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Vulnerability of socio-economic systems

Concepts and definitions from a theoretical and research perspective

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1 The concept of 'vulnerability'

Approaches in disaster reduction have become much more complex and emphasis has shifted from relief to mitigation. Consequently, vulnerability, resilience, and coping capacities have gained a more prominent role and more light is being shed on social, economic, political, and cultural factors next to the physical dimension of disasters (Thywissen, 2006).

'Vulnerability' has emerged as a central concept for understanding the condition or the predisposition of a system to suffer damage due to a hazard. Broadly speaking, the vulnerability of a system relates to its capacity to be harmed by a threat. Vulnerability can be seen as an internal property of a system, so not directly including the exposure to a threat (see also Gallopín, 2006), but still intrinsically linked with a threat. As threats can be of various nature and origin, discussions on the concept of vulnerability and the scope for measuring vulnerability should be understood within the context of these threats.

An alternative perspective, however, is that vulnerability is a condition or state in which economies or communities exist before a hazard threatens. Consequently, the vulnerability of economic systems to natural disasters may be expressed in terms of a potential to suffer economic or financial harm or loss, expressed either in terms of the magnitude of the consequences of the potential event, i.e. a monetary loss estimate, or in terms of sensitivity and resilience, i.e. the capacity to cope with the loss (Overseas Development Institute, 2005). This definition is derived from research which is mainly focused on the impact of disasters at the macro-scale of national economies and financial systems, and which thus focuses on the relationship between natural disaster impacts and level of economic and social development (Benson and Clay, 2004).

The above-mentioned distinction is highlighted in the following table, where we differentiate between biophysical vulnerability and social vulnerability (Adger et al., 2004; Birkmann, 2006.

Table 1: A first differentiation into definitions of vulnerability

Biophysical vulnerability	**Social vulnerability**
Exposure to hazard	A state
Vulnerability in terms of the amount of (potential) damage caused to a system by a specific threat (climate related/hazard)	An internal state of the system before it encounters an hazardous event
Ultimate impact of the hazard	Not a function of hazard itself
Function of the frequency and severity of a given hazard	Condition of the exposed system

Although there are different schools of vulnerability research, such as the disaster risk community, the food security research or global environmental change research communities, the United Nations in its International Strategy for Disaster Reduction (UN /ISDR, 2004b) claims that a consensus can be seen in the fact that nowadays nearly everyone views vulnerability as an "internal side of risk" .

In this context vulnerability is an intrinsic characteristic of a system. That means the conditions of the exposed element or community at risk are core characteristics of vulnerability. Birkmann (2006) illustrates (see Table 1) how this concept of vulnerability as an intrinsic characteristic element of the system has widened to a concept that is primarily related to people (sphere 2 of Figure 1); developed towards a dualistic approach of susceptibility and coping capacity (sphere 3); to a multi-structure, including also adaptive capacity and the interaction with perturbations (sphere 4); and to the current debate which shows that vulnerability includes various thematic dimensions (sphere 5). In summary, while formerly vulnerability was primarily associated with physical aspects; nowadays vulnerability includes also economic, social, environmental and institutional aspects.

