

Risk, Hazard, and Disaster

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Abstract

Natural hazard research began as a study of cultural perceptions to extreme naturally occurring events. Since the advent of the study, natural hazard literature has become steeped in terminology that is sometimes confusing to the reader. The concepts of *hazard, risk, and disaster* are often confused with one another and with the extreme event itself. Although the extreme event is inherent in hazard, risk, and disaster terminology, it is not synonymous with the terminology.

The concepts of hazard, risk, and disaster are a function of individual and/or cultural perceptions and what a particular individual and/or culture values. Because extreme naturally occurring events are ubiquitous, the terminology is variable on differing perceptions of the event.

1.1 Introduction: Background in Terminology

Although naturally occurring events have profoundly affected societies from the earliest recordings of man, significant interest and research of natural hazards and disasters has been a fairly recent endeavor. Beginning with Gilbert White, modern hazard analysis commenced in the 1930's. The popularity of "hazard-related research" grew and by the 1970's White and others had developed a field of study that provoked scientists from around the globe to further develop a model for natural hazards (Smith, 1996, pp. 3-4).

The development of such a model has not been such a simple process, mainly because it has become tangled in its own terminology. One may find that any scientific model for natural hazards is steeped with the terms "hazard, risk, and disaster." Because these terms are casually used in everyday vernacular, their meanings lack precision; not to mention that translated into different languages the terms take on an even broader range of definitions (Varnes, 1984, pp. 10). Authors of various hazard-related textbooks attempt to define the terminology, but similar to the human fingerprint each author's definitions are unique. One author may provide a definition for risk, where another author uses the same definition for hazard.

An attempt to alleviate confusion in the terminology was made in 1982 when UNDRO (United Nations Disaster Relief Co-ordinator) delineated the term hazard from risk with definitions that were meant to be applied universally. The nature of UNDRO's definitions proved to be less than ubiquitous as authors in the 1990's are still compelled to provide their own definitions for the seemingly simple yet difficult terms 'hazard, risk, and disaster.'

Maybe it is too arduous to apply universal meanings to the terminology and concepts of natural hazard studies, and it is up to the individual to assign his/her own definitions based on his/her perceptions. After all, that is how Burton, Kates, and White sought to pioneer the study of natural hazards; by comparatively analyzing the perceptions of various individuals and cultures to extreme natural events (White, 1974, pp. 3-4).

The following sections consist of documented definitions of the term's hazard, risk, and disaster, and a discussion of their validity. In discussing these terms, where does one begin? David Alexander (1993, pp. 7) perceives the sequence for an extreme natural event as being: Hazard – Risk – Disaster. Because the study of natural hazards revolves around the extreme natural event itself, it is important to establish where the 'event' fits into the terminology. I am going to begin with the term hazard because some authors imply that the 'event' and the 'hazard' are synonymous.

2.1 Hazard

Before defining the term hazard, the concept of an 'extreme event' should be realized. Simply stated, an extreme event is "any event in a geophysical system displaying relatively high variance from the mean" (White, 1974). Although Gilbert White does not include the concept of hazard in the definition of an extreme event, some authors have:

"A hazard is a perceived natural event which threatens both life and property" (Whittow, 1979).

"Hazard is best viewed as a naturally occurring or human-induced process or event with the potential to create loss, i.e. a general source of danger" (Smith, 1996, pp. 5).

American Geological Institute writes, "A naturally occurring or man-made geologic condition or phenomenon that presents a risk or is a potential danger to life or property" (Alexander, 1993, pp. 7).

Is a hazard a naturally occurring event or phenomenon? Perry Rahn (1986, pp. 489) would answer 'NO' to this question because "there is a distinction between an event, a hazard, and a disaster. A natural event, whether geological, climatological, etc., is simply a natural occurrence," whereas "a hazard, geological or otherwise, is the potential danger to human life or property." In other words, if an event takes place in an uninhabited region there is no potential threat to humans and therefore the event cannot be a hazard. While Rahn provides clear justification that the concepts event and hazard are not synonymous, it is important to recognize that they are not mutually exclusive. Because extreme events do occur in regions occupied by humans, there is an inherent relationship between an event and a hazard (White, 1974). Most authors agree that the definition of a hazard has to include an interaction between humans and an event:

"A condition or situation which has the potential to create harm to people, property, or the environment" (IPENZ, 1983).

