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Different Ways to Decrease Vulnerability to Increased Climate Variability and Extremes

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Abstract: *This article analyses two approaches to decreasing vulnerability to the impacts of increased climate variability and extremes (CC) in mid-central Vietnam: one based on investments in infrastructure to protect the environment (referred to as ecological resilience) and another with an emphasis on approaches of decreasing vulnerability through development more broadly by increasing incomes, especially for the poor, and strengthening of social capital and institutions (referred to as social resilience). The two approaches are analysed within the framework of sustainable adaptation which emphasizes targeting the risks and vulnerability stemming from the root courses of impacts of CC and the capacity to cope with the inevitable impacts of CC. The article describes how rapid economic growth and socio-economic differentiation in Vietnam during the past 25 years have diversified social resilience and the ability to adapt to the impacts of CC. This is exemplified by examining the effects on socio-economic groups in the three different agro-ecological zones in Quang Nam Province.*

Key words: *Vulnerability and resilience to climate change, sustainable adaptation, Vietnam, economic growth and social differentiation.*

1. Introduction

It is no longer to be debated whether or not societies, communities and individual households have to adapt to increasing climate variability and extremes. The facts show that climate change is resulting in an extra burden for poor developing countries and especially those that are most prone to the effects of a changing climate. Low lying coastal areas are more prone to saltwater intrusion in soils and fresh water sources and to inundation due to rise of seawater level, and regions in the tropical typhoon belts are more prone to damaging storms and floods as well as some areas are more prone to severe droughts. How severely impacted different localities are from changing and extreme weather conditions is however

dependent on the ecological resilience as well as the social resilience of the specific area in question. Some areas that may get severely physically hit by extreme weather conditions may easily recover due to strong institutions and a strong economic foundation and social capital, while other areas may suffer severely from less dramatic weather events due to internal conflicts, poverty and/or weak institutions. It is therefore essential to understand the context specific relationship between social and ecological resilience to climate variability and extremes (Adger 2000). While climate changes in Quang Nam Province, which this article is concerned with, are forecasted (Kelly *et al.* 2001, World Bank 2010) it still has to

be proven whether they actually are already taking place. In any case, the extreme weather conditions already existing in the province have a serious impact on environments and economic development, which are only going to be exacerbated with the forecasted increased climate variability and extremes. Both the existing extreme climate conditions and the predicted will, for convenience, be abbreviated CC in the following.

As it is often the poorest regions of the world that are most vulnerable to CC, it is crucial for their necessary adaptation to the inevitable changes to have informed considerations on the proportionate weight between social resilience (i.e. socio-economic strength and strength of social and institutional networks) and ecological resilience (i.e. robustness of ecosystems and landscapes) in specific locations. These considerations are often expressed as a choice between investments in development and poverty alleviation through economic growth and strengthening of social resilience (i.e. social development and institutional enhancement) or infrastructure constructions to protect the environment and thereby enhance ecological resilience. This is also often expressed as the interfaces between climate change adaptation and poverty alleviation or mainstreaming poverty-environment efforts (UNDP-UNEP 2011). This article will discuss the relationship between social and ecological resilience in the specific context of Quang Nam Province in the Mid- Central Vietnam and hence the pros and cons of the two ways of decreasing vulnerability to CC.

2. Theoretical Framework and Key Concepts

The analysis of vulnerability, resilience and adaptation will be conducted within the framework of sustainable development, emphasizing the poverty-environment nexus in adapting to CC. sustainable development is of crucial importance for the capacity of fragile communities and societies to adapt to climate change. This thinking is very much in line with a special volume of the journal *Climate Policy* (7, 2007) where the editors, Bizikova, Robinson and Cohen, in their editorial emphasize the need of an integrated approach considering the linkages among climate change adaptation (A) and mitigation (M) in the context of sustainable development (SD). AMSD emphasizes that climate change adaptation

and mitigation are part of the wider development goals in transition towards sustainability (Bizikova *et al.* 2007).

