From Risk to Resilience

Working Paper 2

Pinning Down Vulnerability : From Narratives to Numbers

Daanish Mustafa (KCL)
Sara Ahmed, Eva Saroch (ISET-India) &
The Risk to Resilience Study Team

PROVENTION CONSORTIUM

KING'S College LONDON
University of London

ISET

From Risk to Resilience

Working Paper 2

Pinning Down Vulnerability : From Narratives to Numbers

Daanish Mustafa (KCL)
Sara Ahmed, Eva Saroch (ISET-India) &
The Risk to Resilience Study Team

November, 2008

Please use the following reference for this working paper:
Mustafa, D., Ahmed, S., E. Saroch and The Risk to Resilience Study Team, (2008): Pinning Down Vulnerability: From Narratives to Numbers, From Risk to Resilience Working Paper No. 2, eds. Moench, M., Caspari, E. & A. Pokhrel, ISET, ISET-Nepal and ProVention, Kathmandu, Nepal, 28 pp.

This publication is made possible by the support of the ProVention Consortium and United Kingdom's Department for International Development (DFID). The research programme is supported through DFID grant number OHM0837, NOAA award number NA06OAR4310081 and the Canadian International Development Research Centre (IDRC) Centre file 103232-001. Views and opinions expressed within do not necessarily reflect the positions of ProVention, IDRC, NOAA or DFID. The findings, interpretations and conclusions expressed in this paper are those of the authors alone.

First Edition: 2000
November, 2008.

ISBN: 978-9937-8019-7-3

Series editors: Marcus Moench, Elisabeth Caspari & Anil Pokhrel.

Published by: ProVention Consortium, Institute for Social and Environmental Transition and Institute for Social and Environmental Transition-Nepal.

Cover: Thousands of people lost their houses and livelihood following the Kosi embankment breach on August 18, 2008. Photograph of displaced people living in temporary shelters in Nepal Tarai. Photo by Ajay Dixit.

DESIGN AND TYPESETTING
Digiscan Pre-press Pvt. Ltd., Kathmandu, Nepal.

PRINTED AT
Format Printing Press Pvt. Ltd., Kathmandu, Nepal.

Contents

Introduction

The concept of vulnerability has been one of the most insightful and influential additions to hazards and climate change research during the last three decades. While vulnerability analyses from varying intellectual and theoretical perspectives have enriched the conceptual and analytical understanding of the patterns of damage from environmental extremes, their contribution to the policy realm has been peripheral at best. Some of the reasons for the lack of integration of vulnerability in policy include: the dissonance between the policy-makers' concern with aggregate populations at the meso and macro national scales and the vulnerability analyst's general bias towards socially differentiated household and community levels at the micro and meso scale (Mustafa, 2002 and 2004); policy-makers' social position as representatives of the prevailing political and economic structures and many vulnerability analysts' concern with fundamental inequities of the social structures and the need for systemic change (Hewitt, 1983, Wisner et al., 2004); and finally, the general policy-makers' need for simpler, generalized, actionable, preferably *quantitative* information for input into policy process, and the spatially and temporally nuanced, complex, generally *qualitative* information directed towards understanding causation rather than prescribing action generated by vulnerability analyses (e.g., see Swift, 1989; Bohle and Watts, 1993).

This paper presents an empirically tested quantifiable vulnerability and capacities index (VCI) which provides a simple tool for development practitioners and policy-makers to assess vulnerability at scale in disaster and extreme climate risk regions. By defining and quantifying appropriate criteria for the three key dimensions of vulnerability, namely material (income, education), institutional (infrastructure, social capital) and attitudinal (sense of empowerment), the VCI is a comprehensive tool for measuring differential vulnerability at the household and community level in both rural and urban areas. The VCI as it has been developed and field-tested here can be used by NGO teams and community animators to collect baseline information on vulnerability in a village or urban community so as to not only target specific interventions and limited resources at vulnerable households, but also to later monitor impacts and outcomes of the same. In looking at vulnerability at both the household and community level in a given context, whether urban or rural, the VCI provides an objective understanding of the differential dimensions of

vulnerability, i.e. *which* social groups (e.g., dalits, minorities, tribals) and households within such groups (e.g., female-headed or those living in low-lying areas) are more vulnerable than others and *why*.

However, we understand that in trying to quantify a complex and nuanced concept such as vulnerability there will be many competing criteria, scores and weights that can be ascribed and that this index is by no means definitive. In addition, as with any framework or tool, the VCI on its own without supporting narrative on the local context, hazards/risks and social relations is rather meaningless. The reasons why certain households and communities are vulnerable or the rationale behind the numbers need to be explained briefly in order to develop a more complete analysis for the design of policy and development interventions that address vulnerability.

This paper begins with a review of the literature on developing measures of vulnerability. Building upon a critical review of the vulnerability literature, the paper then outlines a theoretically informed and empirically testable quantitative index of vulnerability. Some results of the ongoing field testing of the index are then shared, along with a short note on methodological challenges. The paper concludes with suggesting ways on how a quantitative capturing of social vulnerability could be useful in informing better hazards policy with the ultimate goal of disaster risk reduction and vulnerability mitigation.

Vulnerability: What Can It Be Good For?

The concept of vulnerability, even at the definitional level, has generated considerable debate in the academic community. While the physical scientists and engineers have typically equated it with physical exposure to extreme events and adverse outcomes, on the social [scientific] side the emphasis has been on failure of entitlement to resources, and [social] structural factors making certain groups differentially disadvantaged in the face of disasters (Adger, 2006). Some have attempted to bridge the gap between the physical and social scientific perspectives on vulnerability by proposing the concept of a 'vulnerability of place' where biophysical exposure intersects with political, economic and social factors to generate specific configurations of vulnerability (Cutter, 1996; Cutter et al., 2000). This paper will not engage in or revisit the vigorous, somewhat useful but ultimately unsatisfying definitional debates on vulnerability. Instead, we define vulnerability as susceptibility to suffer damage from an environmental extreme and relative inability to recover from that damage (Mustafa, 1998, McCarthy, 2001), which is the most cited and understood definition of vulnerability, and move on from there. Furthermore, we understand vulnerability to be more of a chronic state of being rather than an outcome of environmental extremes. Therefore, our emphasis will be on defining the metrics for recognizing, measuring and ultimately addressing vulnerability as defined above, instead of revisiting the well known basics.

According to Adger (2006: 277), measuring vulnerability has been an ongoing challenge for vulnerability researchers:

> "Vulnerability research, if it is to contribute to wider debates on resilience and adaptation faces significant challenges, in measurement, in handling perceptions of risk, and in governance. The challenges . . . include those of measuring vulnerability within a robust conceptual framework, addressing perceptions of vulnerability and risk, and of governance."

Anderson and Woodrow (1989) proposed the capacities and vulnerability analysis matrix, which came to be one of the more influential schemas for monitoring the vulnerability of communities and households. The matrix, however, primarily relied

upon qualitative information, and was used by many influential NGOs (ActionAid, 2005; Davis, 2004). Our vulnerability and capacity index (VCI) draws heavily upon the insights of this schema. Others have gone a step further towards devising quantitative vulnerability indices, but most of that work has been at a macro, national scale, relying upon aggregated country level data sets (e.g., Vincent 2004, World Bank 1999). Few have attempted composite vulnerability indices for the smaller community and household level (e.g., Bosher et al., 2007).

