International Journal of Applied Research 2018; 4(3): 293-296

ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2018; 4(3): 293-296
www.allresearchjournal.com
Received: 11-01-2018
Accepted: 12-02-2018

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Review on concept of resilience to climate induced disasters and its contested measurement approach

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Abstract
Resilience has got a growing recognition in the areas of international development agendas because it is believed to be an important tool in addressing the multifaceted vulnerabilities of people. There are many definitions and conceptualizations of resilience. Such varied meanings of resilience also resulted lack of consensus on its measurement approaches. Despite the lack of consensus many used the traditional objective method while few employed the subjective assessment approach in the field of ecology, disaster management and food security. Given the relevance and the growing recognition of the concept of resilience, applying both approaches in a complementary way would result a better and holistic understanding of the issue under investigation.

Keywords: Resilience, resilience concept, ecology, disaster management

Introduction
The concepts of resilience become important in a changing environment where natural and manmade disasters continue to affect the lives of millions of people. Building resilience in places where people are vulnerable to shocks and at risk could imply a reduction of humanitarian intervention for future exposure to shocks [1]. Resilience is considered as vital tool that enable people to respond and adopt towards shocks better, hence it has got a growing recognition to the top of the development agenda [2]. Recently, international organizations such as Food and Agricultural Organization of the United Nations had incorporated the concept in their strategies. However, resilience within the context of disaster management is still in its early stage and its definition, framing and measurement is new in the literature. This created a varied conceptualization and measurement approaches. This review presents the growing conceptualization of resilience and explores the debate on the measurement approaches. It sheds light on the weaknesses and strengths of resilience measurement approaches. This review will contribute to the body of knowledge on resilience within the context of climate induced disasters agenda.

Conceptualizing resilience: Resilience has been defined in many ways depending on the contexts it is applied. Some authors documented the advancement of resilience discourse over time [1, 2]. The etymological meaning of the word resilience comes from the Latin word *resilire*, translated as "to rebound or recoil" [3].
In the 1960s and 1970s, resilience in the field of engineering has been defined as "the capacity of a material to absorb energy when it is deformed elastically and then, upon unloading to have this energy recovered" [4]. Resilience in the latter context was understood in relation with returning back to the previous situation or gaining back the prior status.
Soon after, ecologists started to use the term in relation with the issue of ecosystem dynamics around equilibrium. One of the most quoted definitions in the ecosystem literature is the one proposed by [5], where resilience is defined as "a measure of the ability of these [eco] systems to absorb changes of state variables, driving variables, and parameters, and still persist" [5]. To put it in a simple way, as [6], explains, resilience is the extent to which an ecosystem can withstand shocks and still maintain to function. Here the term was used in a narrow sense to depict two things: the speed of recovery from disturbance and the ability to return to a previous or to the original status.

For the latter case, some authors argued that a system may not necessarily return back to the same function or existence after a disturbance, as [7] describes the advancement of the term's meaning where the "resilience of complex adaptive systems is not simply about resistance to change and conservation of existing structures". Rather it is the potential for the possibility of successfully adapting to changed circumstances by paving the way for a new state. This is particularly important in situations where the original state may not be the preferred situation to return. For instance, the post-shock restoration of a household or a community to a food insecurity or poverty situation would not be desirable.

Then the concept of resilience began to gain its popularity in various fields such as disaster risk reduction, climate change and food security [8]. Particularly, in the last decade the scope of resilience has broadened its application to social and ecological systems [9, 10], focusing on concepts such as persistence, adaptability, and transformability which are taken as features of resilience [11, 7].

In a detailed manner, [7] stated that "resilience is no (longer) simply about resistance to change and conservation of existing structures (the engineering definition)" or even about "buffer capacity and (the ecological definition) persistence to change while maintaining the same function". Rather, it is viewed as an emergent idea that includes two more concepts which are the adaptive capacity of the system and the transformative capacity [8].

In [12] adaptive capacity refers to "the capacity to learn, combine experience and knowledge, adjust responses to changing external drivers and internal processes, and continue operating" [11]. defined the transformative component as the "capacity to create a fundamentally new system when ecological, economic, or social structures make the existing system untenable". In other words, resilience of a human system can be thought to comprise a range of different capacities: the capacity to bounce back after a shock, the capacity to adapt to a changing environment, and the transformative capacity of an enabling institutional environment [13]. These three concepts are considered as components of resilience in many studies which in turn clarify that resilience is a multidimensional concept.

