Climate Change, Adaptation and the Environment in Central Vietnam

Ole Bruun and Thorkil Casse

Abstract This introduction locates Central Vietnam in the international debate on climate change in developing countries, particularly in terms of socio-economic impacts. Central Vietnam is considered the most vulnerable region of the country in terms of exposure to the effects of climate change. The prospects of a rise in sea level, threats to agricultural production in coastal zones, and risks of increasing weather variability imply higher frequencies of storms, heavy rains and droughts. In order to determine how people, communities and public authorities adapt to new circumstances however, these overall challenges must be placed in a real-life context. There is a gap in the international climate change debate between, on the one hand, a reliance on technical approaches and overall mechanical modeling to countries and regions, and on the other, the perspectives that derive from local environmental data collection and socio-economic analysis. Complexities increase dramatically when working at the lower and intermediate levels: the observed processes of change are not only ascribable to climate change, but to globalization, policy changes, marketization, general economic development, and large-scale human interventions in the environment. There is an urgent need for integrated approaches, such as the building of environmental management into climate change responses, addressing the total impact of livelihood stresses in social vulnerability perspectives, and ensuring that overall adaptation policies adequately address social justice.

Keywords Socio-economic impact of climate change • Global and local change • Social vulnerability • Adaptation • Modernist development policies • Centralist planning • Conflicts with social and environmental objectives

O. Bruun (✉) · T. Casse
Department of Society and Globalisation, Roskilde University, Universitetsvej 1, 4000 Roskilde, Denmark
e-mail: obruun@ruc.dk

T. Casse
e-mail: casse@ruc.dk

O. Bruun and T. Casse (eds.), *On the Frontiers of Climate and Environmental Change*, Environmental Science and Engineering, DOI: 10.1007/978-3-642-35804-3_1,

1 Challenges

Vietnam unquestionably belongs to a group of development countries with high population densities and sensitive ecosystems, to which climate disruptions pose a huge challenge. Countries like India, Bangladesh, Madagascar, Zimbabwe, Mozambique, Haiti, Vietnam and many others, already suffer the combined effects of adverse conditions like population pressure in coastal areas, environmental degradation, inadequate technologies, underdeveloped economies and the differentiating forces of globalization.

A variety of international sources point out that Vietnam is both highly vulnerable and heavily exposed to the risks of increased weather variability and climate change, including storms, droughts, flooding and saline water intrusion (e.g. Chaudhry and Ruysschaert 2007; ADB 2009; MONRE 2009; WB 2010). Particularly, the socio-economic impacts are a concern to Vietnam's present phase of development (McElwee 2010). Climate change is further believed to threaten the poor and upset poverty reduction (Sperling 2002; MONRE 2007). At the same time Vietnam is already among the major receivers of general aid funding, amounting to 30$ per capita per year over the period 2005–2010 (DAC). A series of typhoons during the last decade, most recently the 2009 typhoon Ketsana, caused enormous damage and intensified a focus on climate change in development aid; following World Bank evaluations and appeals from the Vietnamese government, massive donor funding is now directed towards climate change adaptation and mitigation.

The present study contributes to country-specific and regional analyses of climate change impacts and adaptations. By focusing on Central Vietnam it will place overall challenges in a factual context and show how people, communities and public authorities cope with new circumstances. Noted above, complexities increase dramatically when working at this intermediate level. Processes of change tend to relate only implicitly to climate change, but more explicitly to the overall factors of development. Addressing such interacting processes of change calls for interdisciplinary methodologies and explorative means of interpretation. Indeed, climate change impacts, like disasters, cannot be studied separately from 'normal' life. Changeable as it may be, the risks involved in climate change must be seen against the vulnerability created by many people through their normal existence (Wisner et al. 2004, p. 4). Yet the unprecedented confluence of these powerful and transformational forces break up society along new fault lines, and pushes resource exploitation towards new frontiers.

Picking up this challenge, the present work builds on extensive field studies in Central Vietnam and brings together inputs from a range of disciplines, including economics, human geography, science, political science, anthropology and the humanities. It concentrates on rural areas, where the majority of the population lives and whose livelihoods are predominantly drawn from natural resource management, and it spans all three topographical zones of Central Vietnam (coastal, mid-elevation and highland). It is academic in orientation, but speaks as much to

developers, planners and decision makers. The strictly hard science components are limited to overviews of climate and agricultural data, while the bulk of the material attends to socio-economic, human-geographical, political and cultural aspects of vulnerability and adaptation.

2 Global to Local Change

We do not challenge the necessity of climate change action to reduce global warming and its potentially catastrophic consequences (e.g. Giddens 2009). Nevertheless, we find it imperative to raise some critical issues relating to the implications of a narrow climate focus and its devolution to national and local politics, where it inevitably introduces a new terminology, sets new agendas and potentially reshuffles power relations. There is a risk that it may overshadow existing concerns, such as poverty alleviation, good governance and sustainable development. There is a need to recontextualize the climate change rationale into a societal reality.

Global concern over a long-term change in weather patterns has been nourished by rising average temperatures, which are likely to increase the future frequency of extreme weather events such as storms, heavy rainfall and heat waves. It will further imply rising sea levels due to the melting of polar ice sheets, with major long-term impacts on low-lying coastal regions and river deltas, including the most densely populated areas of Vietnam. The country has an extensive coastline, stretching over more than 3,000 km, with crucially important river deltas on the Red River and the Mekong River. Most parts of the country are subjected to tropical cyclones and monsoon rains, at the same time making them heavily exposed to increasing weather variability and climate change. "Climate Change's Impact on Natural Hazards in Quang Nam Province, Mid-Central Vietnam" shows some key data for Central Vietnam and makes a comparison with national climate scenarios, in order to forecast trends in flooding, drought and landslides. For the central region, changes in temperature and precipitation are not significant as yet, while an increasing intensity of typhoons may be documented. Nevertheless, tropical cyclones appear to be more powerful in strength and those at Beaufort wind force 12 or more have increased from two in each of the decades 1981–1990 and 1991–2000 to five in the period of 2001–2008 (Van Tan 2010, p. 35). As shown below, however, other observable changes like increasing flooding disasters and landslides are inherently multi-causal.

In an absolute sense, climate change relates to the statistical distribution of weather patterns over extended periods of time. In common parlance, it is qualified as anthropogenic climate change, also known as global warming or anthropogenic global warming.[1] In a given locality global warming, implying something

[1] The UN Framework Convention on Climate Change thus defines climate change as 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods' (UNFCC).

gradual and uniform, tends to be a misnomer, since its impact is both uneven and unpredictable: it may appear as temperature oscillations, increasing fluctuations over the year, erratic patterns, or show up as out-of-the-ordinary natural hazards. Besides, changing climatic conditions are not inherently equivalent to disaster and projected changes in climate may have both beneficial and adverse effects in a given locality, for instance relating to agriculture, ecosystems, water resources and human health. The greater and faster the change in climate conditions, however, the greater likelihood that adverse effects will dominate. "Is Climate Change a Reality for Agriculture in Quang Nam Province?" examines key trends in agricultural production in Central Vietnam, including recent land use changes, new crop varieties, general intensification, and increasing uses of fertilizer and pesticides. Despite the general experience of an increasing frequency of typhoons, heavy rain and flooding, available materials show substantial overall growth of all forms of agricultural production, including grain cropping, aquaculture and forestry. Nevertheless, efficient physical planning and coastal protection remain great challenges for adaptation.