Vulnerability research has been good for adding nuance to our understanding of the patterns of damage from hazards, linkages between everyday life and hazards, and parallels between the geographies of injustice, poverty and exclusion and the geographies of damage from hazards (e.g., Cutter, 1996; Mustafa, 1998 & 2005; Pelling, 1998 & 1999; Watts, 1983; Wisner, 1993). But if the concept of vulnerability is to go beyond understanding reality to changing it by contributing to disaster risk reduction and adaptation to climate change, then metrics have to be devised for measuring it. This article is an attempt towards realizing that potential of vulnerability research by formulating a quantitative index for measuring vulnerability. We draw upon theoretical insights from vulnerability research coupled with empirical research, primarily in South Asia, in addition to earlier attempts at measuring vulnerability to formulate the index in the proceeding section.

Geography of Vulnerability: From Narratives to Numbers

Formulation of an index of anything is invariably an exercise in generalization, where one is bound to exclude what many may consider important variables, and present a static snapshot of a dynamic reality (Vincent, 2004), particularly when it comes to such a concept as vulnerability. As Adger (2006: 274) puts it:

> "Measurement of vulnerability must therefore reflect social processes as well as material outcomes within systems that appear complicated and with many linkages that are difficult to pin down . . . the translation of this complex set of parameters [of vulnerability] into a quantitative metric in many ways reduces its impact and hides its complexity."

While the impact of the full conceptual and analytical weight of vulnerability may indeed be reduced by a quantitative measure, its communicative impact particularly in a comparative sense and in terms of relaying critical information for non-expert policy-makers cannot be underestimated. Therefore, difficult as it may be, we are attempting to quantify vulnerability. With the above caveats in mind, we turn to the discussion of rural and urban household level and community level VCIs.

The vulnerability index identifies eleven most critical drivers of vulnerabilities and its converse, capacities from the universe of drivers of social vulnerability identified in the literature. The index is not pretending to be comprehensive, but rather indicative, and because it is concerned with persistent conditions that drive vulnerability, the index does not measure them relative to any thresholds of damage from specific hazards as some other vulnerability indices, e.g., see Luers et al., 2003 and Luers, 2005. The main thematic areas in the VCI are consistent with the thematic areas mentioned by Twigg (2007) under the theme of risk management and vulnerability reduction for resilient communities, in addition to similar quantification exercises by others (e.g., Bosher et al., 2007). Furthermore, Table 1 is specific to household level vulnerability analysis in rural areas, while a modified VCI for rural community level vulnerability analysis is listed in Table 3. In the interest of simplicity and covariance between different components of the index, it is an additive model, thereby avoiding the mathematical problem of a few

TABLE 1 | A composite Vulnerabilities and Capacities Index for the household level in rural areas (RHH-VCI)

	Types of Vulnerability and Indicators	Vul.	Cap.
	Material Vulnerability	**35**	
1	Income Source: If 100 per cent dependent on a local level productive asset, e.g., fishing, land, shop, etc. • Lower vulnerability score by 1 for every 10 per cent of non-local income reported • Subtract 2 if the income source is stable and insensitive to local hazard. • Add 2 to the score if the income source is unstable, e.g., day labour.	10/12	
2	Educational Attainment: If no member of the household is literate • Lower vulnerability score by 1 for every 5 years of schooling of the most educated male member of the household. • Lower the score by 2 for every female member's 5 year schooling.	5	
3	Assets: If none of the assets are immediately fungible, e.g., farm implements, household items • Lower the score by 1 for every Rs. 20,000 of fungible assets, e.g., tractor, animals, savings, jewellery (to be calibrated empirically).	8	
4	Exposure: Distance from the source of prime hazard, e.g., river, coastline, landslide zone. If within the equivalent of 10-yr. flood plain • Lower the score by 1 for the equivalent of every 10-yr. flood plain residence and or assets. • Lower the score by 1 for every piece of evidence of hazard proofing, e.g., building of a house on higher plinth for floods, light construction, low cost construction which could be rebuilt with local resources.	10	
	Institutional Vulnerability	**50**	
5	Social Networks: Membership of ethnic, caste, professional or religious organization or grouping. If none, then • Lower vulnerability score by 2 for every instance of past assistance by a group/organization in adversity. • Lower multiple times if multiple organizations. • Lower score by proportion of respondents reporting the organization to be efficacious.	10	
6	Extra-local kinship ties: If no extra-local kinship or other ties which could be source of shelter and assistance during adversity • Lower the score by 2 for every immediate family member living extra-locally • Lower the score by 1 for every non-immediate family member living outside	5	
7	Infrastructure:		
	Lack of an all-weather road	4	-4
	If seasonal road then		-2
	Lack of electricity	2	-2
	Lack of clean drinking water	2	-2
	Lack of robust telecommunications (mobile coverage)	4	-4
	Lack of local medical facility	4	-4
8	Proportion of dependents in a household:		
	If the proportion is greater than 50 per cent	5	
	• Lower the number by 1 for every additional earning member	or	
	If a single parent headed household	10	
9	Warning Systems:		
	Lack of a warning system	4	-4
		or	or
	Warning system exists but people are not aware of it or don't trust it	4	-4
10	Membership of disadvantaged lower caste, religious or ethnic minority	5	
	Attitudinal Vulnerability	**15**	
11	Sense of Empowerment:		
	Self declared community leadership		-10
	or		or
	Proximity to community leadership		-10
	Proximity to regional leadership structure		-15
	or		or
	Access to national leadership structure		-15
	Lack of access to community or regional leadership	10	
	Lack of knowledge about potential hazards (lower score by 1 for every type of hazard and its intensity accurately listed by respondents)	5	
	Total Possible Vulnerability Score	**100**	

components having too amplified an effect on the overall vulnerability scores, e.g., educational attainment may be associated with community leadership, therefore causing an amplified effect of that variable if it is a multiplicative function. Also, some scores somewhat counter-intuitively may end up being negative, which will indicate an overall capacity for that category. That is just a mathematic quirk, because of the fact that the primary concern with the index is measuring vulnerability. If in a happy circumstance the score is negative, then that would indicate a high level of capacity on the part of the household.

The overall weight distribution of vulnerability drivers between the three categories of material, institutional and attitudinal vulnerabilities is 35, 50 and 15%, respectively. This distribution is roughly consistent with the weights used by Vincent (2004) of 20% for economic wellbeing and stability, 20% to demographic structure, 40% to institutional stability and strength of public infrastructure, and 10% each to global interconnectivity and natural resource dependence for measuring vulnerability of African countries. Since we are operating at the micro scale, our material vulnerabilities category encompasses the first and the last two of her categories, while the demographic structure category is not as applicable at the micro scale or household and communities. Furthermore, general distribution varies slightly as we go from household to community level and from rural to urban areas.

Diverse livelihoods, rather than the quantum of income, is one of the key elements of resilience against environmental hazards (Moench and Dixit 2004). Besides, accurate and comparable field level data on income levels is extremely hard to get. Therefore, the diversity and stability of livelihoods is listed as a key component contributing to capacity and its converse to vulnerability in this case. The maximum score is 10, with an additional 2 conditional upon the stability of the income sources. In urban areas, however, diversity of income sources is a little less important than the absolute magnitude of them, because of the service and industrial based monetized economies of urban areas. There may yet be a safety net for an urban resident if the income is being derived from wage earners overseas or in another cities, therefore the category remains important. Thus in urban contexts the weight of the category will be a conditional 10.