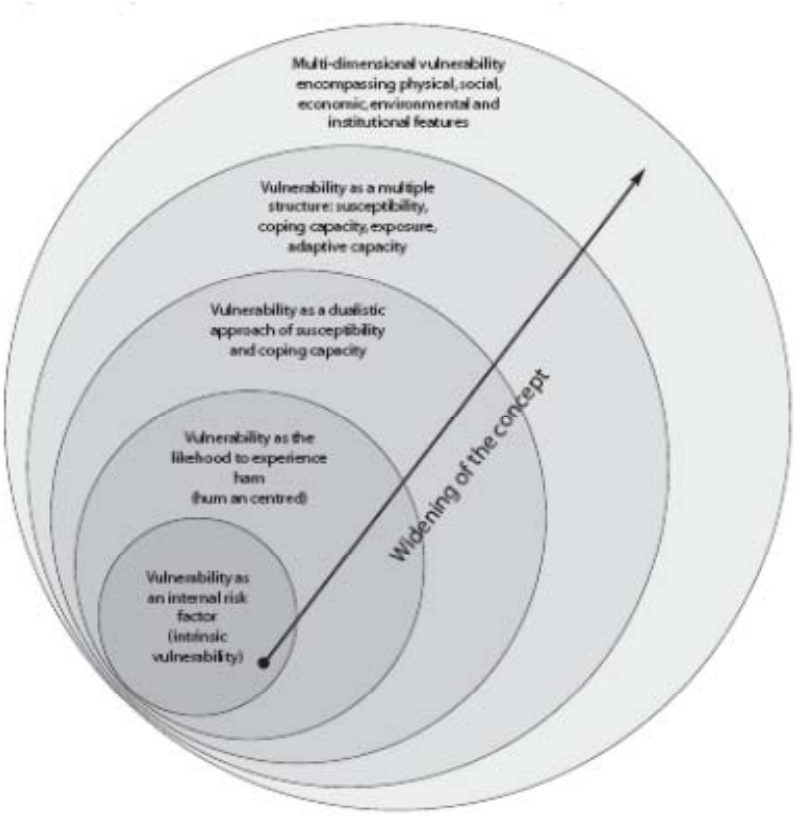
The above-mentioned typology and broadening of the vulnerability concept has led to confusions concerning definitions and concepts of vulnerability, best illustrated by Weichselgartner (2001) who includes a table of 23 different definitions of vulnerability, and Cutter (1996) citing 18 definitions. More recently, Thywissen (2006) presented a comprehensive review of the “Babylonian confusion” around the definition of the key concepts and terms in the field of disaster reduction, including vulnerability and resilience. In her comparative glossary of core terminology of disaster reduction, she presents 37 different definitions of ‘vulnerability’ which are used across multiple disciplines (see Appendix I).

As a consequence of this confusion, almost every aspect of vulnerability – including how to measure and gain estimates from it – is the subject of intense debate.

Additionally, a number of related concepts enter the vulnerability debate; which neither are defined in a uniform and crisp manner. Related concepts include: susceptibility, resistance, resilience, coping capacity, mitigation, adaptation, and adaptive capacity.

Before presenting and discussing various other variants of vulnerability it is thus necessary to present various scientific paradigms and consequent scientific language on the concept of vulnerability. It appears that there are different discourses (shared meanings) about the contested concept of vulnerability and resilience.

Figure 1: A first differentiation into definitions of vulnerability



2 Disciplinary scientific paradigms and language

Definitions of vulnerability are necessarily contested by different scientists and there remains a lack of consensus on the meaning of the concept and the methods of operationalising it (Cutter, 1993; Cutter, 1996). The different views on vulnerability across and between disciplines (Adger, 2006) can partly be explained by the focus on different components of risk, responses to risk and welfare outcomes. Consequently, within the hazards literature, vulnerability has many different connotations, depending on the research orientation and perspective (Cutter, 1996). The term is used to mean different things by different authors (Adger, 1999). While social scientists tend to view vulnerability as representing the set of socio-economic factors that determine people's ability to cope with stress or change, climate scientists often view vulnerability in terms of the likelihood of occurrence and impacts of weather and climate related events (Nicholls et al., 1999).

A same type of argument is used recently by Adger (2006) arguing that two major research traditions acted as seedbeds for ideas on vulnerability of social and physical systems: the analysis of vulnerability as lack of entitlements and the analysis of vulnerability to natural hazards.

In the field of disaster research, discourses (i.e. shared meanings) about the contested concepts of social and economic vulnerability and resilience emerge and multiply on an almost daily basis, often merging fluidly with one another to varying degrees. Distinguishing between these discourses depends heavily upon the degree of resolution employed (Bankoff et al., 2004). Characterizing them accurately requires considerable explanation. These discourses are rarely only about social or economic vulnerability, and may be intertwined with arguments about environmental or other forms of vulnerability or insecurity. Discourses on vulnerability appear to be far more numerous than on resilience (because interest in social resilience emerged rather recently), although it is perhaps artificial to separate these concepts. Some discourses, which clearly relate to vulnerability, hardly mention this term but instead use other closely related terms. The discourses identified below should be interpreted in these contexts (see Appendix II). Two levels of discourse are distinguished in Appendix II, Level 1 represents a coarser level of analysis, while Level 2 takes a finer-level approach to distinguishing between different discourses which all broadly fit into the social and political economy analysis discourse category identified at Level 1.

