of these through time"; "if resilience is low, identity may be lost and if identity is lost, resilience was low."	
	Economic resilience (Rose and Krausmann, 2013)	Static economic resilience is the ability of a system to maintain function when shocked, while dynamic economic resilience is hastening the speed of recovery from a shock.	This refers to the efficient utilization of resources.
	Disaster resilience (UNDP, 2013)	A transformative process of strengthening the capacity of communities to anticipate, prevent, recover, adapt and/or transform from shocks, stresses and change.	Emphasis is on resilience building in disaster affected communities.

Source: Authors' compilation.

In broader context, resilience is about people and their ecosystems as integrated social-ecological systems in which social systems and ecosystems are recognized as coupled, interdependent, and coevolving (Berkes and Folke 1998; Folke 2006). Analysis of the research on resilience shows most of the multidimensional conceptualization emphasizes human-environment interactions that negate resilience. In this article, we are concerned with the contextualizing the concept, since the marginalized context of rural social–ecological systems in the Horn of Africa plays a significant role in their resilience. The research also adds that this contextual resilience is both inherent and dynamic due to the ongoing interaction of climate (in this case drought) and other perturbations (internal and external) with the biophysical and socio-political dimensions of the pastoralist system.

3. Pastoralist strategies, resilience and drought

Pastoralism is a major economic production strategy for many people deriving a rural livelihood in the Horn of Africa, in which people raise herds of livestock based on extensive land use and often some form of herd mobility, mostly in arid and semi-arid lands (ASALs) (Ellis and Swift, 1988). Currently, extensive pastoralism occurs on about 80 per cent of the land area of the Horn of Africa, mostly in the drylands, where approximately 90 million tropical livestock units (TLU) that provide livelihoods for pastoralists (IGAD, 1990). The pastoral population of the Horn of Africa has been estimated at between 12 and 25 million people (Headey, Tafesse and You, 2012).

This region is known as one of the world's most food insecure regions with increasing human populations that are highly dependent on the natural resource base for their livelihoods. According to Niamir-Fuller (1998) and McGahey, Davies and Barrow, (2008), pastoralists make efficient use of flexible resource utilization strategies that enable them to cope with the high spatio-temporal resource variability typical of arid and semi-arid areas. In the Horn of Africa region, pastoralists survive in "fragile ecosystems" that are perpetually affected by drought and are continually threatened by desertification. The diverse livelihood systems of the pastoralists enable them to cope with and recover from stresses and shocks, maintain or enhance their capabilities and assets while not undermining natural resources. Studies by Rass (2006), Schilling, Opiyo, and Scheffran (2012) and Opiyo et al.,(2015a) show that the livelihoods of pastoralists depend on, first, the availability and access to assets (capital), such as water, pasture, animal health services, social networks, markets, credit and education; and second, the environment in which these assets are combined for production and consumption, specifically the political, organizational and institutional infrastructure; and third, the dynamic context of risks (drought, violent conflicts, human and animal disease outbreaks, and competition for natural resources) and seasonal trends that affect assets and the environment, and undermine livelihoods resilience. Scenario studies by Swift (2000) concluded that the pastoral economy is likely to thrive in the region by the year 2020 as a result of favorable climatic conditions for livestock production in the drylands.

Today, despite their resilient social-ecological adaptations, many pastoralist systems are failing to meet households' livelihood needs and maintain ecological resource balance (Kaye-Zwiebel and King, 2014). The sustainability of their resilience is threatened by a complex and interrelated range of social, economic, political and environmental changes which include climate change in the form of decreasing mean annual precipitation accompanied by increasing variability and recurrent droughts (Fraser et al., 2011). Indeed, most social-ecological systems that support pastoralism have undergone dramatic change in the last century due to climatic, landscape and institutional shifts. Because pastoralist strategies are developed in relation to particular landscapes, livelihoods and institutions, social and ecological changes have altered the relationships between these elements, with an impact on the effectiveness of particular strategies (Agrawal, 2010; Wangui et al., 2012). Understanding indicators related to environmental and social changes is thus important for livelihood resilience, especially with the recent frequent drought events observed in the region associated with climate variability and change.

