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Dynamics of Social Vulnerability, Impact and Adaptation to Climate Change

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ABSTRACT

Social vulnerability refers to the susceptibility of individuals, communities and societies to harm from various hazards and their capacity to cope with, recover from or prevent such harm. Social vulnerability to climate change is increasingly being observed in developing countries like India. Climate change severely impacts on the natural and socio-economic systems of developing countries. The objective of this paper is to review a conceptual model of social vulnerability to climate change and understanding the social and economic processes which facilitate and adaptation strategies. Vulnerability is the state of individuals, groups, communities defined in terms of their ability to cope with and adapt to any external stress placed on their livelihoods and well-being. The vulnerability or security of any group is determined by the availability of resources and crucially by the entitlement of individuals and groups to call on these resources. This perspective extends the concept of entitlements developed within neo-classical and institutional economics. Factors like linkages with village level institutions, level of social participation, linkages with non-governmental organization, peer group networks, gender disparities and employment, security in self-employment, mass media exposure, media ownership also plays a major role in reducing social vulnerability regarding climate change and adaptation strategies.

Keywords: *Adaptation, Climate change, Impact, Vulnerability*

Introduction

The idea of social vulnerability is at the center of much research into human adaptation and interaction with the physical environment. Social and natural scientists have trying to attempted to explain the role of hazards and of periodic and extreme events. The evidence assembled for the Intergovernmental Panel on Climate Change (IPCC) 1995 Second Assessment Reports examines the potential climatic threats, but does so by concentrating on the regions or ecosystems which are threatened: forests, agriculture and coastal regions for example. This approach, making both physical and social systems the object of analysis is applied in the Second Assessment Report (Watson *et al*., 1996) to impacts on human health, water resources, ecosystems and physical infrastructure. Human life and livelihood is at risk from natural phenomena such as earthquakes, volcanoes, foods, droughts, tsunamis and other hazards with human origins. In these cases vulnerability has been used to describe the state of exposure, usually associated with a geographical location rather than with individuals or social groups. In applying the concept of vulnerability to outcomes rather than impacts, vulnerability has also been examined in

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relation to food insecurity and famine.

Defining and operationalizing vulnerability

The essential features of a model of social vulnerability to climate change are focuses on social aspects of the phenomenon. An approach to vulnerability based on human welfare leads to environmental changes associated with climate change gaining significance when they have an impact on the relative and absolute well-being of individuals and groups: According to O'Keefe and colleagues (1976), without people, there is no disaster. A theory of vulnerability to climate change must also encompass the collective nature of vulnerability of a group or community to the impacts of climate change, involving a complex set of factors, including the institutional arrangements for preparedness for hazards. With greater numbers of social factors involved in collective vulnerability (gender, ethnic and other differentials of vulnerability (Blaikie *et al*., 1994), as well as the nature of different climate-related hazards, an exclusive focus on economic and material aspects of vulnerability has been argued to be misplaced.

Cannon (1994) agrees that assets tend to be redistributed after a flood or drought in accordance with the pre-existing patterns of ownership (hence income and assets are a suitable indicator of vulnerability), some impacts of events such as floods are not correlated with wealth and economic criteria do not exactly reflect vulnerability. These diverse aspects determining vulnerability can be conceptualized as a set of entitlements: it is the structure or architecture of these entitlements which underpins both security and vulnerability (Adger and Kelly, 1998). These potential rights and reciprocal social coping mechanisms and informal social security are building and often only exactly determined in times of crisis (Platteau, 1991; Moser, 1998; Leach, Mearns and Scoones, 1997).