The AMSD approach that puts sustainable development first recognizes the need for reducing greenhouse gasses (GHG) emissions and identify/enhance capacity for adaptation to and actual response to climate change. AMSD is, according to the editors, built around principles of participation, scenario development and social learning that include four stages: 1. identifying local sustainable development scenarios, 2. linking climate change impact, 3. identifying linkages between mitigation and adaptation and 4. developing an integrated AMSD implementation strategy (ibid. p. 273). The editors and authors of the special issue of *Climate Policy* strongly advocate for a participatory approach involving community members and local agencies who know the local bio-physical and societal context and who know the history of adaptation to local climate variability. This pool of local wisdom and experiences of adaptation measures is invaluable for enhancing the capacity for adaptation to CC. The present study concerning Quang Nam Province also confirms that building on contextual local experiences in reducing vulnerability and mobilizing capacity for adaptation requires a new approach to knowledge creation. By combining applied action research with academic research and local knowledge, experiences from similar situations worldwide can inspire local knowledge creation to cope also with new challenges from increased climate variability and extremes.

Eriksen and O'Brien (Eriksen and O'Brien 2007) mention, addressing both poverty and vulnerability to climate change are two of the major challenges to sustainable development in the 21st Century. They distinguish three measures for intervention to reduce vulnerability to climate change:

1. Target **risks** posed by climate change, i.e. destruction or deterioration of physical or social infrastructure
2. Aiming at strengthening the **capacity to cope** with and adapt to climate stress, e.g. alternative sources of income (on-farm and non-farm), diversifying crop and animal production, diversifying land use, etc.

3. Targeting causes for **vulnerability**, e.g. poor market channels, poor educational levels and lack of political back-up, remoteness due to poor physical infrastructure, conflicts etc.

Poverty is closely related to all three levels, but the interface between vulnerability reduction and poverty reduction measures, Eriksen and O'Brien call 'sustainable adaptation'. (Eriksen and O'Brien 2007), p. 338) and according to them:

'Given the broad nature of measures required for reduction of vulnerability of the poor, adaptation is a social development issue as much as (if not more than) an environmental and technological issue' (ibid. p. 348-49).

Sustainable adaptation is first and foremost a societal development issue, in the light of which environmental and technological issues in reducing vulnerability and poverty should be considered.

'Vulnerability and poverty cannot be addressed together unless, in addition to the bio-physical risks associated with climate change, the specific risks of the well-being of the poor, their adaptive capacity, and the processes shaping the vulnerability are also targeted'. (ibid. p. 349)

It is important to note that social vulnerability even of the poorest segments of the population¹ in Vietnam is lower than in most other developing countries, due to a coherent socio-political structure of the society that has decreased poverty considerably during the past 25 years. Meanwhile, social differentiation has increased rapidly and, as I shall show in this article, has diversified the resilience to CC. While Vietnam in general has a higher social resilience due to rapid economic growth and strong government institutions, the ecological vulnerability of Mid- Central Vietnam vis-à-vis CC is high. The long coastline located in the tropical belt of typhoons and the steep slopes covering the Midlands in between the coastal zone and the high mountains bordering Lao PDR, are very prone to extreme storms, landslides, floods and droughts.

3. Definitions

As emphasized by the IPCC in 2012: The concepts and definitions related to climate change reflect the fact that they evolve as knowledge, needs and con-

texts vary. Disaster risk management and adaptation to climate change are dynamic fields and have in the past exhibited and will necessarily continue in the future to exhibit such an evolution (IPCC 2012, p. 30). However, in the same report, the IPCC defines **climate change**

'as change in the state of the climate that can be identified (e.g. by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use'.

Vulnerability is defined as the extent to which a natural or social system is susceptible to sustaining damage from climate change (IPCC 2012).

However, the definitions of the key concepts used in this article, such as vulnerability, resilience, sensitivity and adaptation to a large extent follows the definitions provided by Adger (Adger 2000) and Adger, Kelly, *et al.* (Adger *et al.* 2001), emphasising the relationship between the social and the ecological aspects:

Social Resilience describes the ability of groups and communities to cope with external stresses, naturally or socially induced, while *Ecological Resilience*, in the same way, describes an ecosystem's ability to cope with stresses. *Resilience* is as such an antonym to *vulnerability*. There are two dimensions of resilience (and vulnerability). One is the *sensitivity* signifying the buffer capacity of an ecosystem or the capabilities and coherence of a social group or, expressed in a different way, the magnitude of disturbance that can be absorbed before an ecosystem changes or the social coherence is seriously disturbed. The other dimension of resilience is the capacity of ecosystems and social groups to recover from shocks or disturbances in terms of speed and extent of recovery. The epistemology of understanding the building blocks and processes of ecosystems and social groups is of course very different, but there is a clear interrelationship in understanding social and ecological resilience, particularly for social groups and communities that are dependent on ecological and environmental resources for their livelihoods (Adger 2000). Even though this article mainly deals