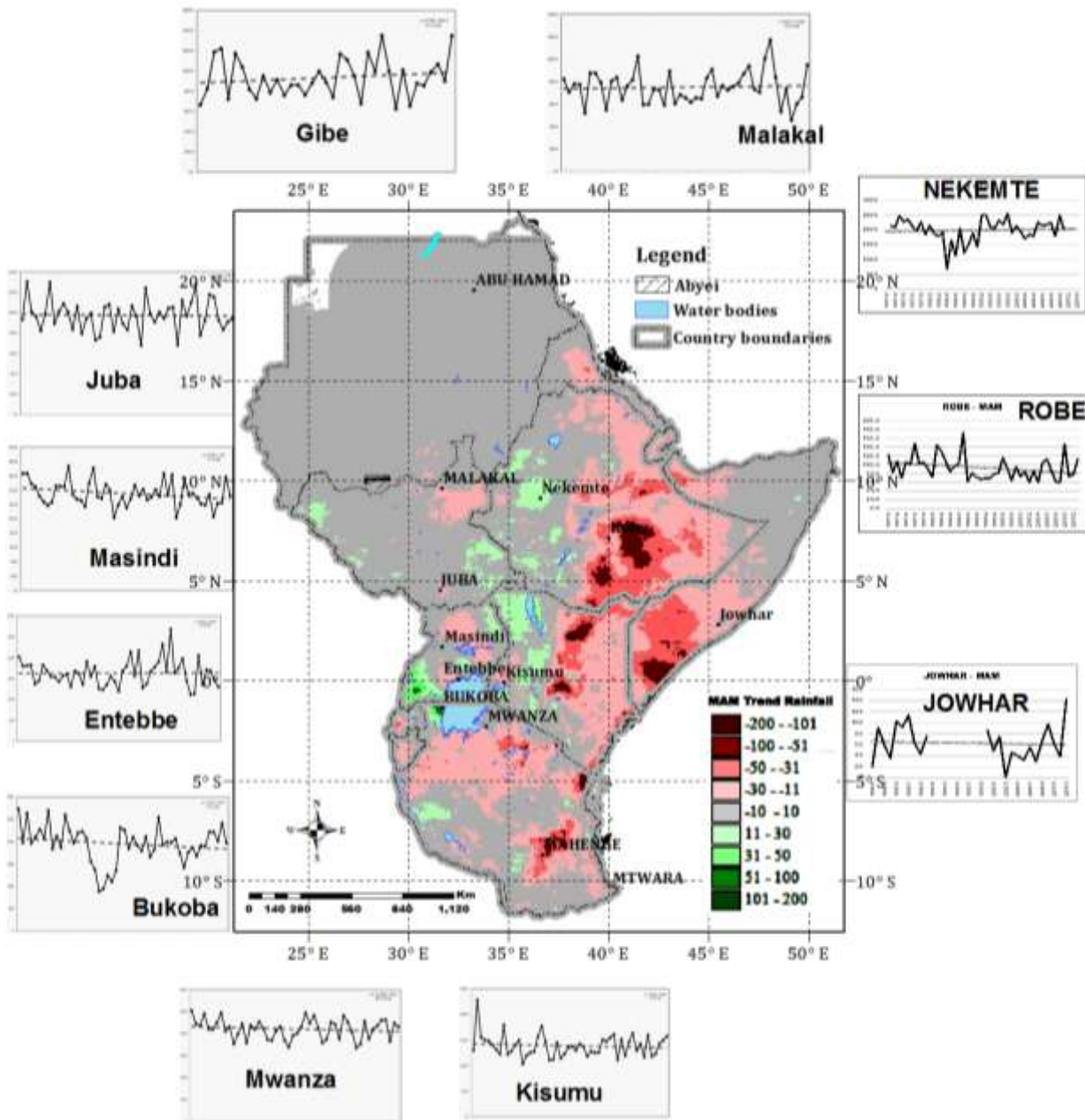


Figure 1: Spatial plot (monthly observed blended data 1961-2013) depicting March, April and May (MAM) rainfall trend with observed station temporal trends (1961-2013). Source: WFP/ICPAC Atlas.

There was a trend of decreasing rainfall during much of the period 1961-2013 (Figure 1), which had an extreme impact on the lives and livelihoods of the pastoralists. In the last two decades, droughts, in which conditions of well below average rainfall were widespread, occurred during 1998, 2000, 2005/06, 2007, 2008, 2009 and 2010/11 (Nicholson 2014). According to Nicholson (2014), the last four drought episodes have been particularly long and severe. Most of the countries within the Horn of Africa region have been hard hit by extreme conditions almost continuously since the early 2000s. While drought has been the most prevalent of these extreme conditions, this period has also included extreme flood conditions that likewise have devastating consequences on the resilience of the population in the drylands (IPCC 2012). Clearly, the severity and persistence of drought along with the abrupt shifts between extremes is the focus of most resilience studies in the Horn of Africa region.