Formal education, as a driver of vulnerability has half as much weight as diverse incomes in rural context., Bosher et al. (2007), for example, investigated the impact of formal education on access to various resources to reduce vulnerability in rural Andhra Pradesh in Southern India and found that while higher education was associated with greater access to public facilities and, to a lesser extent, political networks, people with lower levels of formal education enjoyed a comparable amount of assets and higher access to social networks. Besides, in agrarian economies formal education is not as critical in terms of access to livelihood opportunities or to social capital. So in this VCI the maximum vulnerability score is 5. Of course, formal education can be a capacity for a household and therefore households with more highly educated members can get on the capacity side of the equation, which may offset their vulnerability on other counts. In urban areas, however, formal education is key to gaining access to livelihoods and facilities.

TABLE 2 | A composite Vulnerabilities and Capacities Index for the household level in urban areas (UHH-VCI)

	Types of Vulnerability and Indicators	Vul.	Cap.
	Material Vulnerability	**35**	
1	Income Source: If 100 per cent dependent on a local level employment or productive asset • Lower vulnerability score by 1 for every 10 per cent of non-local income reported • Subtract 2 if the income source is stable and insensitive to local hazard. • Add 2 to the score if the income source is unstable, e.g., day labour.	8/10	
2	Educational Attainment: If no member of the household is literate • Lower vulnerability score by 1 for every 5 years of schooling of the most educated male member of the household. • Lower the score by 2 for every female member's 5 year schooling	10	
3	Assets: If none of the assets are immediately fungible, e.g., farm implements, household items • Lower the score by 1 for every Rs. 20,000 of fungible assets, e.g., tractor, animals, savings, jewellery (will have to be calibrated empirically)	5	
4	Exposure: Distance from the source of prime hazard, e.g., river, coastline, landslide zone. If within the equivalent of 10-yr. flood plain • Lower the score by 1 for the equivalent of every 10-yr. flood plain residence and or assets. • Lower the score by 1 for every piece of evidence of hazard proofing, e.g., building of a house on higher plinth for floods, light construction, low cost construction which could be rebuilt with local resources.	10	
	Institutional Vulnerability	**50**	
5	Social Networks: Membership of ethnic, caste, professional or religious organization or grouping. If none, then • Lower vulnerability score by 2 for every instance of past assistance by a group/organization in adversity. • Lower multiple times if multiple organizations. • Lower score by proportion of respondents reporting the organization to be efficacious.	10	
6	Extra-local kinship ties: If no extra-local kinship or other ties, which could be source of shelter and assistance during adversity • Lower the score by 2 for every immediate family member living extra-locally • Lower the score by 1 for every non-immediate family member living outside	5	
7	Infrastructure:		
	Lack of an all weather road	4	-4
	If seasonal road then		-2
	Lack of electricity	2	-2
	Lack of clean drinking water	2	-2
	Lack of robust telecommunications (mobile coverage)	4	-4
	Lack of local medical facility	4	-4
8	Proportion of dependents in a household:		
	If the proportion is greater than 50 per cent	5	
	• Lower the number by 1 for every additional earning member	or	
	If a single parent headed household	10	
9	Warning Systems:		
	Lack of a warning system	4	
		or	-4
	Warning system exists but people are not aware of it or don't trust it	4	or -4
10	Membership of disadvantaged lower caste, religious or ethnic minority	5	
	Attitudinal Vulnerability	**15**	
11	Sense of Empowerment:		
	Self declared community leadership		-10
	or		or
	Proximity to community leadership		-10
	Proximity to regional leadership structure		-15
	or		or
	Access to national leadership structure		-15
	Lack of access to community or regional leadership	10	
	Lack of knowledge about potential hazards (lower score by 1 for every type of hazard and its intensity accurately listed by respondents)	5	
	Total Possible Vulnerability Score	**100**	

Therefore, in urban areas the maximum vulnerability score will have to be 10 for lack of formal education. Table 2 outlines the household level vulnerability matrix for urban areas. The differences between the rural and urban household indices will be explained as the narrative progresses.

Fungible assets can be important in terms of helping recovery. Earlier research by Mustafa (1998) found that maintenance and selling of farm animals to recover from flood damage was an important and widely reported component of recovery. The element, although important towards recovery, is not as important as diverse livelihoods towards building disaster resilience. The component may also be more difficult to get reliable information on, and to calibrate. In urban areas, however, the weight assigned to the category is reduced to 5 because of the monetized nature of urban economies where fungible assets such as household appliances are not very significant in terms of their resale value and the sale of more valuable items, e.g., jewellery, scooters, land, etc., can seriously undermine the resource picture and mobility of the household.

At the community level in rural areas there is a category for communal property, where collectively owned or managed water, land or forestry resources could be a source of income and resource extraction for communities, thereby allowing recovery from disasters. The category has been given a lower weight because of a lack of documented evidence about the significance of the contribution of communally held properties in recovery and building resilience. In the urban areas, because of a general lack of communal property the category has been dispensed with altogether (Table 4).

Exposure to specific hazards is a component of material vulnerability, but only a component and not the whole picture (Cutter, 2000). As per Cardona (2004: 38)

> ". . . one cannot be vulnerable if one is not threatened, and one cannot be threatened if one is not exposed and vulnerable. Hazard and vulnerability are mutually conditioning situations and neither can exist on its own."

But since environmental hazards are ubiquitous and in fact hazardousness of life is a central theme in some philosophical traditions, particularly the ones with the most influence in hazards research, e.g., pragmatism (Wescoat, 1992), the attention of necessity has to be on the social in addition to the physical component as well. Recognizing the importance of exposure, the weight assigned to measures of it is 10.

Under institutional vulnerability, social networks and social capital have been deemed to be important contributors to building resilience and helping recovery from hazards (Fussel, 2007; Bosher et al., 2007; Twigg, 2007), particularly since they can be conduits for information, preparedness, relief and recovery. Accordingly, under the institutional vulnerabilities and capacities category, evidence of the existence of efficacious horizontal organizations and networks is accorded a weight of 10. Extra-local kinship ties, although important, are difficult to assess in terms of their quality. In the case of the recent earthquake in Pakistani administered Kashmir

TABLE 3 | Community level Vulnerabilities and Capacities Index for rural areas (RCom-VCI)

	Types of Vulnerability and Indicators	Vul.	Cap.
1	**Material Vulnerabilities**	**30**	
	Income Source: If 100 per cent households dependent upon local level asset for livelihood, e.g., land, tractor, fisheries etc.	8/10	
	• Lower vulnerability score by 1 for every 10 per cent of households reporting non-local income		
	• Subtract 2 from the overall score if the income sources reported by more than 50 per cent households are stable and insensitive to local hazard.		
	• Add 2 to overall score if the income sources are unstable, e.g., day labour.		
2	Educational Attainment: If literacy rate is less than 50 per cent then	5	
	• Lower vulnerability score by 1 for every 10 per cent of additional female literate members of the community		
3	Assets: If no collectively owned community assets	5	
	• Lower the score by 1 for every productive collective community asset with open access to community members (will have to be calibrated empirically).		
4	Exposure: Distance from the source of prime hazard, e.g., river, coastline, landslide zone. If within the equivalent of 10-yr. flood plain	10	
	• Lower the score by 1 for the equivalent of every 10-yr. flood plain residence and or assets.		
	• Lower the score by 1 for every piece of evidence of hazard proofing, e.g., building of a house on higher plinth for floods, light construction, low cost construction which could be rebuilt with local resources.		
	Institutional Vulnerability	**50**	
5	Social Networks: Evidence of the existence of equitable, democratic community organization. If none then	10	
	• Lower vulnerability score by 2 for every instance of the community organization helping community members.		
	• Raise the score based on community members' perception of power imbalances in the organization. If the organization dominated by 1 person or family, then the score will be 10. Lower it based on evidence of wider participation.		
6	Extra-local kinship ties: If no extra-local kinship or other ties, which could be source of shelter and assistance during adversity	5	
	• Lower the score by 1 for every 20 per cent of locals reporting extra-local kinship ties.		
7	Infrastructure:		
	Lack of an all weather road	4	-4
	If seasonal road then		-2
	Lack of electricity	2	-2
	Lack of clean drinking water	2	-2
	Lack of robust telecommunications (mobile coverage)	4	-4
	Lack of local medical facility	4	-4
8	Proportion of dependents in a household:		
	If unemployment or under-employment rate more than 50 per cent then	10	
	• Lower the score by 1 for every 5 per cent drop in unemployment rate.		
9	Warning Systems:		
	Lack of a warning system	4	-4
		or	or
	Warning system exists but people are not aware of it or don't trust it	4	-4
10	Community of disadvantaged lower caste, religious or ethnic minority	5	
	Attitudinal Vulnerability	**20**	
11	Sense of Empowerment:		
	Self declared spirit of self help		-10
	or		or
	Access to official levers of power		-10
	or		or
	Access to national leadership structure		-15
	Lack of self help ethos or access to official levers of power	10	
	Lack of information on local hazards (lower vulnerability score by 1 for every 10 per cent of the respondents accurately describing the nature and possible intensity of hazards)	10	
	Total Possible Vulnerability Score	**100**	

