

PREVIOUS RESEARCH

The multidisciplinary nature of vulnerability analysis is reflected in the number of literatures that are relevant:

- Vulnerability to climate change
- Adaptation to climate change
- Impacts of climate change
- Natural hazards and responses, especially related to drought, storms, and floods
- Social indicators
- Sustainability.

Findings from research in all these areas contribute to understanding the scope of the problem, the environmental factors that condition adaptive capacity, the human factors that determine adaptive capacity, and various candidate methods for measuring these factors.

Vulnerability, Adaptation, and Impact Research

Much of the literature on adaptation and vulnerability is in the form of case studies.¹ This literature provides richly detailed information on how societies adapt (or fail to adapt) to climatic change and events such as droughts and floods. Smith et al. (1996) focus on managing adaptive change, using theoretical frameworks and sectoral information. Ribot et al. (1996) provide detailed case studies of semi-arid tropical regions, while the case studies in Kaspersen et al. (1995) analyze empirical data to determine whether regions such as Amazonia and the Aral Sea basin meet their definition of “critical environmental regions.” Single case studies include the US drought of 1987-98 (Riebsame et al. 1991), destruction of mangroves in Vietnam (Kelly and Adger 1999), drought in China (Chen 1991), the urban heat island (Changnon 1981), sea level rise (Nicholls and Leatherman, 1995), and many others. Collectively, the case studies provide a benchmark with which to corroborate quantitative assessments of adaptive capacity.

Chambers (1989), summarizing case studies in vulnerability, coping, and policy, asserts that vulnerability is increasing in less industrialized countries because of a decline in patron-client obligations (except South India), decline in the support of an extended family, the rising costs of social events such as weddings, and the localized sale of the means of livelihood. The main asset of most poor people is their bodies, so health, especially of the breadwinner, is a crucial issue for all members of households.

Downing's work on vulnerability recognizes the multivariate nature of societal vulnerability as including social, economic, and political structures. Causes of vulnerability may be remote from the site where people are experiencing climate-related impacts. Bohle et al. (1994) frames a causal structure including the human ecology of production, expanded entitlements in market exchanges, and political economy. Poor people depend on others, e.g., informal markets, international aid. Alternative models of

¹ Other techniques used in vulnerability studies include historical narratives, contextual analyses, statistical analyses, and GIS and mapping techniques.

causality are the pressure and release (PAR) model, which focuses on the intersection between exposure and a hazard or disaster event, and the access to resources model, which locates root causes in political and economic forces (Blaikie et al. 1994).

The Intergovernmental Panel on Climate Change (IPCC) established a methodology (IPCC 1991) that included response strategies, focusing on potential sea level rise (see also Bijlsma et al. 1996). Nicholls et al. (1995) assigned two sets of costs: for protection of important areas and for total protection.

The World Coast Conference aggregated case studies to measure vulnerability (WCC 1994), again used primarily to assess vulnerability of countries to sea level rise. The results show a wide range of vulnerabilities among 30 countries and 8 localities in five categories (Rahman and Huq 1998, Nicholls 1995): people affected, people at risk, capital value at risk of loss, land at risk of loss, and wetlands at risk of loss. Thus Kiribati and the Marshall Islands are estimated to have 100% of their people affected, Uruguay less than 1%. In a subsequent study of 10 countries (Nicholls and Leatherman 1995), Bangladesh, Senegal, Nigeria, and Egypt appeared most vulnerable (Rahman and Huq 1998).

Particularly interesting for conceptual purposes are studies that consider ecosystems and human institutions together. Berkes and Folke (1997), for example, stress the importance of a systems approach and adaptive management, emphasizing institutions and property rights. They list socio-ecological practices and mechanisms for resilience and sustainability, including protection of species and habitat, restrictions on harvest, multiple species management, and nurture of sources of ecosystem renewal (Berkes and Folke, 1997:418). Folke et al. (1998) locate resource management problems in a failure of fit between the temporal and spatial scales of the institutions that are responsible for management and the ecosystems to be managed; i.e., an institution that must try to manage part of a watershed and report yearly are too narrowly focused to provide long-term resilience in the whole watershed. Ribot et al. (1996) discuss the semiarid tropics as cases of social vulnerability, which is “configured by the mutually constituted triad of entitlements, empowerment and political economy” (Ribot, 1996:3).

