

Supplementary Materials: Vulnerability Assessment Models to Drought: Toward a Conceptual Framework

Kiumars Zarafshani, Lida Sharafi, Hossein Azadi and Steven Van Passel

Terminology

- Adaptive capacity

“The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences” [1].

- Biophysical vulnerability factors

“Biophysical vulnerability factors are related to system properties investigated by the physical sciences. These two categories may sometimes overlap, for instance in the case of built infrastructure” [2].

- Climate change

“Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcing such as modulations of the solar cycles, volcanic eruptions, and persistent anthropogenic changes in the composition of the atmosphere or in land use. Note that the Framework Convention on Climate Change (UNFCCC), in its Article 1, defines climate change as: ‘a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods’. The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition, and climate variability attributable to natural causes” [1].

- Climate variability

“Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, *etc.*) of the climate on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability). See also climate change” [1].

- Coping

“The use of available skills, resources, and opportunities to address, manage, and overcome adverse conditions, with the aim of achieving basic functioning of people, institutions, organizations, and systems in the short to medium term” [1].

- Coping capacity

“The ability of people, institutions, organizations, and systems, using available skills, values, beliefs, resources, and opportunities, to address, manage, and overcome adverse conditions in the short to medium term” [1].

- Disaster management

“Social processes for designing, implementing, and evaluating strategies, policies, and measures that promote and improve disaster preparedness, response, and recovery practices at different organizational and societal levels” [1].

- Drought

“A period of abnormally dry weather long enough to cause a serious hydrological imbalance. Drought is a relative term; therefore any discussion in terms of precipitation deficit must refer to the particular precipitation-related activity that is under discussion. For example, shortage of precipitation during the growing season impinges on crop production or ecosystem function in general (due to soil moisture drought, also termed agricultural drought), and during the runoff and percolation season primarily affects water supplies (hydrological drought). Storage changes in soil moisture and groundwater are also affected by increases in actual evapotranspiration in addition to reductions in precipitation. A period with an abnormal precipitation deficit is defined as a meteorological drought. A mega drought is a very lengthy and pervasive drought, lasting much longer than normal, usually a decade or more” [1].

- Exposure

“The presence of people, livelihoods, species or ecosystems, environmental services and resources, infrastructure, or economic, social, or cultural assets in places that could be adversely affected” [1].

- External forcing

“External forcing refers to a forcing agent outside the climate system causing a change in the climate system. Volcanic eruptions, solar variations, and anthropogenic changes in the composition of the atmosphere and land use change are external forces. Orbital forcing is also an external forcing as the insolation changes with orbital parameters eccentricity, tilt, and precession of the equinox” [1].

- Hazard

“The potential occurrence of a natural or human-induced physical event or trend, or physical impact, that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources. In this report, the term hazard usually refers to climate-related physical events or trends or their physical impacts” [1].

- Hard and soft dimensions

“Soft aspect refers to intangible whereas hard aspect indicates tangible vulnerabilities, such as Physical damages. Hard aspects will have impact on the soft aspects as well” [3].

- Institutions

“Institutions are rules and norms held in common by social actors that guide, constrain, and shape human interaction. Institutions can be formal, such as laws and policies, or informal, such as norms and conventions. Organizations—such as parliaments, regulatory agencies, private firms, and community bodies—develop and act in response to institutional frameworks and the incentives they frame. Institutions can guide, constrain, and shape human interaction through direct control, through incentives, and through processes of socialization” [1].

- Internal vs. external vulnerability factors

“Internal vs. external vulnerability factors refer to characteristics of the vulnerable system or community itself. Vulnerability factors that can be controlled by the considered community, such as the land use within their jurisdiction, are also considered internal. All other vulnerability factors are denoted as external. The designation of a particular factor as internal or external may depend on the scope of the vulnerability assessment. National policies, for instance, would be regarded as internal in a national assessment but as external in an assessment at the communal level” [2].

- Mitigation

“The lessening of the potential adverse impacts of physical hazards (including those that are human-induced) through actions that reduce hazard, exposure, and vulnerability” [1].

- Risk

“The potential for consequences where something of human value (including humans themselves) is at stake and where the outcome is uncertain. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the consequences if these events occur. This report assesses climate-related risks” [1].

- Risk assessment

“The qualitative and/or quantitative scientific estimation of risks” [1].

- Risk management

“The plans, actions, or policies implemented to reduce the likelihood and/or consequences of risks or to respond to consequences” [1].

- Scenario

“A plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technological change, prices) and relationships. Note that scenarios are neither predictions nor forecasts, but are useful to provide a view of the implications of developments and actions. See also Climate scenario, Emission scenario, Representative Concentration Pathways, and SRES scenarios” [1].

- Sensitivity

“The degree to which a system or species is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea-level rise)” [1].

- Socioeconomic vulnerability factors

“Socioeconomic vulnerability factors are those that relate to economic resources, the distribution of power, social institutions, cultural practices, and other characteristics of social groups typically investigated by the social sciences and the humanities” [2].

- Stressors

“Events and trends, often not climate-related, which have an important effect on the system exposed and can increase vulnerability to climate-related risk” [1].

References

1. IPCC. *Climate Change 2014: Impacts, Adaptation, and Vulnerability*; Cambridge University Press: Cambridge, NY, USA, 2014.
2. Fussel, H.-M. Vulnerability in Climate Change Research: A Comprehensive Conceptual Framework. FAVAIA. Working Paper 2, 2005. Available online: https://www.pik-potsdam.de/research/transdisciplinary-concepts-and-methods/archiv/projects/project-archive/favaia/pubs/fuessel_2005.pdf (accessed on 12 June 2009).
3. Roy, A.; Kundu, A. Management of information security in supply chains—A process framework. In *Proceedings of the CIE42 Proceedings, Cape Town, South Africa, 16–18 July 2012*.