Overall climate change merges with a great amount of local weather variation to create a range of outcomes. Central Vietnam is considered the most vulnerable region in terms of *exposure* to the effects of climate change (WB 2010), including, particularly, storms, flooding, landslides and droughts, and although the region does not overall rank among the most critical in *sensitivity*, particularly poverty and economic diversification are major concerns. Historically, Vietnam's exposure to extreme weather has resulted in countless disasters and loss of lives, but has also provided its inhabitants with a rich experience in coping with the effects of droughts, flooding, storms, and similar events on agriculture and society, both individually and collectively in a strong state: sensitivity to climate change must be seen against the historical and societal context. Hence, an evaluation of the present impact of weather and climate events in Central Vietnam has to take two separate factors into account.

First, this is a historical hazard-prone region, part of the Southeast Asian 'typhoon belt', in which the season from July through November brings frequent heavy winds, on average four to six times per year, maturing into typhoons (tropical cyclones with wind speeds over 32.8 m/s or 118 km/h). There is also plenty of rain that feeds a natural abundance of vegetation and a huge biodiversity. Until quite recently, only a narrow belt of the lowland coastal areas and river deltas were inhabited by sedentary agriculturalists, while inland and highland forest regions were 'shatter zones' (Scott 2009). These were inhabited by slash-and-burn agriculturalists and hunter-gatherers of a great ethnic variety. The historical context and present situation of one such ethnic minority is described in "Interacting Cultural and Environmental Change: The Co (Cua) Minority of Central Vietnam", showing that the simultaneous felling of the forest and moving of the population in ambitious state schemes has altered both landscapes and habitation patterns.

Since the earliest historical records, Vietnamese culture has embraced the environment in transformational schemes. As an 'ancient hydraulic civilization' it has harnessed rivers and constructed dikes and irrigation canals for the cultivation of

lowland paddy rice while restraining the natural occurrences of flooding in gradually increasing areas, inevitably taking risks in the process. The great spatial variety of Vietnam provides very diverse natural and man-made environments, and livelihoods are often earned in locations where opportunities and hazards coalesce.

When man-made dikes burst during heavy rains or when flooding reaches higher-than-usual levels, natural hazards may turn into societal disasters. There is a long historical record of flooding and disaster: the city of Hanoi has recorded 20 'historical floods' during its 1,000 year history as a capital, in the last century in 1915 and again in 1971, when a '250 year flood' overwhelmed the dikes and according to some estimates killed as many as 100,000 people. Typhoons are a perennial threat; the Haiphong typhoon of 1881 was among the deadliest in human history, claiming an estimated 300,000 lives. Most recently, 1997 typhoon Linda killed 3,000 people in the Red River Delta, and floods in 1999, 2008 and 2010 also claimed many casualties across Vietnam. As a perennial threat to Vietnam as a whole it applies to Central Vietnam more specifically. Recent historical records include a terrible storm that swept away a French-built railway line between Danang and Hoian in 1915/16, the highest ever recorded flooding in 1964 (during the most active typhoon season ever recorded), a great flood in 1999 claiming 700 lives, and serious floods in 2007 and 2009. To these events may be added the memories of local people, in which the endless loss of crops, domestic animals, houses and property in seasonal, but unpredictable floods, and the destruction of houses during typhoons, are closely interwoven with family history. There is a constant and inescapable element of risk in all human and agricultural activity in this historical natural hazard-prone region, but also a long historical experience in coping with changeable conditions.

Second, it must be stressed with even greater weight that external, anthropogenic climate changes, whatever their scope, invariably interact with a range of local environmental interventions. These are occurring at an accelerating rate in the present phase of Vietnam's social and economic development. More specifically, industrialization, infrastructure and other construction (see "Paradoxes in Adaptation: Economic Growth and Socio-Economic Differentiation. A Case Study of Mid-Central Vietnam"), fish and shrimp farming (see "Is Climate Change a Reality for Agriculture in Quang Nam Province?"), dam and reservoir building for hydropower (see "Paradoxes in Adaptation: Economic Growth and Socio-Economic Differentiation. A Case Study of Mid-Central Vietnam" and "Rural Households: Socio-Economic Characteristics, Community Organizing and Adaptation Abilities)", forest clearing for construction and population movements (see "Natural Resource Management Impact on Vulnerability in Relation to Climate Change: A Case in a Micro-Scale Vietnamese Context" and "Interacting Cultural and Environmental Change: The Co (Cua) Minority of Central Vietnam)", and plantation forestry development (see "The Push for Plantations: Drivers, Rationales and Social Vulnerability in Quang Nam Province, Vietnam") lend a whole new set of circumstances for all land and resource uses in Central Vietnam. Similar transformation processes can be found in other regions of Vietnam, such as the Mekong Delta (Fabres 2011). Indeed, both historically and in modern times the Vietnamese

have engaged with their physical environment in a transformational fashion and pushed for an expansion of resource uses as a basis for a growing population. The sense of urgency in integrating environmental management with climate change response is further discussed below.

Climate change data may assume absolute value over time, but as evident from the above, climate change impacts and adaptations hardly constitute a meaningful field of study in isolation: there is no clear baseline or status quo to measure against, neither historically, nor today. Presently, climate data may only be applicable at the community level in a very narrow sense. For instance, rainfall and its temporal distribution may be measured at local stations. But for the farmers in much of Central Vietnam, water resources are drawn from rivers, streams and canals, the levels and flows of which depend on a range of factors, including upstream forest cover, hydropower construction, major reservoirs, local dikes and general water management. Similarly, crop growth and biomass production may be measured separately as a function of temperatures and precipitation, but the individual farmer participates in a constant process of grain hybridization, improved fertilization and pest control, and increasing global market integration, often leading to entirely new cropping or land use patterns (see "Paradoxes in Adaptation: Economic Growth and Socio-Economic Differentiation. A Case Study of Mid-Central Vietnam"–"The Push for Plantations: Drivers, Rationales and Social Vulnerability in Quang Nam Province, Vietnam"). Compared again with the Mekong Delta, the effects of climate change on rice production may be a reduction of the arable area, which is responded to by the increasing use of agrochemicals which again will spell other long-term challenges (Sebesvari et al. 2011, see also "Vietnam's Food Security: A Castle of Cards in the Winds of Climate Change"). Inevitably, the impacts of local climate disruptions merge with impacts of changing lands uses as well as environmental disruptions and interventions to form multiple, interacting processes of change.