All in all we might conclude that the majority of definitions largely conceive vulnerability as a function of susceptibility to loss and of the capacity to recover – this capacity is then termed 'resilience'. The term 'vulnerability' has been said to have negative connotations and according to some authors should be turned around and approached positively as 'resilience', or as the capacity to cope with or adapt to change. This is broadly similar to the concept of adaptive capacity which has been used and developed by climate change researchers (Adger et al., 2004). Some writers prefer to use the term resilience in place of vulnerability because of these more positive connotations. See for wxample the United Nations International Strategy for Disaster Reduction (UN/ISDR, 2004a) which defines 'capacities' as the opposite of 'vulnerability'.

Particularly this relation between vulnerability and resilience is a debated one. In the context of environmental and hazard management, the concepts vulnerability and resilience are obviously related, but the specific nature of the relations is not obvious. Literature ranges from considering vulnerability:

1. As the reciprocal of resilience, to
2. Seeing resilience as a component of vulnerability, to
3. Considering vulnerability as the static and resilience as the dynamic propensity of a system in relation to a threat.

3 Economic systems vulnerability

Economic vulnerability is well-documented from the conceptual and empirical viewpoints (e.g. Briguglio, 1995 for small-island states; Atkins, 2000 for developing countries), and there is a discrete body of literature on the economic vulnerability of nation states to 'shocks' of various

types, not necessarily natural or na-tech ones, but which illuminate the economic factors which may magnify or reduce economic impacts of disasters. Within this literature there is a particular focus on the economic vulnerability of small states (Atkins, 2000), including small island states, for example Papua New Guinea (e.g. Manning, 2004) and Malta (Briguglio et al., 2004), which are more sensitive to 'exogenous shocks', arising out of their economic openness. Economic resilience is defined in this context as the policy-induced ability of an economy to withstand or recover from the effects of such shocks.

Most of this national scale literature focuses strongly on the distributional or social dimensions of economic vulnerability which relate to the capacity of people to cope with the impacts of disasters. There are examples of how the economic vulnerability to disasters of poor and socially disadvantaged groups can be increased or decreased by economic development (Overseas Development Institute, 2005).

The strong inter-relationships between economic and social systems vulnerability are well demonstrated in the disasters field by research which utilises a political economy paradigm. For example, in relationship to vulnerability analysis and flood disasters in developing countries, Cannon's concept of socio-economic vulnerability includes 'livelihood resilience' in which the key variables include income opportunities, assets and savings (Cannon, 2000). Poverty and the relationships between income and the daily costs of food are key determinants of social vulnerability in a case study of flood vulnerability at the city scale in Manila in The Philippines (Zoleta-Nantes, 2000).

There is a considerable body of literature on flood losses mainly aimed at methods for assessing flood loss or damage potential. This literature has recently been reviewed as part of the European Commission funded FLOODsite research programme (FLOODsite, 2007). Most of the research underpinning this literature is concerned with a 'unit-loss approach' in which detailed 'local' or property/building level damage data and other loss data are aggregated to describe flood damage potential or economic systems vulnerability at neighbourhood, settlement or sub-catchment level (e.g. Penning-Rowsell, 2005). This research acknowledges that some people will suffer a greater degree of harm than others from the same damage or financial loss and has developed a 'vulnerability index' to highlight the locations in which particularly vulnerable groups exist (Messner, 2006).

Economic system vulnerability is most commonly addressed at either the macro/national or micro/local scale in the literature (see for a recent example Jonkman, 2008). Regional scale assessments have been made by aggregating generalised unit flood loss data for homes and businesses (e.g. Office of Science and Technology, 2004).

A major contribution to the conceptual definition and measurement of the very much related concept of economic resilience is made by Rose (2007). Moreover what Rose (2007) defines as *static economic resilience* can be seen analogous to what others call the reciprocal of vulnerability, i.e. the exposure of a system to a shock and its potential to incur damage (Bockarjova, 2007).

Van der Veen and Logtmeijer (2005) investigated vulnerability and resilience by relating a high GIS resolution data framework to a low resolution macro economic model, where complementary economic sectors diminish macro disaster damage.

In the community of disaster research a more or less general type of methodology is applied: e.g. in assessing the vulnerability to earthquakes and floods researchers exchange their model specification. In a recent EU, US and Asia workshop on disaster management it appeared surprisingly that economists dealing with earthquakes, floods and hurricanes spoke the same language and could share a common methodology (Van der Veen, 2003; Van der Veen, 2004).

