

Vulnerability assessment and sustainable development

Recognition of the trends discussed above has focused attention on sustainable development. In particular, growing awareness of the negative and irreversible impacts of past development gains on the world's ecosystems has raised the specter of spiraling and expanding vulnerability that can be neither controlled nor contained. As a recent publication of the World Bank puts it, "Accelerated changes in demographic and economic trends have disturbed the balance between ecosystems, increasing the risk of human suffering, death, and destruction" (Kreimer and Munasinghe 1990, p. 3). Not only has the number of disasters risen over recent decades (that is, events with negative consequences on humans), but even more striking is the fact that the number of extreme weather events (whether or not they have had an impact on human societies) has also risen "about 50 percent on average each decade between 1900 and 1990, accelerating significantly since 1950" (Kreimer and Munasinghe 1990, p. 3).

The evidence of perturbations in the environment and ecosystems is strong. While debates continue within the scientific community regarding the actual changes that have occurred or are occurring in nature, most who study these issues agree that human-caused environmental degradation *probably* has had significant long-term impacts. As the leadership of the Scientific and Technical Committee of the IDNDR notes, "The increasingly realistic mathematical models of global climate tend to suggest a more hazardous world in the future" (Bruce 1993, p. 3). And, the point is widely accepted that sustainable development strategies must directly address the ways in which economic progress affects vulnerability.

Important, also, of course, are the effects of vulnerability on economic progress and, particularly, on the sustainability of that progress. One point of interaction discussed above is that human actions continue to undermine the environment. Significant damaging actions are undertaken by vulnerable populations who see no options for survival except to continue their (harmful to the environment) practices. Patterns of marginal living—in agriculture, in herding, in fishing, in forestry, that is, in the range of human activities undertaken to derive a livelihood directly from nature—often deplete the resources on which survival depends. This is increasingly true as population pressures mount.

Two additional points about the impact of vulnerability on the prospects for sustainable development should be made. Cumulatively, environmental degradation has produced a group of environmental refugees who comprise "the single largest class of displaced persons in the world" (Jacobson 1988, p. 37). These trends are likely to worsen over the next few decades and will, themselves, add to the pressures exerted on the environment of the regions to which they flee and undermine the chances of achieving sustainable development in those regions. Finally, current government-sponsored development efforts in many countries reinforce the tendencies toward future environmental depletion in an attempt to meet citizens' immediate needs for food, jobs, housing sites, and so forth. Short-term strategies undertaken in the name of development contribute to long-term hazards and reinforce the negative impact of vulnerability on the prospects for sustainable development.

However, because high and increasing vulnerability undermines the pursuit of sustainable economic strategies, reducing vulnerability and making progress in

sustainable development are mutually reinforcing. The linkage of the two may work either positively or negatively. Sustainable development is not possible without an explicit component that reduces vulnerability, and vulnerability will never truly be reduced until approaches to development are altered to meet the sustainability criteria now under discussion.

The characteristics of vulnerability

Above, we reviewed the growing understanding of disaster vulnerability gained through decades of experience with disaster response, and we discussed and identified the ways in which efforts to improve human life through development have been linked with trends toward increasing vulnerability. We further noted the interaction and mutual reinforcement of vulnerability reduction and sustainable development. With this background, we can identify five characteristics of vulnerability that must be understood and reflected in any vulnerability assessment framework. These characteristics are at the heart of the nexus of past development, increasing vulnerability, and future sustainable development. Specifically, vulnerability is complex, dynamic, cumulative, sometimes irreversible, and frequently impossible to contain.

Vulnerability is complex

It is not necessary to reiterate the myriad factors that together constitute and shape vulnerability, yet the starting point for assessing vulnerability must be to acknowledge that it is complex and affected by multiple factors. While always complex, however, vulnerability is shaped by different factors in different settings. That is, vulnerability is specific to a particular location, group, and circumstance.