3 Key Livelihood and Climate Problems

With Vietnam's implementation of Doi Moi (renovation) policy in 1986, initiating a 'socialist-oriented market economy', the Communist organization of production in reality ended (see "Paradoxes in Adaptation: Economic Growth and Socio-Economic Differentiation. A Case Study of Mid-Central Vietnam"). The country entered a steady transformation process towards market-driven forms of production, while upholding one-party rule. With accelerated transformation and land reform, the rural population gained new opportunities, but was at the same time faced with a range of new stresses, such as insufficient land, water and capital, eroded security, and a range of new inequalities relating to income, land and labour. Most critically, a rising differentiation between coastal and inland districts and between rich and poor generally impact adaptation capabilities negatively. Both opportunities and stresses are increasingly individualized in rural

communities, the texture of which begin to break up from the impacts of marketization, private business, land transfer, wage labour and migration.

Albeit trivial, but substantiated by a large interdisciplinary field material, we argue that for rural people climate change must be seen in the context of those other stress factors already present. In Central Vietnam as elsewhere, common stress factors in rural areas relate to the conventional challenges of resource exploitation, demography and weather events in agricultural societies, including land and water scarcity and inescapable poverty. In simple terms, but nonetheless highly significant, farmer households in climate sensitive areas are less burdened by the individual components of their livelihood stress than by their total impact. Conversely, improved livelihoods in general will better enable them to deal with any single factor separately, including that of climate change.

Despite possible climate change impacts, Vietnam in general and the Central region has experienced rapid economic growth and increasing export earnings (see "Paradoxes in Adaptation: Economic Growth and Socio-Economic Differentiation. A Case Study of Mid-Central Vietnam" and "Is Climate Change a Reality for Agriculture in Quang Nam Province?"). GDP per capita has increased rapidly over the last 15 years, and the positive economic growth has improved livelihoods and reduced rural poverty levels. However, what could be interpreted as signs of decreasing vulnerability, due to economic growth and diversification in times of high demand for wood products, shrimps, rice and so forth, might turn out to increase vulnerability in times of substantial climate changes. Local people might adapt to weather events by cutting the rotation period for acacia plantation forestry, constructing houses with a first floor to rescue human and valuables, in the event of rising water levels or by purchasing boats. In this sense, the people of Quang Nam already adapt to circumstances. The problem is that these new economic activities are highly vulnerable to typhoons and flooding disasters. Only when disasters happen years apart and the economic gains from consecutive regular harvests of timber or shrimps can balance out eventual losses, will these adaptation strategies appear feasible. Our research tends to indicate that the poorest local people pay the price for the increased frequency of disasters, due, in part, to their dependency on casual work and small incomes from acacia or shrimp farms.

Thus, in the short term, hard-won gains are hardly threatened by climate change, but rather by an increasing social differentiation and the rising costs of living and of public goods. With a progressing liberalization of land tenure, capital accumulation opportunities in rural areas have increased and given rise to intense competition over land and resources. As analyzed in "The Push for Plantations: Drivers, Rationales and Social Vulnerability in Quang Nam Province, Vietnam", many farmers have turned to plantation forestry on gradually increasing plots as an effect of both government programs and market forces. Villages are gradually transformed in the process, since rich and middle-income households as well as outside investors can afford the necessary investments, while poorer households may be marginalized. Pro-poor growth tends to be relegated in the process and social conflict may increase in the old villages. "Rural Households: Socio-Economic Characteristics, Community Organizing and Adaptation Abilities", drawing on the

joint socio-economic survey (described below in the methodology section) and fieldwork in rural areas shows how diverse groups of households cope differently and have varying levels of vulnerability. A great many households are unable to cope with the tough new market conditions, such as due to disabilities, disease, old age, too many children or other adverse conditions. "Health Impacts of Climate and Environmental Change: Awareness and Challenges to Adaptation" takes a closer look at the public health aspects of present climate and environmental change, and discusses the present health situation in selected rural areas. Despite gains in terms of a decreasing occurrence of infectious diseases, many rural households report an increase in health problems.

Economic growth has facilitated a downward trend in natural hazard fatalities, but at the same time has caused a growing trend in economic losses. The socio-economic survey questionnaire also examined to what extent vulnerability can be monitored in quantitative and economic terms. The analysis, presented in "Livelihood Stresses Under the Constraints of Climate Change Vulnerability in Quang Nam", shows the case of the Ketsana typhoon in 2009: apart from the poor households at the lowest end, the households most seriously affected were those having invested in acacia forestry. A low degree of institutional adaptation means that although disaster-affected households may receive some measure of compensation, disaster relief mostly secures a bare minimum of existence.

As a result of better infrastructure and disaster preparedness, Vietnam now seems less vulnerable compared to many other developing countries. In economic terms the volume of activity and degree of economic diversification in rural areas are key issues for poverty: overall economic diversity is now increasing, while crop diversity tends to be declining in rural areas (e.g. McElwee 2010). These new patterns inevitably contribute to shaping the impacts of natural hazards. Economic losses incurred by extreme weather events are not limited to coastal areas, but now tend to be evenly distributed across geographical zones. While poorer households are more subject to losses from damage on houses, thus being materially vulnerable, higher income groups suffer greater losses in production assets (plantation forestry and aquaculture), thus primarily being vulnerable in a financial sense. Yet the economic diversification of a given area tends to be a moderating factor for all.

Variations between districts of a province seem to be repeated in variation between provinces. Natural disaster vulnerability varies significantly at the provincial level and the present study may indicate that (by multivariable linear regressions), substantial parts of this can be explained by differences in socio-economic development. As described in "Climate Change's Impact on Natural Hazards in Quang Nam Province, Mid-Central Vietnam", higher provincial per capita income appears to reduce provincial natural disaster fatality rates, while inequality, poverty, infant mortality and urbanization were significantly and positively correlated with fatalities. This is consistent with our general argument, that the key concern should be the aggregate impact of stress factors. It remains an issue, that despite a declining rate of disaster fatalities, large groups of households are highly vulnerable when disasters strike and are left with either a minimum amount of state relief, or food handouts and unsystematic support from NGOs.

4 Government and Institutions Matter

Both climate and environmental change, appearing to interact in complex patterns at the local level, call for adaptive forms of government. When impacts overwhelm local adaptive capacity, local communities need external support in their adaptation efforts. A prerequisite for strong local governance institutions is, of course, an efficient national government that can devolve the necessary power down through the system; an issue for national-level government institutions is therefore to identify the most effective means to support local adaptation. Actual adaptive capacity depends heavily on local dynamics, however, in which the livelihood impacts for vulnerable people and local governance structures at district level are in focus. Overall, a crucial parameter for success is the extent to which government policies can promote a synergistic relationship with local government institutions and vulnerable groups.