Social vulnerability to climate change is therefore defined as the exposure of groups or individuals to stress as a result of the impacts of climate change and related climate extremes, following from the definition outlined by Chambers (1989). Stress encompasses disruption to groups or individuals' livelihoods and forced adaptation to the changing physical environment. Vulnerability can therefore be explained by a combination of social factors and environmental risk, where risk is those physical aspects of climate related hazards exogenous to the social system. Vulnerability to climate change involves changes in these parameters over time. Change in social vulnerability from its baseline level incorporates notions of economic development, as well as adjustments to livelihoods based on adaptation to climatic conditions, and changes in institutional and political structures. If institutions fail to plan for changing climatic conditions and risks, social vulnerability increases.

It is helpful to disaggregate social vulnerability into the two distinct aspects of individual and collective vulnerability in order to clarify the scale issue and the unit of analysis. Individual vulnerability is determined by access to resources and the diversity of income sources, as well as by social status of individuals or households within a community. Collective vulnerability of a nation, region or community is determined by institutional and market structures such as the prevalence of informal and formal social security and insurance, and by infrastructure and income. Collective vulnerability is exacerbated by exogenous environmental changes which will occur through climate change. The two aspects of vulnerability are obviously interlinked. At the community level social vulnerability is affected by relative distribution of income, access to and diversity of economic assets and by the operation of informal social security arrangements.

Poverty and vulnerability

Poverty is an important aspect of vulnerability because of its direct association with access to resources which affects both baseline vulnerability and coping from the impacts of extreme events. This aspect of the framework is akin to entitlements analysis, but forms only one component. It is argued here that the incidence of poverty, as observed through the quantifiable indicator of income, is a relevant proxy for access to resources, in its multifaceted forms. Resources and wealth in themselves do not constitute security since resources are mediated through property rights and access to them. Access in this context can be taken to mean involving the ability of an individual, family, group or community to use resources which are directly required to secure a livelihood. Access to those resources is always based on social and economic relations (Blaikie *et al*., 1994). Access to resources is difficult to observe and measure directly however and in that respect is similar to the concept of entitlements to resources (Sen, 1981; Leach, Mearns and

Scoones, 1997). Both are difficult to measure because of their temporal and seasonal dimensions and because they involve transactions and exchanges between different members of households. Poorer people tend to live in more marginal and more hazardous areas, though the causality in this relationship is difficult to determine. Location affects the elements of poverty: in economic terms marginal areas have higher marginal costs of access. Transport to centers of distribution of government social security at times of hazard impacts, and the higher exposure of marginal areas to hazards such as poor housing susceptible to earthquake damage or land prone to flooding are both elements in this spatial vulnerability-poverty interaction.

Resource dependency, social persistence and vulnerability

Resource dependency is an element of individual vulnerability and is constituted by reliance on a narrow range of resources leading to social and economic stresses within livelihood systems. These stresses are manifest in instability and increased variance in income and risk of failure and in social instability as manifest through the impacts of migration. Resource dependency demonstrates the coevolutionary nature of the social and natural systems being examined with social and economic systems themselves being resilient to their apparent vulnerability. Resource dependency relates to communities and individuals whose social order, livelihood and stability are a direct function of its resource production and localized economy (Machlis, *et al*., 1990). But for individuals, choices in livelihoods and social investments are more likely to be observed through income and other variables such as migration which indicate stability at the household level. Yet we can conclude that it is equally important to examine coping strategies employed both by communities and individual members to mitigate the influence of production systems on the social order.

The diversity of income sources, and the variability of those income sources across time, can be used as an indicator of vulnerability at the household level, where it is hypothesized that the greater the diversity of income the greater resilience of livelihood to disruption of particular sources. The variability of income sources due to climatic or other environmental variables can be incorporated through classifying the income sources by climatic dependence thus giving an indicator of the importance of climate to household-level income. Migration is an important factor in resource dependency, but is a phenomenon the presence of which, confusingly, is cited both as evidence for instability and a component of enhanced stability, depending on the type of migration examined.

