

Vulnerabilities to Natural Hazard: Case Study on Landslide Risks in La Paz

Paper for the World International Studies Conference (WISC) at Bilgi University,
Istanbul, Turkey, 24- 27 August 2005

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Introduction

Before the 1980s the study of risks and disasters was mainly focused on the hazards features and on post-disaster reactions. Natural disasters were seen as the only result of natural forces: geophysical, hydrometeorological or biological hazards. Pre-disaster intervention was reduced to engineering techniques (construction of dikes, contention walls, etc.); risk management was reduced to disaster management: emergency warnings, search and rescue operations with command and control schemes. Historically, the starting point of social sciences' studies of disasters can be traced back to the study of Samuel Prince in 1920¹. The study was asking very good theoretical questions about crises and social change but have been little followed. After World War II disaster studies questioned the psychological impact of disasters and were mainly driven by a western vision. For more than 60 years disaster studies have remained caught into a technicist paradigm with a post-disaster focus, attributing natural causes to natural disasters and considering disasters more than risks. Since about 25 years some researchers have begun to rethink disasters and put the emphasis on risks. They have questioned the preceding view of disasters and disaster management, and discovered what is now considered as axiomatic in risk studies: vulnerability is the key to understand disasters.

The shift towards the study of what is happening *before* the occurrence of disasters is now widely recognized and understood through the rapid rise and triumph of the concept of vulnerability. It is now so widely employed in many different fields that a new threat is coming: that all the remarkable progress of what has been found out through the study of vulnerability become subsumed into a conceptual magma driven by theoretical fashion which might as well disappear as quick as it has appeared. Another threat to the progress of risk studies through vulnerability studies is the revival of the old economicist neo-classic theories based on econometrics, which consider vulnerability as a mathematical function constituting a negative externality.

There is so much confusion around this notion that it could well become unusable, like many concepts that have disappeared or have been reappropriated by institutions for their own practical purposes. This would be a pity; that is why we believe it useful to clearly precise its meaning, usefulness and how it could be used to better understand risks and disasters. For that purpose we propose to clarify vulnerability, then suggest some new and existing models to analyse it, and then apply some of them briefly to the case study of landslides in the city of La Paz, Bolivia.

¹ Prince, Samuel (1920), *Catastrophe and social change. Based upon a Sociological Study of the Halifax Disaster*, New York, Columbia University.

I. Definitions and conceptual precisions

A. *Vulnerability is a component of risk*

Vulnerability has emerged from a notion of the everyday language to a more elaborated concept. There is a tendency to use it independently from the context, like «the vulnerable people» in general. In fact vulnerability is both context-dependant and subject-dependant: *one* is vulnerable *to something*, in a given place and at a given time. There is a «stake», i.e. someone or something threatened, and a threat, i.e. a hazard, like a storm, an earthquake, etc. For instance, the people living in the Pacific coast in december 2004 were vulnerable to a tsunami, which caused the disaster. There were at risk of a tsunami disasters. One can define risk as a probability of undergoing damages by one or several hazards, and a disaster as a «realized» risk, i.e. a social disruption provoked by the impact(s) of one or several hazards exceeding the capacities to cope of the affected society. Risk is a virtual and latent potentiality, and disaster is more concrete, observable, a sensible phenomenon. The hazard alone is not able to «convert» a risk into a disaster. For example, a heavy rain or an earthquake is not necessarily disastrous or damage-generator. There must be specific conditions of vulnerability: the presence of populations or goods (stakes) in hazardous areas, and some of their internal properties which render the damages possible: a certain fragility and incapacity to resist or face. That is what the concept is covering. Vulnerability is thus a component of risk, the latter being the encounter of a hazard with vulnerable stakes.

B. *Definition*

In a more elaborated way, vulnerability can be described on the one side as a *propensity to undergo damages*, i.e. a state of fragility that raises the susceptibility of the stake to suffer the impact of a damaging phenomenon. On the other side, vulnerability is the incapacity to anticipate, cope with, resist to, adapt to, and recover from hazards. Vulnerable units are either non-resistant, i.e. incapable of withstanding the shock (without adapting); and/or non-resilient, i.e. incapable of absorbing the shock and adapting back to an acceptable state.

