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Indicators/parameters of socio-economic vulnerability

A theoretic and research perspective

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1 Indicators/parameters of socio-economic vulnerability

Many initiatives have been undertaken to develop indicators to measure vulnerability in its different dimensions. The United Nations Universities Institute for Environment and Human Security (UNU-EHS) has been active over the last decade to look into state-of-the-art vulnerability assessment, particularly in the field of hazards (e.g Brikmann and Wisner, 2006; Birkman, 2006). The Tyndall project reviewed work on vulnerability indicators and developed more formal approaches to develop indicators of vulnerability and adaptive capacity in the field of climate change policy processes (Adger et al., 2004)

Indicators are qualitative or quantitative parameters that describe features of a certain, often complex and ill-defined, phenomenon and communicate an assessment of the phenomenon involved (Dopheide and Martinez, 2000). The latter implies that, although indicators can be either descriptive or normative, they always have implicitly or explicitly a reference to a norm. This makes indicators clearly different from simple measurements.

The rationale behind measuring vulnerability and the use of vulnerability indicators has been summarized in Birkmann (2006). Vulnerability indicators can have the following functions: i. identification and visualisation of vulnerability; ii. evaluation of political strategies; and iii. monitoring implementation of strategies and actions.

More practical motives for the development and use of vulnerability indicators include: vulnerability indicators help to set priorities (among groups and/or areas); they provide background information for action; they help to raise awareness (among policy makers and in civil society); they assist to monitor and analyse trends; and they enhance the empowerment of local groups and communities if developed and used as part of community-based disaster management and self-assessment (Wisner et al., 2004) – see workshop UNU-EHS.

The numerous initiatives to measure, qualify and/or assess vulnerability are well summarised and documented (Adger, 2000; Adger et al., 2004; Birkmann, 2006). However, many of the initiatives to measuring vulnerability often lack a systematic and transparent approach (Birkmann, 2006). As Downing (2004) emphasizes *"the indiscriminate use of indicators—pick any that seem relevant and are available—must be avoided"*. Rather it is important to develop and have a conceptual model as a basis for any indicator development. At the same time it can be argued that the "indiscriminate" search for indicators and the many indicator initiatives have contributed to an improved understanding of what is actually meant with vulnerability and how vulnerability is perceived, including its related factors.

In this sense, any initiative or procedure to develop indicators follow either a more deductive, theory-based approach or a more inductive approach, based on statistical relationships. In the first case the indicators are developed and selected based on a good understanding and a strong conceptual framework of the phenomenon under study (vulnerability). In the second case indicators are selected based on data and observed empirical relationships that best assesses the phenomenon under study.

However, in both cases, even in the more inductive approach, eventually a good conceptual understanding of the concept being measured, i.e. vulnerability remains crucial.

In literature and in a number of indicator initiatives a sequence of phases and steps have been proposed to develop indicators. Many of these procedures for indicator development will include as an early phase, i.e. before developing and identifying the actual indicators and collecting the data, the development of an appropriate conceptual framework. An example is given in Birkmann (2006), where nine steps are proposed: 1. defining goals; 2. scoping; 3. choosing indicator framework; 4. defining selection criteria; identifying potential indicators; 6. choosing a final set of indicators; 7. analysing indicator results; 8. reporting; and 9. assessing indicator performance.

Many vulnerability indicator studies neither belong to the pure deductive or the pure inductive approach. Many studies eventually work with a set of multiple indicators that were partly based on a basic definition and concept of vulnerability, but to a large extent also determined by the data availability. Indicator programmes that effectively attempt to enhance the understanding of the concept will have to be iterative in nature; combining elements of the deductive as well as the inductive approach and including sufficient feedback loops with the main users and stakeholders involved. A complex and debated concept as vulnerability will, however, require a minimum of consensus on the adopted definitions and framework.

Adger (2004) discusses three characteristics of vulnerability and vulnerability research that present particular problems when devising vulnerability indicators; which are complexity and limited understanding of the concept or phenomenon (i.e. the paradox as put forward by Birkmann (2006) *"We aim to measure vulnerability yet we cannot define it precisely"*); the issue of different scales; and the dynamism. The first point refers to the earlier reported seemingly unending debate on what vulnerability is, making the operationalisation of vulnerability through indicators an even more difficult task.

Within the last few years, three major global projects have been carried out to measure risk and/or vulnerability with the help of indicators and indices at the national scale, for international and global comparisons, namely:

1. the Disaster Risk Indexing project (DRI) of the UNDP in partnership with the UN Environment Programme-Global Resource Information Database (UNEP-GRID);
2. the Hotspots indexing project implemented by Columbia University, the ProVention Consortium (under the umbrella of the World Bank); and
3. the Americas programme of IDEA in partnership with the Inter-American Development Bank (IADB).

These projects can be considered as important initiatives which represent the first comprehensive global and regional assessments of disaster risk; for a summary and review of these initiatives, see Pelling (2005) and Birkmann (2007). Whereas Pelling (2005) focuses primarily on the methodologies used, Birkmann (2007) places more emphasis on aspects of applicability and policy implications and outlines challenges and limitations of the different approaches.