Good examples of applied research on earthquakes can be found in Okuyama (2004) and Rose (2007). For landslides we also see new methodologies incorporating notions of vulnerability (Sterlacchini, 2007).

In Appendix III we provide an overview of concepts used in the literature, which are related to economic systems vulnerability.

4 Social vulnerability[1]

Social vulnerability is determined by a complex range of social factors and is a multi-faceted concept incorporating issues such as livelihood, housing, security and gender. Social norms and customs, international, national, private and public law may regulate these constituents of vulnerability, and these constituents may differ from country to country. The nature of social vulnerability will depend on the nature of the hazard to which the human system in question is exposed. Much of the early work on social vulnerability was formulated in developing countries where the most vulnerable groups tend to be those who have not met their fundamental needs, such as adequate food, shelter and health care. Vulnerability is therefore seen as a function of social and economic wellbeing and subsequently the term has been applied increasingly within a socio-economic framework. Lately, researchers have seen the value of transferring this knowledge base to developed world contexts (Blaikie et al., 1994).

From a scientific perspective, it would be useful to identify a list of all factors that influence social vulnerability, but from a practical perspective it could be useful to identify from this list a subgroup of factors that could be used to assess, monitor and change vulnerability. Possible criteria that such a subgroup of factors should fulfil include: 1) explain most of the variance in vulnerability, 2) have data that are accessible in a timely manner and at little to no expense (e.g. census data such as the decadal data collected by the US Census Bureau) and 3) able to be influenced through risk communication activities or adoption of protective action measures, including measures that both mitigate a hazard or the effects of a hazard.

There is general agreement in the hazards research community about some primary factors that influence social vulnerability, but there is substantial disagreement concerning the selection of variables that represent the broad concepts of these factors and measures for the

[1] 1 Social vulnerability in this section refers to the vulnerability of the social systems (next to economic systems and possibly institutional, psychological and cultural aspects of vulnerability) and is different from the 'social vulnerability' as presented in the previous Section 1 and Table 1, where the distinction is made between biophysical and social vulnerability. The latter distinction relates to the perception of vulnerability as an exposure (physical) or as a state (social vulnerability).

variables. Some of the key factors thought to influence social vulnerability are summarized below in Table 2 (see also Cutter et al., 2001; Tierney, Lindell and Perry, 1999; Putnam, 2000; Blaikie et al., 1994).

Table 2: Factors that influence vulnerability (*adapted from Cutter, Boruff et al. 2003*)

Factor	**Examples**
Lack of access to resources	*Information* (e.g. of hazards, protective action decision options, etc); *knowledge* (i.e., this translates to more informed and prepared citizens and includes understanding of warning sources (environmental, informal and formal) and mitigation, preparedness and response actions); and *technology* (e.g. warning communication devices such as radios, cell phones, televisions)
Limited access to	Political power and representation
Lack of social capital	Social networks and connections
Beliefs and customs	That neglect or ignore hazards or mitigation of hazards and their effects. Ethno-cultural differences, for example.
Building stock and age	Number, density and type of buildings and whether or not their age predates significant building design codes and enforcement.
Frail and physically limited individuals	Those who are unable to take protective actions or require outside assistance to do so (e.g. very young or old, sick, disabled)
Type and density of infrastructure and lifelines	Urban versus rural areas.

Cutter et al. (2003) developed a list of characteristics that influence social vulnerability that are most often cited in the hazards and disaster literature. This list shows descriptions of the concepts, literature sources, and whether or not the characteristic correlates positively or negatively, or both, with social vulnerability. While the list of characteristics is a good reference for identifying concepts that could be explored to assess social vulnerability, again, there is no wide agreement on the selection of specific variables to measure these concepts.

The growing importance of the social dimension in disaster and hazard management can be well illustrated in relation to flood policies, which until recently was dominated by a technical worldview. Much flood defence has aimed at stopping or alleviating damage occurring through structural means (i.e. defence schemes). In addition, the response to hazards has been a 'command and control' mentality that focused on clean-up and the rescue of survivors. However, the social aspects of flood risk management have gained in importance in recent years (Mileti, 1999a). There is now a realisation that true flood prevention and mitigation will need to address not only the hydrological factors, but also the economic, social and political factors influencing wider society and underpinning the impact of damaging floods (White and Howe, 2002). Response to flooding has also changed to an emphasis on the reduction in loss of life and property through mitigation, preparedness, response and recovery (Cutter et al., 2000). Vulnerability to flooding is now broadly recognised as being a function of both the physical environment and the socio-economic and political context (Parker, 2000). Key among

those factors fostering coping capacity at various phases of the hazard cycle is social capital (Pelling, 1998; Cannon, 2000). Social capital is made up of the networks and relationships between individuals and social groups that facilitate economic well-being and security.