TABLE 4 | Community level Vulnerabilities and Capacities Index in urban areas (UCom-VCI)

	Types of Vulnerability and Indicators	Vul.	Cap.
	Material Vulnerability	**35**	
1	Income Source: If 100 per cent households dependent upon local level employment of asset for livelihood, e.g., shop, factory job, etc. • Lower vulnerability score by 1 for every 10 per cent of households reporting non-local income • Subtract 2 from the overall score if the income sources reported by more than 50 per cent households are stable and insensitive to local hazard. • Add 2 to overall score if the income sources are unstable, e.g., day labour.	10	
2	Educational Attainment: If more than 75 per cent of the community is illiterate • Lower vulnerability score by 1 for every 10 per cent of additional reported male literate members of the community • Lower vulnerability score by 2 for every 10 per cent of additional female literate members of the community	10	
3	Assets: If no collectively owned community assets • Lower the score by 1 for every productive collective community asset with open access to community members (will have to be calibrated empirically).	5	
4	Exposure: Distance from the source of prime hazard, e.g., river, coastline, landslide zone. If within the equivalent of 10-yr. flood plain • Lower the score by 1 for the equivalent of every 10-yr. flood plain residence and or assets. • Lower the score by 1 for every piece of evidence of hazard proofing, e.g., building of a house on higher plinth for floods, light construction, low cost construction which could be rebuilt with local resources.	10	
	Institutional Vulnerability	**50**	
5	Social Networks: Evidence of the existence of equitable, democratic community organization. If none then • Lower vulnerability score by 2 for every instance of the community organization helping community members. • Raise the score based on community members' perception of power imbalances in the organization. If the organization dominated by 1 person or family then the score will be 10. Lower it based on evidence of wider participation.	10	
6	Extra-local kinship ties: If no extra-local kinship or other ties, which could be source of shelter and assistance during adversity • Lower the score by 1 for every 20 per cent of locals reporting extra-local kinship ties.	5	
7	Infrastructure:		
	Lack of an all weather road	4	-4
	If seasonal road then		-2
	Lack of electricity	2	-2
	Lack of clean drinking water	2	-2
	Lack of robust telecommunications (mobile coverage)	4	-4
	Lack of local medical facility	4	-4
8	Community unemployment rate:		
	If unemployment or under-employment rate more than 50 per cent then • Lower the score by 1 for every 5% drop in unemployment rate	10	
9	Warning Systems:		
	Lack of a warning system	4	-4
		or	or
	Warning system exists but people are not aware of it or don't trust it	4	-4
10	Community of disadvantaged lower caste, religious or ethnic minority	5	
	Attitudinal Vulnerability	**20**	
11	Sense of Empowerment:		
	Self declared spirit of self help		-10
	or		or
	Access to official levers of power		-10
	or		or
	Access to national leadership structure		-15
	Lack of self help ethos or access to official levers of power	10	
	Lack of information on local hazards (lower vulnerability score by 1 for every 10 per cent of the respondents accurately describing the nature and possible intensity of hazards)	10	
	Total Possible Vulnerability Score	**100**	

(PAK), there is considerable evidence that extra-local kinship ties were important in terms of moral and material support to earthquake affected areas (Khan and Mustafa 2007). However, there is also evidence that sometimes, extra-local family members are either unable or unwilling to extend significant help to disaster victims, possibly because of their own precarious livelihood situations, and can at times become a burden in terms of social obligations rather than an asset (e.g., see Mustafa 2004). Consequently, in the absence of any reliable measures of the quality of the relational ties and the mixed contribution of extra-local kinship ties to disaster recovery, the weight assigned to this category is 5.

The proportion of dependents in the household is similarly considered to be an institutional vulnerability because the effects of it are institutionally mediated. Having a large family by itself is not a bad thing, because of the extra labour that comes with large families in rural settings. But dependents, particularly young children and the elderly, in the absence of social systems for taking care of them, can be a drain on family resources. Therefore, in light of the mixed evidence on this category and avoiding the Malthusian bias for small families, the category is assigned a weight of 5. In the case of single parent headed households, however, because of the clear case for enhanced vulnerability, the weight assigned is 10.

The infrastructural measures are similarly listed as institutional vulnerability, because they are a function of the quality of governance in a society. Accordingly, each of the categories is assigned a weight commensurate with our assessment of their importance in facilitating relief and recovery from the outside, dissemination of information and warning, access to livelihood opportunities and general awareness and empowerment (Moench and Dixit, 2007). Warning systems are, however, a special case where just the existence of a warning system is not sufficient, but rather its credibility and awareness is just as important.

The last category of belonging to an ethnic or religious minority and/or lower caste can be an important factor in determining vulnerability. Bosher et al. (2007), while investigating the impact of caste on vulnerability in India, found that the contribution of caste towards vulnerability was much more complex and mediated by many other factors, e.g., the characteristics of the community they lived in and the lower caste people's access to specialized social networks. Similarly, for ethnic or religious minorities, sometimes specialized networks can facilitate access to resources for relief and recovery in addition to employment and education opportunities, e.g., the Aga Khan network primarily catering to the Ismaili religious community in South Asia and Africa, various church groups helping minority Christian communities in South Asia, as well as Scheduled Caste politicians directing state resources towards their constituencies. Because of this mixed contribution of ethnicity and/or caste towards vulnerability, the weight assigned to the category is 5.

Among the attitudinal vulnerabilities, sense of empowerment is considered to be the key category (Delica-Willison and Willison, 2004). Proximity to local and regional power structures in addition to a personal sense of efficacy - all self perceived - is evidence of a sense of empowerment in the face of adversity. Proximity

to power structures can be very effective in terms of channeling relief and recovery in the aftermath of disasters and even gaining access to government services in addition to critical productive resources which otherwise may not be possible for disadvantaged poor, minority or low caste groups (Mustafa, 2002; Bosher et al., 2007). Furthermore, knowledge about and attitude towards potential hazards can also be critical in determining behaviour and vulnerability to hazards (e.g., see Crozier et al., 2006; Burton et al., 1993). But because perceptions and attitudes are constructed socially, at least at the household level the weight on the variable is 5. The category, however, has a higher weight of 10 at the collective community level both in the urban and the rural areas.