The analysis and discussion of the approaches and indicators for risk and vulnerability at different levels by (Birkmann, 2007) showed that these approaches can fulfil relevant functions like identifying and highlighting areas most at risk and pointing to where risk and vulnerability reduction is needed.

However, major shortcomings that were identified included: the challenges and limitations regarding the data; the issues of up- and downscaling, and the contextualisation.

Research has clearly indicated that vulnerability is spatially and socially differentiated, and the scale of analysis is most important. National level assessments can result in loss of information and capturing local variability and pockets or hotspots of vulnerability are important.

There is a distinct body of literature on economic vulnerability indices. This literature and related research which is part of the development framework seeks to identify the vulnerability of national economies to exogenous shocks. This work often focuses upon less developed economies, small states and small island states (Briguglio et al., 2004). There is a separate group of vulnerability studies with a long history which seek to identify those population groups which are most likely to experience the adverse impacts of natural hazards including flood hazards, in order to target preventative measures and disaster relief (Mbithi and Wisner, 1973; Kamau et al., 1989; Reardon and Matlon, 1989; Cutter 1996; FIVIMS 2000; FEWSNET, 2000). Most of this research has focused upon developing countries at the local to regional spatial scales. However, social and environmental indicators research is currently experiencing a renaissance, especially in the area of sustainability science. There are now many examples of the use of indicators to assess human vulnerability to various hazards and threats in developed countries (e.g. Cutter et al., 2003; Granger et al., 1999 and Dwyer et al., 2004). Many sets of indicators have been developed to examine highly context-specific processes. For example, the United Nations Development Program's Human Development Index (UNDP, 2000) provides a composite indicator of human wellbeing, as well as indicators of gender disparity and poverty among nations. The World Bank similarly provides annual data and indicators in its World Development Indicators Reports (e.g. World Bank, 2003).

With the growth in the recognition of climate change and its linked natural hazards, such as floods, as a global threat many assessments have been made of the potential impacts in different world regions (Jallow et al., 1996; Nicholls et al., 1999; Schiller et al., 2001). Many of these studies use a vulnerability framework, and recently progress has been made towards more formal assessments of vulnerability (Adger et al., 2004). Research has clearly indicated that vulnerability is spatially and socially differentiated, and the scale of analysis is most important. National level assessments can result in loss of information and capturing local variability and pockets or hotspots of vulnerability are important.

Phases and criteria of indicator development

Vulnerability and resilience may thus be examined at a variety of levels or scales e.g. the individual, family group, household, community, local, national, regional or even global levels (Adger et al., 2004). The development of indicators of social vulnerability to natural hazards is a relatively small area of research, particularly within applications to industrialised nations. There is still no consistent set of metrics used to assess vulnerability to environmental hazards, although there have been calls for just such an index, and Cutter et al. (2003) talk of the need for redirecting social indicators research. It is possible, however, to identify certain criteria to aid indicator selection. It must be remembered that indicators only provide an 'indication' of much broader and complex social concepts, and therefore good indicators must have a clear conceptual basis in order to measure what is intended. The following criteria can be used as a

guide for the selection of indicators (Cutter et al., 2003; Adger et al., 2004; Dwyer et al., 2004). Indicators should be:

- Reliable and verifiable
- Sensitive to change over time
- Simple and easily understood while reflecting complexity of concept
- Quantitative – measurable via readily understood model
- Recognisable by others
- Objective
- And, ideally, comparable within and between communities

The work by Adger et al. (2004) is particularly comprehensive in identifying indicators and parameters of social and economic vulnerability to climate change hazards, and is almost directly applicable to all natural hazards. Indicators tend to focus on processes that shape variations of vulnerability in time and space, and these processes operate at different spatial scales. For example, while decreasing labour availability is a process that may manifest itself on a community level, a national level indicator may aim to capture the processes that shape the local level decrease, such as urbanisation and de-agrarianisation. Adger et al. (2004) distinguish between 1) output-based and 2) predictive indicators of socio-economic vulnerability which explain more about underlying causes. The number of people killed by a hazard over a time period is an example of 1), whereas parameters measuring adaptive capacity are an example of 2).

Criteria for peer review of vulnerability assessments (Downing, 2004)

- Does the assessment combine a qualitative narrative of the conditions of vulnerability with quantitative assessment and modelling?
- Has vulnerability been defined, taking account of common definitions among stakeholders to the assessment and with respect to the exposure unit, threat and consequences?
- Does the choice of indicators reflect the conceptual understanding of vulnerability, in particular the sequence of driving forces, exposures and consequences?
- Does the depiction of aggregate vulnerability reflect multiple attributes and has been validated by stakeholders to the assessment?
- Is the assessment of vulnerability linked to selection of adaptation options and strategies?

