



Social Vulnerability to Climate Change and Extremes in Coastal Vietnam

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Summary. — A framework for analyzing social vulnerability is outlined, an aspect largely underemphasized in assessments of the impacts of climate change and climate extremes. Vulnerability is defined in this paper as the exposure of individuals or collective groups to livelihood stress as a result of the impacts of such environmental change. It is constituted by individual and collective aspects which can be disaggregated, but are linked through the political economy of markets and institutions. Research in coastal northern Vietnam shows that baseline social vulnerability is enhanced by some institutional and economic factors associated with Vietnam's economic transition from central planning, namely the breakdown of collective action on protection from extreme events and an increasingly skewed income. Offsetting these trends are other institutional changes associated with the dynamic nature of the economic restructuring and evolution of the market transition in Vietnam, which decrease vulnerability. © 1999 Elsevier Science Ltd. All rights reserved.

1. INTRODUCTION

This paper outlines a conceptual model of social vulnerability to climate change in order to better understand the processes of social adaptation to climate change impacts, particularly in rural agrarian societies, by examining present day vulnerability to extreme events. Social vulnerability is the exposure of groups or individuals to stress as a result of social and environmental change, where stress refers to unexpected changes and disruption to livelihoods. This definition emphasizes the social dimensions of vulnerability following the tradition of analysis of vulnerability to hazards, food insecurity and as a dimension of entitlements. This is in contrast to the predominant views on vulnerability to the impacts of climate change which concentrate on the physical dimensions of the issue. A set of indicators is developed to examine the relative vulnerability of any given set of individuals or social situation. These concepts are applied to a case study District in northern Vietnam, demonstrating that present day climate extremes as well as social and economic change result in an evolving state of vulnerability with offsetting

and interlocking social, economic and institutional facets.

There is a critical need to understand the processes by which adaptation to global environmental change comes about, and the implications of these processes for present day vulnerability to these changes. Such enhanced understanding informs both the scientific community and policy makers of the underlying causes of vulnerability, and the potential policy for ameliorating such vulnerability.

At present there is agreement, at least in principle, by the world's governments that

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human impacts on the global climate system are significant. They further agree that these impacts are important enough to demand co-ordinated international action. But the years since the signing of the UN Framework Convention on Climate Change at the Earth Summit in 1992 have resulted only in frustration that this apparent scientific consensus is undermined by inaction such as that demonstrated at the Kyoto Agreement of the Convention in December 1997. The continued global rise in greenhouse gas emissions projected for the late 1990s and the early part of the next century will ensure that global climate change will not be avoided (Wigley, Richels and Edmonds, 1996). Even if there were concerted international action, however, the projected impacts of the enhanced greenhouse effect, namely changes in the global climate system, will occur. The world is therefore committed to adapting to a changed climate system in all its manifestations. This makes the understanding of adaptation and coping mechanisms, and hence the state of vulnerability, one of the most important research issues within the area of global environmental change.

The central insight brought by social scientists to the process of adaptation is that vulnerability is socially differentiated. The origins of the term can be traced through analysis of famine, hazards and entitlements, where the term has been applied in describing the state of individuals and societies coping with variability and stress (for applications and history of the concept see Ribot, Najam and Watson, 1996; Leach, Mearns and Scoones, 1997; Downing, 1991; Chen, 1994; Adger, 1996; Bohle, Downing and Watts, 1994; Watts and Bohle, 1993). Vulnerability is a state of well-being and is not the same for different populations living under different environmental conditions or faced with complex interactions of social norms, political institutions and resource endowments, technologies and inequalities. The causes of vulnerability are related to the environmental threat and fundamentally to the economic and institutional context. Indeed changes in the social causes of vulnerability often happen at much more rapid temporal scales than many environmental changes (Watts and Bohle, 1993).

The impacts of extreme climate events are the principal climate phenomenon which enhance vulnerability, though vulnerability refers to the outcomes of these impacts (Downing, 1991). Since it is climate extremes which are impor-

tant, understanding of vulnerability to climate change should be based on the analysis of present day vulnerability informed by historical perspectives (Adger, 1996). High and uncertain impacts from extreme climate events are a global phenomenon and can only be ameliorated to a limited extent by technological advance and enhanced resources and income (Burton, Kates and White, 1993). Indeed, the institutional context of vulnerability to extreme events is a key determinant of vulnerability. As Ben Wisner highlighted 20 years ago, in the context of hazards more generally:

The systematic comparison of individual and societal response to disaster in social formations dominated by different modes of production (e.g., feudal, capitalist, socialist) is a potentially rich scientific undertaking, but one largely neglected (Wisner, 1978, p. 80).

The area has indeed remained largely neglected in the 20 years since then, as evidenced by recent assessments of physical vulnerability to climate change. 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. For example, the IPCC report estimates that 46 million people per year are currently at risk from flooding due to storm surges in the world's coastal zones, and that climate change induced sea level rise, in the absence of adaptation, could double this figure (IPCC, 1996, p. 12). The IPCC assessment provides generic guidelines for appraising multiple threats in a single region, but does not, however, address what Wisner (1978) was alluding to: namely differentiated social vulnerability under different threats and under different economic and institutional circumstances; and the coevolution of those economies, institutions and social orders with the climate system.

The idea of social vulnerability to external change and stress is at the center of much research into human adaptation and interaction with the physical environment. This is particularly the case where social and natural scientists have attempted to explain the role of hazards and of periodic and extreme events.

Human life and livelihood is at risk from natural phenomena such as earthquakes, volcanoes, floods, droughts, tsunamis and other hazards with human origins (e.g., Varley, 1994; Hewitt, 1997). 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 relation to food insecurity and famine (Downing, 1991; Watts and Bohle, 1993; Bohle, Downing and Watts, 1994).

Within social science approaches to hazards the concept of vulnerability has been developed by Hewitt (1983) and others, providing a challenge to what they regarded as a dominant view which described the causality of risk from hazards as "running from the physical environment to its social impacts" (Hewitt, 1983, p. 5). Thus even social science analysis of hazards, up till the 1980s, were primarily "technocratic" and prescriptive, by incorporating the human element in hazards as an input to designing planning, warning and coping systems. The radical reversal suggested by Hewitt (1983) and others, was to emphasize economic and social structure as a cause of vulnerability, rather than as a contribution to hazard mitigation. The causes of vulnerability to hazards under the Hewitt (1983) approach are therefore lack of access to resources: poverty and marginalization translate into vulnerability through the mechanisms of coping behavior and stress. The credence of this approach is reflected in later work by Kaspersen *et al.* (1995), who review the concepts surrounding vulnerability in the context of an assessment of critical "regions at risk" from environmental change. They conclude that vulnerability "appears to be emerging as the most common term in... discussions of the differential susceptibility of social groups and individuals to losses from environmental change" (Kaspersen *et al.*, 1995, p. 11).