At the global level, the rise of the number and severity of disasters is more important than the increase of the hazards themselves which is most probably due to the reactions of the earth system to the anthropogenic attacks of its ecosystems. This means that the vulnerability of the human societies have risen, i.e. they are more disaster-prone; their internal conformation and organization favors the transformation of hazards into disasters. This shows the extreme importance of a good understanding of vulnerability. Now if all the pre-disaster conditions not directly related to the hazards can be analyzed through vulnerability, one could object that the concept is too broad, encompasses everything, and would therefore be unusable for analytical purposes. This is not so: even though it is very broad, complex, dynamic, almost all-encompassing, it can be sliced to render the analysis possible, before reconstructing the entire puzzle in a more dynamic and relational way. For that purpose we are proposing here some models to analyse vulnerability.

II. The models

A. *Analysing vulnerability through slicing*

The first model we would like to propose to analyze vulnerability to natural hazards is a decomposition in analytical parts.

Vulnerability has two sides in interaction : the exposure, and a series of insufficient capacities :

Exposure

- **physical exposure**: presence and density of the people, habitat, networks, goods and services in risk zones, defining potential losses or damages, both human and non-human (stakes).
- **socio-ecological**: human-induced ecosystemic perturbations aggravating the natural hazard (deforestation, land degradation, street pavement, some engineering practices, climate change, etc.)

insufficient capacities to prevent, prepare for, face and cope with hazards and disasters

- **physical weakness**: insufficient capacity of an individual or an asset to resist or recover from a hazard's impact.
- **juridical-legal**: inadequate state of the legislative and judiciary regulations to prevent, mitigate, prepare for, face and recover from disasters.
- **institutional**: inadequate state of the institutional disposals, at all levels, to prevent, mitigate, prepare for, face and recover from disasters.
- **technical**: inadequate knowledge and/or use of risk management techniques.
- **political**: weakness of the political powers, their legitimacy and control which hinders risk management.
- **socio-economic**: social and economical elements which raise the susceptibility of undergoing disasters and lower the capacities of self-protection, such as : socio-spatial segregation, large inequalities of wealth and of access to the security disposals, misery, anomie and social disorganization, poor social position and social isolation of exposed people, existence of higher social risks undergone by people.
- **psychological and cultural**: inadequate security paradigm or risk perceptions ; cultural anomie or weakness; attachment to risk zones or risky behavior, non-willingness or incapacity to protect oneself.

The overall vulnerability of someone, a community or a society is a mix of some or all of these dimensions. Almost all of these vulnerabilities include an informational dimension (lack of information, bad information, misinterpretations, etc.). They are also generally both collective and individual, so the model can be applied to a societal analysis as well as to a household-centred analysis.

B. Terry Cannon's 5 components of vulnerability²

A very interesting classification of vulnerability components has been elaborated by Terry Cannon.

- **Livelihood & its resilience** : assets and income earning activities
- **Base-line status – initial well-being** : health (physical & mental), nutrition
- **Self-protection** : quality of house construction & location
- **Social Protection** : adequacy of building controls; large-scale measures
- **Governance** : power system, rights, status of civil society

The degree to which a household is vulnerable depends on its livelihoods (assets and income earning activities), initial well-being (health and nutrition), self-protection (quality of house construction & location), the social protection provided by society, and its governance structures (power system, rights, etc.).

This analysis takes into account different social dimensions and levels of analysis: the individual/household level, and its relation to broader social structures. It is more relational and very informative. But the application is mainly a household-centred one.

C. Vulnerability and capacity assessment (VCA) models

As we have seen the second dimension of vulnerability is a series of insufficient capacities. It is generally not a binary matter of presence/absence of capacity, but more of a degree in which people are *not capable enough* to resist or recover properly. Therefore the analysis should not be purely pathogenic, but seriously consider the capacities, abilities to cope, i.e. the elements lowering the vulnerability and contributing to *resistence* and *resilience*. It is increasingly recognized that risk analysis must encompass an analysis of vulnerability and capacity. Field workers, unsatisfied with usual mitigation methods, proposed a tool called *vulnerability and capacity assessment* (VCA), but its reappropriation by social scientists is still in its infancy. They consider vulnerability as being predictive and operationalizable:

« vulnerability should involve a predictive quality : it is supposedly a way of conceptualizing what may happen to an identifiable population under conditions of particular risks and hazards. Precisely because it should be predictive, ?vulnerability assessment?should be capable of directing development aid institutions³. »

The first comprehensive attempt to propose a VCA, from Anderson and Woodrow⁴ in 1989, proposed a matrix of vulnerabilities and capacities crossed by three categories :

² Terry Cannon, presentation at the NCCR-NS Workshop, Basel, 2005. Adapted from Blaikie, Piers; Cannon, Terry; Davis, Ian; Wisner, Ben, 1994, 2004²: *At Risk. Natural Hazards, People's Vulnerability, and Disasters* (London: Routledge).