“A potential loss that can cause human, social, environmental or economic harm” (Gardenier, 1992).

“A potential threat to humans and their welfare” (Smith, 1992).

“A geologic hazard is a phenomenon associated with geologic processes that can produce a disaster when a critical threshold is exceeded and can result in significant loss in life or property” (Coates, 1981, pp. 257).

“The hazard involves the human population placing itself at risk from geophysical events” (Alexander, 1993, pp. 4).

Although these authors explicitly highlight the relationship between a hazard and a region inhabited by humans, they have omitted a factor that is vital to the hazard definition. None of these definitions include the importance of the distinct individual or cultural perception that makes the concept of hazard unique for different regions of the world. In doing so, they have somewhat ignored the original efforts of White, Kates, and Burton to create a hazard model that measured “the interaction of people and nature” (White, 1974).

In 1967, efforts in defining a hazard with respect to floods grew in scope. White, Kates, and Burton implemented a “collaborative program of research which attempted to explore the applicability of findings from the flood studies to other geophysical hazards and to investigate the interaction of social and natural systems in a variety of environments and cultures beyond those that had thus far been covered in North America” (White 1974). From their comparative studies of cultures they found that a hazard is a function of an individual or group of individuals’ perception to an extreme geophysical event. Because different cultures perceive and therefore classify extreme events with differing degrees, their adjustments to these events are not universal. The “adjustment of the human use system” is controlled by cultural perception based on what individuals’ value (White, 1974). The following table outlines the characteristics of a hazard that White, Kates, and Burton (1978, pp. 22-24) found to be relevant to cultural perceptions (Lischka, 1983).

Hazard Characteristic	Definition
Magnitude	Only those occurrences that exceed some common level of magnitude are extreme.
Frequency	How often an event of a given magnitude may be expected to occur in the long-run average.
Duration	The length of time over which a hazardous event persists, the onset to peak period.
Areal Extent	The space covered by the hazardous event.
Speed of Onset	The length of time between the first appearance of an event and its peak.
Spatial Dispersion	The pattern of distribution over the space in which its impacts can occur.
Temporal Spacing	The sequencing of events, ranging along a continuum from random to periodic.

Table 2.1 Definitions of Hazard Characteristics

Although Gilbert Whites' work was pioneering, his definition for hazard can be complicated for the reader. White (1974) defines a hazard as "an interaction of people and nature governed by the co-existent state of adjustment of the human use system and the state of nature in the natural events system." I prefer the similar yet simpler definition that David Chapman (1994, pp. 1-3) created:

A hazard is "an interaction between a system of human resource management and an extreme or rare natural phenomenon, which may be geophysical, atmospheric or biological in origin, greatly exceeding normal human expectations in terms of its magnitude or frequency, and causing a major human hardship with significant material damage to infrastructure and/or loss of life or disease."

Chapman's definition is easy to comprehend, does not treat 'hazard' and 'event' as synonyms yet does not give them exclusivity, and implies a sense of cultural perception. The only change I would make to the definition is explicitly point out the variability of the hazard concept based on cultural perceptions of what people value:

Hazard /'haz_d/ n. \ an interaction between humans and an extreme natural event with respect to cultural perceptions and value systems.

2.2 Risk

The concept of risk is often confused with hazard. Part of the confusion can be attributed to translational origins. Varnes (1984) writes, "In particular, our French

colleagues advise that the French word 'risque', as used in the current ZERMOS programmed of landslide hazard zonation, is equivalent to the English word 'hazard' as used for the occurrence of an event rather than consequent damage or loss." Varnes' example is a linguistic problem that exists within any widespread study or discipline and probably plays a minor role in the confusion between risk and hazard. The confusion exists because "the usage of terms by writers of English is varied" (Varnes, 1984). For example, Smith (1996) defines risk as "the probability of hazard occurrence, while Varnes (1984) defines hazard as "probability of occurrence of a potentially damaging phenomenon." These two definitions are virtually identical and reflect an uncertainty in the terminology, leaving one to ponder whether risk and hazard are two different words for the same concept.