The origins of the use of vulnerability to describe the state of society environment interactions under stress lead to a number of general observations on vulnerability which can be applied in the climate change context. Vulnerability has an historical and time dimension; it is related to economic aspects of livelihood and land use; power and political dimensions are important in contextualizing vulnerability; and individuals and groups exhibit differential vulnerability. In addition, extreme events are the key climate change context. Thus vulnera-

bility for individuals or groups can change over time; is differentiated between and within groups through their institutional and economic position; and is affected by environmental change. Existing policies and practices in agriculture, forestry and coastal resource management, as well as inequitable distribution of productive resources, in themselves can have perverse effects of increasing vulnerability, and hence can be "maladaptive" (Burton, 1997). Stress, under this definition, is associated with unplanned disruption and can incorporate the coping and recovery aspects of vulnerability.

The social vulnerability approach developed in this paper integrates both economic and other social science perspectives to vulnerability. It is also novel in applying these concepts in the context of long-term environmental change associated with climate change. The empirical research is based on present day risk rather than scenarios of future risks. Hence the model is relevant for climate risk assessment, and represents a departure from the approaches within assessments of the impacts of global climate change to date.

2. DEFINING AND OPERATIONALIZING VULNERABILITY

(a) *A definition*

The essential features of a model of social vulnerability to climate change is first, that it 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: in the words of 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 — see 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. For example, while 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 (Cannon, 1994, p. 28), 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 fluid 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 in this paper 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 are 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. *Indi-*

vidual 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 (Table 1). 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. Further, vulnerability to climate extremes is determined by the institutional arrangements which organize warning, planning and other services summarized as "collective" vulnerability in Table 1. The major indicators of vulnerability are poverty and resource dependency at the individual level and inequality and institutional adaptation at the collective level. The rationale for these and their observation and measurement are now discussed.

(b) *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

Table 1. *Collective and individual vulnerability to climate change: determinants and indicators*

Type of vulnerability	Causes in relation to climate extremes	Indicators of vulnerability
Individual vulnerability	Relative and absolute poverty; entitlement failure; resource dependency	Poverty indices; proportion of income dependent on risky resources; dependency and stability
Collective vulnerability	Absolute levels of infrastructure, development; institutional and political factors – insurance and formal and informal social security	GDP per capita; relative inequality; qualitative indicators of institutional arrangements

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, p. 48).

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. So, for example, households have the right to obtain credit in flood years in coastal Vietnam as long as they have maintained economic contributions to the agricultural co-operative. This right or entitlement is only observable, however, when those circumstances arise because it is, more often than not, only a customary or verbal agreement. Similarly, the informal assistance between Communes in Vietnam may be concentrated among war veterans or other specific groups or associations. Again, these potential rights and reciprocal social coping mechanisms are fluid and often only exactly determined in times of crisis.

In addition, some aspects of access are spatially manifest, but again are correlated with poverty. 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.

Access and entitlement to resources also have temporal dimensions, in that access to resources is a prerequisite for recovery from the impacts of hazards. In addition, entitlements to resources extend the period before which a hazard results in emergency coping strategies, such as migration or the selling of nonproductive assets. Access is secured through rights and responsibilities which themselves change over time. The impacts of hazards on households include injury or mortality; temporary or permanent migration due to perceived risk or ac-

tual loss of land or other resources; and the loss of other capital and infrastructure. The net result of all these impacts is therefore on changes in poverty, through resulting lack of labor or capital. Such temporal changes in access to resources lead to a "ratchet effect" (Chambers, 1983) in poverty, translating ultimately to changes in baseline social vulnerability over time.

Given certain conditions, poverty is a meaningful proxy for access to resources, and income is a good proxy for poverty. The state of income or consumption reflects, but is not exactly correlated with, the access to resources. The limits to this relationship are dependent on what Sen (1984) defined as entitlements, "the set of commodity bundles that a person *can* command in a society using the totality of rights and opportunities that he or she faces," and which are in fact bound by legality or custom. In other words, opportunities to avoid poverty (such as by raising income) are often constrained by rights to buy or sell resources. As an example, households in coastal areas may have rights to subsistence use of products extracted from mangroves, but are legally barred from trading in these commercially. The household's apparent income poverty does not in this case reflect lack of access to the resources, but rather lack of access to markets. Nevertheless, lack of income or lack of consumption captures many aspects of lack of resources, particularly where many goods and services are exchanged in markets.

Poverty is used in this study as an important indicator of individual vulnerability to climate extremes and to climate change, because poverty can be directly related to marginalization and lack of access to resources which are critical when faced with the risk of hazards and the resultant stress on livelihoods. Income is taken as an economic indicator of poverty, recognizing that this is an external measure but one which correlates with other aspects of poverty relevant for vulnerability, such as health indicators (Glewwe and van der Gaag, 1990). Poverty definitions can both encapsulate "basic needs" in some absolute sense at one extreme, with 'relative deprivation' as a subjective measure at the other extreme (e.g., Baulch, 1996; Blackwood and Lynch, 1994). Income is replicable and comparable across differing groups, however, and over time in particular locations, and thus a relevant indicator providing a picture of how baseline vulnerability changes over time and space.

Poverty is therefore one aspect of vulnerability which, given the assumptions here, can be quantified and to which perceptions of risk can be grounded. Poverty affects vulnerability through individuals' expectations of the impacts of hazards and their ability to invest to alleviate risks; and affects the coping and recovery from extreme events through directly constraining opportunities for coping and reducing the resilience to impacts.

(c) *Resource dependency, social resilience 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 of particular sources; and in social instability as manifest through, for example, the impacts of migration. Resource dependency, in this sense, 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, Force and Burch, 1990; Adger, 1997b). 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. So, for example, Machlis, Force and Burch (1990 find correlations at the community level between social variables and resource production for forestry and mining resource dependent communities in the United States. Yet they 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" (Machlis, Force and Burch, 1990, p. 421).

Resource dependency in this context can be characterized as dependent on the structure and diversity of income, social stability and resilience. Dependency and its implications can be observed through a combination of reliance on climate dependent resources; variability in such income sources; and migration and other social variables associated with stability and resili-

ence. 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. This confusion arises because migration occurs for a plethora of reasons, which are often classified as "push" and "pull" factors. Push migration is that movement of people caused by a deleterious state of affairs in the home locality (such as loss of assets), where pull migration is the demand to move caused by attractive circumstances elsewhere (often in urban areas).