4. Analytical framework for resilience indicators

There have been attempts to devise frameworks for examining the causal structure of the resilience of people and systems to shock and stresses (Carpenter et al., 2001; Béné et al., 2012; Frankenberger et al., 2013). These conceptual frameworks help only in characterizing the multiple dimensions of resilience. However, they are often difficult to apply to measurement and analysis because they provide limited assistance in identifying indicators to evaluate resilience interventions. In this article, an analytical framework for resilience indicators is proposed that could be used to analyse resilience. Although it is not intended to replace the richness of other existing conceptual frameworks, but rather to help link existing conceptual frameworks to the practice of resilience measurement and analysis. The basic concepts used in the proposed analytical frameworks have been explored in a variety of studies that seek to characterize the resilience of systems and people (Ifejika, Wiesmann and Rist, 2014). Because the concept of resilience is multifaceted and often ill-defined, this article seeks to expand on the three components of resilience capacities - absorptive, adaptive and transformative - for ease of resilience indicator identification for measurement and analysis.

4.1 Absorptive capacity

Absorptive capacity is the various (coping) strategies by which individuals and or households moderate or buffer the impacts of shocks and stresses on their livelihoods and basic needs without suffering permanent, negative impacts on longer-term well-being (Cutter, Christopher and Christopher, 2010; Béné et al., 2012). From a livelihood perspective, capacity as portrayed by household capital and their dynamics reflect absorptive capacity. Several studies have examined the components of resilience (Ifejika, Wiesmann and Rist, 2014), and have noted that when absorptive capacity is exceeded, the individual will then exercise their adaptive resilience.

4.2 Adaptive capacity

Adaptive capacity has been described as "the ability of a household or community to adjust to changing social, economic and environmental conditions (including climate variability and extremes) to moderate potential damages, and take advantage of opportunities, or to cope with the consequences" (Adger, 2006). These are proactive responses. Typically the indicators of adaptive capacity operate in a medium-term time frame and at household and or community level.

A review of the literature suggest that most assessments of adaptive capacity at the household or community level have focused on assets and capital as indicators for measuring disaster resilience (Adger et al., 2004; Brooks, Adger and Kelly 2005; Béné et al., 2012). While this is useful in understanding what resources households have or need to cope with shocks and stresses, the asset-oriented approaches tend to mask the role of the processes, perceptions and functions that inform the choices made in adapting to changing social, economic and environmental conditions (Opiyo et al., 2015a). Understanding adaptive capacity, therefore, also requires recognition of intangible processes such as decision-making, perceptions and governance, the fostering of innovation and experimentation, and exploitation of new opportunities and the structure of local institutions. According to Levine (2014), this should go beyond measuring indicators of what a household or individual *has* to recognizing what a household *does* that enables it to adapt.

4.3 Transformative capacity

Transformative capacity connotes the "capacity to create a fundamentally new system when ecological, economic or social structures make the existing system untenable" (Walker et al., 2004). Transformative capacity refers to often significant changes that enable more lasting resilience at community and system (or enabling environment) levels. O'Brien (2012) defines transformative capacity as a system-level change that enables more lasting resilience and often challenges the status quo in a substantial way. Transformation can be intentional (i.e. driven by the deliberate actions of people), autonomous (e.g. natural selection) or unintentional (forced).

purpose and detail, depending on who is proposing it, and for what reason. However, the identification of indicators could serve as the baseline set of conditions, from which to measure the effectiveness of resilience programmes, policies and interventions specifically designed to improve drought resilience for pastoral systems. An indicator is a quantitative or qualitative measure derived from observed facts that simplify and communicate the reality of a complex situation (Freudenberg, 2003; Marshall et al., 2010). Indicators reveal the relative position of the phenomena being measured, and when evaluated over time, can illustrate the magnitude of change (a little or a lot) as well as the direction of change (up or down; increasing or decreasing) (Cutter, Christopher and Christopher, 2010). An indicator provides metrics to set priorities, measure progress, and aid in decision-making processes. In this article we propose that resilience indicators could be defined both at outcome and impact levels.

Figure 3 illustrates a result-based framework for outcome and impacts measurements. The results-based framework presents a shift from focusing on the inputs and activities (resources and procedures) to focusing on outcomes and impacts and the need for sustainable benefits. Results are the changes occurring as an effect of interventions and may be changes in individuals, people, groups, communities, governments or systems. A results-based monitoring and evaluation system could therefore provide feedback on the actual outcomes and impacts of resilience building interventions. If appropriate quantifiable indicators and qualitative narratives are identified at a higher level, the framework could provide a continuous process of collecting and analysing information to compare how a project, programme, or policy initiative is being implemented against initially expected results (Kusek and Rist, 2004). Since resilience measurement requires the monitoring of higher level, long-term outcomes and impacts beyond the single project timeframe, this results-based framework could act as a guide to the level at which analysis should be done.