with socio-economic groups, I think it is important to also understand the vulnerability and resilience of individual households as members of a community. In determining individuals households' or communities' capacity of adaptation to CC, the resilience, and hence vulnerability, of the socio-economic units, will be understood as their own inherent resilience and vulnerability in the context of the resilience and vulnerability of the socio-economic framework and institutions - from the local to the national level - framing their opportunities of adaptation. This understanding of socio-ecological resilience and adaptive capacity is very much in line with Jonathan Ensor's translation of these definitions into practical implementation:

'...resilience would refer to the amount of external disturbances that a small-scale farming community could withstand before the community members lose livelihoods or well-being. Adaptive capacity, on the other hand, determines how people can make changes to their system. It is through adaptive capacity that people are able to change their livelihoods to make them more resilient – which is to say better able to withstand external disturbances such as droughts or shift in seasonal temperatures.' (Ensor 2011, p. 13)

4. Empirical Data

Vietnam, and especially the long coastline bordering the South China Sea, being one of the areas severely prone to climate changes and Quang Nam Province in the belt of tropical typhoons in the middle of that coastline, is a location in need of an informed basis for making decisions on how best to enhance resilience to extreme weather conditions. Although climate changes are predicted in the region, the actual CC is yet to be proven. However, the existing extreme weather conditions (heavy storms and precipitation, droughts and heat waves) have a major impact on the environmental conditions in the region. The article draws on field work carried out in the province of Quang Nam from 2009 to 2011² and especially on a household survey carried out in 2009, interviewing 166 households in five districts in Quang Nam Province, using a large comprehensive questionnaire³. This article more specifically is based on in-depth interviews supplementing the household data collected from Nui Thanh District and the three communes of Tam Tra, Tam Thanh and Tam Hoa. These three communes

represent the mountainous zone, the midlands and the coastal plains, being the main agro-ecological zones in Mid-Central Vietnam, acknowledging the inherent problems in comparing agro-ecological and administrative geographical units.

5. Hypotheses

While Vietnam has experienced impressive economic growth rates since the Doi Moi reforms were introduced in the 1980s, the liberalisation and the further diversification of the economy has also been followed by an increasing socio-economic differentiation and hence diversified the social resilience and capacities to adapt to climate changes. How the implementation of these reforms in Quang Nam has influenced different households' and communities' capacities to adapt to environmental changes in the Province, already impacted severely by extreme weather conditions, will be discussed through the analysis of the following four groups of interrelated hypotheses. The hypotheses were generated as a result of the author's discussions with the various stakeholders during the fieldwork:

- The increased income diversification has made the rich households less vulnerable to effects of CC in terms of health and safety, while they at the same time feel more vulnerable to CC than poorer households.
- Although the poor segment of the population is more vulnerable in terms of health and safety to effects of CC they perceive poverty and insufficient access to land as greater obstacles to better livelihoods than climate change drivers.
- Access to non-farm incomes in general enhances the social resilience of households.
- Government officials generally consider it better to invest in physical structures to mitigate the effects of CC while especially the poor and mid-level households prefer enhanced socio-economic capabilities to adapt to actual effects of CC

6. Socio-Economic Differentiation and Diversified Vulnerability

It is difficult to get comparable statistical figures across the different epochs of Vietnam's recent his-

tory as the statistical categories and administrative borders have been changing. However, Table 1 gives an indication of the rapid economic growth during the past 17 years and the increasing socio-economic differentiation in the Mid-Central Region of Vietnam⁴.