Migration of part of the available labor in a household which results in remittances to the household are generally undertaken for the purpose of *reducing dependency* and enhancing livelihood security and opportunities (Ellis, 1998; Stark, 1991). Where a whole household migrates, such action is often associated with coping with extreme events, and often occurs as a last resort (Davies, 1996). This second type of migration is not easily captured within a study of baseline vulnerability as the households have moved from the location, thereby, in certain circumstances, masking the true extent of vulnerability of a community by biasing any sample toward remaining households. Livelihood stability can, however, be enhanced through remittances associated with migration and paid employment. A feature of remittance income is that it is generally not dependent on local environmental conditions: remittance income is usually derived from urban sources or sometimes from agricultural, forestry or fisheries income in some other region.

Those parts of a population who are resource dependent tend to be poorer and also politically marginalized (Bailey and Pomeroy, 1996). Many households in agrarian economies are characterized however by their diversity of livelihood sources with this diversity having

many determinants and impacts (Ellis, 1998). Diversifying income sources may be a strategy for reducing dependency and vulnerability of individuals at the household level, but can also result, it is argued, in increased vulnerability (e.g., Berry, 1993; Ellis, 1998). Observing dependency therefore requires examination of the links between diversification and poverty, through for example distinguishing household characteristics of the poor; through presenting information on informal economic activities and their intrahousehold aspects; and by reference to demographic factors. Thus social vulnerability to climate extremes at the individual or household level involves all aspects of resource use dependency and political economy associated with access to resources and ultimately to livelihood entitlements. A key issue in observing vulnerability is that the dynamic nature of the phenomenon is difficult, but not impossible, to capture.

(d) *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 (see Baland and Platteau, 1997, for example). 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 (e.g., 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" (see Sandler, 1997 for a review).

Many public goods which are associated with environmental risks are however "weakest-link technologies," in that the nonprovision 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. The level of infrastructure, institutional preparedness, and other factors important in the implicit collective vulnerability of a country, region or community may not be accurately reflected in measures of economic activity. Increasing inequality over time within a population, or between different parts of the population, increases collective vulnerability to climate change. Such changes in inequality are linked to the reduction of communal allocation of resources and the pooling of risk, and other social phenomena associated with the "moral economy." In addition, inequality and vulnerability linkages are associated with relationships between inequality, diversification of income sources and poverty. In other words, inequality affects vulnerability *directly* through constraining the options of households and individuals when faced with external shock; and *indirectly* through its links to poverty and other factors.

The direct links between inequality and vulnerability, as demonstrated in the upper part of Figure 1, concern the concentration of resources in fewer hands, constraining coping strategies based on private resources for households faced with external stresses. As has been shown under conditions of drought in agricultural societies, both income (immediately accessible resources) and wealth (disposable capital assets) are important in coping strategies (Watts, 1991; Davies, 1996). Hence distribution directly affects the ability of households as part of the community, to cope with the impacts of extreme events. The impact of skewed access to resources can be ameliorated in all social situations by the effectiveness of institutions.

The indirect link between inequality and vulnerability, in the lower part of Figure 1, is through skewed accumulation being associated with increased levels of poverty, and hence insecurity. Once again this is a complex issue

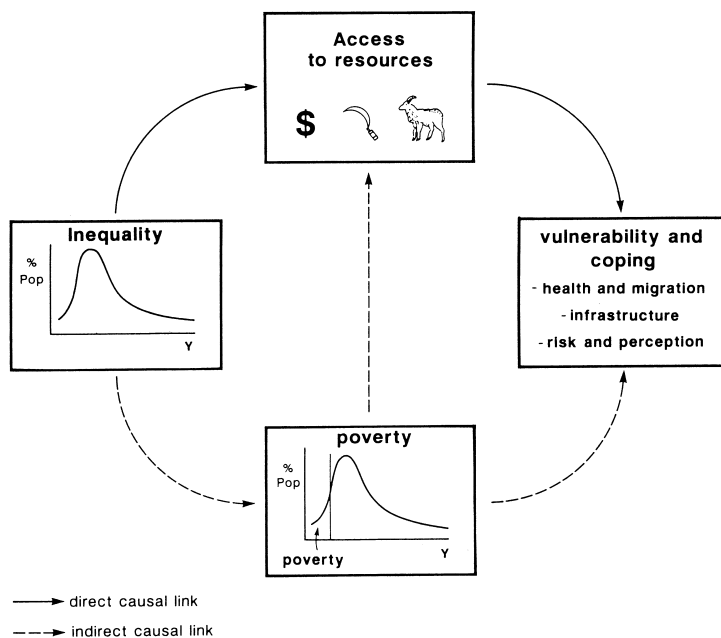


Figure 1. Direct and indirect links between inequality and vulnerability.

whereby rising inequality does not necessarily *cause* poverty, but both poverty and inequality are jointly associated with *constraints* on coping strategies. An example of such a constraint is where wealth concentration confines access to credit to certain sectors of the population, thereby *reinforcing* income poverty and enhancing vulnerability.

The importance of the indirect link between inequality and vulnerability is illustrated by the common argument that reducing inequality in the long term reduces poverty. There is, however, no underlying theory which predicts the relationship between inequality and poverty (Reardon and Taylor, 1996). In terms of the ability of households within a population to cope with external stresses and the causes of vulnerability, the diversity of income sources is also an important factor. At the micro-level, there is no fundamental predetermined relationship between inequality, poverty and income diversification.

The reasons for investigating poverty, inequality and institutional adaptation, and the connections between them, is to identify barriers and strategies for alleviating vulnerability to external shocks. When poverty and inequality are determined by a common constraint, such as access to labor markets, then there is a

“natural complementarity in policies to reduce poverty and inequality” (Reardon and Taylor, 1996, p. 902). By contrast if diversity of income sources and inequality move in opposing directions, then different strategies are required to reduce different aspects of vulnerability. In summary, inequality of income within a population is an important indicator of collective vulnerability, though the relationship is complex, involving direct and indirect linkages. Inequality can be relatively easily measured, with the various indicators having their own characteristics. But the important issue in vulnerability analysis is determining the causes of the observed inequality, thereby informing the nature of the collective vulnerability.

(e) *Indicators of institutional effectiveness in ameliorating vulnerability*

All the indicators of vulnerability to climate extremes discussed so far are predicated by the influence of institutions on their operation. 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 pre-determined social commitments and world-views (see Jordan and O'Riordan, 1995; March and Olsen, 1996). 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. So, for example, is decentralization of the responsibility for collective action for coastal defence from Province to District level in Vietnam, an appropriate institutional response to changing risk? 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, p. 150) of hazards depending on the period since previous impact. The fundamental motivation for collective security enhancement and vulnerability reduction is highlighted by Thompson (1997) as an organizing principle for the examination of cultural attitudes within institutions.