One of the strengths of this VCI is that it looks at the core common drivers of vulnerability across household and community level scales and across rural and urban divides, without changing drastically. Such simplicity can be useful for medium to small NGOs and even government line departments when it comes to monitoring vulnerability. More importantly, the utility of the VCI approach is in terms of mapping vulnerability so as to channel resources and policy interventions where the need for vulnerability mitigation and risk reduction is the highest. Geography of vulnerability, when mapped and recognized by the people at risk as well as the decision-makers, can help bridge the perceptual divide between the two in addition to contributing towards safer societies.

Doing the VCI: A Brief Note on Methodology

Data to compile the VCI can either be drawn from primary sources, e.g., household surveys or focus group discussions for the community level VCI, or from secondary data sources (existing surveys). All the cases that are being shared here are based on primary data collection, usually a simple household questionnaire or a checklist for the focus group discussions. All data collection tools that we developed and used were simple enough for community researchers to adopt, the idea being that they could repeat this exercise six months or one year down the line to look at the impact of the various adaptation or disaster risk reduction interventions. Before undertaking data collection, there has to be thorough discussion of the scoring amongst field team members, and it must be done by at least two field researchers, particularly for some of the more difficult calibrations on livelihoods, assets and exposure. We also recommend that scores and their rationale are discussed in the group before being finalized and the discussions thoroughly documented before being shared with a wider audience.

In the next few sections we discuss the results of the VCI from three different hazard risks and institutional environments: Eastern Uttar Pradesh and coastal Gujarat in India (rural household VCI) and seven urban communities in Rawalpindi, Pakistan (urban community VCI). In all these field areas adaptation pilots are ongoing and the presence of civil society organizations facilitating awareness on disaster risk reduction is significant, particularly in the case of the Indian sites.

The VCI: Insights and Analysis from the Field

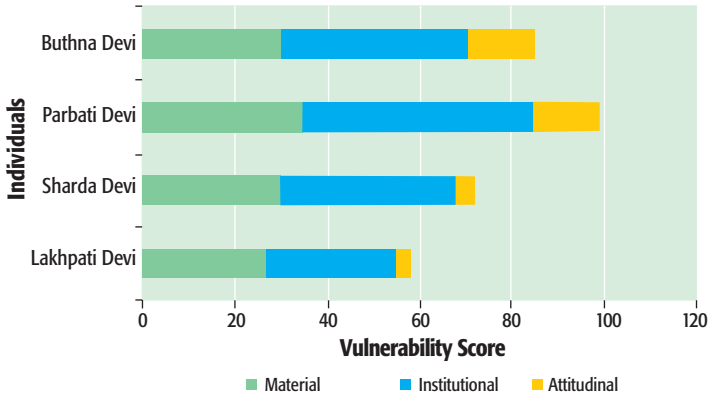
Eastern Uttar Pradesh, India

In order to understand the differential dimensions of vulnerability, we undertook a small pilot assessment of four households from two hamlets in two villages: Akbarpur tola in Aalamchak village and Bandhapur tola in Sonatikar village in the Eastern Uttar Pradesh state of India. In both villages, a local NGO, the Gorakhpur Environmental Action Group (GEAG), has been working on sustainable agriculture, livelihood diversification and access to micro-credit, particularly for women. Average landholdings in the area are less than an acre and about 25 % of the

rural population is landless, working as agricultural labourers or in other non-farm activities.

Figure 1 shows the vulnerability scores for four women from two different villages, flood and drought prone, and institutional affiliations as members or not of self help groups (SHGs). These are the basic organizational mechanisms for facilitating women's participation in a range of development interventions around sustainable agriculture and gender rights by the local NGO, GEAG (see Risk to Resilience Working Paper Nos. 4 & 5).

FIGURE 1 | VCI scores of four women in Gorakhpur district, Eastern Uttar Pradesh, India



It is clear from Figure 1 that the two women who are SHG members, Lakhpati Devi and Sharda Devi, have lower VCI scores than the two women who are not members of any SHG. Though Lakhpati Devi comes from a lower caste background (*chamar* or sweeper community) and has a large family, there is evidence of livelihood diversification: two of her sons have migrated (to Gujarat and Punjab) and do send remittances home, while her daughter works as a daily labourer on the land of a large farmer. In addition, she has access to strong social support networks and extra-local kinship ties, while her work with GEAG on sustainable agricultural techniques and her leadership role in the SHG (chairperson) has given her 'voice' or power in community decision-making forums. Sharda Devi, on the other hand, though also a member of the SHG and coming from a lower caste community (*dalits*), has limited livelihood diversification opportunities or social support networks compared to Lakhpati Devi. Her family of seven includes five school-going children, all dependents. They own less than one acre of land, and apart from occasional work in the brick kilns, have few alternative sources of income.

In the case of the other two women, Parbati Devi is an uneducated widow from the *kevat* (boatmen) caste group (middle caste category) and is the sole bread earner for her large family which includes seven school-going children. She has the highest vulnerability score (almost 100), no assets, no social support networks or extra-local kinship ties and lives virtually in abject poverty, working as a daily labourer and also eking out a living from her small landholding (half an acre). Buthna Devi is also illiterate and from the *kevat* community with a large family, including 11 dependents. She works with her husband on their one acre of land, has a few assets and some extra-local kinship ties which she can call upon at times of need. However, she has limited livelihood diversification opportunities and little institutional support.

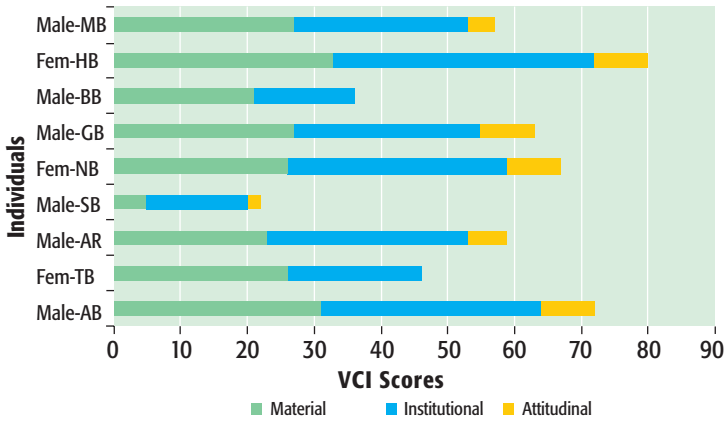
In sum, despite the general low status and vulnerability of rural women in these two villages of Gorakhpur district, the vulnerability index allows us to identify which women are worse off. This assessment has shown that women with access to social networks, particularly extra-local, as well as institutional support (collective

mobilization into SHGs, access to information on agriculture) are marginally 'better off' than those women who lack either or both. In addition, a woman like Lakhpati Devi scores a lower vulnerability total because as the chairperson of the SHG she has access to local/regional governance structures and her involvement in community decision-making provides her with a strong sense of self efficacy/ empowerment. The quantitative index communicates the differential vulnerability and the drivers of that to decision-makers so as to facilitate appropriate action.

Household Level VCI in Three Coastal Villages in Gujarat, India

In the same vein as Gorakhpur, the VCI index was also tested in three coastal communities of Gujarat using a questionnaire designed to address the elements of the VCI index. Overall, 30 households in three villages were surveyed but in the interest of brevity we report the VCI scores of 9 individuals from the survey who represent high, medium and low vulnerability scores in their communities (Figure 2). Selection criteria for the households was purposive and based on our joint understanding of the underlying factors that affect vulnerability: livelihood diversification (farm and non-farm based occupations), physical location and type of house (in a floodplain), gender and social exclusion (female headed household or low caste, tribal or minority) and institutional affiliation (membership in SHGs or village *panchayat*[1] or other community organizations). The three coastal villages from which these nine households have been drawn - Sartanpar, Katpar and Tarasara - are all affected by frequent storms, cyclones, floods and salinity intrusion both as a result of sea level rise (storm surges) and excessive groundwater pumping for agriculture.