Inequality as an indicator of collective social vulnerability

At the collective level, social vulnerability is determined by relative distribution of income; access to and diversity of economic assets and by the operation of formal and informal institutional coping mechanisms. Specifically, vulnerability to climate extremes is determined by the formal institutional arrangements which organize warning, planning and other services but also by the institutions of the wider political economy. The relationship between inequality and vulnerability is however, not unidirectional, since it is argued that under certain circumstances inequality facilitates provision of services for the good of communities by those with cumulated assets (Baland and Platteau, 1997). An example here is where a set of wealthier actors can provide and maintain irrigation and water management services in agricultural communities which given absolute equality would not exist. Similarly arguments surrounding the existence of moral economy within agrarian societies focus on the reciprocal provision of the means of survival by landlords and wealthier individuals in times of stress (Scott, 1976). Many of these arguments, however, presuppose that the public goods which are provided come about through provision by some for the benefit of all. Such public goods are associated with best shot technologies.

Many public goods which are associated with environmental risks are however weakest-link technologies, in that the non-provision of these goods jeopardizes all collective security. An example here is the protection of a sea-dike where only one breach is only needed to cause damage across a wide area. Thus inequality and collective vulnerability are directly or indirectly linked as outlined below, in a manner that is dependent on the type of risk involved but also mediated by the institutional arrangements for coping with such risks. The collective aspects of vulnerability involve interaction at various scales, from a single community to a country.

Indicators of institutional effectiveness in ameliorating vulnerability

There are various indicators of vulnerability to climate extremes which influence the climate. Poverty, the use of resources and the distribution of assets and income within a population are all institutionally determined and hence central to a political economy analysis of vulnerability. Since it is formal political institutions that devise and implement the legal enforcement of property rights, all economic structures can be conceptualized as dependent on the institutional structure. In a wider sense, institutions incorporate structures of political power and legitimacy; standard operating procedures; as well as predetermined social commitments and worldviews (Jordan and O'Riordan, 1995). These characteristics of institutions allow examination of how adaptation occurs at the various levels. Adaptation can therefore be observed through changing formal institutional structures and through examination of the perceived legitimacy or lack of legitimacy of institutions and through institutional changes. These characteristics therefore rely on examination of structures of institutions and constraints on their evolution, and on the constraints they exert on individuals and have been termed the institutional architecture (Sanderson, 1994).

The scale of institutional analysis is obviously important within this domain although individuals are constrained by institutions within the dominant political economy, Thompson (1997) stresses the diversity of adaptation to external stresses of both individuals and formal institutions. The most difficult aspect of the observation of institutional change is the assessment of whether the change is appropriate for the external threat or environmental change. Appropriateness can be examined by whether institutional changes are legitimized within the internal or external constituencies and stakeholders of the institutions and whether they are timely or even anticipatory. In the case of hazard impacts this may only be judged when the institutions are put to the test through the real events. The appropriateness of formal institutional arrangements for collective action in circumstances where hazards are a threat may themselves be undermined by reduced keenness of perception (Burton, Kates and White, 1993) of hazards depending on the period since previous impact. The fundamental motivation for collective security enhancement and vulnerability reduction found as an organizing principle for the examination of cultural attitudes within institutions.

Approaching Social Vulnerability and Adaptive Capacity

Social vulnerability has a long history in a number of fields. Research into the impacts of hazards has examined the vulnerability of different groups in relation to events such as earthquakes and floods for many decades. In contemporary climate change research, definitions of vulnerability and adaptive capacity are more variable. Climate change introduces a level of uncertainty and spatial pervasiveness that challenges the traditional view of hazards as containing distinct phases: pre-event, event and post-event or distinct impact zones such as a landfall site or epicenter. In contrast, climate change impacts are long-term, multi-scale and widely distributed, though potentially uneven across time and space. Vulnerability is a function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity and its adaptive capacity (McCarthy *et al.*, 2001). In this luting from climatic variation and sensitivity refers to the susceptibility of potential loss from these impacts. Adaptive capacity is defined as an element of vulnerability that includes the characteristics of communities, countries, and regions that influence their propensity or ability to adapt. These definitions are often represented in the formula:

Exposure + Sensitivity + Adaptive Capacity = Vulnerability

The definition and representation of vulnerability in this formula has significantly influenced the design of vulnerability assessments as it forces us to consider how different factors contribute to vulnerability. However, as recognized in the most recent IPCC report (2014), conceptualizing vulnerability in this simple linear formula neglects the broader social, political, and economic forces shaping how a community is affected by natural disturbance.