The EU Floods Directive (European Commission, 2007) requires an assessment of flood risks aiming at reducing the adverse consequences for economic activities and human health, as well as cultural and environmental values. Quantitative flood risk indicators and flood risk maps are identified as the means of responding to this Directive and each country is seeking to produce such indicators (e.g. Office of Public Works (Ireland), 2008). The Directive specifies that the maps should show the number of inhabitants affected and the type of economic activity

potentially affected. Research undertaken for Ireland (Office of Public Works, 2008) assesses the flood risk indicators currently in use in the EU and recommends adoption of certain indicators in Ireland. Indicators are being developed as part of the National Flood Risk Assessment methodology, Catchment Flood Management Plan methodology and the Thames Estuary 2100 strategy in England and Wales. Some of the key indicators relating to economic and social vulnerability are listed in Appendix XII. Comparisons of economic (direct and indirect loss) and intangible (e.g. health damage) indicators used in England and Wales, Holland, the Czech Republic and different parts of Germany are tabulated by the Office of Public Works (2004). Appendix XII also includes some parameters and indicators which might be used in assessing institutional vulnerability. There are also a growing number of post-flood reviews of the functioning, or in some case the under-performance, of flood emergency response organisations.

Any flood vulnerability analysis needs information about the elements at risk, which can be specified in terms of element-at-risk indicators, exposure indicators and susceptibility indicators (Meyer and Messner, 2005 - see Figure 2), reflecting different conceptual models. In this regard natural and social science indicators are both of importance. From considering data from the literature, Tapsell et al. (2005) suggest a number of common indicators for assessing social vulnerability to flooding which could be applied across European states (Appendix XIII). These include indicators of elements at risk, exposure indicators and susceptibility and resilience indicators. The symbols indicate whether the variable may be an indicator of increased or decreased social vulnerability (+ = increases vulnerability, - = decreases vulnerability). While not fully explaining all the underlying causes of social vulnerability these variables provide an initial metric for operationalising the concept. However, evidence from recent research in Europe indicates that noone is per se highly vulnerable to flooding (Steinführer et al., 2007). There is some evidence for the vulnerability of certain social groups which were identified as vulnerable at different points in time and during different phases of a flood event.

2 Problems with the use of indicators

The use of taxonomies of ‘vulnerable groups’ such as those outlined in Appendix XII (e.g. women, children, the elderly), is not without problems (Wisner, 2005). Although there is truth that these groups may often have ‘special needs’ and that there is empirical support for the use of such ‘check lists’, the taxonomic approach fails in that it produces too many ‘false positives’, e.g. not all women are equally vulnerable. Buckle et al. (2000) and Brown and Damery (2002) see the use of taxonomies such as these to be a very limited view of vulnerability in that these categories have not been adequately explored and may give rise to a stereotyped and unenlightened view of risk and capacity for hazard response.

Other research has revealed that the identification of vulnerability must be balanced by that of capacity (Anderson and Woodrow, 1998). For example, although acknowledging women’s

tendency to vulnerability, Fothergill's reviews of the literature on gender and disaster (1996; 1998) found a number of examples (within warning communication and response) of women being generally more risk-aware, more likely to believe and act upon warnings, and more likely to relay them to others. Additionally, to have access to local community or family networks (social capital) can also counterbalance the negative effects of a lack of financial and other resources (Fordham, 1999; Tapsell et al., 1999; Cannon, 2000). Moreover, the same property type may indicate different levels of vulnerability according to the ownership status of the occupant.

Another problem is that although researchers are beginning to recognize the differential vulnerabilities of social groups, these analyses are often one-dimensional, i.e. they focus on gender or race/ethnicity or age etc. but not on the interactions within and between several social groups. Although indicators may not in isolation make a person vulnerable, a combination of these indicators, or the relationship between indicators, may render an individual highly vulnerable (Dwyer et al., 2004). Therefore, we need to know how vulnerabilities are compounded to create the most vulnerable (Wisner, 1993). Many of the indices apply additive models to produce their vulnerability scores. However, relationships of indicators can take many interactive forms, not all of which are additive and need to be considered. Cutter et al. (2003) also conclude that not all indicators are necessarily equal, and the need to develop a defensible weighting scheme is important.

3 Sources of data

Sources of data for vulnerability indicators may be primary or secondary. Primary data, usually obtained via social surveys, can be tailored to the specific research question to be addressed. However, this approach is time-consuming and expensive in terms of organisation and analysis. Secondary source data such as the census are more cost-effective than primary data but the research is then constrained by the need to fit the conceptualisation of vulnerability around the available data (Pelling, 2006). Not all social data is nationally available in some EU member states to which vulnerability and/or resilience indices might be attached, however, member states are now requested to supply statistical data on their populations. Some countries do not hold national censuses (Germany, Sweden, Iceland). For countries where there is no census data other alternative data sources are needed. Data is normally available on 'core' topics but some data is on 'non-core' topics which include optional variables that vary depending on national priorities (University of Thessaly, 2004). Moreover, the last date of collection of national data varies. Some countries also hold additional types of registers (e.g. Denmark for income, education, social security etc.). In the case of some Eastern European states, which historically developed under different socio-economic and political systems and administrative boundaries, comparative data is not always available. It is also unclear at what level data is available. For example, in the UK data is available at the very local level of Output Areas (average population per unit of 296 – divided by 2.4 for number of households). However, this

does not appear to be the case for many countries and it may not be possible to distinguish regional variations (Tapsell et al., 2005).