FIGURE 2 | VCI scores of selected participants from three coastal villages in Gujarat, India



Livelihood diversification and migration comprise the autonomous adaptation strategies that people engage in while the landscape of community institutions, adaptive infrastructure and social support networks varies across the three villages, constraining the capacity of individuals to respond to disaster risks. Most of the households here are dependent on farm labour - seasonal and insecure - or high risk activities such as fishing and salt farming, which are affected by dangerous storms or annual flooding, respectively. Only two households have access to better/low risk income opportunities, such as teaching, (Male-SB, Sureshbhai, Tarasara village), and running a shop (Male-BB, Bhagatbhai, Sartanpar village) which has a significant impact on lowering their vulnerability scores. These two households also have *pukka* houses (made out of higher quality materials such as bricks or cement) or have raised their plinth to minimize flood damage. In addition, they have access to strong social support networks and community decision-making forums such as the village *panchayat*. The Male-BB is

[1] *panchayat:* group of elected village leaders.

in fact the village *sarpanch* (elected leader), but his vulnerability score has been raised slightly because of the high number of dependents in his family.

In terms of attitudinal vulnerability, Female-TB (Tappuben, Katpar village) scored zero here because she is a member of multiple village organizations including the disaster management committee and the *pani samiti* (water and sanitation committee, a sub-committee of *panchayat*). Despite being an agricultural labourer and living in a *kuchha* house (made of locally available materials such as mud) in a low-lying area of the village, Tappuben has strong social support networks including extra-kinship ties which have helped her at times of adversity. In contrast, Female-HB (Hansaben, Sartanpar village) has one of the highest vulnerability scores in this sample because she is a daily wage labourer, with a high number of dependents, no social support and living in a *kuchha* house in a low-lying, flood prone area of the village.

Community VCI - Gujarat Three Villages

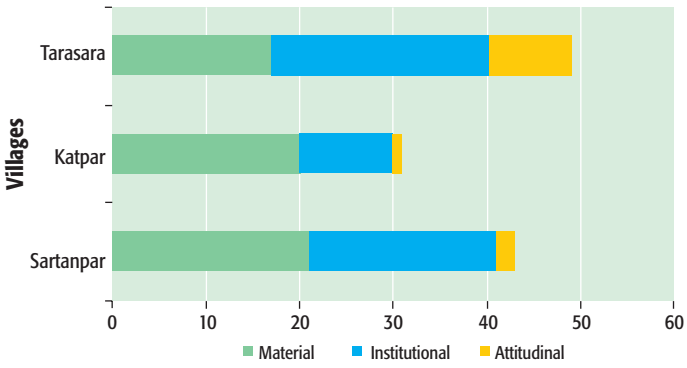
Community level VCIs were facilitated through mixed (men and women) focus group discussions in all the three villages. The community VCI scores are on average lower than the individual household scores which is partly explained by the strong sense of collective mobilization in Gujarat and the relatively more effective functioning of a variety of local institutions including temple groups, self help groups, *panchayats*, disaster committees and a range of community natural resource management institutions (Figure 3). In the village of Sartanpar, for example, despite the high degree of exposure to floods, cyclones and salinity ingress on the one hand, and poor drainage and lack of infrastructure (all weather road, primary health centre) on the other, the village has a range of community organizations and a *sarpanch* who everyone considers active and responsive. In addition, there are a number of women on the *panchayat* (at least seven) and according to other community members, they have a voice and do participate in decision-making.

Katpar village is also prone to floods and cyclones, but has some degree of livelihood diversification - a number of families are engaged in rope making or seek daily work at the onion processing factory in the nearby town of Mahua - but this is not accessible if the road is flooded. Here too, there is a strong sense of collective action represented by a range of community organizations and an active *panchayat* which has been able to negotiate with district level government departments for basic facilities such as a secondary school that girls can attend and a primary health care facility, resulting in the lowest vulnerability score.

In contrast, in Tarasara village, which faces the same physical hazard risks, there is a distinct lack of community organizations and village politics are clearly divided into two factions: BJP (Bharatiya Janata Party), which is the ruling party at the state level, and the Congress, which is part of the ruling United Progressive Alliance at the national level. So strong are the factional politics that it has been difficult for Utthan, a local NGO, to facilitate even the basic SHG, nor does anyone question the functioning or otherwise of the *panchayat*, resulting in the highest community vulnerability score of all the three villages.

In sum, these community level VCI scores clearly indicate the importance of effective, accountable and transparent local governance in reducing disaster risks and facilitating adaptive capacity, given that other conditions - physical risk, literacy, livelihood diversification and infrastructure - remain largely the same in all the three contexts.

FIGURE 3 | Community VCI scores from three villages in coastal Gujarat, India



Community VCI-Rawalpindi Urban Flood Plain, Pakistan

The Lai[2] Basin in the Rawalpindi/Islamabad urban conurbation in Pakistan drains a total area of 244 km^2 south of the Margalla hills, with 55 per cent of the watershed falling within the Islamabad Capital Territory and the remaining portion within the downstream Rawalpindi Municipal and Cantonment limits. Frequent flooding in the Lai Basin affects 400,000 of the poorest residents of the twin cities. Vulnerability analyses were conducted in various neighbourhoods of the city to apprehend the structure and distribution of vulnerability in the downstream Rawalpindi city.

Most of the localities selected for the analysis were physically exposed to flooding hazard and were victims of the previous floods. Despite this bias, a substantial differential in vulnerabilities was found among the communities showing how vulnerability is a complex and multi-layered construct. The community surveyed in Ratta Amral was judged to be the most vulnerable and the one in Dhok Dallal the least vulnerable among the studied communities (Figure 4). The community in Ratta Amral owed its predicament to the fact that it is a tent and mud house community squatting illegally on government owned land. The community members do not even have national identity cards, which are necessary to access almost all government services. Some of the community members are Afghan refugees, who live under constant fear of deportation and have difficulty accessing jobs in the formal sector. The poor infrastructure in the area coupled with their precarious legal status renders the community highly vulnerable.

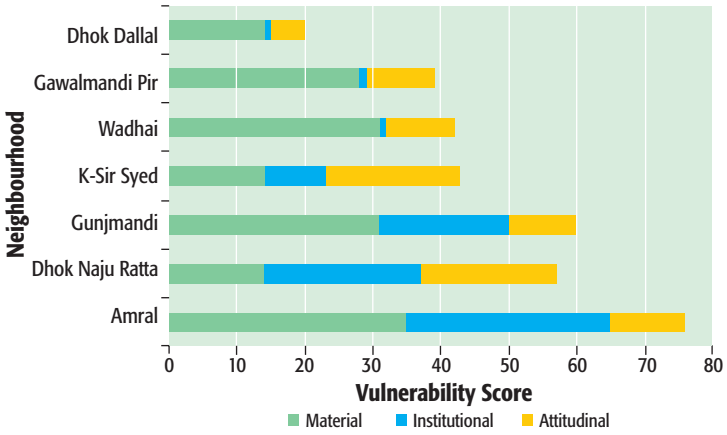
The least vulnerable group hailed from Dhok Dallal where the riverbanks are relatively higher compared to other areas. Most people living there are local with kinship ties in the rest of the city and the better off business and shop owners live on inner streets, away from the river. With a better sense of community in the area organized around a religious organization and with a number of residents serving as civil defense volunteers, the community had very low institutional vulnerability (Figure 4). Social services are better than most areas with six tubewells for drinking water and a hospital. In fact, in all of the three communities that had lower institutional VCI scores, it was the relatively better infrastructure that often cancelled out the vulnerability induced by lack of active community organizations.