The social vulnerability approach to hazard and disaster management argues that society also creates conditions in which people face disasters differently (Blaikie et al., 1994). Social vulnerability is partially the product of social inequalities (those social factors that influence or shape the susceptibility of various groups to harm and that also govern their ability to respond), however, it also includes spatial inequalities – those characteristics of communities and the built environment, such as level of urbanization, growth rates and economic vitality, that contribute to the social vulnerability of places. Those who are most vulnerable socially are generally expected to be most vulnerable in disastrous events.

Vulnerability is thus intimately related to social processes in disaster-prone areas and is usually related to the fragility, susceptibility or lack of resilience of the population when faced with different hazards. People or communities are resilient or vulnerable in the context of particular situations, especially their risk environments. For example, quality of housing will be an important determinant to a community's vulnerability to a flood but is less likely to influence its vulnerability to drought. People with very different backgrounds/occupations may be equally resilient in totally different situations. For example, a person may be vulnerable to a particular loss such as flooding of their home, but they may have resilience in terms of being insured, having skills to repair damage or personal networks to provide them with emotional support. In this case their resilience is independent of the potential for loss or vulnerability.

Morrow (1999) refers to the social construction of disaster vulnerability and to the social exclusion of some groups in disaster response. According to the literature on social vulnerability, it might be expected that specific social groups within communities, e.g. households with young children, older residents, long term ill or disabled, unemployed, and those on lower incomes or with lower social status, would be particularly vulnerable during hazardous events. These groups are outlined in more detail in section 6 below on Indicators/parameters of socio-economic vulnerability.

However, vulnerability is not static; if someone is deemed 'vulnerable' at the present time, this does not imply this person will remain so (Tapsell et al., 2005). The same applies to the non-vulnerable; people may become vulnerable due to forces or processes such as aging, illness or redundancy, which are independent of adverse events such as floods. In addition, people may become vulnerable as a direct consequence of an adverse event. An example of this would be increased insurance premiums following a flood, which may make the insurance prohibitively expensive, or it may be affordable but only at the expense of some other resource, thus compromising the individual's or family's quality of life.

A number of social science based research studies have been conducted on volcanoes that investigate aspects of social vulnerability and these are certainly increasing at the greatest rate in the young history of volcanology. These studies are often conducted by interdisciplinary teams representing fields of sociology, geology, geography, public health, medical science, public policy and planning. Research questions are often broad but occasionally narrowly defined. Examples of major research topics described in the literature are outlined in Appendix IV (Table IV.a for non-health related topics and in Table IV.b for health related topics).

Major challenges in reducing social vulnerability lie in the need to develop a society that has the knowledge, skills, and resources (material and intellectual) to implement protective actions for health and property, such as occurs when people shelter in place or evacuate. A second major challenge lies in the need to develop an effective volcano early warning system that remains robust in communities faced with a variety of volcanic unrests ranging from slight or background unrest to high intensity eruptions over durations of hours, days, to months, even decades.

Much of the literature related to warnings is not specific to volcanoes and there are two models widely accepted in the USA. First, is the *Protective Action Decision Model* (PADM) of Lindell, Perry and colleagues (Houts, Lindell et al., 1984; Lindell and Prater, 2002; Lindell and Perry, 2004), which draws heavily from emergent norm theory (Turner and Killian, 1987) and behavioral decision theory. Second is the *Warning Response Model* (WRM) of Mileti and colleagues (Mileti and Sorensen, 1990; Mileti and Fitzpatrick, 1992; Mileti and O'Brien, 1992). These models are based on several decades of warning, evacuation, and disaster research literature (Mileti and Peek, 2000; Lindell and Perry, 2004), but they differ in some specific details such as their delineation of *cognitive processes* (a focus of the PADM) and warning *message characteristics* (a focus of the WRM). However, the fact that they are derived from the same basic literature leads them to make similar predictions about disaster response. Since the concept of 'warning' means that the time available to respond is restricted, often to tens of minutes to hours or days (sometimes longer periods of weeks to months at most), effective public response to warning messages requires that actions be taken in the time frame necessitated by the hazard activity. This requires that warnings and responses be engrained in the social and cultural fabric of a population at hazard. This in turn is strongly influenced by characteristics such as age, ethnicity, education, etc.