Table 1. Economic growth and socio-economic differentiation in Mid-Central Vietnam

	Average monthly income for poorest quintile 1000 VND	Average monthly income for richest quintile 1000 VND	Difference between richest and poorest quintile
1992-93	33.3	139.8	4.19
1996	80.13	454.68	5.67
1999	91.5	577.3	6.31
2008	274.0	1911.0	6.97
2010	371.1	2683.0	7.20

Quang Nam Statistical Yearbook various years⁵

Table 1 shows that both the poorest and the richest 20% of the population had a rapid increase in incomes from 1992-93 to 2010, but while the richest quintile has 19 times their income, the poorest quintile only 11 times their income during that period. While the difference between the richest

and the poorest quintile in 1992-93 was 4.19 times, that difference had increased to a factor 7.2 in 2010. What is also notable is that the official poverty line of 200,000 VND per month covers only the absolute poorest households as the average income for the poorest quintile in 2010 was almost double that amount⁶. Comparing the figures in Table 1 for the whole Mid-Central Region with the figures in Table 2, only covering Quang Nam Province, it is noticeable that the differences between the richest and poorest quintiles in Quang Nam are about the same as for the whole region. The figures for the differences between the richest and the poorest quintiles in Quang Nam Province is 6.5 times compared to 6.31 for the whole region in 1999 and the same difference of 7.20 is found for Quang Nam as for the whole region in 2010. In terms of income differentiation, Quang Nam Province represents the Mid-Central Region well. Table 2 describes the differences in incomes for Quang Nam Province according to residence, income source and income quintiles.

The Quang Nam Statistical Yearbook, 2010, shows an average increase in household incomes in Quang Nam Province from 2004 to 2010 of 200%, but that the average covers over big differences. While the urban population had an increase of 236% during the six years, the rural population only experienced an

Table 2. Monthly average income per capita (1000 VND at current prices) by residence, income source and income quintile in Quang Nam Province

	1999	2002	2004	2006	2008	2010 (Preliminary)	Percentage Change 2004 - 2010
Total			328.8	459	693.7	985.8	200%
Urban			414	626.4	939.2	1393	236%
Rural			312.8	424	641.1	886.9	184%
Salary and wages			120.1	182.7	269.6	447.1	272%
Agriculture, forestry and fishing			103.7	120.9	176.6	168.5	62%
Non- Agriculture, forestry and fishing			605	88.4	124.8	220	264%
Quintile 1	78.9	104.9	122.4	166.2	249.3	308.9	152%
Quintile 2			202	275.2	407.4	552.7	174%
Quintile 3			275.8	385	568	796.4	189%
Quintile 4			375.9	530	799.1	1146.6	205%
Quintile 5	512.8	503.4	665.4	938.2	1441	2218.9	233%

(Quang Nam Statistics Office 2005, Quang Nam Statistics Office 2011)

income growth of 184%. This is reflected in the differences of an increase of 264% for non-agriculture, forestry and fishing activities while the agriculture, forestry and fishing activities only experienced a meagre growth of 62%, which is then again reflected in the differences in increases of salaries of 233% for the richest quintile while only one of 152% for the poorest quintile⁷.

These statistical figures are confirmed by the household survey carried out in five districts in Quang Nam Province in 2009. Here 83.3% of the 18 rich respondents (out of the total of 166 respondents) confirmed that they perceived their living standards had improved substantially within the last 20 years, while only 23% of the 13 poor respondents found that their living standards had improved substantially. On the contrary, 31% among the poorest households found that their living standard had decreased substantially. The answers to the same question within the past 10 years were almost the same. Even though an increase in incomes of 62% for farmers and fishermen and an increase of 152% for the poorest quintile within a period of six years seems high, the costs of living have increased even more and with the liberalisation policies, the poorest feel less taken care of by the Government than previously. Although the general improvement in living standards are acknowledged, the disproportional growth and increased inequality seems to be a major concern for the poorest.

Looking at the geographical distribution of perceived changes in living standards, the results of the household survey for the three communes in Nui Thanh district show that the substantial increase in living standards is more significant in the upland and midland communes of Tam Tra and Tam Thanh than in the coastal commune of Tam Hoa where one third of the respondents felt that their living standards had decreased marginally or substantially. In-depth interviews with households and officials from the three communes and Nui Thanh District point to forestry plantations of acacia trees as being the main source of income that has made the rich households richer in the upland and midland communes. The acacia plantations are especially very vulnerable to extreme storms that have hit the province several times within the past years and have created major damages and loss of incomes from the tree plantations. So while 61% of the rich households in the

Quang Nam survey lived in high quality concrete houses with several floors and therefore were much less at risk in terms of life and health than the poor households, of whom none lived in concrete houses with several floors, the rich households were more vulnerable to CC in terms of loss of income as a majority of it stemmed from ecological vulnerable tree plantations in the highlands or from shrimp and fish ponds in the coastal zone. The higher social resilience of the rich households made them less vulnerable to CC in terms of safety and health but the lower ecological resilience of the high income earner of acacia plantations and shrimp and fish ponds in the coastal zone made them more vulnerable to CC in terms of income generation. The rapidly growing incomes among the richest households had both made them less vulnerable to CC through building stronger houses with more floors and more vulnerable to CC as they have established ecological vulnerable income earning activities such as acacia plantations and ponds for aquaculture. The increases in incomes among the poorest households have not been enough for them to build safer houses or acquiring more land and they subsequently consider poverty and insufficient access to land as bigger obstacles to better livelihoods than CC.