Okrent (1980) distinguishes between risk and hazard with his analogy of "two people crossing an ocean, one in a liner and the other in a rowing boat. The main hazard (deep water and large waves) is the same in both cases but the risk (probability of drowning) is very much greater for the person in the rowing boat. Thus, while an earthquake hazard can exist in an uninhabited region, an earthquake risk can occur only in an area where people and their possessions exist." (Smith, 1996). It is clear in the ocean liner/rowing boat analogy that hazard and risk are distinguishable concepts, but the earthquake example deviates from the analogy. As previously stated in Section 2.1, a hazard cannot exist in an 'uninhabited region' because a hazard involves the interaction of people and nature. Therefore, in the earthquake example, the hazard should involve severe ground shaking and/or ground rupture in a populated region, whereas the risk should refer to the probability of people and/or their possessions being destroyed by the collapse of a building. For someone living in a fortified building and someone living in a dilapidated shack the earthquake hazard is the same, but the risk is much greater for the person in the shack.

In both the ocean liner/rowing boat analogy and the adjusted earthquake example, the concept of risk is a function of probability or chance. Further, the relationship between risk and probability in the literature is pervasive:

Einstein (1988) defines risk as the probability of an event multiplied by the consequences if the event occurs.

IPENZ(1983) defines risk as "the probability that a potential hazard will be realized and the probability of the harm itself."

Chapman (1994) writes, "risk is a function of the probability of the specified natural hazard event and vulnerability of cultural entities.

Smith (1992) simply states that risk is "the probability of hazard occurrence."

UNDRO (1982) provides a quantitative definition for risk by multiplying the probability of a hazard occurrence (H) by the vulnerability (V) by the social elements (E), thus $R_t = (E) (H.V)$ (Alexander, 1993, pp. 7)

Either directly or indirectly the definitions for risk are unanimously a combination of probability and loss, but perhaps the UNDRO (1982) and Chapman (1994) definitions push the concept of risk further by taking into account the vulnerability of a particular population. As stated previously in Section 2.1, cultures vary in their perception of extreme events and what they value in life. It is the perception of value and therefore the adjustment to an extreme event that makes vulnerability variable from culture to culture. As a result, UNDRO's definition of risk can vary with different degrees of vulnerability.

A thorough definition of risk must include the probability of loss and recognizes that degrees of vulnerability change with what people value:

Risk /risk/ n.\ an assessment of what a particular group of people value and the probability of losing what they value as the result of a hazard.

My definition is not too dissimilar to Keith Smith's (1996) definition: "Risk is the actual exposure of something of human value to a hazard and is often regarded as the combination of probability and loss."

2.3 Disaster

A disaster is also sometimes confused with an extreme event. Similar to the concept of hazard, a disaster has to occur in a region inhabited by people. One could therefore reason that an extreme event and a disaster are not synonymous, but an extreme event is inherent in a disaster.

Most authors give the same meaning for disaster. Rahn (1986), Smith(1996), and Whittow (1979) agree that a disaster occurs when "the hazard is realized." The problem with this definition is it assumes that hazard is a universal concept with little variation. From section 2.1, we know that the definition of hazard is dependent on various cultural perceptions to an extreme event. Therefore the concept of disaster must take into account cultural perceptions. Smith (1996) offers a broader definition for disaster that implies a sense of perception. He writes, "a disaster generally results from the interaction, in time and space, between the physical exposure to a hazardous process and a vulnerable human population." As previously stated in section 2.2, vulnerability is a function of what people value and consequently affects their perceptions.

The inclusion of vulnerability in Smith's disaster definition not only implies a cultural perception but it also suggests that risk, as well as hazard, must be realized. If the probability of loss must become a reality for a disaster to take place, what magnitude of loss equates to a disaster (Alexander, 1993)? The ambiguity of the disaster concept lies within this question. As Keith Smith says "there is no universal agreed definition of the scale on which loss has to occur in order to qualify as a disaster." In other words, the definition of disaster is unique to different cultures and their perceptions of loss:

Disaster /di`za:st_/ n.\ the onset of an extreme event causing profound damage or loss as perceived by the inflicted people.

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