The issue of the appropriateness of institutional change is addressed in the framework

proposed in this paper with reference to the economic implications of institutional change — how some institutional change affects the environment for the other economic indicators of vulnerability. Thus, for example, changes to government structure in Vietnam can be examined for changes in power and resulting responsibility for common security and vulnerability. They can also be examined for their impact on poverty, inequality and other social goals and factors. Second, institutional inertia and rent-seeking in the face of demands for change can be observed. Protection of the status quo is a major barometer of inappropriate institutional change, particularly when the social political and physical environments are demanding changes in institutions, bureaucracies and structures.

Institutional *change* within formal power structures has significant policy implications in the amelioration and adaptation to environmental stress. Environmental issues in general tend to be downplayed within institutions. They do not fit easily into reorganization of operating cultures and procedures; and for a number of reasons the inherent nature of periodicity and threshold nonmarginal changes of many environmental stresses ensures that the costs of institutional learning from one event to the next are high. Thus the reorientation of formal institutions in the face of evolving risk is a significant challenge, but, due to the pervasive role of institutions in determining vulnerability, this is the arena where impacts on all facets of vulnerability are made.

Institutional *inertia* is also examined assuming that inertia is often an active rather than passive strategy for retaining power, and hence constrains externally forced changes in a dynamic physical and political environment. Part of the structural inertia can alternatively be observed through rent-seeking behavior, defined as the expansion of formal institutions for their own welfare maximization.

The purpose of this analysis of institutions is to draw out how formal institutional changes impacts on social vulnerability. But the quantitative and qualitative aspects of individual and collective vulnerability all have institutional dimensions. Hence simply reporting quantitative indicators of the poverty and dependency phenomena and their change over time, excludes information on the structural causes of vulnerability. Thus those institutional aspects of individual and collective vulnerability are explained in greater depth through

qualitative analysis of institutional changes, and their direct impact on vulnerability for each indicator of vulnerability, and separately in terms of formal institutions themselves.

In summary, social vulnerability to climate change is made up of the elements of individual and collective vulnerability and can be observed through both quantitative and qualitative indicators of the causes and consequences of such vulnerability. Social vulnerability in general encompasses disruption to livelihoods and loss of security, and for vulnerable groups is often pervasive and is related to the underlying economic and social situation. But vulnerability also encompasses access and entitlement to resources, the power relationships in the relevant institutions in state and markets, and the cultural and historical context.

3. A CASE STUDY IN VIETNAM

(a) *Methods and data*

Since Vietnam incorporates large fertile, low-lying and densely populated deltas of the Mekong and the Red Rivers and is subject to the impact of landfall typhoons, Vietnam would be classified as a region physically vulnerable to present day climate extremes and potentially to changes in the typhoon regime as a result of increased interannual climate variability in future. But Vietnam has diverse coastal regions, and an analysis of the climatic regime itself does not reveal the processes by which different sections of the population may become or remain vulnerable to the impacts of climate extremes. Hence the analysis presented here focuses on a single District to analyze these processes leading to vulnerability social and physical.

Xuan Thuy is an agricultural District in Nam Dinh Province on the fringe of the Red River Delta in northern Vietnam. The District is physically vulnerable to climatic changes due to its topography, proximity to the coast, and the present condition of its physical infrastructure. The Red River Delta, along with the Mekong Delta in the south of Vietnam, have the highest level of agricultural commodity export from their regions, and in line with national trends (Pingali *et al.*, 1997), Xuan Thuy has almost doubled its agricultural output since the mid-1980s. The agrarian economy of Vietnam operates through a formal and sophisticated

system social security facilitated, even in the post-collectivization era, through local level government institutions. Vulnerability is therefore shaped by a complex set of relationships between the underlying economic and social situation and the dynamics of change in both these and the physical environment.

Fieldwork was carried out in Xuan Thuy District during 1995 and 1996, through collection of secondary archive data and through household survey and semi-structured interviewing of key informants. A survey of households in 11 Communes was based on a stratified area sample. Secondary data on Xuan Thuy District for agricultural production, income, population and other variables and on 80 coastal aquaculture enterprises were collated. These data sources form the basis of the quantitative analysis of household level vulnerability through resource dependency and poverty; and quantitative analysis of distributional issues.

Data for analysis of institutional adaptation and of institutional inertia in the treatment of present climate extremes in Xuan Thuy District were collected through qualitative data from Commune-level officials and from households within these Communes, as well as discussions at the District level. This involved semi-structured interviews with Commune officials in 11 Communes in Xuan Thuy and with households within those Communes in April and May 1996. The same Communes were used as for the quantitative household survey: all of the coastal as well as two inland Communes were covered for both officials and household respondents. This strategy aims to produce qualitative data on Commune-level institutional practices; on household-level adaptation; and underlying views on the hazardous nature of the physical environment. The research is therefore based on a mixture of key informants, for the trends in social institutions; and of comprehensive quantitative and qualitative information for the coastal dike maintenance system. Informants at the Commune level were largely made up of Village Committee Chairs or Vice-Chairs, or the manager of the Commune agricultural co-operative.

The data collected to explain historical and present social vulnerability are summarized in Table 2. This shows that both time-series and cross-section data are necessary to develop a rich understanding of the phenomenon of social vulnerability. Data were also collected at various levels of the institutional hierarchy to validate and triangulate the analysis of power

Table 2. *Summary of data sources for analysis of vulnerability in Xuan Thuy District, Vietnam*

Data Source	Scope	Purpose
Quantitative household survey	60 households randomly selected from 11 Communes. Income and economic activities; limited questions on historical storm impact	Analysis of poverty, resource dependency and distribution of income
Qualitative household survey	21 households subset identified from historical storm impact questions from previous survey. Qualitative survey on details of historical impacts, present collective action and perceptions of risk	Analysis of institutional adaptation and perceptions of institutional change
Commune and District officials: interviews	Officials from 11 Communes in semi-structured interviews. Vice chairs of Village Council or Head of co-operative. Qualitative survey of historical impacts, present storm protection organisation and funding	Analysis of institutional adaptation and the wider political economy of Doi Moi
Secondary District-level data	Historical quantitative data on agricultural production and structure of economic activity at District level and by Commune. Census survey of aquaculture	Analysis of resource dependency and the role of aquaculture in past and present income distribution

relationships which are also central to the political economy of vulnerability.

(b) *Individual vulnerability in Xuan Thuy District*

An indicator of absolute poverty gives scope to measure this aspect of social vulnerability. The choice of poverty indicator is determined by the objective of the study: whether this is to relieve poverty in the short or long term; the importance of inequality; and the social context of the deprivation. Such considerations for poverty measures are reviewed by Blackwood and Lynch (1994), who illustrate the tradeoffs in simplicity, data requirements and relevance for policy-making for various poverty indicators. A poverty measure relevant for vulnerability to climate change needs to be sensitive to the availability of state assistance in alleviating the impacts of extreme climatic events when they occur. Evidence suggests that it is the poor who are discriminated against in terms of access to such resources in disaster situations, making them inherently more vulnerable. Thus individuals at the lower end of the distribution of income are more susceptible to the impacts of extreme events because they have little diversity in their income sources and fewer "reserves" to absorb shocks. These are added to the institutional factors which act to disempower the poorer sections of populations and prevent their access to resources for recovery.