Natural Hazards and Responses

The literature on natural hazards exhibits a mix of focal points, very often emphasizing the environmental vulnerabilities of specific places as the starting place for discussing societal and governmental responses. Buckland (1997), for example, discusses rainfall in Zimbabwe and yields of agricultural crops (maize hybrids and sorghum). The study locates causes of drought impacts in highly variable yields, population pressures and consequent overfarming, and increased numbers of livestock. Rook (1997), on the other hand, details the relationship between foreknowledge of the 1991-1992 southern African drought and its consequences. In this case, early discussions with donors and timely deliveries prevented disaster.

Burton et al. (1993) characterize the responses to hazardous events as loss acceptance, loss reduction (either control of the event or reduction in vulnerability), changes in

resource use, migration, or some combination. Poor societies may have a high capacity to adapt through traditional bearing or sharing of losses. Modern industrial countries share losses with the wider society through relief or insurance programs and by technological fixes.

Much research, mostly case studies, has been done on how the poor adapt to climate or weather hazards. Chen's (1991:108) narrative of a drought-affected village in India contains a good summary of the coping strategies of the poor: "growing a mix of crops and/or rearing a variety of livestock, entering the labour and tenancy (sharecropping) markets as needed, drawing down stored goods or fixed assets, adjusting consumption, borrowing, using common property resources, migrating (seasonal), and drawing upon traditional social security arrangements." One measure of vulnerability that can be used is the number of income- or food-generating strategies that are available to households in an affected society.

Work such as Chen's is rooted in Sen's (1981) analysis of poverty and famines and his theory of entitlements. Sen makes an important distinction between what exists and who can command what is there. The amount of food is unimportant compared to who has access to it.

Riebsame et al. (1991), in their study of the 1987-1989 drought in the United States, inventory some vulnerability-reducing strategies available to wealthy nations: building and enlarging reservoirs, improving water systems with public funds, changing farm policies, establishing new insurance and aid programs, and taking sensitive lands out of food production. Even so, there were hardships because accurate information was not available or not used, and emerging plans were lacking or out of date.

Research into societal responses to drought, flooding, and extreme weather events provides partial analogues to both capacity to deal with climate change and with its likely negative manifestations. It is well established that climate variability or change factors alone are insufficient to predict whether societies will decline or flourish (see, e.g., Glantz 1988, Meyer et al. 1998); what societies do in response to change determines their well-being. Concluding that people died/fluoresced/migrated/intensified because climate changed simply affirm the consequent. More valid analysis would ask, for example, "It did get cold and they did die out, but why?" "Intervening between the physical events and the social consequences is the vulnerability of the society and its different groups, activities, and individual members" (Meyer et al. 1998:238).

Sustainability

Banuri et al. (1994:7) enlarge on the Brundtland definition of sustainability by adding the formation of social capital and equity: "Sustainable human development, therefore, can be defined as *the enlargement of people's choices and capabilities through the formation of social capital so as to meeting as equitably as possible the needs of current generations without compromising the needs of future ones.*" Such a definition has clear implications for vulnerability, in that social capital is key to building resilience. Sustainable development projects, in this view, will be effective only if they are locally

designed and controlled, open and participatory, inspirational, and catalytic. Musters et al. (1998) characterize sustainable development as entailing “a permanent political discussion” in which people must choose carefully what to control and how to control. Describing all the valuable features of a socio-environmental system requires detailing both structures and functions, i.e., tables and maps.

Environmental and Social Indicators

Considerable attention has recently been devoted to development of indicators of sustainable development. This work has been conducted in both political and research contexts and was motivated by the conclusion that “commonly used indicators such as GNP and measurement of individual source or pollution flows do not provide adequate indications of sustainability” (Chapter 40 of Agenda 21). The United Nations Commission on Sustainable Development (UNCSD) sought to coordinate a process that reached consensus on a set of indicators that reflected the many concerns encompassed by sustainable development and that could be used and incorporated in internationally comparable reports and databases. The process led to development of a number of different analytical frameworks for indicators of sustainable development. These include approaches that focus on environmental media (e.g., air, water, land, living resources); “goals” (indicators selected according to legal and administrative mandates); “sectors” (indicators of environmental impact from the perspective of economic sectors – transportation, industry, agriculture, etc.); and “thresholds” (warning or “precautionary” indicators which warn when a critical threshold is exceeded). Across these approaches, a “Driving Force-State-Response” (DSR) model was adopted by the UNCSD that considers the state of components of the human system, the state of the environment, and potential policy or societal responses to reduce forcing of undesirable environmental change (Mortensen, 1997). These indicators do not consider the effects of environmental change on human activities.

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