Differing constellations of actors and policies are essential at different stages of climate, weather or environmental disruption impacts. Early warning systems and training are crucial elements of enhancing livelihood resilience, whereas financial capital, including access to credit and insurance, are vital for long-term recovery. The policy challenge is to identify specific needs in response to given circumstances; that is, which assets will provide the greatest resilience and adaptation capacity. Yet the greatest adaptation capacity of communities will be reached when policy and finance are accurately aimed and efficiently and accountably applied. It is definitely an asset in Vietnam that a reasonable level of governance and public services are available in rural areas, and coordinated response is achievable. However, balancing government inputs with the adaptive capacities in local communities necessitates the identification of relevant local partners, including community and civil society organizations. Presently, as seen in "Impediments to Climate-Induced Disaster Management: Evidence from Quang Nam, Central Vietnam" and "Rural Households: Socio-Economic Characteristics, Community Organizing and Adaptation Abilities", the old communist mass organizations have a near-monopoly on rural organization, and the self-organizing potential of local and non-government associations is poorly utilized.

Immediately after the war, the Socialist Republic of Vietnam employed population, land use and forestry practices expressive of a high-modernist thinking, with serious repercussions for the environment, such as a rapidly declining forest cover. In the later phase, particularly forest policies have been revised and forest cover has increased by means of mainly plantation forestry. Many aspects of the development process are still subjected to centralized state planning, which raises many issues of rights, participation and sustainability. Several aspects of how the state 'sees' development, such as favoring large-scale social and technical engineering, employing high-modernist ideology, upholding centralized Party-state leadership, and keeping a level social terrain by means of an incapacitated civil society (Scott 2004, p. 5), are still oriented towards an optimistic and uncritical mastery of both nature and society that does not always fit in easily with global agendas. Furthermore, social science studies of climate change increasingly focus on the

mechanisms by which climate change discourses and technocratic, large scale mitigation and adaptation interventions inadvertently produce new risks, potentially eroding livelihoods and alienating affected groups (e.g. Marino and Ribot 2012).

Public information dissemination and awareness-raising are important elements in climate and environmental change, such as described in "Climate, Environment, and the Role of Media". Equally relevant is the extent to which alternative visions and civil society voices have access to conventional and new digital media. In Vietnam the media in principle are controlled by public authorities and are intended to support state policy. But investigative journalism is on the rise and the media are increasingly used to express discontent with land grabs, unequal development, pollution, illegal mining, environmental problems and so forth.

Everywhere, government may be expected to provide for the health, safety and welfare of local communities. Worst-case scenarios emerge when the government fails to protect the poor and the environment, and the local population in response rejects their own responsibility to change unsustainable land management arrangements. Thus social contracts break down. For instance, in a study from northern Vietnam, the majority of farmers attributed the responsibility for flooding to the mismanagement of the artificial hydropower reservoirs and denied that they could adopt measures to ease the detrimental effects of flooding (Schad et al. 2012). Correspondingly, our own study shows that at times, centralist planning antagonizes farmers, such as when hydropower construction increases flooding levels in downstream communities, or when population movements affect old communities and ethnic minorities (see "Paradoxes in adaptation: Economic growth and socio-economic differentiation. A case study of mid-central Vietnam", "Rural Households: Socio-Economic Characteristics, Community Organizing and Adaptation Abilities", "Natural Resource Management Impact on Vulnerability in Relation to Climate Change. A Case in Micro-Scale Vietnamese Context" and "Interaction Cultural and Environmental Change: The Co (Cua) Minority of Central Vietnam"). The continuance of aggressive and modernist development policies, as ingrained in industrial agriculture with heavy chemical inputs, may further threaten food security in rural areas in times of crisis (see "Vietnam's Food Security: A Castle of Cards in the Winds of Climate Change").

5 The Scope of the Study: Objectives, Concepts and Orientation

A series of key concepts, interrelated in scope and orientation, form the joint background of the study. Some initial delineation is presented here, leaving the qualification and application to individual chapter authors. Our common perspective makes a basic distinction between *natural hazards*, including those deriving from climate variability, and people's *vulnerability* to hazards. This implies that social structures in the general sense are the cause of vulnerability as much as they may respond to external conditions (e.g. Hewitt 1983; Adger 1998; Wisner et. al. 2004).

Social vulnerability, understood as an inadequate capacity of individuals or groups to cope with and recover from the impact of hazards, is therefore a characteristic of society and its underlying social, economic and political conditions (e.g. Bankoff 2003; Gaillard et. al. 2007; Schipper 2007).[2] Social vulnerability deals with the causes and distribution of vulnerability independent of, or before the event of a natural hazard. For instance, this is captured in the disaster 'pressure and release' (PAR) model (Wisner et al. 2004). This traces the progression of vulnerability through root causes in society itself, dynamic pressures in institutions and macro-conditions, and unsafe conditions of all sorts in local communities; disasters then occur as the culmination of progressing vulnerability on one side and natural hazards on the other.

Since the social dimension of vulnerability spans a range of entitlements and institutions, local efforts towards improved livelihoods inevitably depend on conditions in the broader society. Vulnerability and poverty tend to be closely related, and measures to alleviate them must correlate. An important observation is that 'although poor people are usually among the most vulnerable, not all vulnerable people are poor' (Moser 1998, p. 3). This means that in contrast to poverty as a simple expression of income level and well-being, vulnerability must include the risk of a household becoming poor (Chaudhuri et al. 2002). In tangible terms, the ability to cope with the impacts of natural disasters is a function of various socio-economic factors, including age, gender, land property, capital, education and access to financial transfers from outside. Deficiencies and weaknesses among these factors are similar to those resulting in poverty.

Further highlighting relativity, the presence of inequality can augment the collective vulnerability of a community. Noted above, in quantitative terms vulnerability may be measured in the losses incurred by the households and the disaster relief through the institutional framework, but clearly both the institutional capacity and aspects of poverty and inequality require qualitative and contextual assessments. For institutional adaptation, there is a crucial distinction between starting-point and end-point vulnerability (O'Brien et al. 2004). End-point vulnerability is an outcome of vulnerability in linear terms, linking climate change projections to an impact on an exposure unit (for example a household). Starting-point vulnerability, on the other hand, is contextual, based on a non-linear process of a multidimensional view of climate change. It has been pointed out that up until now, the end-point or outcome vulnerability has dominated the debate, and adaptation policies are defined quite narrowly to that end. Another related approach compares first generation (more technically oriented) and second generation (more society oriented) vulnerability assessments (Füssel and Klein 2006). In the second-generation assessments, non-climatic drivers (demographic, social, economic and political) are considered to affect the sensitivity of a community or a society

[2] Obviously, a social vulnerability perspective has a different orientation than a technical vulnerability perspective (such as applied by the IPCC), which in general terms defines vulnerability as a function of exposure, sensitivity and adaptability.

to respond to climate changes. Economic globalization and urbanization represent examples of such non-climatic drivers.