Thus these two issues of inequality within the poor part of the population and the role of policy in influencing poverty severity, leads to the adoption of composite poverty indices (which incorporate these aspects) for the examination of poverty as an element of vulnerability in Xuan Thuy. The measures used are therefore the poverty severity measures (P_0 , P_1 and P_2) developed by Foster, Greer and Thorbecke (1984 and widely used for quantitative analysis of income poverty.

Table 3 shows that the poverty indicators which are available for the Red River Delta area and for Vietnam, as a whole, are much higher than those derived from the household survey for Xuan Thuy at both of the poverty lines. Thus for the poverty line which excludes most of the population (the food poverty line), Xuan Thuy is seen to have one-quarter the headcount ratio of either the Red River Delta or of rural Vietnam (column 2). Estimates by the World Bank (1995) are that almost one in four of the population of rural Vietnam do not come up to this food poverty line. The average poverty gap for the Xuan Thuy population is much higher than average for Red River Delta or rural Vietnam. Similarly for the basic needs poverty line, the proportion of Xuan Thuy now classified as poor is less than half of that of Red River Delta or rural Vietnam, with a similar larger poverty gap than average for the country (column 3). These differences between Xuan Thuy and the remainder of Vietnam can be interpreted

Table 3. *Estimates of absolute poverty and their sensitivity to poverty line estimates for Xuan Thuy, Red River Delta, and rural Vietnam*

(1) Basis for poverty line	(2) Food poverty line ^b			(3) Basic needs poverty line ^c		
	Xuan Thuy ^a	Red River Delta	Rural Vietnam	Xuan Thuy	Red River Delta	Rural Vietnam
Poverty line (VND 000 per capita)	708	708	708	1003	1003	1003
Headcount ratio (P_0)	0.06	0.24	0.28	0.18	0.49	0.57
Poverty gap ratio (P_1)	0.21	0.04	0.06	0.31	0.14	0.17
Average poverty gap (VND 000 per capita)	151			309		
Poverty severity (P_2)	0.3	1.0	2.1	1.9	2.9	4.7

^a Xuan Thuy estimates based on household survey. Red River Delta and Rural Vietnam results reported from World Bank (1995). US\$ 1 = VND 11,000. Poverty measures P_0 , P_1 , P_2 are following Foster *et al.* (1984).

^b Food poverty line is defined as the cost per capita of purchasing food to yield 2,100 calories intake per day, calibrated for regional variations in food prices.

^c Basic needs poverty line is defined as cost per capita of this minimum food purchase plus the mean costs incurred for non-food expenditure for households at this income level. Thus basic needs represent, in this case, culturally necessary minimum expenditure (see Malik, 1993 for example).

ted as Xuan Thuy having a smaller proportion of poor people, but those who are poor fall well behind the average of the population.

These comparisons of poverty indicators for the incidence of poverty in Xuan Thuy, and the comparisons with the wider situation in Vietnam lead to several conclusions and observations. Xuan Thuy is a relatively prosperous area of northern Vietnam, in terms of the small numbers of people classified as poor by these criteria. The mean levels of incomes are higher for Xuan Thuy than for the Red River Delta. This relative prosperity reflects the access to fertile agricultural land, and productive coastal resources of the population in general. The data focus on income-based measures of poverty. Income is used here as a proxy for other aspects of poverty, such as inaccessibility, lack of human infrastructure and other variables. Some social mechanisms, particularly of land allocation and social security at the Commune, ensure relatively low numbers of marginalized landless households in this District.

Dependency is defined as reliance on a range of resources which leads to stress within livelihoods and is made up of reliance on risky resources, especially among the poor. But such reliance is ameliorated through adaptation, so the concept also requires examination of phenomena such as social stability. Dependency can be observed through proxy indicators at the household level where these are available. In Xuan Thuy, dependency can be examined by reference to the household characteristics of the poor; by reference to information on informal

economic activities; and with reference to demographic factors associated with resource dependency. These indicators of dependency add depth to the discussions on poverty above in explaining social vulnerability at the individual level.

For coastal communities almost all sources of income could be characterized as being "climate dependent" in some sense. The primary resource-dependent activities are those associated with agriculture, fisheries and aquaculture. Other sources, particularly those associated with wage labor and remittances from family members living elsewhere, are less or only indirectly "climate dependent," and indeed household investment in such activities is often motivated by risk-minimizing strategies within households. In Xuan Thuy, historic data on climate extremes show that the seasonal incidence of landfall typhoons results in the greatest impact on rice agriculture, with less impact on salt-making and other activities. An early season typhoon in July tends to result in greatest damage as it coincides with the period before harvest of the first of two rice crops. Such storms disrupt the harvest as well as affecting the rice seedlings being germinated for transplanting for the second crop. The other major agricultural activities, crops of vegetables and fruits, tend not to be affected by landfall typhoons. Salt-making, another important economic activity in coastal Communes, is dependent on favorable weather, relying on high temperatures and periods without rain. The process relies on the capturing of tidal sea water

and evaporating the water with sand in a continuous process until, after four concentrations, marketable salt is obtained. For those households involved salt-making, it is often the primary economic activity.

The dependency of household income on climate-dependent income sources is shown for households in Table 4(a), as a series of correlations between household characteristics and income sources. In this case, climate dependent income ($Y(\text{ClimDep})$) is taken as being the sum of rice, aquaculture and salt production income for each household. The results show that total household income is positively correlated with the greater diversity of sources of income for the household; with remittance and wage income; and with climate dependent income (Table 4(a)). Remittance and wage income would appear to be utilized as a diversification strategy, but not necessarily by the larger households (negative correlation between diversity and household size) since lower per capita income itself is negatively correlated with household size.

In disaggregating climate-dependent income in Table 4(b), it can be seen that aquaculture and rice income are positively correlated with income while salt-making is negatively correlated with both income and with diversity and remittance and wage income. Table 4(b) therefore demonstrates that salt-making is as-

sociated with poor, heavily constrained households, who have particular characteristic resource dependencies. The sources of income for the poor and nonpoor sections of Xuan Thuy's population have significantly different profiles. The poor section of the population has a much greater proportion of its mean income derived from salt-making, reflecting not the greater access to salt-making areas, but rather a greater incidence of poverty in the coastal Communes of the south of the District where there is a major agricultural land scarcity. Poor households rely to a slightly greater extent on rice and agriculture for their mean income, and from the household survey data are shown to not presently be engaged in commercial aquaculture at all.