Vulnerability is dynamic

Vulnerability is the product of interactions between natural and environmental forces and human, social, and political constructs. Because these are always changing in and of themselves and because they force corresponding changes through their interrelatedness, vulnerability is never static. Vulnerability assessments must, therefore, contain some system for noting and recording the direction and magnitude of change that is occurring.

Vulnerability is compounding and cumulative

Vulnerability is a self-compounding and cumulative phenomenon. Quite often, when people are vulnerable to and experience one disaster, they are left more vulnerable to subsequent hazards. If their resources are destroyed, if the assistance they receive promotes dependency, if their families or other social systems are undermined, they have less resilience for facing future hazards (Anderson and Woodrow 1989). Of course, disaster educators hope to see the reverse. That is, if people suffer once from their vulnerability, it is hoped that they will be motivated to undertake hazard preparedness and mitigation efforts that will reduce their vulnerability in the future. Too often, however, especially among poor and marginalized groups, vulnerability accumulates and compounds.

In addition to undermining economic reserves and personal confidence, vulnerability is additionally self-compounding in that one type of vulnerability, such as poverty, is often related to other types, such as poor health or lack of education. In this sense, too, people who are vulnerable in one aspect of their lives tend to be vulnerable in others.

Vulnerability is sometimes irreversible

Because depletion or extinction of the elements in the natural resource base lies at the heart of current vulnerabilities, sometimes these losses pose all the more serious threats because they are irreversible. That is, as resource use or effluent production approaches irreversibility in nature, vulnerability derived from them increases (Schramm and Warford 1989, pp. 11–12).

Vulnerability frequently has no borders and cannot be contained

Increasingly, also, environmentally based hazards (and vulnerability to them) are without borders or containment. Loss of the ozone layer, nuclear exposure due to accident, chemical poisoning, and so forth move with the winds and waters and atmosphere, so that the exposure to them (and resultant vulnerability) is separated from causation and is random and encompassing rather than controlled and limited.

It remains, now, to join these five characteristics of vulnerability to previously developed aspects of vulnerability assessment in a framework that communities and nations can use to analyze the sources of their vulnerability, to assess its seriousness, and to devise appropriate programmatic responses to reduce or eliminate it.

A vulnerability assessment framework

A vulnerability assessment framework must be simple enough to be useful but complex enough to capture reality. No framework can supplant thought or substitute for intelligence. As a tool, a framework can provide a schema for (1) ensuring that all factors considered critical for

understanding are included in an assessment and for (2) picturing—and, thus, reminding us of the importance of—the relationships among these factors. It cannot, itself, make judgments or structure actions to be undertaken. It can be used by skilled, knowledgeable, and thoughtful people to help them do so.

Our framework has four steps. There is nothing surprising about these, because they reflect precisely the learning cataloged above.

Step 1: What? Identifying hazards

Scientific and technical information about the likelihood or probability of the occurrence and the magnitude, frequency, scope, and duration of hazards should be incorporated into this step. However, two categories of hazard must be considered. Technical and systems-based hazards must be included in addition to the so-called natural hazards of wind, water, earth, and fire. These include fuel, chemical, and nuclear accidents; breakdowns and disruptions in information, communication, and transport systems on which societies depend; and other dangerous perturbations that grow out of the production and distribution techniques of human societies.

This step can be pictured in the simple matrix shown below.

<i>What?</i>	<i>Probability</i>	<i>Magnitude</i>	<i>Frequency</i>	<i>Scope</i>	<i>Duration</i>
<i>Natural hazards</i>					
<i>Human systems-based hazards</i>					

Step 2: Who? Identifying exposure

Following the early vulnerability assessments, we acknowledge the importance of identifying the individu-

als, groups, and communities that are most exposed to any given hazard. This aspect of the assessment must take into account more than mere proximity, however. It must include any of the physical, geographical, economic, social, political, or psychological factors that cause some people to be particularly exposed to the dangers of any given hazard while others are, because of any of these factors, relatively protected. In some cases, because societies are connected to one another through environment, markets, and political systems, exposure is comprehensive and borderless. However, even though everyone has the potential to suffer from a borderless hazard, factors of wealth, reserve resources, options, and the like mean that different groups have differential risks. This step should consider all of these factors.