[2] This spelling comes closest to the phonetic pronunciation of the name and is most widely used. Other spellings, e.g., Leh and Lei, are also in use.

In most of the neighbourhoods though, the more socially isolated living along with general cynicism about their own efficacy or that of the government yielded relatively higher attitudinal vulnerability scores than were expected. In the poorer communities like Ratta Amral and Gunjmandi, however, a stronger sense of community yielded a relatively lower attitudinal vulnerability score than the more middle class neighbourhoods of K-Sir Syed and Dhok Naju.

The Dhok Dallal community did share the lack of trust in government and faces most of the hazards such as solid waste dumping and rodent infestation but were attitudinally more resilient and actively sought solutions to local problems. They also felt that despite the dismal performance of the local government, partnership of communities with government was the only way forward. The optimism may be based on the fact that one of the members was active in local politics and felt more empowered.

FIGURE 4 | VCI scores from the Lai flood plain in Rawalpindi, Pakistan



The above case studies illustrate the utility of the VCI index in identifying individuals and communities who may be differentially more or less vulnerable. The VCI further helps elucidate the reasons for differential vulnerability and provides avenues for exploring interventions to address the drivers. The type of illustrative data and analysis presented above could help decision-makers spatially and sectorally target their interventions to promote greater resilience in the face of hazards.

Conclusion: Towards the Policy Contours of Hazardscapes

The VCI proposed in this paper can facilitate the communication of vulnerability analysis to policy-makers and hence facilitate disaster risk reduction. The field testing of the index is ongoing. So far the results of the field testing indicate that there is a good congruence between narrative vulnerability analysis and VCI scores; however, further testing and refinement is warranted. It must be emphasized that the VCI is a data organization tool, as well as a data collection tool such as a questionnaire. Any number of data collection tools, from PRAs (participatory rural appraisals) to participant observation to secondary data to basic questionnaires, can be used to obtain relevant data. Additionally, VCI is meant to complement the well known and tested narrative vulnerability analysis not replace them. Furthermore, its main benefit is comparative analysis between households within a community and communities within a region and an urban area rather than an absolute indicator representing thresholds of low, moderate or high levels of vulnerability. If enough data is collected and with significant testing, absolute thresholds of high, medium and low vulnerability could be derived empirically, but they are not built into the structure of the VCI. Lastly and most importantly, the VCI can be critical in mapping household and community vulnerability, thereby allowing formulation and targeting of specific disaster risk reduction related initiatives.

Social vulnerability has been the most elusive when it comes to formulating a universally agreeable definition and indicators of it. The VCI is an attempt at a compromise, but a necessarily limited indicator of it. Quantitative indicators are bound to make some elements unhappy and dissatisfied because it may seem to miss a critical nuance important to them intellectually or in light of their experiences. But if indicators are treated as an approximation of reality rather than the reality then they can be useful. The VCI presented here is probably open to abuse just like any other statistic, e.g., the well known critiques of GDP per capita numbers. But being aware of that susceptibility to abuse and with appropriate caution, the VCI can be an invaluable tool in facilitating the development of a safer environment for the most vulnerable.

Bibliography

ActionAid (2005). Participatory Vulnerability Analysis: A Step by Step Guide for Field Staff, London: ActionAid International.

Adger, W. N. (2006). Vulnerability. Global Environmental Change, 16: 268-281.

Anderson, M. and P. Woodrow (1989). Rising from the Ashes: Development Strategies in Times of Disasters, London: Westview Press.

Blaikie, P., T. Cannon, I. Davis and B. Wisner, (1994). At Risk: Natural Hazards, People's Vulnerability, and Disasters. New York: Routledge.

Blaikie, P. M., and H. C. Brookfield (1987). Land Degradation and Society. London: Methuen.

Bosher, L., E. Penning-Rowsell and S. Tapsell (2007). Resources accessibility and vulnerability in Andhra Pradesh: Caste and non-caste influences. Development and Change 38(4): 615-640.

Burton, I., R. Kates, G. White (1993). Environment as Hazard. New York, NY: Guildford Press.

Cardona, O. D. (2004). The need for rethinking the concepts of vulnerability and risk from a holistic perspective: a necessary review and criticism for effective risk management. In Bankoff, G., G. Frerks and D. Hilhorst (eds.) Mapping Vulnerability: Disasters, Development and People. London: Earthscan, 37-51.

Crozier, M., J. McClure, J. Vercoe and M. Wilson (2006). The effect of hazard zone information on judgments about earthquake damage. Area. 38(2): 143-152.

Cutter, S., J. K. Mitchell and M. S. Scott (2000). Revealing the vulnerability to people and places: A case study of Georgetown county, South Carolina. Annals of the Association of American Geographers 90(4): 713-737.

Cutter, S. (1996). Vulnerability to environmental hazards, Progress in Human Geography 20(4): 529-539.

Cutter, S., J. K. Mitchell and M. S. Scott (2000). Revealing the vulnerability to people and places: A case study of Georgetown county, South Carolina. Annals of the Association of American Geographers 90(4): 713-737.

Delica-Willison, Z. and R. Willison (2004). Vulnerability reduction: a task for the vulnerable people themselves. In Bankoff, G., G. Frerks and D. Hilhorst (eds.) Mapping Vulnerability: Disasters, Development and People. London: Earthscan, 145-158.

Enarson, E., and M. Fordham (2001). From women's needs to women's rights in disasters. Environmental Hazards: Human and Policy Dimensions 3: 133-136.

Enarson, E. and B.H. Morrow, eds. (1998). The Gendered Terrain of Disaster: Through Women's Eyes. Westport, CT: Greenwood Publications.

Fussel, H. (2007). Vulnerability: a generally applicable conceptual framework for climate change research. Global Environmental Change. 17: 155-167.

Hewitt, K., ed. (1983). Interpretations of Calamity, Winchester, MA: Allen & Unwin Inc., 1997. Regions of risk: A geographical introduction to disasters. Harlow, U.K.: Longman.

Khan, F. and D. Mustafa (forthcoming). Navigating the contours of Pakistani hazardscapes; disaster experience vs. policy. In Moench, M. and A. Dixit (eds.) Working with the winds of change: towards strategies for responding to the risks associated with climate change and other hazards. ISET-Nepal and ProVention: Kathmandu, Nepal.

Luers, A.L. (2005). The surface of vulnerability: An analytical framework for examining environmental change. Global Environmental Change. 15: 214-223.

Luers, A.L., Lobell, D.B., Sklar, L.S., Addams, C.L., Matson, P.A. (2003). A method for quantifying vulnerability, applied to the agricultural system of the Yaqui Valley, Mexico. Global Environmental Change 13, 255-267.

Moench, M. and A. Dixit, eds. (2004). Adaptive Capacity and Livelihood Resilience: Adaptive Strategies for Responding to Floods and Droughts in South Asia. Boulder, CO: ISET.

Moench, M. and A. Dixit, eds. (2007). Working with the winds of change: towards strategies for responding to the risks associated with climate change and other hazards. ISET-Nepal and ProVention: Kathmandu, Nepal.

Mustafa, D. (1998). Structural Causes of Vulnerability to Flood Hazard in Pakistan. Economic Geography 74(3): 289-305.