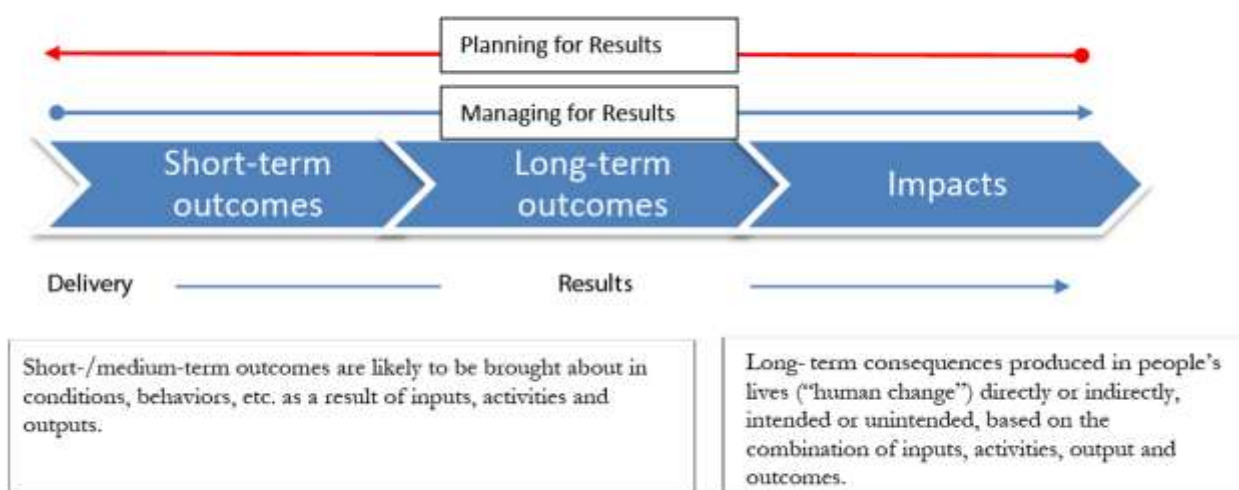


Figure 3: Results-based frameworks for measurements

In the IGAD region, with its constantly changing natural, social and economic conditions, indicators for resilience measurement could ultimately help determine whether households, communities and larger populations are on a trajectory toward greater vulnerability or greater resilience. In relation to social-ecological systems, however, Darnhofer, Fairweather and Moller (2010) suggest “farming systems are probably too complex and variable in time and space to be easily defined by existing resilience models so as to provide useful guidance on the indicators. The fact that resilience is an emergent property of a system, arising from the unique interaction between individual, capacities, and context implies that no two systems are alike and that what makes one resilient may not

necessarily work for another. Darnhofer, Fairweather and Moller (2010) therefore assert that developing sets of proxies or indicators, as suggested by Bennett, Cumming and Peterson, (2005), Carpenter, Bennett and Peterson, (2006), and Ifejika, Wiesmann and Rist (2014), is a more useful approach to assessing resilience than trying to measure resilience itself.

However, the range of outcome and process indicators that could possibly be used to assess the various components of resilience is vast. Table 2 lists a set of outcome and process indicators that could be subjected to sensitivity analysis to assess their fitness for measuring the dimensions of community resilience to drought. Because the science of resilience measurement is still in its infancy, incremental empirical steps such as these are necessary to: i) advance our understanding of the multidimensional nature of resilience and its constituent parts, but more importantly to ii) provide metrics that are easily understood and applicable to the decision making process. Other studies suggest that some of these indicators could be combined to devise a composite resilience index that is a composite measure of the different dimensions of household or community resilience (Alinovi, Mane and Romano, 2008). A number of composite indicators are already used in the contexts of environmental hazards, poverty and disasters. Cutter, Christopher and Christopher (2010) describe a range of these, including those focusing on social vulnerability to natural or technological hazards, such as the Social Vulnerability Index, the Prevalent Vulnerability Index, the Index of Social Vulnerability to Climate Change for Africa et al.. Given the highly multi-dimensional nature of resilience, the composite indicators (combining a poverty index, an asset index, a social capital index, a food security/nutrition index, a health index, a coping strategy index, an ecosystem health index and a poverty-environment index) could probably provide a good measure of the impact of investment in resilience in a given context.