The matrix below depicts this step.

Who: Individual <—> Community <—> World

Factors	Exposure	Capacity to withstand
Proximity		
Economic class		
Social status		
Political status		
Psychological condition		

Step 3: Why? Identifying the complex sources of the hazard

This step incorporates the complexity and interrelatedness of natural, social, and developmental factors. Essential to assessing the impacts of hazards—to getting a complete picture of vulnerability—is analyzing why a particular hazard exists, why certain groups are more exposed to it than other groups, and whose actions, choices, or decisions were involved in creating it and why. Vulnerability is greater when the causes of hazards are

deeply embedded in social and political or economic structures that are difficult to alter or reverse; when exposure to the hazard arises from deep-seated social and political structures for which we have no ready remedies; or when the decisionmakers and action-takers who help to “create” the hazard are powerful, removed from its consequences, and have little motivation to change their behavior or are powerless and poor and have few options other than to contribute to and exacerbate the hazard.

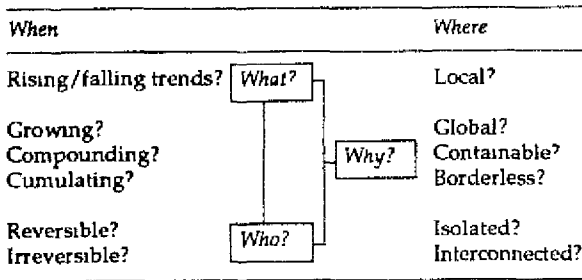
The diagram below depicts the major factors to be considered in asking why a particular hazard occurred and why a particular group was exposed.

Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
History What happened to make vulnerability high?	Who was involved in the decisions and choices?	What are their economic, social, and psychological characteristics?	Who is most affected by the decisions and choices?	What are their economic, social, and psychological characteristics?

Step 4: Time and space dimensions

Finally, the fourth step of vulnerability assessment takes account of the dynamic change and interrelatedness of factors that affect vulnerability. Included here are considerations of trends over time (increasing or decreasing? simple growth or compounding, cumulative growth? reversible or irreversible?) and over space (local or global? containable or borderless? isolated or interconnected?). Vulnerabilities that are growing, cumulating, tending toward irreversibility, and expanding through their interconnectedness without being containable within borders clearly pose far more serious problems and demand more immediate attention than those that exhibit the opposite characteristics. Assessment of vulnerability is incomplete without this step.

The fact that this step sets the broad context for the other three steps is illustrated in the diagram below.



As successive steps of the assessment framework incorporate the more immeasurable factors that require judgments based on values and the weighing of competing social, political, and economic goods, some people may become increasingly uncomfortable with the tool. Nonetheless, the importance of all of these factors is compelling. Their incorporation is neither utopian nor frivolous. They are essential aspects of the disaster vulnerability equation.

Additionally, although imprecise in the quantitative sense, all of these factors are increasingly evident and indisputable to researchers and policymakers alike. A broad review of the literature on vulnerability shows that these themes emerge time and again and that both research scholars and practical technicians cross traditional disciplinary boundaries and acknowledge even more complex factors as they seek to understand how and why vulnerability occurs.

Serious and humane motivations underlie efforts to expand the definition of vulnerability. The future of human life and of human social and political systems depends, to some large extent, on our ability to reduce our vulnerability to hazards, especially the vulnerability that is differentially experienced across social groups, and to pursue new approaches to development that ensure lasting, sustainable security and welfare.

Notes

1. In fact, we believe that solutions do exist, but they are not to be sought only in the scientific or technological spheres. Solutions will come, if they come at all and in time to reverse vulnerability, also from the spheres of social science—politics, communication, education, negotiation—that support effective decisionmaking and policy reform.
2. A billion is 1,000 million.

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