Generally, apart from its varied conceptualization resilience has now become a central paradigm in dealing with issues such as climate change adaptation, disaster management and social protection [14].

Contrasting measurement approaches: The theoretical challenges of the resilience concept created inconsistencies in understanding resilience which in turn result absence of a uniform approach. The demand toward a standardized measure of resilience is ongoing. There is no agreed up on mechanism yet on its measurement [15]. Even, within a specific discipline such as resilience to climate extremes there is no clear consensus [16].

In spite of the resilience concept ambiguities, there exists a key distinction between its measurement approach, known as objective and subjective measures.

In most objective approaches, the resilience measurement begins by identifying resilience-related capacities (to absorb, adapt and transform) that are believed to be relevant to respond to a particularly identified shock [17]. Then objective indicators that represent physical, social, institutional and economic dimensions of resilience will be assigned. Finally, these dimensions will be merged to create a composite index.

While this approach has its own benefits, there are certain weaknesses. First, the selection of all indicators or variables that support people's livelihood in a specific-context is very challenging [18]. This is due to the fact that what resulted resilience in one society may not be the same for others. Second, setting objective-indicators that are assumed important by external experts is also value-laden and contested [19, 17]. Although in objective measurement approach experts are best placed to evaluate other people's lives, and have a better understanding of the factors that contribute to people's own resilience such top-down measure may not exactly reflect how people see themselves which may be harder to understand and measure [20]. In line with this, according to [21] resilience is not simply assessing tangible objective elements, such as the availability of various livelihood assets but also considering the wider socio-cultural and psychological elements.

Subjective resilience measurement is believed to offer an important advantage in terms of complementing traditional objective way of measurement. Given the multifaceted nature of resilience, the assessment may be done in a way that allows people to freely respond what they perceive about their situations. Although such kinds of data require considerable technical and human resources, it allows for rich subjective information to be gathered without dictating responses [22].

This approach is based on the notion that people have a good understanding of their own resilience which is referred as perceived resilience [23]. Accordingly, subjective forms of information are crucial to help answer questions about whether households or communities are resilient, but also why some are resilient and others are not. This information not only helps to reduce the uncertainty in selection indicators but also help to explain the attitudes, beliefs and cultural values that influence the decision-making processes. Moreover, measurement of objective resilience typically requires the collection and analysis of data across a large number of variables [18] while subjective assessment could be done using a limited number of questions that are further reduced using statistical techniques. This is particularly important where accurate and large socioeconomic datasets are inadequate.

There are some methodological weaknesses of subjective measurement approach. The most commonly cited concern is the validity of self-reported responses. This is because reports of subjective resilience are individual judgments and might be influenced by many contextual factors [20]. The same authors further explain that there are situations people tactically report to questions in their own self-interest. For instance, in areas where people rely on humanitarian assistance to meet their basic livelihood requirement, there is a possibility that they may intentionally choose to be considered vulnerable so as to sustain the assistance. Unlike objective approach, subjective measurement may also require a thorough understanding of the context and political economy of the surveyed area [20]. This is because, contrary to the above example, in a socially attached stigma with the living conditions, households may not want to be considered having low levels of resilience and deliberately respond as having higher level apart from the reality. These kinds of situations put the subjective measurement in question. Generally, despite the weaknesses and strengths in each

approach there are many studies that used the objective approach in measuring resilience [24, 32] while few others employ subjective analysis on the field [20, 33].

Conclusion: Resilience is understood and continues to be defined in different ways due to its multidimensionality. Hence, there is no one single definition that fits for all. The measurement approaches are not universal, both objective and subjective assessment techniques are used, which means measuring resilience is still not clear. However, there is a growing interest in incorporating resilience approach in many studies which shows its relevance in the field of disaster management.

Assessment of resilience at any level not only requires precise objective measurement but also subjective analysis of complex relationships related with the concept. Hence, mixed method approach works better to capture a more holistic understanding of what it takes to be resilient through examination of judgments as well as the measureable characteristics of socio-ecological systems.

Acknowledgement: The author is thankful to (Ministry of Education, Ethiopia) for sponsoring my scholarship and Department of Environmental Sciences, Andhra University, Visakhapatnam, India for providing this opportunity. This review is part of the doctoral thesis work of the author. All views and interpretations and conclusions expressed in this paper are those of the author and not necessarily those of the supporting institutions.

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