Thus, the political and socio-economic processes of marginalization and differentiation are crucial for understanding and assessing vulnerability, and they surface in very tangible factors like poverty and low levels of resource entitlements and economic opportunities (e.g. Brooks 2003; O'Brien et al. 2004; Marino and Ribot 2012). Particularly relevant for the political context of Vietnam, as a one-party state, is that social and political inclusion or exclusion is crucial for vulnerability, since marginalized groups may lack voice and influence on decision making (Eriksen et al. 2011; Bruun 2012). Approaches to vulnerability based on *entitlements*, understood as resources available to households based on their common assets, production and institutional arrangements, thus pursue the socially generated impediments to disaster readiness and management and to adaptation (see "Impediments to Climate-Induced Disaster Management: Evidence from Quang Nam, Central Vietnam" and "Natural Resource Management Impact on Vulnerability in Relation to Climate Change. A Case in Micro-Scale Vietnamese Context").

Vulnerability may also be monitored in quantitative terms, such as by means of a three-tier framework consisting of poverty, inequality, and institutional adaptation (Adger and Kelly 1999). Noted above, when looking at the typhoon Ketsana in 2009, the poorest households as well as those engaged in acacia production and shrimp farming were hardest hit (see "Livelihood Stresses Under the Constraints of Climate Change Vulnerability in Quang Nam" and "Natural Resource Management Impact on Vulnerability in Relation to Climate Change. A Case in Micro-Scale Vietnamese Context"). A declining diversity of crops and of household livelihoods in many rural areas coalesces with eroding social safety nets in the reforming society: they may eventually clash with the likely impacts from climate change (McElwee 2010, p. xiii). In particular, a livelihood strategy based on acacia mono-cropping presents a double-edged sword. On the one hand, the acacia tree species is efficient in reducing water flow-off and economically profitable, thereby reducing social vulnerability and leading to a general increase in farmer incomes. On the other hand, dependency on monocropping exacerbates the impact of natural hazards like typhoons and droughts, thus potentially differentiating households between those with greater assets and those with no alternative income sources to turn to. Quantitative approaches to vulnerability may further elucidate the stratifying mechanism in climate interventions (Marino and Ribot 2012), such as when the poor and landless are increasingly pushed towards casual work on wealthier households' plantations.

The above is in no way a denial of the significance of geographical location in the sense of proximity to the source of a natural threat or high exposure to such (e.g. Cutter et al. 2003, p. 4). *Physical vulnerability* associated with a given area must be taken into account in any community assessment and comparison (e.g. Adger 2006), and the geographical characteristics of local communities, such as land and forest entitlements, water availability, distance to markets and accessibility by road are crucial denominators (see "Paradoxes in Adaptation: Economic

Growth and Socio-Economic Differentiation. A Case Study of Mid-Central Vietnam", "Impediments to Climate-Induced Disaster Management: Evidence from Quang Nam, Central Vietnam", "Livelihood Stresses Under the Constraints of Climate Change Vulnerability in Quang Nam" and "Rural Households: Socio-Economic Characteristics, Community Organizing and Adaptation Abilities"). Yet location in itself is not a consistent factor (for disaster losses and economic vulnerability across geographical zones, see "Livelihood Stresses Under the Constraints of Climate Change Vulnerability in Quang Nam"). Vulnerable people are also found outside the most vulnerable places, and even fragile physical environments may provide access to wealth for some people (Moser 1998, p. 3; Chaudhuri et al. 2002; O'Brien and Leichenko 2000, p. 224). Highly risk-prone areas in Central Vietnam offer great economic opportunities, while the burden of poverty has been shifting across geographical space.

Place is itself subject to change: with the growing impact of *environmental interventions* (understood as alterations in the physical environment for economic or demographic purposes), including both mitigation projects targeted at reducing risks and those deriving from economic development as described above, place-bound vulnerabilities will constantly alter for better or worse. When seen in even a brief historical context, the ethnic mountain dwellers of Central Vietnam, who up until the war period controlled huge natural resources, have backslid to become without comparison the poorest populations segment in present society (see "Interacting Cultural and Environmental Change: The Co (Cua) Minority of Central Vietnam"). Poor fishing communities struggling with declining marine resources have suddenly found their coastal setting a new spot for holiday resort development, providing new land and labour opportunities. Notwithstanding structural conditions, both social and place-bound vulnerabilities are increasingly dynamic factors in industrializing and globalizing locales. It may further be argued with regard to physical vulnerability, that any complex society can be expected to offer some measure of protection against and compensation for place-specific exposure, since local governments in principle provide for the health, safety and welfare of their local communities.

In a Vietnamese context the *household* (a cohabitation unit usually spanning several generations and primarily consisting of members related through marriage and blood) still tends to be the basic socio-economic unit. Household vulnerability strikes through in key variables, such as access to land, livelihoods and employment, household composition, education, social group belonging, ethnicity, and access to financial and other transfers from outside (the special relationship between vulnerability and poverty will be discussed in "Livelihood Stresses Under the Constraints of Climate Change Vulnerability in Quang Nam" and "Rural Households: Socio-Economic Characteristics, Community Organizing and Adaptation Abilities"). Living with uncertainty and climate variability are constitutive elements of small farmer production in most parts of the world. Efforts to cope with stresses and external shocks are inherent in local production systems and household strategies. When seen in the perspective of the rural household, climate change represents a *stress factor* similar to other stress factors already present, such as those deriving from the interacting processes of change described above. Poor or

vulnerable households frequently suffer multiple and mutually reinforcing shocks from very diverse circumstances. These include living on marginal and risky land, lacking capital, having poor housing, being poorly educated and being prone to suffering health problems (see "Climate, environment, and the role of media"). Simply put, the poor suffer not only from the event of a given disaster, but as much from the social conditions under which they already live (e.g. Adger and Kelly 1999).

Adaptation is commonly defined as adjustment in natural or human systems in response to actual or expected climate stimuli and their effects, thus carried out either in direct response to or in anticipation of changing climatic conditions. In the specific context of socio-economic analysis, however, it may be understood as combined decision-making processes and actions, undertaken to maintain capacity in the face of current and predicted environmental change (e.g. Nelson et al. 2007). It can therefore activate a range of indigenous knowledge backgrounds and informal institutions contained in local culture as well as rely on the formal institutions of state and government. These include both conventional and targeted climate change and disaster prevention institutions (see "Impediments to Climate-Induced Disaster Management: Evidence from Quang Nam, Central Vietnam"). *Adaptive capacities* by which to adjust and adapt, are inherent in any natural or social 'system'. However, in a social context they are inevitably subject to questions of Who? and How?, accentuating issues of poverty, social differentiation, migration, human rights and democracy.