Systems-Oriented Approaches to Social Vulnerability

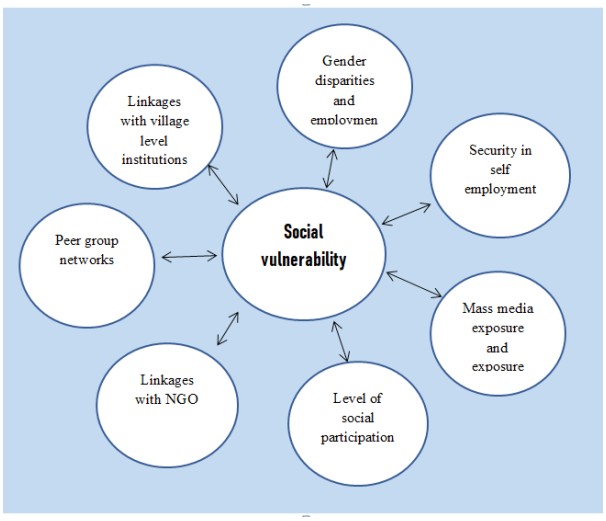
Most of the researchers focused on the vulnerability and adaptive capacity of systems. Much of work draws on the social-ecological systems literature that attempts to conceptually couple human and natural systems (Gunderson and Holling, 2002; Berkes, 2007). Focus of this framework was feed-

backs, linkages and resilience. Feedbacks refer to processes that reinforce or modify the behavior of a system and how a community changes behavior in response to a fire event. Systems approaches use the concept of linkages to refer to the connections or points of interactions between different elements of a system, such as the way management and forest communities are partially integrated, or the relationship between fish stocks and quotas for fishing in a marine system.

Resilience refers to the ability of a system to undergo change while maintaining the capacity to retain, re-organize, or regain the same structure and function prior to disturbance. These concepts illustrate the dynamic and relational dimensions of adaptive capacity and vulnerability as they direct attention to the interactions among aspects of a system and how they change over time. The focus on linkages and feedbacks within social-ecological systems highlights how vulnerability can emerge from social or ecological processes and the interconnections between these two domains (Nelson and others 2007). The focus of a systems-oriented approach continues to center on exposed units with "units" contextualized within broader systems (or even with systems as exposure units). Problematically, much of this work also continues to conceptually divorce social systems from natural ones. For instance, climate change is often positioned as an external threat to the system rather than as a system-generated disturbance. This is an important point because what is included or excluded from the definition of the system can shape how we think of vulnerability and adaptive capacity. Moreover, a systems approach so far has also encountered significant difficulties in dealing with issues of social or political power and may overlook the fact that different individuals, communities and organizations have unequal abilities to act and adapt to change (Davidson, 2010; Thornton and Manasfi, 2010).