Table 2: Indicators for measuring social-ecological resilience

Capacities	Description	Outcome indicators	Composite indicators
Absorptive capacity			
-Assets ownership and access	Assessing levels and changes in conditions of and access to livelihood assets/capitals (Ifejika, Wiesmann and Rist, 2014).	Livestock ownership No. of assets owned No. of productive assets owned Access to critical resources i.e. water	Poverty index Asset index
-Coping strategies	Monitoring long-term trends in food insecurity for disaster affected households.	Coping Strategy Index	Social capital index
-Informal social safety nets	Measuring the extent to which households provide an effective social safety net among themselves - from relatives and other social structures outside pastoral systems (ODI, 2009).	Increased demand for local goods Improved relations Increased remittances from family members	Food security/nutrition index
-Social cohesion	Assessing the extent to which social networks for mutual co-operation and supportive relations exist in a community. (Maxwell, 1996).	Trust at the community level relations	Health index
Adaptive Capacity			
-Diversity of livelihoods	The process by which rural households construct a diverse portfolio of activities and social support capabilities in order to survive and to improve their standards of living (Ellis, 1998).	Contribution of livelihood activities to total income Income sources	Coping Strategy Index
-Human capital	Measuring literacy level, knowledge (experience), skills, and health conditions. The educational attainment and health status of individuals/households shapes their ability to absorb the negative impacts of a shock and to successfully adapt to changing social, economic, and environmental conditions (Black and Hughes, 2001:3; Béné et al., 2012).	Completion rate Adult literacy rates by sex Labour force participation	Ecosystem health index
-Social Capital	The degree to which a community's resources (Physical, symbolic, financial, human, or natural) are reinvested in social relations (Onyx and Bullen 1997; Putnam, 2000; Folke et al., 2005).	Community participation The existence of networks and mutual trust within a community. Number of people who are part of a local network Reciprocity	Poverty-environment index Resilience index
-Physical capital	Measuring capital created by economic production processes, such as roads, machinery, tools, water, telecommunications and transportation systems (Ellis, 2000; Peacock et al., 2010).	Infrastructure conditions Amount of conservation farming equipment or low input farming, Pasture size	
-Financial capital	Trends in population living below the relative poverty line and/or income inequality in affected areas based on income/yields and savings (Gupta et al., 2010).	Percentage of the population living above the poverty line Labour income Savings in the form of livestock – herd size Yields per acre	
Transformative capacity			
-Institutions	Policies, rules, local norms; existing rules and regulations governing resources use and access.	Attributes of good governance Access to livestock services Access to market and private sector institutions Improvement in communication networks	
-Network structures	Networks are particularly important for economic development and resilience because they provide resources and information that are otherwise unavailable at an individual level. (Aldrich, 2012).	Access to communal natural resources Availability of formal safety nets in communities. Improvements in communication networks Bridging and linking social capital Membership in groups	
-Governance mechanism	How well governance systems are oriented to protecting the rights of different groups, for example, by recognizing the rights of pastoralists to manage communal rangeland (Béné et al., 2012).	Enhanced investments in good governance Governance units	
-Policies and regulation	Track policies and regulations for disaster resilience	Changes in land tenure policies Cross-border mobility of humans and livestock	

Source: Authors' compilation

6. Conclusion

This article provides a first attempt at understanding an indicators framework for measuring pastoralists' drought resilience. Since the science and practice of resilience is still in its infancy, incremental empirical developments such as these are necessary, first, to advance researchers' and practitioners' understanding of the multidimensional nature of resilience and its constituent parts, but, second and more importantly, to, provide metrics that are easily understood and applicable to the decision making process.

The proposed indicators could not only provide a useful way to examine the composite score for household resilience, but could also enable comparisons to be made between regions within the same ecological conditions. While national governments may be more interested in using the indicators to establish overall patterns and in looking for intervention strategies that improve the resilience across the entire region, county-level officials might be more interested in intervention opportunities at the local levels, and in examining county-level scores. By establishing baselines for resilience using these indicators, it becomes possible to monitor changes in resilience over time in particular places and to compare one place with another.

Conceptually, there is still a considerable amount of work to do on resilience indicators in terms of sensitivity to shocks and stresses within various contexts. Determining appropriate resilience indicators is not an end in itself; they are simply tools that can be used to define or point to more significant issue. Similarly, adoption of an indicator framework for the measurement of resilience is important in providing a comprehensive picture of the specific elements that contribute to resilience and clarifying the types of information that must be collected in order to measure it adequately. In conclusion, this framework provides a basis for an in-depth empirical analysis of resilience from a disaster perspective. Such a guiding framework has the potential to contribute to planning, monitoring and evaluation of projects and policies, including measures to adapt to extreme climate variability and change, and can thus positively influence the resilience outcomes of such interventions.

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