Obviously a great breath of studies is needed to get a clear sense of the multiple adaptations that individual households and communities perform. However, there is a lack of consensus about which factors determinate adaptive capacity and how to measure success; some scholars indicate the possibility of ending up with an adaptive capacity deficit (Williamson et al. 2012). If disaster plans prove unrealistic in the advent of natural hazards, such as when disaster relief does not reach out (see "Impediments to Climate-Induced Disaster Management: Evidence from Quang Nam, Central Vietnam" and "Livelihood Stresses Under the Constraints of Climate Change Vulnerability in Quang Nam"), adaptive capacity in obviously at fault. But there is also a crucial time dimension. This is because adaptation takes place in response to events or a series of events over time, which demands a period of consideration that tends to delay action. Thus, the full sequence of climate events, change of strategies, and real-life adaptations only becomes visible over a temporal length. Studying the process demands repeated data collection over a lengthy period of time. And making sense of our field experiences as researchers further expands the time frame, to the point where the 'adaptations' documented may no longer be sufficient or even relevant. As inferred above, the range of qualities enjoyed by the broader society also determine the space for opportunity.

The above conceptual discussion focuses on the consecutive levels of land uses, resource management, institutions and governance. As indicated in the discussion of physical vulnerability, however, individual actions and social processes cannot be viewed in isolation from the natural resource base with which they interacting. Placing them in a joint socio-ecological framework is tempting (Berkes and Folke 1998; Adger 2006), but fosters other challenges. For example, studies of

'environmental stress factors' commonly involve both 'social and ecological systems' (Berkes et al. 2003) and point to a complexity that may only be investigated through meta-level approaches and broad conceptual constructs. Commonplace terminology in climate change and vulnerability studies, notably concepts of 'systems', 'adaptation', 'capacity' and 'resilience', project images that rural communities are oriented towards harmony and equilibrium and strive to revert to a given and static state. Over the years, successive studies have pointed out that 'natural systems' may not have a single steady state, but organize around a series of possible states (e.g. Holling 1973; Nelson et al. 2007), or may be characterized by non-equilibrium dynamics (e.g. Folke 2006). This lends further credibility to complexity theory which rules out certainty in principle (e.g. Prigogine 1997; Mitchel 2009). Speaking of 'social systems' in local communities as the other side of the equation, and even seeing social structures as integral to nature (Berkes and Folke 1998; Adger 2006), further adds to the vagueness in integrated socio-ecological approaches. Social 'systems' easily become corrupted and inadvertently geared towards short-term gains while degrading the natural environmental.

With the present rate of development in rural areas of Central Vietnam we continuously see land use forms discontinued and breaking up as both natural and social 'systems'. This frequently results in villages communities leaping into a whole new state. Examples include labour intensive grain and vegetable cropping for subsistence converted into extensive cash cropping due to labour migration, rice fields being pooled into large fish and shrimp farms, hilly forest land being cleared for acacia plantation forestry, local population being shifted out for reservoir construction, or entire agricultural areas transforming into industrialized town life. Moreover, and contrary to popular perceptions of rural communities, the present phase of development may be characterized with social and cultural values becoming decreasingly stability orientated, and increasingly geared towards optimally exploiting natural and social systems for a transfer into modern-sector, industrialized, or urban life.

In these circumstances, what does 'adaptation' really imply? Obviously, not every adaptation is a good one (Eriksen et al. 2011), and local 'communities' may in fact desire land use transitions that seriously burden the environment (for the concept and meaning of 'community' in Central Vietnam, see "Livelihood Stresses Under the Constraints of Climate Change Vulnerability in Quang Nam" and "Rural Households: Socio-Economic Characteristics, Community Organizing and Adaptation Abilities").

6 Integrating Climate and Environment

A rapidly growing body of international literature is establishing climate change vulnerability and adaptation as a separate field. It has been bestowed with its own distinct discourse, academic assemblies and publications, and donor organizations have built up targeted aid programs in its wake. There is a risk of separating the 'climate' from the natural environment in which people live, work and sense the

world, thereby overexposing technical and meteorological parameters of change. This can also neglect those social, national and global structures which commonly impact the physical environment in developing countries on a far greater scale. And little is gained if climate change response is sidelining the vital areas of accountable governance and sustainable development. Fortunately, a sense of urgency and responsibility feeds the debate on climate change mitigation and adaptation processes. But we wish to emphasize that when global policies and initiatives enter national politics in weak or non-democratic countries, they easily get caught up in the kind of rhetoric that props up regime legitimacy while referring social and environmental ills to incontrollable or outside forces. In the case of Vietnam, central control and political interest in the climate change discourse merge together with overall political priorities, which in practice affects a separation of climate change response from environmental protection (Fortier 2010; Bruun 2012, see also "Natural Resource Management Impact on Vulnerability in Relation to Climate Change. A Case in Micro-Scale Vietnamese Context" and "Interaction Cultural and Environmental Change: The Co (Cua) Minority of Central Vietnam").

The integration of climate change adaptation and mitigation with environmental protection, as much as with any development initiative, is given in a 2006 OECD Declaration and specified in OECD policy guidance (OECD 2009), and has been further developed in many individual donor strategies. Such integration is echoed in the Vietnamese Action Plan for Climate Change (MONRE 2007) and remains a stated goal of the foreign donors contributing to its funding. Yet there are multiple obstacles for carrying it out in practice. These include the procedural and economic priorities laid out in overall government policy, but also cultural issues, power politics and practical set-ups on the ground. After extensive field studies in Central Vietnam we wish to point out that environmental protection and commonplace attention given to sustainable development, are taking the back seat everywhere in favour of immediate economic gains. Most disturbingly, the very conception of environmental protection may gradually be sidelined by the climate change discourse. There are pertinent arguments for further strengthening the environmental dimension of any action on climate change. We propose three such leading arguments.

First of all, there are the technical-administrative concerns. There is presently a risk of both policy making and implementation being compartmentalized into 'conventional' environmental and 'new' climate change organs, each with a narrow accountability towards their respective ministries, policies and donors. New agencies are set up, leading to an incessant flow of policy and strategy papers, and individual ministries have joined in with their own climate change programs. Experience from Central Vietnam calls into question a constricting approach to climate change impacts. Depending on context, it is pertinent to address short-term strategies in exploitation of natural resources, resource degradation, polluting and destructive activities, and irregularities in local land management. All of these are likely to interact with and even aggravate climate change impacts. We believe that in order to make relevant and realistic recommendations for local

communities aimed at long-term benefits for their climate change adaptation and resilience, environmental and human land use factors must be taken into account throughout. As noted above, the hydropower construction and changing forestry patterns presently taking place in several provinces of Central Vietnam, appear to impact river flows far more dramatically than climate change. For instance, farmers and city dwellers in Quang Nam experienced unusually rapid and destructive flooding in the aftermath of the 2009 Ketsana typhoon. However, later news revealed that major hydropower plants at the same time released surplus water into the rivers (LAV 2009a, b). The regulatory function of their reservoirs is increasingly called into question, and they may in actual practice amplify natural cycles by retaining water in the dry season and releasing it during rains in order to optimize production. The joint party-state-private push for the expansion of hydropower capacity is enormous and environmental impact assessments (EIAs) are not allowed to delay the process. In fact, evidence suggests that construction work may be started and land use permits issued to developers even before data collection for EIAs is undertaken (Dao 2010).

