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Vulnerability

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Abstract

This paper reviews research traditions of vulnerability to environmental change and the challenges for present vulnerability research in integrating with the domains of resilience and adaptation. Vulnerability is the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt. Antecedent traditions include theories of vulnerability as entitlement failure and theories of hazard. Each of these areas has contributed to present formulations of vulnerability to environmental change as a characteristic of social-ecological systems linked to resilience. Research on vulnerability to the impacts of climate change spans all the antecedent and successor traditions. The challenges for vulnerability research are to develop robust and credible measures, to incorporate diverse methods that include perceptions of risk and vulnerability, and to incorporate governance research on the mechanisms that mediate vulnerability and promote adaptive action and resilience. These challenges are common to the domains of vulnerability, adaptation and resilience and form common ground for consilience and integration.

Keywords: Vulnerability; Disasters; Food insecurity; Hazards; Social-ecological systems; Surprise; Governance; Adaptation; Resilience

1. Introduction

The purpose of this article is to review existing knowledge on analytical approaches to vulnerability to environmental change in order to propose synergies between research on vulnerability and on resilience of social-ecological systems. The concept of vulnerability has been a powerful analytical tool for describing states of susceptibility to harm, powerlessness, and marginality of both physical and social systems, and for guiding normative analysis of actions to enhance well-being through reduction of risk. In this article, I argue that emerging insights into the resilience of social-ecological systems complement and can significantly add to a converging research agenda on the challenges faced by human environment interactions under stresses caused by global environmental and social change.

I review the precursors and the present emphases of vulnerability research. I argue that, following decades of vulnerability assessment that distinguished between process and outcome, much exciting current research emphasizes multiple stressors and multiple pathways of vulnerability. This current research can potentially contribute to emerging resilience science through methods and conceptualization of the stresses and processes that lead to threshold changes, particularly those involved in the social and institutional dynamics of social-ecological systems.

Part of the potential convergence and learning across vulnerability and resilience research comes from a consistent focus on social-ecological systems. The concept of a social-ecological system reflects the idea that human action and social structures are integral to nature and hence any distinction between social and natural systems is arbitrary. Clearly natural systems refer to biological and biophysical processes while social systems are made up of rules and institutions that mediate human use of resources as well as systems of knowledge and ethics that interpret natural systems from a human perspective (Berkes and Folke, 1998). In the context of these social-ecological systems, 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-organise and the

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capacity for adaptation to emerging circumstances (e.g. Carpenter et al., 2001; Berkes et al., 2003; Folke, 2006).

Vulnerability, by contrast, is usually portrayed in negative terms as the susceptibility to be harmed. The central idea of the often-cited IPCC definition (McCarthy et al., 2001) is that vulnerability is degree to which a system is susceptible to and is unable to cope with adverse effects (of climate change). In all formulations, the key parameters of vulnerability are the stress to which a system is exposed, its sensitivity, and its adaptive capacity. Thus, vulnerability research and resilience research have common elements of interest—the shocks and stresses experienced by the social-ecological system, the response of the system, and the capacity for adaptive action. The points of convergence are more numerous and more fundamental than the points of divergence.

The different formulations of research needs, research methods, and normative implications of resilience and vulnerability research stem from, I believe, the formulation of the objectives of study (or the system) in each case. As Berkes and Folke (1998, p. 9) point out, 'there is no single universally accepted way of formulating the linkages between human and natural systems'. Other areas of research in the human–environment interaction (such as common property, ecological economics or adaptive management) conceptualize social-ecological linkages in different ways. The common property resource tradition, for example, stresses the importance of social, political and economic organizations in social-ecological systems, with institutions as mediating factors that govern the relationship between social systems and ecosystems on which they depend (Dolšak and Ostrom, 2003). Ecological economics, by contrast, links social and natural systems through analysis of the interactions and substitutability of natural capital with other forms of capital (human, social and physical) (e.g. the 'containing and sustaining ecosystem' idea of Daly and Farley, 2004). Adaptive management, by contrast, deals with the unpredictable interactions between humans and ecosystems that evolve together—it is the science of explaining how social and natural systems learn through experimentation (Berkes and Folke, 1998). All of these other traditions (and both vulnerability and resilience research in effect) seek to elaborate the nature of social-ecological systems while using theories with explanatory power for particular dimensions of human–environment interactions.

Evolving insights into the vulnerability of social-ecological systems show that vulnerability is influenced by the build up or erosion of the elements of social-ecological resilience. These are the ability to absorb the shocks, the autonomy of self-organisation and the ability to adapt both in advance and in reaction to shocks. The impacts and recovery from Asian tsunami of 2004, or the ability of small islands to cope with weather-related extremes, for example, demonstrate how discrete events in nature expose underlying vulnerability and push systems into new domains where resilience may be reduced (Adger et al., 2005b). In a world of global change, such discrete events are becoming more common. Indeed, risk and perturbation in many ways define and constitute the landscape of decision-making for social-ecological systems.

I proceed by examining the traditions within vulnerability research including the fields of disasters research (delineated into human ecology, hazards, and the 'Pressure and Release' model) and research on entitlements. This discussion is complementary to other reviews that discern trends and strategies for useful and analytically powerful vulnerability research. Eakin and Luers (2006), Bankoff et al. (2004), Pelling (2003), Füssel and Klein (2006), Cutter (2003), Ionescu et al. (2005) and Kasperson et al. (2005), for example, present significant reviews of the evolution and present application of vulnerability tools and methods across resource management, social change and urbanization and climate change. These build on earlier elaborations by Liverman (1990), Dow (1992), Ribot et al. (1996), and others (see the paper by Janssen et al. (2006) for an evaluation of the seminal articles).

Elements of disasters and entitlements theories have contributed to current use of vulnerability in the analysis of social-ecological systems and in sustainable livelihoods research. Livelihoods research remains, I argue, firmly rooted in social systems rather than integrative of risks across social-ecological systems. All these traditions and approaches are found in applications of vulnerability in the context of climate change. The remaining sections of the paper examine methodological developments and challenges to human dimensions research, particularly on measurement of vulnerability, dealing with perceptions of risk, and issues of governance. The paper demonstrates that these challenges are common to the fields of vulnerability, adaptation and resilience and hence point to common ground for learning between presently disparate traditions and communities.

2. Evolution of approaches to vulnerability

2.1. Antecedents: hazards and entitlements

A number of traditions and disciplines, from economics and anthropology to psychology and engineering, use the term vulnerability. It is only in the area of human–environment relationships that vulnerability has common, though contested, meaning. Human geography and human ecology have, in particular, theorized vulnerability to environmental change. Both of these disciplines have made contributions to present understanding of social-ecological systems, while related insights into entitlements grounded vulnerability analysis in theories of social change and decision-making. In this section, I argue that all these disciplines traditions continue to contribute to emerging methods and concepts around social-ecological systems and their inherent and dynamic vulnerability.

While there are differences in approaches, there are many commonalities in vulnerability research in the