³ Cannon, T., Twigg J. and Rowell J. (2003), *Social vulnerability, sustainable Livelihoods and disasters*, Report to DFID Conflict and Humanitarian Assistance Department (CHAD) and Sustainable Livelihoods Support Office.

⁴ Anderson, M. and Woodrow, P (1998), *Rising from the Ashes : development Strategies in Times of Disaster*, London, IT Publications, 1989¹

- « **Physical/material** : what productive resources, skills and hazards exist ? » . « What made the people affected by disaster physically vulnerable : was it their economic activities (...), geographic location (...) or poverty/lack of resources ? »
- « **social/organizational** » : what are the relations and organization among people. » «What was the social structure (...) before the disaster and how well it served the people when disaster struck» ? « what impact disasters have on social organization » ? ;
- « **motivational/attitudinal** : how does the community view its ability to create change». »What people's beliefs and motivations are, and how disasters affect them⁵ »

This matrix is both a conceptual tool and a tool to guide practical assessments in communities. For Cannon and al, it should be completed by 5 factors: “disaggregation by gender, disaggregation by other differences (e.g. economic status), changes over time, interaction between categories, and different scales or levels of application (e-g- village or national levels)⁶”.

Apart from the interesting categorization, these types of VCA have the advantage of being very practical, operational, and insisting on skills and capacities of the exposed or affected people, usually underestimated or misunderstood by risk managers. It also insists on the social and cultural aspects, as the Oxfam methodology does:

“vulnerability is quite explicitly seen as a social phenomenon that is related to level of exposure to risk (...), in combination with a range of factors (...) that affect people's ability to cope with their exposure⁷.”

A more comprehensive assessment model has been developed by CDP and CRDN. It comprises 5 elements: “hazard assessment”, “description of disaster situation or crisis”, “analysis of people's capacities and coping strategies”, “explanation of why hazards become disasters”, prioritization by “community people of the elements at risk that need to be protected or strengthened.⁸”

This model is very interesting as it both allows a theoretical and a practical, ground-based understanding of a specific situation of risk and insecurity, in a people-centered approach and with control of the exposed people themselves.

Another interesting model is DMI's “Victim Security Matrix”. It crosses four vulnerability and security elements - food security, water security, habitat security, work security - with four factors: “special groups and areas”, “institutions and governance”, “resource allocations and accountability”, “technology and environment⁹”. It places the emphasis and explanation in the livelihoods strategies to secure the first four elements.

⁵ Cannon, T., Twigg J. and Rowell J. (2003), *Social vulnerability, sustainable Livelihoods and disasters*, Report to DFID Conflict and Humanitarian Assistance Department (CHAD) and Sustainable Livelihoods Support Office, pp 9-10

⁶ Ibid., p 10.

⁷ Ibid., p 36.

⁸ Heijmans, a. (2001), *vulnerability : a matter of perception*, Benfield Greig Hazard Research Centre, University college of London, working paper, november 2001, pp 13-14. www.benfieldhrc.org

⁹ Twigg, J. (2001), *Sustainable Livelihoods and Vulnerability to Disasters*, Working paper, Disaster Mitigation Institute (DMI), March 2001, p 7.

D. Livelihood approaches

1. Sustainable Livelihood (SL)

Indeed, a whole area in disaster research is developing around (sustainable) livelihoods, considering “vulnerabilities, of all kinds, as part of the context in which livelihoods are shaped.”¹⁰

This kind of approaches is very close from the Human Security-based approaches, as shown by DFID’s definition of livelihoods:

“A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base.”¹¹

The aim of the model is both analytical and normative:

“The SL approach seeks to understand the many factors influencing people’s choice of livelihood strategy and then to reinforce the positive aspects (...) and mitigate the constraints.”¹²

A *vulnerability context*, in relation with some *transforming social structures and processes*, and a series of *livelihood assets* (equivalent to capacities, both material and social) determine some *livelihood strategies*, to end up with *livelihood outcomes* (food security, income, reduced vulnerability, etc.).

Categories of vulnerability are *trends* (large-scale social, economical, technological and political), *shocks* (health, natural, economic, conflict, crop) and *seasonality*.