Implementing first-order adaptation measures is no guarantee that the entire adaptation process is successful (Birkman 2011). As a relevant example, building dykes in the northern Mekong delta enabled farmers to continue their agricultural production, but the adaptation measures had negative effects on the fish stock and increased the dependence of local farmers on agrochemicals (reduction of flood induced fertilization). In another example, it was suggested that the Vietnamese coast line should be divided into risk zones, and to adopt non-infrastructural, low-tech solutions in low-lying zones, such as building houses on stilts and constructing high-lying storm shelters (Boateng 2012). In Quang Nam, rich and middle-income families are now also constructing two-storey houses to shelter food and people during periods of extreme flooding (see "Rural Households: Socio-Economic Characteristics, Community Organizing and Adaptation Abilities").

Second, there are economic considerations. Economic losses from disasters are increasing on a global scale as a consequence of economic development, and are occurring independently of climate change. When adding the climate change factor, losses can only be expected to increase further. Sound environmental planning is the better economic approach to both sources of loss, while providing better protection of human lives, particularly in typhoon and flooding prone regions. The transitional ambiance in Vietnamese rural areas only exacerbates the problem. For example, the most successful of agriculture and aquaculture farmers, forestry entrepreneurs, gold miners, industrialists and officials may hastily generate enough wealth to leave their local areas, and many do in fact leave for a better life in the city or abroad. But a consequence is that they take little interest in the environment they leave behind for their less fortunate community members. Not pushing economic opportunities to the limit may be a better way to secure income opportunities for the remaining inhabitants and may provide a sustainable environment for future generations.

Third, there is an ethical dimension. Placing climate change in a longer time frame, involving potentially far greater impacts than presently felt, inevitably

brings ‘global justice’ to the fore and calls for assistance to developing countries. Unfortunately, this is not enough to safeguard rural livelihoods. Since climate disruptions manifest themselves through both weather events and the state of the natural environment in which all take a share in a given location, the pattern of distribution of vital resources and entitlements should be the accompanying concern. It is consistent with both the social vulnerability and entitlements approaches to extend the climate change adaptation debate with aspects of social and environmental justice. Equal access to land, water, energy and other resources, equal access to protection from natural hazards and severe weather, equal treatment in government policy and planning, and equal access to participation in policy making and regulation, are as essential for local communities, as the global politics of responsibility and justice. Irrespective of the political context, international mechanism like the 7th Millennium Development Goal of environmental sustainability, and the international environmental and biodiversity protection regimes, should be natural ingredients in any climate change response.

An overall framework for addressing climate change impacts and adaptations would therefore be three-dimensional, consisting of strengthening local community and household robustness, resilience and adaptation (a social dimension); securing overall social, economic and political development (a state dimension); and protecting environment and resources, seeing climate and environment as a unity (an environmental dimension).

7 Methodologies and Common Constraints

This study uses a range of independent and mixed methods, ranging from climate change scenario construction and quantitative and statistical analyses to qualitative interviewing, policy analyses and fieldwork. The separate chapters will outline their respective methodologies.

In Quang Nam province we started out with a comprehensive household survey, including 166 households in 5 districts across the province, and covering a broad range of issues related to socio-economic conditions, stress factors, land uses and changes, climate responses, past disaster experiences, local government responses and health impacts. Extensive data-checking and follow-up interviewing in all communities created a large knowledge base as well as a valuable network for continued research, both among local people, officials and institutions.

Concerning current land uses and land use changes in Central Vietnam under the influence of external factors like policy making, the market, and climate change, the project in Quang Nam built up a large amount of data spanning both agriculture, aquaculture and forestry. Separating the various impacts on current land use changes and new production strategies is inherently difficult, due to methods to distinguish climate change impacts needing further development. However, ongoing analyses with inputs from hydrological studies, biomass and crop analysis, economics, disaster management studies and sociology, including migration

and ongoing changes in ownership structures, all address the central issues of vulnerability, resilience capacity and adaptation.

Working with government is a sine-qua-non in Vietnam and access was not always as easy as we wished. It required lengthy procedures through our counterpart in Hanoi and subsequently through provincial and local governments, where there was always a possibility of each level having their own reservations. Certain districts in Quang Nam province are not easily accessible for research, despite the entire province in principle being open to tourism. Particularly, highland districts with large minority population segments proved difficult to access. For this reason the present study has a bias towards lowland and mid-elevation areas and ethnic Vietnamese communities (except "Interacting Cultural and Environmental Change: The Co (Cua) Minority of Central Vietnam"). Similarly, the countless localities for hydropower construction were in principle out of bounds. Considering the current enormous scale of funding, authorities may not be impartial to the exposure of external climate threats to anyone associated with foreign donors. Corruption is generally acknowledged to remain at a high level, such as in land management and emergency aid (e.g. WB 2011) despite constant government programs to combat it. As a consequence, a range of economic activities and land and resource use practices escape formal statistics, while infusing any data material with great uncertainty.

The current state of statistical data accumulation in Vietnam is a separate issue, as a great local diversity of practices and capabilities contribute to statistical uncertainties. A systemic challenge is the cumulative method of reporting, by means of which data travel from Village to Commune to District to Province authorities (through four independent levels), each level working up the statistics and passing it on to the next level, at the same time having their own separate policy implementation and quota duties. When data reaches the statistical bureau there is a probability that it is already more cooked than raw, so to speak. According to interviews with statistical staff, from a professional point of view a direct mode of reporting from lowest to highest level would ensure a higher quality of data. For instance, data on forestry may stem from various departments and administrative levels using their own methods, such as discussed in "The Push for Plantations: Drivers, Rationales and Social Vulnerability in Quang Nam Province, Vietnam".

Studies of social climate change impacts would automatically seek to establish baselines, or baseline scenarios, against which impacts are measured, with or without adaptation. However, for the reasons above, even when consisting of dynamic projections of land use, production, population growth, urbanization, and so forth, they tend not to capture the true scale of change as experienced on the ground. The problem is how to proceed under these circumstances? Working up statistics, conducting research in local communities, taking samples, etc. is the conventional approach, which may, over time, produce the desired results; several contributions to this book follow this track. Another approach, perhaps more true to experience, would be to reject baselines and apply instead a series of momentary analyses, focusing on conditions, practices, allocations, needs and inequalities at any given point in time. A

truly dynamic approach will necessitate repeated field studies and analyses, however, possibly involving local participation in monitoring change. While the first approach may favor larger scale analyses and state-driven interventions, the latter may favor the smaller scale issues, taking into account the totality of impacts from climate and environmental change as well as from general development.