Diversity should characterize the livelihood strategies of households in coastal areas, because of the physical availability of traditionally commonly managed resources such as coastal fisheries and mangroves (Bailey and Pomeroy, 1996). This is demonstrated for all but the poorest households in Xuan Thuy. Households tend not to be dependent on a single resource. But they can still be effectively dependent on a single ecosystem, where the various income sources are interrelated. For example, if mangrove forests are converted to private aquaculture, then both the access to honey production, fuelwood and other re-

Table 4. *Correlation coefficients for Xuan Thuy sample for (a) household characteristics including "climate-dependent income", and (b) household characteristics with disaggregated income sources*^a

(a)	Income	Diversity	Household size	Remittances	Y(ClimDep)		
Income	1						
Diversity	0.226	1					
Household size	-0.338**	-0.079	1				
Remittances	0.228	0.345**	-0.118	1			
Y(ClimDep)	0.693**	0.160	-0.068	0.012	1		
(b)	Income	Diversity	Household size	Remittances	Aquaculture	Salt	Rice
Income	1						
Diversity	0.226	1					
Household size	-0.338**	-0.079	1				
Remittances	0.228	0.345**	-0.118	1			
Aquaculture	0.350**	0.105	0.015	-0.127	1		
Salt	-0.245	-0.069	0.261*	-0.068	-0.159	1	
Rice	0.659**	0.123	-0.164	0.191	-0.044	-0.345**	1

Source: Xuan Thuy household survey. *Significant at 5% level. **Significant at 1% level. ^aY(ClimDep) defined as income from rice + aquaculture + salt-making. Remittances = remittance income and wage income. Diversity = number of different income sources reported by households.

sources will be affected, and the impact on coastal fisheries will be detrimental. Thus the resilience of livelihoods in coastal areas are directly correlated with the resilience of the coastal ecosystems on which they are dependent. This aspect is only indirectly observable in the formal poverty and dependency indicators examined, partly because of the role of intrahousehold strategies in alleviating dependency. In Xuan Thuy both women and children collect a wide range of material from coastal mudflats and from the mangrove areas. Many of these resources are for domestic consumption and cannot therefore be easily quantified, but demonstrate the paradox of diversity of livelihood strategies while still being essentially dependent on a single ecosystem.

One further aspect of resource dependency is its link to demographic instability. Lack of access to alternative economic opportunities, both within the poorer part of the population and because of geographical reasons can force migration and other demographic strategies into effect. Diversifying income sources through migration enhances security in the formal sense identified in the indicators above, but has also implications for household integrity. Many households therefore disappear in vulnerability assessment when migration occurs, in the absence of allocated land or a house.

The striking difference between migration strategies in different parts of Xuan Thuy illustrates the role of the coastal ecosystems in this process. Inland Communes have traditionally had high rates of migration, whereas coastal Communes have had low rates. Migration to Hanoi for work in the recycling industry is concentrated in two villages in the north of the District (DiGregorio, 1997). Almost half of the total recycling industry for the whole metropolitan area of Hanoi is undertaken by residents from these two Xuan Thuy villages.

Part of the explanation for migration from the northern Communes of the District has to do with the lack of access to coastal resources for those Communes. Traditionally managed common property resources associated with fisheries and mangroves previously formed a significant asset for the coastal Communes in Xuan Thuy, explaining the relative lack of outmigration for employment sources. Under the present market liberalization, where the mangroves have been allocated to private leaseholds, the migration patterns are already beginning to be radically altered, based on

observations in Xuan Thuy in the period since 1995. Seasonal migration to Hanoi and the Provincial capital of Nam Dinh, and the remittances they contribute to the resident household, are increasing in Coastal Communes where traditionally migration was low. This, it could be argued, reduces vulnerability by increasing total household livelihood sources, and by increasing the proportion of non "climate-dependent" income. In this case temporary and seasonal migration is part of a strategy to reduce vulnerability at the household level. Increased migration and diversification enhance household security and resilience.

(c) *Implications for assessing individual vulnerability*

The purpose of estimating indicators of poverty and dependency in Xuan Thuy is to examine the role these play in vulnerability to climate change. The justification for the focus on absolute poverty is that poverty exacerbates vulnerability through lack of resources for handling external shocks; correlation of poverty to disempowerment and lack of access to resources when shocks occur; and the reliance of the poor on communal and other resources which may be more physically vulnerable to external shocks.

Historically, centrally planned economies with a well-developed state apparatus for distribution of resources and social security systems have relatively low income inequality. The reduction in the influence of the state, however, has led to increased incidence of poverty in many former centrally-planned economies. The results in the previous section have illustrated that at present, poverty is confined to a minority of the population in Xuan Thuy (18 percent), and that the incidence of poverty coincides with lower land allocation and the nonparticipation in coastal aquaculture, and possibly with the reliance on communally managed or open access resources. The results for Xuan Thuy show the redistribution or transfer required to bring that part of the population out of poverty. The targeting of poor households through poverty alleviation is a difficult task, on which there is copious experience in rural areas throughout the world. The pitfalls of poverty alleviation include finding the poor households; the effects of poverty alleviation (such as employment, schemes, land allocation, food for work

schemes and others) on the nonbeneficiaries; and the identification of sustainable sources of economic activities or employment (see Ravallion and Sen, 1994, for example).

The change in resource use, particularly that into aquaculture at the expense of mangrove forests in coastal areas, can be demonstrated to be offsetting the positive impacts of falling absolute poverty. Increased vulnerability is brought about by increasing dependency on aquaculture and other resources with high risk of failure from natural hazards, and uncertain returns in volatile markets. In Xuan Thuy migration and remittances form an important part of the livelihood risk minimizing household strategies, with migration in northern coastal Vietnam to both regional urban centers, principally to Hanoi.

(d) *Inequality and collective vulnerability in Xuan Thuy District*

Xuan Thuy has relatively high income inequality compared to Vietnam in general, and that this has been exacerbated by the emergence of aquaculture in the Xuan Thuy economy. In the observed rising inequality in the centrally planned economies, the issue of the causality of these changes in inequality remains unresolved.

As argued above, however, changes in the distribution of income are related to the phenomenon of collective vulnerability. Income inequality is a *proxy* for general inequality of access to resources, with increasing income inequality directly correlated to, if not caused by, a concentration of the ownership of productive assets in a smaller proportion of the population. Thus the opportunities for the enhancement of resilience and robustness of livelihoods through general raising of income levels are being forfeited, through an increased concentration of productive resources.