7. Poorer Households Find Access to Land of Greater Importance than CC

According to the household survey, all income groups have become slightly more dependent on agriculture during the past 10 and 20 years. The poor segment of the population, however, has become dependent on agriculture and direct utilisation of natural resources to a higher degree than the rich households⁸. In the mountainous commune of Tam Tra in Nui Thanh district, two third of the respondent have become more dependent on agriculture and none had become less dependent, while the situation was opposite in the coastal commune of Tam Hoa where 60% of the respondents had become less dependent on agriculture and only 20% had become more dependent. While more than two thirds of the poor respondents found access to land insufficient or very insufficient, half of the rich households found access to land sufficient and only 12% found it very insufficient. This seems to explain why the poor households find climate drivers less important obstacles to generating incomes than poverty factors such as access to land and employment, while climate

drivers score highest as an explanation to obstacles to increase incomes among the rich households. As most poor households do not have the capital needed for the substantial investments in tree plantations or in ponds for fish and shrimp farming in the coastal zone, they are less vulnerable in terms of losing their investments, but more vulnerable in terms of life and health. 85% of the poor segments of the population live in clay houses or poorly constructed brick houses, often located in areas most prone to flooding, landslides and other adverse effects of CC. The poorer households in general have become more dependent on agriculture and direct utilization of natural resources for their livelihood and therefore find poverty factors, such as restricted access to land and lack of employment as more serious obstacles to improve their livelihoods than climate change drivers. However, they are more vulnerable to CC in terms of life and health due to poorer housing and their generally lower social resilience than the richer households.

8. Income diversification as a measure to mitigate adverse effects of CC

The information gathered from in-depth interviews with households and government officials in Quang Nam Province and especially in the three communes in Nui Thanh District confirm that primarily the young (unmarried) household members go for off-farm incomes, primarily in Saigon and in South Vietnam in general. The construction of the Chu Lai Industrial Zone in Nui Thanh District has created many industrial jobs, especially for residents of the district. It was estimated that off-farm incomes in Tam Hoa and Tam Thanh districts in the coastal and the midland zones contributed about 20% of the gross incomes in the district. This trend of diversifying income sources is slowly taking root in Vietnam and is in line with experiences from other developing countries where increasing adverse impacts of CC and an increasing dependency of agriculture and direct utilization of natural resources, accentuate a growing tendency of especially younger people looking for off-farm incomes and remittances through migration work (Cooper *et al.* 2008).

9. Reducing Social or Ecological Vulnerability?

While strengthening of the social resilience of the households through non-farm income activities was considered a viable way by government officials to mitigate the adverse impacts of CC in the province, all officials interviewed, considered government investments in infrastructure (like dykes, roads, dams and water reservoirs, etc.) as a better investment than development projects to decrease poverty in adapting to adverse impacts of CC. This was in opposition to most households interviewed, but especially among the poorer households, who considered government poverty alleviation through direct financial support or development projects as a more feasible measure to adapt to CC. The rational explanation given was unanimously that poverty alleviation through development would allow the individual households to adapt to the problems created by CC as they actually occur, while investments in infrastructure to enhance ecological resilience were often wasted as nobody can predict the actual consequences of CC.

Our research in Quang Nam Province in general seems to confirm that a resilient social-ecological system has a greater capacity to avoid unwelcome surprises from external disturbances which very much rely on social resilience as defined by Tompkins and Adger as the

'ability of groups or communities to adapt in the face of external social, political, or environmental stresses or disturbances' (Tompkins, and Adger 2004).

Empowering households, groups and communities through addressing development needs in terms of economic development and employment opportunities, creating social networks, knowledge sharing and government institutions caring for the livelihood of the communities, will enhance the adaptive capacities of local communities to cope also with extreme weather situations.