It is worth noting that social-psychological factors also influence social vulnerability through their influences on decisions to seek information, prepare or respond with adaptive behaviour. Variables in this category include risk perception, self-efficacy (the notion that an individual has the ability to mitigate a hazard or its effects), outcome expectancy (the idea that a hazard or its effects can be mitigated by anyone), trust (e.g. in emergency management authorities), sense of community (feelings of belonging) and attachment to place.

In *earthquake* research, Cole (1994, 1995) applied Social Accounting Matrices in order to estimate the impact of disasters on groups in society.

Finally, a conceptualisation of vulnerability, which has gained in significance in the scientific community in recent years, is that of Cutter et al. (2000) and Cutter (2003). The authors use a conceptual model of vulnerability that incorporates both biophysical and social indicators to provide an 'all-hazards' assessment of vulnerability at the local level. These may be particularly relevant for comparing results from diverse locations and contexts as they incorporate the notion of 'place' which may also correlate with territory.

5 Inter-relationships between socio-economic vulnerability and territorial and systemic vulnerability

Socio-economic vulnerability is intimately related to territorial vulnerability because of the particular historical-cultural evolution of the social and political characteristics of territories which may be identified (e.g. functional urban areas, sub-regions, regions). Hewitt (1997) suggested the uniqueness of territorial vulnerability when he referred to the "geographicalness" of risks (i.e. hazards) and argued the importance of taking into account the interrelationships and distinctive mix of conditions that define human settlements and regions.

Two case studies from the literature demonstrate the importance of the 'territorial experience'; although there are many other similar case studies in the literature (cf. Mitchell, 1999).

Firstly, Parker and Tapsell (1997) demonstrate how, through longevity, London – the oldest of contemporary megacities – has developed a unique perspective on urban hazards with low recurrence intervals because there have been correspondingly more opportunities for through adoption of particular institutional and policy responses.

Secondly, in the context of a dynamic newly-industrializing economy, Chan (1995) reveals how the socio-economic vulnerability of Peninsular Malaysian society is heavily differentiated by the variegated ethnic mix. In this society, where economic vulnerability may be measured by income level, the low income, predominantly rural Bumiputeras (i.e. the indigenous Malays) might be expected to display the highest levels of vulnerability to floods. However, their vernacular 'kampung' house architecture is well adjusted to flooding, and their territorial social capital which includes their strong kinship bonds, make them less vulnerable to flooding than more mobile, higher income Chinese and Indian groups living in less well adapted flood prone urban settings.

Systemic vulnerability refers to physical, economic and social systems which are functionally connected, including at different levels of functioning such as the local/urban and regional systems. Connections may work laterally (i.e. between neighbouring regions) as well as vertically (i.e. between sub-regions and the region, or between regions and the nation). The initial effects of flooding, whether they be physical, social or economic can propagate from one system to another and from one level or region to another so that the initial impact is spread, and increased or magnified.

The impacts of hurricane Katrina on New Orleans in 2005 are a powerful illustration of the systemic vulnerabilities propagated by physical and economic vulnerabilities and the differential fragilities of businesses. The economic impacts on New Orleans, including the collapse of municipal tax revenues, business bankruptcies, the disruption of utilities, the delay of exports due to the closure of the port, and the property damage, spread to the State and on to the federal level temporarily increasing energy prices, reducing annual economic growth by up to 1%, and seriously affecting the global insurance/re-insurance industry.

Against this, construction materials markets and businesses saw gains in the reconstruction phase. Some companies and public agencies with business continuity plans in place faired much better than those who did not, but generally small and medium enterprises may often be

particularly susceptible to loss and bankruptcy. Large companies who had made contingency plans to transfer staff to pre-planned accommodation in another state avoided much loss and disruption. The loss of over 1,800 lives, long-term evacuations of families, loss of communities, business bankruptcies, the problems people encountered in dealings with insurance companies and ill-health caused by the event and its aftermath, are just some of the surface indicators of human suffering and social impacts (Birch et al., 2006).