Mustafa, D. (2002). To each according to his power? Access to irrigation water and vulnerability to flood hazard in Pakistan, Environment and Planning D: Society and Space. 20(6): 737-752.

Mustafa, D. (2004). Reinforcing vulnerability? The disaster relief, recovery and response to the 2001 flood Rawalpindi/Islamabad, Pakistan. Environmental Hazards: Human and Policy Dimensions, 5(3/4): 71-82.

Pelling (2003). Toward a political ecology of urban environmental risk: The case of Guyana." Political Ecology: An Integrative Approach to Geography and Environment-Development Studies, eds. Karl S. Zimmerer and Thomas J. Bassett 73-93. New York: Guilford Press.

Pelling, M. (1999). The political ecology of flood hazard in urban Guyana. Geoforum, 30: 249-261.

Pelling, M. (1998). Participation, social capital and vulnerability to urban flooding in Guyana. Journal of International Development, 10: 469-486.

Platt, R. (1986). Floods and man: A geographer's agenda. In Geography Resources and Environment: Themes from the work of Gilbert F. White, vol. 2., eds. R. Kates and I. Burton, pp. 28-68, Chicago: University of Chicago Press.

Simpson, E. and S. Corbridge (2006). Geography of things that may become memories: the 2001 earthquake in Kachchh-Gujarat and the politics of rehabilitation in the prememorial era. Annals of the Association of American Geographers, 96(3): 566-585.

Tobin, G. A. and L. M. Whitford (2002). Community resilience and volcano hazard: the eruption of Tungurahua and evacuation of the faldas in Ecuador. Disasters, 26(1): 28-48.

Twigg, J. (2007). Characteristics of a disaster-resilient community: a guidance note. For DFID Disaster Risk Reduction Interagency Coordination Group.

Vincent, K. (2004). Creating an index of social vulnerability to climate change in Africa. Tyndall Centre for Climate Research, Working Paper 56. University of East Anglia, Norwich, UK.

Watts, M. J. and H. J. Bohle (1993). The space of vulnerability: The causal structure of hunger. Progress in Human Geography 17: 43-68.

Watts, M. J. (1983). On the poverty of theory: natural hazards research in context. In Interpretations of Calamity, ed. K. Hewitt, 231-262. London: Routledge.

Wescoat, J. (1992). Common themes in the work of Gilbert White and John Dewey: A pragmatic appraisal. Annals of the Association of American Geographers 82:587-607.

White, G. F. (1945). Human Adjustment to Floods. Research Paper 29. Chicago IL: University of Chicago, Department of Geography,

_____, (1973). Natural hazards research. In Directions in Geography, ed. Chorley, R. J., 193-216, London: Methuen.

Wisner, B., Blaikie, P., Cannon, T. and I. Davis (eds.) (2004). At Risk: Natural Hazards, People's Vulnerability and Disaster, London and New York: Routledge.

Wisner, B. (1993). Disaster vulnerability: scale, power, and daily life. Geojournal, 30(2): 127-140.

World Bank (1999). Small States: A Composite Vulnerability Index. Small States Conference - St. Lucia February, 17-19, 1999. Retrieved from http://wbln0018.worldbank.org/external/lac/lac.nsf/c3473659f307761e852567ec0054ee1b/629bfda942b112e2852567fc00530409?OpenDocument on Oct. 14th 2007.

Annex I: Working Paper Series

Working Paper Number	Title	Lead Authors	Focus
WP 1	The Cost-Benefit Analysis Methodology	Reinhard Mechler (IIASA)	CBA methods
WP 2	Pinning Down Vulnerability: From Narratives to Numbers	Daanish Mustafa (KCL); Sara Ahmed, Eva Saroch (ISET-India)	VCI methods
WP 3	Downscaling: Potential Climate Change Impacts in the Rohini Basin, Nepal and India	Sarah Opitz-Stapleton (ISET); Subhrendu Gangopadhyay (University of Colorado, Boulder)	Climate downscaling methods
WP 4	Evaluating Costs and Benefits of Flood Reduction Under Changing Climatic Conditions: Case of the Rohini River Basin, India	Daniel Kull (IIASA); Praveen Singh, Shashikant Chopde (WII); Shiraz A. Wajih (GEAG)	India floods
WP 5	Uttar Pradesh Drought Cost-Benefit Analysis, India	Reinhard Mechler, Stefan Hochrainer, Daniel Kull (IIASA); Praveen Singh, Shashikant Chopde (WII); Shiraz A. Wajih (GEAG)	India drought
WP 6	Costs and Benefits of Flood Mitigation in the Lower Bagmati Basin: Case of Nepal Tarai and North Bihar, India	Ajaya Dixit, Anil Pokhrel (ISET-Nepal); Marcus Moench (ISET)	Nepal Tarai and North Bihar floods
WP 7	Pakistan Case Study: Evaluating the Costs and Benefits of Disaster Risk Reduction under Changing Climatic Conditions	Fawad Khan (ISET-Pakistan); Daanish Mustafa (KCL); Daniel Kull (IIASA)	Pakistan (urban) floods
WP 8	Moving from Concepts to Practice: A Process and Methodology Summary for Identifying Effective Avenues for Risk Management Under Changing Climatic Conditions	Marcus Moench (ISET); Sara Ahmed (ISET-India); Reinhard Mechler (IIASA); Daanish Mustafa (KCL); Ajaya Dixit (ISET-Nepal); Sarah Opitz-Stapleton (ISET); Fawad Khan (ISET-Pakistan); Daniel Kull (IIASA)	Methodology summary
WP 9	Understanding the Costs and Benefits of Disaster Risk Reduction under Changing Climatic Conditions	Marcus Moench (ISET)	Summary report

Annex II: Acknowledgements

This paper provides insights from an evaluation of the costs and benefits of disaster risk reduction and adaptation to climate change in South Asia. The report is based on a set of work undertaken in the Nepal Tarai, Eastern Uttar Pradesh, and Rawalpindi, Pakistan. The progamme as a whole is financed by DFID and has been undertaken in conjunction with related activities supported by IDRC, NOAA and ProVention. The support of all these organizations is gratefully acknowledged. Numerous organizations and individuals have contributed in a substantive way to the successful completion of this report. The core group of partners undertaking field work and analysis included: Reinhard Mechler, Daniel Kull, Stefan Hochrainer, Unmesh Patnaik and Joanne Bayer from IIASA in Austria; Sara Ahmed, ISET Associate, Eva Saroch; Shashikant Chopde, Praveen Singh, Sunandan Tiwari, Mamta Borgoyary and Sharmistha Bose of Winrock International India; Ajaya Dixit and Anil Pokhrel from ISET-Nepal; Marcus Moench and Sarah Opitz-Stapleton from ISET; Syed Ayub Qutub from PIEDAR, Pakistan; Shiraz A. Wajih, Abhilash Srivastav and Gyaneshwar Singh of Gorakhpur Environmental Action Group in Gorakhpur, Uttar Pradesh, India; Madhukar Upadhya and Kanchan Mani Dixit from Nepal Water Conservation Foundation in Kathmandu; Daanish Mustafa from King's College London; Fawad Khan, ISET Associate and Atta ur Rehman Sheikh; Subhrendu Gangopadhyay of Environmental Studies Program, University of Colorado, Boulder. Shashikant Chopde and Sonam Bennett-Vasseux from ISET made substantive editorial and other contributions to the project. Substantive inputs from field research were also contributed in India, Nepal and Pakistan by numerous dedicated field staff and individuals in government and non-government organizations as well as the local communities that they interacted with.


9 789937 801973