Capacities are resumed in 5 *capitals*, : *Human* (skills, knowledge, health), *Social* (relations), *Natural* (resources), *Physical* (infrastructures to support livelihoods), *Financial*.

«Transforming structures and processes» are institutions, at the sociological sense, that determine the livelihoods, the possible strategies, etc.

This kind of explanation is nothing more than an attempt to explain actor’s strategies around livelihoods, something that sociology has tried for more than a century. The 5 capitals remind of Pierre Bourdieu’s 4 capitals, but in a quite modified version; another underlying theory is institutionalism, as the analysis of the role of “transforming social structures and processes” on livelihoods is a simplified institutional socio-economy. As recognized by Twigg, hazards impacts are also underestimated in the model.

But this has the advantage of proposing an alternative view on disasters and security, considering “the significance of hazards and their impact (...) in the vulnerability/livelihoods equation.”¹³

Indeed,

¹⁰ Ibid., p 8.

¹¹ Twigg, J (2001), op. cit., p 9.

¹² Ibid., p 12.

¹³ Twigg, J. (2001), op. cit., p 16.

“vulnerable people and victims of disasters, without using theory, will always place the disaster in the context of their daily struggle to earn a living and feed their families. They can also articulate these issues clearly, if they are given a chance.¹⁴”

2. The Access model

Blaikie and al. have developed a model of disaster risk centered around the household level and livelihoods : the *access model*, which is quite similar to the SL model and obviously served as a basis for it. Access refers to

“the ability (...) to use resources which are directly required to secure a livelihood.¹⁵”

As access to resources is essential to maintain livelihoods, less access means an increased vulnerability. In short, an individual of a production unit have specific resources and assets, material and immaterial, determining a specific access level and further economic opportunities and decisions, also influenced by structures of domination. These decisions lead to livelihoods, a household budget, and further choices, which in turn lead to an outcome: changes in the access profile.

This model, even if it takes into account some social structures, seems too economically-driven to understand all the determinants of risks and vulnerability at household level.

More interesting is their *Pressure and Release* model.

E. The Pressure And Release (PAR) model

This famous and widely reproduced model is based on the idea, that

“ ...an explanation of disaster requires us to trace a progression that connects the impact of a hazard on people through a series of levels of social factors that generate vulnerability¹⁶.”

It is one of the only model of disaster risk and vulnerability that clearly distinguishes between the different causal levels. It is also one of the most ambitious one, that allows a real social science’s analysis.

In the model, the disaster is crunched between the hazards on the one side, and the “progression of vulnerability” on the other. Vulnerability starts from “root causes”, a “set of well-established, widespread processes within a society and the world economy, which reflect the distribution of power”. These political and economical ideologies and systems translate into activities and processes called “dynamic pressures”, which are “macro forces” (e.g. urbanization, debt repayment schedules, etc.) and incapacities (a series of lacks). These pressures, in turn, create the

¹⁴ Twigg, J. (2001), *Sustainable Livelihoods and Vulnerability to Disasters*, Working paper, Disaster Mitigation Institute (DMI), March 2001, p 16.

¹⁵ Blaikie and al., op. cit., p 48. It is close from Amartya Sen’s *entitlements theory* developed in his studies of famines. Sen, A (1984), *Poverty and Famines: An Essay on Entitlement and Deprivation*, Oxford University Press.

¹⁶ Blaikie and al., op. cit., p 22.

“unsafe conditions” which express the vulnerability to hazards of a specific population (exposure of buildings, specific groups, livelihoods; lack of local institutions; endemic diseases, etc.).

In short,

“...the unsafe location is linked by a series of dynamic pressures that can be traced back to root causes¹⁷.”

The great merit of this framework is to recognize, that the deepest causal factors « may ultimately be quite remote from the disaster event itself¹⁸ », therefore operating a breach with commonsense and allowing to construct a scientific object, with a «chain of explanation». It also reminds researchers, that risk and vulnerability are processes that develop through time, thus necessitating to make synchronic as well as diachronic analysis to trace back its genesis.

Only with such a «grand» analysis is it possible to identify and correct the determinants of disaster risk which lead to Human Insecurity. The authors postulate that it is possible to inverse the progression of vulnerability by addressing root causes, reducing pressures and achieving safe conditions.

¹⁷ Ibid., p 26.

¹⁸ Ibid., p 22.