10. Conclusions

While it still has to be proven whether climate change is actually taking place in Quang Nam Province, the predictions definitely point at the ecological vulnerabilities due to the low lying long coastline bordering the South China Sea, the location in the tropical typhoon belt and the steep slopes in the

narrow belt between the high mountains bordering Lao PDR and the coast. The already existing extreme weather conditions in terms of frequent typhoons, rising sea level and droughts deems it pertinent to consider how best to reduce vulnerability to the predicted possibly increased climate variability and extremes.

The research has revealed a paradox as especially the richer households increase their resilience to CC in terms of health and safety but feel more vulnerable to CC than the poorer households due to their increasing dependence of ecological vulnerable high income earning activities like acacia plantations and ponds for aquaculture. As especially the poorer households have become more dependent on agriculture, they consider poverty and restricted access to land and off-farm employment as more serious obstacles to livelihoods than the effects of CC. With the rapidly increasing income differentiation these differences in vulnerability between the richer and the poorer become more significant. This accentuates the need to priorities between support for enhancing ecological resilience in terms of infrastructure projects to mitigate uncertain impacts of CC or enhancing social resilience in terms of empowering communities and especially the poorer households in adapting to actual impacts of CC when they occur.

In assessing how best to decrease vulnerability to CC, based on the present study of Quang Nam Province, it seems highly relevant to use the three distinct targets proposed by Eriksen and O'Brien as mentioned above in targeting the risks posed by climate change where it is obvious that local ecological resilience could be enhanced by building infrastructure, such as safe harbours for fishing boats, higher bridges, stronger houses, dykes in certain cases, etc. The natural variability in weather conditions and the inevitable uncertainty over the direction of future climate changes mean that attempts at vulnerability reduction should, as mentioned by Ensor, focus on 'no regret investments' whose short term benefits is maintained regardless of future prevailing weather conditions (Ensor 2011, p. 7). The **capacity to cope** is obviously of great importance working towards sustainable adaptation. This involves a wide range of strategies including changing land use and farming systems. The creation of non-farm employment as an important strategy for creating possibilities for the farming households getting ac-

cess to alternative sources of income that are less vulnerable to changing climate conditions is also a strategy pursued by the Vietnamese government with the Dien Nam and Chu Lai Industrial Zones in the Province as illustrative examples. **Targeting causes for vulnerability** should, however, be given very high priority as this could remove or amend some of the roots of the problems experienced by individual households and communities. The causes, however, are created from the local to the national to the global level. Mitigating the causes for global warming and the subsequent impacts of CC is a global problem where Vietnam as a fast growing economy can take its share by decoupling the rapidly growing economy from environmental impacts, including emission of GHG. Deforestation is counterproductive to such efforts and more importantly also contributes to run off from heavy rains and thereby contributes to floods and inundation of crops, landslides and other damages. The big number of water reservoirs, mainly for hydropower generation, has also contributed to floods during heavy rains and have exacerbated droughts by storing the water for hydropower generation during the dry season. So while Vietnam as a nation state can only contribute slightly to the reduction of GHG concentration in the atmosphere and the local areas even less, human activities like deforestation and construction (and management) of water reservoirs could exacerbate or diminish impacts from increased climate variability and extremes. These issues are gradually being acknowledged by the Vietnamese Government and the number of hydropower generating plants in Quang Nam Province has been reduced from the planned 65 to 43 according to personal communication with high ranking officials in the Provincial Administration

The research project on the impacts of climate change in Mid-Central Viet Nam has shown the complexity of the problem, especially because the globally human induced global warming resulting in unpredictable and extreme weather conditions create problems in maintaining local livelihoods, especially in areas prone to sea water intrusion, typhoons and droughts like the Mid-central Vietnam. When these 'natural' calamities are exacerbated by human activities like deforestation and construction (and poor management) of water reservoirs and when the impacts, on top of this, are felt differently among the different socio-economic groups in Vietnam where

socio-economic differentiation is developing rapidly, the complexity of the problem is obvious. The study has revealed an increasing diversified social resilience towards CC between the richer and the poorer households, which together with the complexity of the problem calls for a strategy of sustainable adaptation focussing on risks, capacity to cope and targeting the causes for vulnerability as it has been proposed in this article. Such a strategy could help the authorities and communities understanding the complexity and take actions that could somehow alleviate the problems created.