The multiple, interacting processes of change that impact any household in Central Vietnam are at the same time manifestations of those global processes that tie the region to the outside world. The people of Central Vietnam stand on the edge of a new frontier—the frontier of unfulfilled dreams and great opportunities, but at the same time of many perils and unsolved problems.

References

ADB (2009) (Asian Development Bank) The economics of climate change in Southeast Asia: a regional review. ADB, Mandaluyong City

Adger WN (1998) Indicators of social and economic vulnerability to climate change in Vietnam. CSERGE Working Paper GEC 98-02

Adger WN (2006) Vulnerability. Tyndall Centre for Climate Research, Norwich

Adger WN, Kelly PM (1999) Social vulnerability to climate change and the architecture of entitlements. Mitig Adapt Strat Glob Change 4:253–266

Bankoff G (2003) Constructing vulnerability: the historical, natural and social generation of flooding in Metropolitan Manila. Disasters 27(3):224–238

Berkes F, Folke C (eds) (1998) Linking social and ecological systems. Management practices and social mechanisms for building resilience. Cambridge University Press, Cambridge

Berkes F et al (2003) Navigating social-ecological systems: building resilience for complexity and change. Cambridge University Press, Cambridge

Birkmann J (2011) First- and second-order adaptation to natural hazards and extreme events in the context of climate change. Nat Hazards 58:811–840

Boateng I (2012) GIS assessments of coastal vulnerability to climate change and coastal adaptation planning in Vietnam. J Coast Conserv 16:25–36

Brooks N (2003) Vulnerability, risk and adaptation: a conceptual framework. Tyndall Centre for Climate Change Research, Working Paper 38

Bruun O (2012) Sending the right bill to the right people: climate change, environmental degradation and social vulnerabilities in Central Vietnam. Weather, Clim Soc 4(4):250–262

Chaudhuri S et al (2002) Assessing household vulnerability to poverty from cross-sectional data: a methodology and estimates from Indonesia. Department of Economics, Columbia University, Discussion Paper 0102-52

Chaudhry P, Ruysschaert G (2007) Climate change and Human Development. UNDP, Human Development Report Office Occasional Paper, 2007/46

Cutter S et al (2003) Social vulnerability to environmental hazards. Soc Sci Quart 84:242–261

Dao N (2010) Dam development in Vietnam: the evolution of dam-induced resettlement policy. Water Altern 3:324–340

Eriksen S et al (2011) When not every response to climate change is a good one: Identifying principles for sustainable adaptation. Clim Dev 3:7–20 Review article

Fabres B (2011) Think global, act global in the Mekong Delta? Environmental change, civil society and NGOs. In: Stewart MA, Coclanis PA (eds) Environmental change and agricultural sustainability in the Mekong Delta. Springer, Dordrecht, pp 7–34

Folke C (2006) Resilience: the emergence of a perspective for social-ecological systems analysis. Glob Environ Change 16(3):253–267

Fortier F (2010) Taking a climate chance; a procedural critique of Vietnam's climate change strategy. Asia Pac Viewpoint 51(3):229–247
Füssel HM, Klein RT (2006) Climate change vulnerability assessments: an evolution of conceptual thinking. Clim Change 75:301–329
Gaillard JC et al (2007) "Natural" disaster? A retrospect into the causes of the late-2004 typhoon disaster in Eastern Luzon, Philippines'. Environ Hazards 7(4):257–270
Giddens A (2009) The politics of climate change. Polity Press, Cambridge
Hewitt K (ed) (1983) Interpretations of calamity: from the viewpoint of Human ecology. Allen and Unwin, Boston
Holling CS (1973) Resilience and stability of ecological systems. Annu Rev Ecol Syst 4:1–23
LAV (2009a) (Look at Vietnam) Numerous hydroelectric plants built in the central highlands region have made floods in the storm-hit area more serious, experts say. www.lookatvietnam.com. 12 December
LAV (2009b) (Look at Vietnam) Deputy Minister blames reservoirs for worsening floods. www.lookatvietnam.com. 10 October
Marino E, Ribot J (2012) Special issue introduction: adding insult to injury: climate change and 5th inequities of climate intervention. Glob Environ Change 22:323–328
McElwee P (2010) The social dimensions of adaptation to climate change in Vietnam. The World Bank, Discussion Paper 17, December
Mitchell M (2009) Complexity theory: a guided tour. Oxford University Press, Oxford
MONRE (Ministry of Natural Resources and Environment) (2007) National target program to respond to climate change. MONRE, Hanoi
MONRE (Ministry of Natural Resources and Environment)— (2009) Climate change: sea level rise scenarios for Vietnam. MONRE, Hanoi
Moser C (1998) The asset vulnerability framework: reassessing urban poverty reduction strategies. World Dev 26(1):1–19
Nelson DR et al (2007) Adaptation to environmental change: contributions of a resilience framework. Ann Rev Environ Res 32:395–419
O'Brien KL, Leichenko RM (2000) Double exposure: assessing the impacts of climate change within the context of economic globalization. Glob Environ Change 10:221–232
O'Brien KL et al (2004) What's in a word? Conflicting interpretations of vulnerability in climate change research. CICERO Working Paper
OECD (2009) OECD policy guidance on integrating climate change adaptation into development co-operation. OECD, Paris
Prigogine I (1997) The end of certainty. The Free Press, New York
Schad I et al (2012) Why do people not learn from flood disasters? Evidence from Vietnam's northwestern mountains. Nat Hazards 62:221–241
Schipper L (2007) Climate change adaptation and development: exploring the linkages. Tyndall Centre for Climate Change Research, Working Paper 107
Scott JC (2004) Seeing like a state: how certain schemes to improve the human condition have failed. Yale University Press, New Haven
Scott JC (2009) The art of not being governed: an anarchist history of upland Southeast Asia. Yale University Press, New Haven
Sebesvari Z et al (2011) Climate change adaptation and agrichemicals in the Mekong Delta, Vietnam. In: Stewart MA, Coclanis PA (eds) Environmental change and agricultural sustainability in the Mekong Delta. Springer, Dordrecht, pp 219–240
Sperling F et al (ed) (2002) Poverty and climate change: reducing the vulnerability of the poor through adaptation. African Development Bank
Van Tan P (2010) Study on developing detailed climate change scenarios for mid-central Vietnam. Sub-project 3, project 'Assessing impacts of climate change on physical, environmental conditions and socio-economic development in mid-central Vietnam'. Hanoi, Institute of Geography, Vietnamese-Danish research project
WB (2010) (World Bank) Economics of adaptation to climate change: Vietnam. World Bank

WB (World Bank with Danida and Sida) (2011) Recognizing and reducing corruption risks in land management in Vietnam. National Political Publishing House, Hanoi
Williamson T, Hesseln H, Johnston M (2012) Adaptive capacity deficits and adaptive capacity of economic systems in climate change vulnerability assessment. For Policy Econ 24:48–54
Wisner B et al (2004) At risk: natural Hazards, People's vulnerability and disasters, 2nd edn. Routledge, London