If the differences between Inland and Coastal Xuan Thuy are examined, it is clear that inequality rises more over time in Coastal Xuan Thuy, than in the inland Communes as shown in Figure 2, where the Gini coefficient for Coastal Xuan Thuy rises by 0.075 (0.285–0.210) in five years. The indicators therefore show intra-District (between Coastal and Inland) differences in the changes exhibited in income structure. The extent to which such intra-District differences occur is constrained and facilitated by the operation and mechanisms of rural labor and commodity markets. In the Xuan Thuy case there is considerable intervention in agricultural input and output markets, and the planned allocation of labor persisting in the

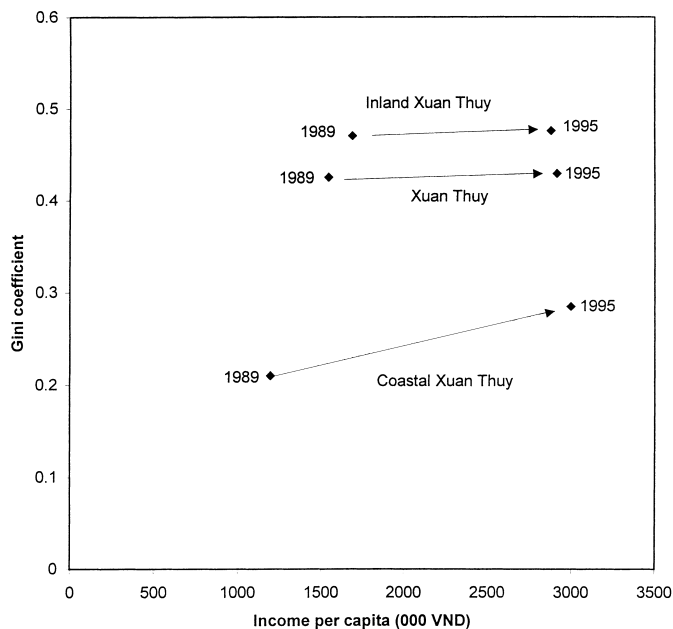


Figure 2. Change in incomes and inequality for Xuan Thuy and by subsample simulated for 1989 and observed for 1995.

Doi Moi period has been a constraining force on interregional increases in inequality.

Income inequality indicator is a proxy for some aspects of collective vulnerability, such as those associated with access to private and communal resources, which are important in recovering from external shocks to livelihoods. They are also closely related to social hierarchies and distribution of formal political power within communities. Rising inequality in Xuan Thuy has direct effects on baseline vulnerability. The concentration of capital in the aquaculture sector is having significant impacts in the further accumulation of wealth and productive assets in the coastal Communes, the residents of which are benefiting disproportionately from market liberalization and the legalization of private aquaculture enterprises in particular.

In the case of Xuan Thuy, the most striking feature of the rise in inequality, in terms of vulnerability, is that the "diversification" from agricultural incomes, primarily by better-off households, has been into sources of non-agricultural incomes which are in fact at greater risk from external shocks associated with environmental change. In addition, the indicators of inequality show that inequality differentials are increasing between Inland and Coastal Xuan Thuy, and increasing for the District as a whole, at rates which are extremely high compared to slow change in inequality observed in most agrarian economies (see Adger, 1997a).

The rising inequality in Xuan Thuy is not associated with factors which lead to increasing poverty. Rather they are associated with rising incomes for most of the population. The inequality-vulnerability link is therefore not the indirect hypothesized link (rising inequality causing poverty), but rather the direct link: that of the concentration of wealth and capital restricting access of a larger proportion of the population from resources for buffering the impact of external shocks.

(e) *Institutions, adaptation and vulnerability*

A key issue raised in the empirical application of this approach is the appraisal of institutional adaptation at various levels within Vietnam. At the national level the political economy aspects of increasing regional autonomy in Vietnam since Doi Moi, and the retrenchment of government are paramount. This is particularly apparent when considering the

civil defence mechanisms which have evolved over centuries of common property resource management, as well as through wartime institutions. These different scales of analysis are tackled by defining the relevant attributes of institutions. The adaptation of different types of institution is observed through their influence on structures of political power and legitimacy, as evidenced by proactive changes in the face of social change as well as by their inertia and "nondecision-making."

An example of the interaction of climate vulnerability and institutions is their role in local level hazard planning and coastal defence. Sea dikes constructed for coastal defence in Xuan Thuy District are the principal physical infrastructure investment to ameliorate the threat of climatic hazards associated with typhoons and coastal storms, and are the major responsibility of the coastal Communes and Districts. Communes officially employ a variety of strategies for use of the revenue they raise for storm protection, depending on whether they have sea dikes within their jurisdiction. Communes next to each other also inevitably have long-standing social reciprocity with their neighbors.

Protection against present day climatic extremes in the form of landfall typhoons is the primary responsibility of the Communes. During the collectivization period, each adult allocated 10 days labor to the task of repairing and maintaining the sea dike system. Since the de-collectivization of agriculture, this collective action role of the agricultural cooperatives has largely been made redundant and been replaced by a tax for coastal protection. This evolution of institutional responsibilities provides a striking example of inertia and rent-seeking by institutions which directly exacerbates vulnerability to present day climatic extremes.

Information provided by Commune officials for 1996 shows that collective maintenance of the dikes remains an ongoing element of hazard mitigation, but only for certain Communes. The actual resources flows demonstrate the tendency for Communes to maximize their own individual interests, through capturing the greatest share of District resources. This is facilitated in the coastal Communes by flows of resources being of actual labor, rather than funds. Allocating their own labor to dike repair ensures that the Coastal Communes limit their taxation, particularly in years where few repairs are required and avoid paying monetary resources to the District government. In the dike

protection season following a year with little storm damage, such as 1995, those Communes who do not directly allocate labor (the inland Communes) still have to pay full tax rates. By contrast, in those years with little storm damage, the coastal Communes can simply undertake their own repairs.

Further, the "hypothecated" tax collected by the District government is not spent annually solely on coastal protection: the tax actually collected is at least four times that spent on coastal protection in years such as 1996. Indeed, the rich coastal Communes receive a "double dividend" of paying lower effective tax rate than inland Communes, along with receiving disproportionate investment in other infrastructure projects. In effect, the coastal areas of Xuan Thuy are a "core" of powerful Communes which capture District-level resources, to the detriment of "peripheral" inland Communes.

Such action constitutes an example of non-decision-making which keeps the political playing field tilted in favor of the coastal Communes. Furthermore, some Commune level officials appeal to the locally held perceptions that storm impact is a major constraint on economic performance. Hence, they argue that it is legitimate to maintain tax collection for sea dike maintenance. When it is convenient to downplay potential storm impacts and other environmental change, however, the officials of the coastal Communes do so. When Commune officials wish to promote economic growth to the exclusion of other policy objectives they trivialize hazard mitigation.