III. Application to the case of landslides in La Paz

In order to illustrate the application of some of these models, we are proposing here to cross the «sliced» analysis and the Pressure And Release model to study the vulnerability of the city of La Paz, Bolivia, and its inhabitants, to landslides hazards :

The progression of vulnerability ----- Types of vulnerability	Unsafe conditions	Dynamic pressures	Causes	Root causes
	Exposure			
Physical exposure	Presence of houses, people and goods in landslides areas	Settlement in hazardous zones	Socio-spatial segregation	Inequality Internal domination structures: hierarchy, class society Marginalization
Socio-ecological exposure	perturbated ecosystems in La Paz	Deforestation ; Inadequate water management and waste management ; Destabilizing of soils	Migration ; Lack of technical knowledge ; Lack of ecological management	Misery ; Inequality ; Domination structures ; Marginalization
Insufficient capacities to prevent, prepare for, face and cope with hazards and disasters				
Physical	physical incapacity to resist or cope with impacts	Diseases ; impossibility to cure oneself ; bad quality of housing	Misery ; Cultural mistrust	Domination structures ; Marginalization
Juridical legal	Inadecuate legal system for prevention and mitigation	Inapplication of norms for land use planning ; Absence of compliance and control mechanisms	Desorganization ; Lack of human and financial resources for effective application ; Corruption and laxism	Generalized system of management of permanent emergency and precariousness ; Dependency towards external powers
Institutional	Lack of an overall and coherent organizational risk management system in the city of La Paz	Confusion, lack of coordination between risk management organization ; Lack of overall prevention strategy	Scientism ; Technicism ; Lack of resources	Generalized system of management of permanent emergency and precariousness ; Vertical structure of power

Technical	Bad use of risk management techniques : constructions without contention walls and with bad foundations, lack of drainage of water, weakening and destabilization of soils for constructions, bad state of canalizations for water management	Lack of ecological management ; Lack of technical knowledge ; Autoconstruction	Migrations ; Lack of resources of individuals and organizations	Domination and dependency towards external powers ; Technicism, scientism
Political	Lack of integral risk management policies in La Paz	Weakness of political powers and instability ; clientelism, lack of long-term vision	Internal domination structures: hierarchy, class society ; Domination and dependency towards external powers ; vertical structure of power	
Socio-economical	Misery: very low income which hardly allow a minimal alimentation; desnutrition of children; extreme isolation: lack of social capital and solidarity; impossibility to sell the house and have access to credit. unemployment and informal economy; job instability	Economic crisis ; Unequal structure of landownership ; Vertical structure of power; Diferences of power among neighborhoods	Liberal market economy ; Internal domination structures: hierarchy, class society ; Domination and dependency towards external powers ; Marginalization and inequality	
Psychological and cultural	Underestimation of risk ; Lack of preoccupation of risk and disasters Wrong beliefs : that the soil is stable for ex. ; Resignation	existence of more important social risks: unemployment, livelihoods, violence ; lack of education in risk and risk management ; lack of trust in existing institutions and organizations Massive unemployment ;	Misery ; absence of care by powers ; lack of resources for education ; high tolerance to risk ; Migration	Liberal market economy ; Symbolic violence ; Internal domination structures ; Domination and dependency towards external powers.

Each line represents a type of vulnerability; the columns represent the progression of this vulnerability to landslides in La Paz, from the existing unsafe conditions to their root causes, going through the dynamic social pressures that lead to the existing vulnerability. We won't go in detail for each line ; the important is to understand, that vulnerability is a complex compound of mainly socio-economical and organizational aspects, that derives from social causes quite remote from the disaster but leading to an increased and effective vulnerability. These vulnerability types and their causes are related to each other and must be analysed in such a dynamic way.

Conclusion

The paper focused on the important notion of vulnerability in order to clarify its meaning, its uses in risk analysis and the models used for a better analysis. We have proposed to combine 2 models of vulnerability analysis and apply them to the case of landslide risks in La Paz. This was a provisional theoretical, voluntarily focused on the societal level. To be more complete the same table could be made for capacity/resilience analysis, i.e. the factors contributing to safer conditions and their causes, such as popular participation, artisanal skills of the people for self-protection, union and organization at the community level to fight for their rights, solidarity, a high political awareness, etc. It could also be completed by a more individual or household analysis which would bring other interesting results.

These vulnerability/capacity analyses are not pure intellectual gaming. They contribute to the understanding of risks and disasters in a pluridisciplinary way. This knowledge is the basis of a better prevention and mitigation of disasters, but also brings new insights in social analysis and some keys to understand the root causes of what we experience.

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