Outcome Approaches to Social Vulnerability

Outcome approaches tend to follow along two lines: starting point and end point research (O'Brien *et al*., 2007). Starting point assessments begin by identifying sensitivity (the susceptibility to potential impacts) to exposure (the magnitude of the impact) in relation to a community's capacity to respond to stress. Accordingly, vulnerability is envisioned as a condition inherent in certain populations. While this is similar to the actor- and system-oriented approaches, in an outcome-oriented approach, the focus is on the populations themselves rather than the broader system in which they are situated. The assumption is that certain characteristics, such as poverty, lack of education, or minority status, make certain groups inherently more vulnerable to the impacts of climate change (see Lynn *et al.*, 2011 for a detailed discussion of how demographic characteristics influence social vulnerability). The strength of this research is that it enables a rapid assessment of sensitivity, or the differential or uneven impacts of climate change on human communities. That said, sensitivity is seen largely as a fixed characteristic or set of attributes rather than as dynamic and emerging from a complex context that produces both vulnerability and adaptive capacity. In contrast, end point assessments focus on exposure. Future vulnerability is assessed in response to a specific event. Analysis begins with projections of future emissions trends, which are then used to understand biophysical impacts and the susceptibility of different regions, groups, or sectors to specific losses generated by those impacts. Both starting point and end point approaches see vulnerability as an outcome of a climate stressor on a vulnerable population rather than the broader contextual approaches that consider vulnerability to be a function of a broader array of processes.



Contextual Approaches to Social Vulnerability

Contextual approaches envision vulnerability and adaptive capacity as highly contextualized within social, political, economic, and ecological contexts at multiple scales from local to global. In particular, a contextual approach examines institutional con-

straints, social and economic barriers, and underlying historical processes and the differential capacities and sensitivities these induce. Context-oriented research is more complex in its considerations than outcome-oriented approaches, examining the various ways that vulnerability and adaptation are constrained or enabled (largely reflecting the list by Yohe and Tol 2002). As such, contextual approaches typically consider governance issues (Adger *et al*., 2009). At the community level, adaptation measures must take into account the will of local citizens, nongovernmental organizations, and local governing bodies. Wall and Marzall (2006) and Zarhan and others (2008) highlighted the ways in which governance influences the relevance, credibility, and legitimacy of different actions to local communities that are seen as critical to formulating potential course(s) of action. A number of works have also highlighted the importance of top-down governance issues in shaping adaptive actions at the local scale (Eakin and Lemos, 2006; Pahl-Wostl, 2009). In the case of national forests, both top-down federal policies and initiatives and local community- and Forest

Factors like linkages with village level institutions, level of social participation, linkages with nongovernmental organization, peer group networks, gender disparities in education and employment, security in self-employment, mass media exposure, media ownership also plays a major role in reducing social vulnerability regarding climate change and adaptation strategies.

Participatory Approaches

Through stakeholder consultation and public engagement processes, participatory approaches seek local definitions of the hazards, risks, and uncertainties that pose threats and how they might manifest in locally meaningful ways (Tompkins *et al*., 2008). A participatory approach in a community might involve local stakeholders in developing a list of local vulnerabilities and context-appropriate means to measure these vulnerabilities. Participatory assessments often utilize both case study research and indicator assessments. Because local stakeholder involvement builds a rich understanding of local context, participatory approaches allow for the recognition of multiple, complex, and overlapping sources and determinants of vulnerability and adaptive capacity. Moreover, this kind of assessment creates the kind of "buy-in" that is necessary to move research results into management actions and policy change to reduce vulnerability and build adaptive capacity. However, like case study approaches, results are highly contextualized and case specific and thus may not be more broadly generalizable. This poses a problem for scaling up and applying findings to other contexts.

Conclusion

Vulnerability research illuminates the different capacities that individuals and communities have to adapt and how those capacities might be strengthened. Vulnerability research helps understand the "multiple and interacting social and environmental stressors" that create climate change impacts. Improved knowledge of social vulnerability will help national forests engage local communities in climate change adaptation planning that benefits both ecosystems and human communities. Climate change is an irreversible change in the climatic conditions which puts the agricultural food production system and food security at risk. As far as the different categories of farmers are concerned, the small and marginal farmers are socially more vulnerable to climatic risks than the medium and large farmers because of their weak economic and social conditions irrespective of the development levels of selected villages. In this context, adaptation is the key to reducing the severe climatic impacts and building the resilience of the agricultural system. This will help the policymakers to achieve the goal of sustainable.

Conflict of Interest- None

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