Similar systemic vulnerabilities are identified in detail in case studies of other floods in the USA, including the Mississippi floods of 1993 (Changnon, 1996) and 1927 (Barry, 1997). Barry's account demonstrates the far-reaching systemic economic, social and political vulnerabilities which a major flood disaster can reveal.

At the national level economic parameters have been used to formulate macro-economic indices for identifying particularly vulnerable territories (Lewis, 1999; Cherveriat, 2000). The UN Development Policy and Analysis Division utilises an Economic Vulnerability Index (EVI) which includes seven parameters including remoteness (i.e. peripherality), merchandise export concentration, instability of agricultural production, and homelessness due to natural disasters (UN Department of Economic and Social Affairs, 2009).

6 Exploration of various interrelationships

6.1 Socio-economic vulnerability and exposure

Exposure is mainly concerned with the population (i.e. number of people) and the value of 'assets' (i.e. homes, businesses, infrastructure), which combine to form an economic system, located in a risk zone (Parker, 1999a). On the other hand, vulnerability relates to the loss of potential values present in this risk zone when resilience (or the capacity to cope with the loss) is taken into account (Parker, 1999b). Both exposure and vulnerability values can be expected to be potentially spatially variable.

Exposure values can be very high, for example, in the centre of cities or in the most economically advanced nations, and such concentrations of assets and wealth can be associated with high economic vulnerability values (for example, where redundancy, robustness and adaptability are poorly-developed) or conversely low economic vulnerability values (for example, where business continuity planning is well-developed leading to well-developed redundancy, robustness and adaptability).

In social terms, spaces with concentrations of high asset values are often associated with high personal wealth leading to low social vulnerability, although in inner cities wealthy neighbourhoods are often closely juxtaposed with poor and disadvantaged ones leading to pockets of significant social vulnerability.

6.2 Socio-economic vulnerability and hazard

A hazard may be regarded as the pre-disaster situation in which some risk of a disaster event exists, principally because a human population has placed itself and its socio-economic system in an exposed situation with overlaid differential vulnerabilities (Alexander, 1993). In this sense, vulnerability stems from the pre-disaster situation, and human vulnerability is a function of the costs and benefits of inhabiting and using risk areas for economic and social gain, although in many developing countries the poor have little choice. When the risk (e.g. a flood) becomes tangible and impending, there is a distinct threat of disaster and disaster can follow. The impact of the disaster is then a function of the magnitude and other characteristics of the hazard, exposure, vulnerability and measures taken to mitigate each of the hazard and its impact.

6.3 Socio-economic vulnerability and damage assessment.

The relationship between socio-economic vulnerability and assessed damages is far from straight-forward. Assessed damage potential can be a poor indicator of economic and social vulnerability to disasters. This will be illustrated in what follows for the case of flooding damage.

Flood damage potential is likely to be high in wealthy communities which may well have large houses filled with consumer goods. Members of such communities may well suffer from a flood, but they are usually well-insured against flood loss, as well as being well-connected and articulate (and thereby able to secure compensation, maximise insurance claims and payouts and generally insulate themselves against crises). Such communities are likely to be much more robust than communities which are poor or less well-off (see Appendix VI). See also Cole (1995) in his application of a social accounting matrix approach to calamity preparedness.

These poorer communities, on the other hand, will generate much lower values for flood damage potential and on the surface this would suggest that their vulnerability is low whereas the opposite may be the case. Unless assessed flood damage potential is adjusted or weighted by social group or socio-economic class, it is likely to provide a misleading measure of socio-economic vulnerability and then there is the risk that investment in flood mitigation measures will flow to the more wealthy areas where the flood damage potential provides high benefits to match high costs.

There are additional reasons why assessed flood damages may initially mislead concerning socio-economic vulnerability. The flood damages which are easiest to assess are usually those which can be readily converted into monetary values, such as the damage to the structure of a building or to its contents. However, research has revealed that the intangible effects of flooding, including health effects, social-psychological and emotional impacts, which are usually not measured in monetary terms may be overlooked or under-estimated.

In the UK and the USA research has shown that the most vulnerable and those in disadvantaged sectors of society are significantly more likely to experience these impacts (Tapsell et al., 1999, 2003; Tapsell and Tunstall, 2001; Tunstall et al., 2006; Green et al., 2007; Rath et al., 2007).