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Notes

1. These to a large extent include single persons (especially the many widowed women after the American War), ethnic minorities, disabled, etc. apart from the segment of the ethnic majority, who are just poor.
2. Researchers from two departments at Roskilde University have in collaboration with the Vietnam Academy of Science and Technology (VAST) carried out a research project on the Impacts of climate change in Mid-Central Viet Nam since 2009. Being member of the team from International Development Studies, the article builds on my research in Vietnam. For reference to the research project and its results, see: www.ecoenvi.org.
3. The Survey was planned by the author in collaboration with Professor Nguyen Ngoc Khanh and Ms. Nguyen Hong Anh, Institute of Sustainable Development and executed by the Institute of Geography at VAST. The survey covers 166 households randomly chosen among rich, poor and middle income households in five districts representing the three agro-ecological zones in Quang Nam.

4. Apart from Quang Nam Province, the Mid-central region of Vietnam consists of the provinces: Da Nang, Quang Ngai, Binh Dinh and Phu Yen
5. I'm grateful to my colleagues Professor Nguyen Ngoc Khanh and Ms. Nguyen Hong Anh, Institute of Sustainable Development for calculating these figures for me.
6. The official poverty line was changed from 80,000 to 100,000 VND per month in 2001 and again to 200,000 VND in 2005. In 2010 it was changed from 200,000 VND to 400,000, which then was approximately 30% higher than the average income for the poorest quintile. The internationally used poverty standard of one USD a day would equal to 600,000 VND per month.
7. For a further description of economic growth and income differentiation in Quang Nam Province since the Doi Moi reform process started in 1986, see: (Buch-Hansen, Nguyen *et al.* 2013)
8. One explanation why poor households have become more dependent on agriculture and direct utilization of natural resources might be that they would previously receive more support from the state. The liberalisation policies have given the rich households more opportunities for income generation from different sources that are not directly dependent on natural resources exploitation.

References

- Adger, W.N., (2000): Social and ecological resilience: are they related? *Progress in Human Geography*, 24(3), pp. 347-364.
- Adger, W.N., Kelly, P.M. and Nguyen, H.N., eds, (2001): *Living with environmental change: social vulnerability, adaptation and resilience in Vietnam*. London: Routledge.
- Bizikova, L., Robinson, J. and Cohen, S. (2007): Linking climate change and sustainable development at the local level. *Climate Policy*, 7, pp. 271-277.
- Buch-Hansen, M., Nguyen, N.K. and Nguyen, H.A. (2013): Paradoxes in Adaptation: Economic growth and socio-economic differentiation. A case study of Mid-central Vietnam. In: O. Bruun and T. Casse, eds., *Climate Change, Environment and Vulnerability in Central Vietnam*. Berlin: Springer Verlag.
- Cooper *et al.* (2008): Coping better with current climatic variability in the rain-fed farming systems of sub-Saharan Africa: An essential first step in adapting to future climate change? *Agriculture, Ecosystems and Environment*, 126.

- Ensor, J. (2011): *Uncertain Futures. Adapting development to a changing climate*. Practical Action Publishing.
- Eriksen, S.E. and O'Brien, K.L. (2007): Vulnerability, poverty and the need for sustainable adaptation measures. *Climate Policy*, 7(4), pp. 337-352.
- IPCC (2012): *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. Cambridge, New York: Cambridge University Press.
- Kelly, P.M., Tran Viet Lien, Hoang Minh Hien, Nguyen Huu Ninh and Adger, W.N. (2001): Managing environmental change in Vietnam. In: W.N. Adger, P.M. Kelly and H.N. Nguyen, eds, *Living with Environmental Change*. London: Routledge.
- Quang Nam Statistics Office (2011): *Quang Nam Statistical Yearbook 2010*. Quang Nam: Statistical Publishing House.
- Quang Nam Statistics Office (2005): *Quang Nam Statistical Yearbook, 2004*. Quang Nam: Statistical Publishing House.
- Tompkins, E.L. and Adger, W.N (2004): Does adaptive management of natural resources enhance resilience to climate change? *Ecology and Society*, 9(2),.
- UNDP-UNEP (2011): *Mainstreaming Climate Change Adaptation into Development Planning*. Nairobi: UNDP-UNEP.
- World Bank (2010): *World Development Report, 2010. Development and Climate Change*. Washington D.C.: World Bank.