The dike protection system is only one aspect of the radical institutional changes observable in Xuan Thuy, many of which may be reducing the potential vulnerability of the population to extreme climatic events. Many of the institutional changes are part of the economic transition process, though these changes are underpinned by attitudes toward the subjective riskiness of the environment. The crucial factor in terms of perception of risk, is that a severe storm (with widespread damage on a District-wide basis) has not occurred since 1986. The private property resolutions of the 1992 Constitution, and the subsequent reform of the land allocation system under the 1993 Land Law, have been paralleled by a relaxation in the legality of private credit systems in rural areas. In the collectivized period, formal credit was only permissible through the Commune cooperative

(Luong, 1992, p. 184). Yet even in that period, private credit did operate and played an important role in coping strategies in Xuan Thuy, for example after the storm impact of August 1986.

The role of credit in recovery from stress and disruption of livelihoods, is particularly important where external assistance is not available for immediate injection of resources. Informal, but illegal, credit systems have been an integral part of the coastal fishing economy in Xuan Thuy. This phenomenon is common to many artisanal fishing communities (see Dow, 1996, for example). Street Associations are informal associations of neighbors within hamlets who have traditionally maintained religious buildings, funeral and marriage ceremonies. Associations, along with reciprocal feasting and gift-exchange, have become revitalized in Xuan Thuy, with Luong (1992), pp. 270–284) observing that these processes play a role in sustaining kinship and lineage ties which are necessary for security in times of crisis. The "nascent" civil society is seen by some commentators as making significant inroads into formal political structures (Malarney, 1997) and hence reinforcing collective decision-making, which would otherwise be lost with the decollectivization.

The most significant factor affecting both the politics of collective action and individual livelihoods is land reform. The role of the Commune institutions as harmonious and efficient allocators of Commune resources is contested. Kerkvliet (1995), for example, argues that the impetus for agricultural reform in the 1980s arose from tensions between the agricultural cooperatives and some households. Many villagers, although recognizing the social security benefits of collectivization, remained skeptical concerning the centralization of power within the national hierarchical system, preferring local level autonomy in resource management, it is argued. Whatever the "everyday politics" of resistance to collectivization (Kerkvliet, 1995; Scott, 1985), the agricultural cooperatives retain a central role in all resource allocation and collective action at the Commune level.

The present land allocation system, following the legislation of 1988 and 1993, is fundamentally different from what has gone before, in that it permits land to be leased, inherited and mortgaged, thereby effectively restricting the role of many cooperatives in any further reform. An assessment of the impacts of the

present land reform by Kolko (1997) argue that some cooperatives now "exist in name only" (p. 92) and that even the Communist Party in some areas have "all but disappeared" (p. 92). Although the institutionalization of tradeable land use rights has proceeded rapidly in the Mekong Delta, the role of cooperatives remains, however, more significant in the Red River Delta. The 1993 Land Law initially limits individual households to three hectares of agricultural land, with tenure for 20 years for annual crops and up to 50 years for forestry and longer term crops. The legitimate emergence of rental markets in land and other agricultural factors of production has been observed widely in the agricultural producing areas in Vietnam.

In summary, the revealed "everyday politics" of decollectivization associated with dike protection system of Xuan Thuy provides insights into institutional adaptation demonstrating increased vulnerability. The Communes essentially use the sea dike resource allocation system to maximize their own budgets, often through unaccountable actions through which the collective vulnerability to the impacts of storms may be increased. At the same time, the system is adapting to the increasing specialization of labor and higher opportunity costs of time for households, who can no longer afford to spend time on labor-intensive actions. By contrast, the enhancement of other informal institutions of civil society within the Communes documented in this section enhance security and potentially reduce the recovery time after the impact of a major storm. Similarly the re-emergence of local-level institutions tends to enhance collective security.

4. CONCLUSIONS

This paper has explored the causal factors of social vulnerability to climate change and present day climate extremes for one District in northern Vietnam. It has concentrated on the individual-level and collective-level vulnerability indicators to determine the vulnerability of the population of Xuan Thuy. In general the population exhibits resilience through its use of available natural resources, but the liberalization process has had, at best, an ambivalent impact on vulnerability as a whole by undermining some institutional practices which acted as security and coping mechanisms in times of stress.

Inequality in income and changes in the incidence of poverty is driven by the market liberalization process. In Xuan Thuy the privatization of mangrove forests and their conversion into aquaculture is the major cause of increasing inequality over time. It is hypothesized that inequality is linked to vulnerability in two ways: directly through concentrating the resources of a population in fewer hands, thereby constraining entitlements for use and disposal of assets under coping strategies in times of stress; and indirectly through the enhancement of poverty and marginalization. In the Xuan Thuy case, only the direct link with vulnerability appears to be important. The concentration of aquaculture resources does not directly enhance poverty, and further, the agricultural land allocation process by which absolute poverty levels are effectively avoided, appears to be relative equitable.

Institutional adaptation appears to have offsetting influences on the vulnerability of Xuan Thuy District given present patterns of land use, land ownership and control and the role of the state in resource and risk management. The reduction in power and autonomy of state institutions associated with collective measures for protection from the impacts of coastal storms is one major accentuation of vulnerability observed in the case study. The agricultural cooperatives no longer play a primary role in allocating labor and resources toward collective action for water and irrigation management or for coastal defence. The atomization of agricultural decision-making has, however, contributed to increased marketed production of agricultural commodities, thereby contributing to the rising incomes in the District. But this has been at some cost to collective security. Offsetting these impacts associated with the rolling back of the state, has been the re-emergence of informal social coping mechanisms associated with both entrepreneurial and community activities.

This paper demonstrates the complex nature of social vulnerability and the importance of the political economy context. It is not meaningful however, to generalize from the analysis presented here to the threat of global climate change over the next century. Different societies face different threats, and have different coping mechanisms and resources with which to implement these (e.g., Ribot, Magalhães and Panagides, 1996). The approach here is applicable, however, to other circumstances;

these aspects of vulnerability can be investigated empirically for other social and climate risk situations. The vulnerability concept developed here attempts to address the issue of scale within coping mechanisms of environmental change by examining the role of vulnerability of individuals and of collective vulnerability to extreme events. But the delineation between what constitutes adaptation and what is observed as coping with the extraordinary or hazardous events remains a central unresolved issue in analysing vulnerability within society environment interactions (see discussion by Dow, 1999).

The causes of social vulnerability are the characteristics of the climatic threat; the political economy context in which the institutions of decision-making, primarily the state in all its manifestations, attempts to minimize or manage threat for the benefit of society but also the benefit of the institutions themselves; and the economic structure and cultural context of adaptation at the individual level. By addressing vulnerability in a comprehensive manner current populations are enabled to address today's climatic extremes and other threats and are better equipped to cope with future uncertainties.

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