

Abstract

This study is motivated by the observation of surprising gaps in the current scholarship on societal risk related to natural hazards and the projected impacts of climate change. Despite the increasing body of literature on this topic, the details of how human vulnerability – as a key component of risk – but also adaptive capacity – as a key component for risk reduction – emerge and progress as part of social processes still tend to be poorly understood, both empirically and theoretically. A distinct lack of attention can particularly be observed with respect to exploring the ways in which vulnerability and adaptation are linked through causal structures and feedbacks. Rifts and conflicts in this relation therefore often go unnoticed even though they render the barriers and limits to vulnerability reduction. In addition, the dynamic pathways of the vulnerability-adaptation-nexus in highly transformative countries and emerging economies need to be analyzed much more thoroughly. Understanding the effects of wider transformation dynamics on the causal fabric of vulnerability and adaptive capacity is not only of great scientific interest but also of practical relevance in order to facilitate adequate and preventive vulnerability reduction and mitigation within the framework of risk governance. Vietnam provides a case of prime relevance in this context given its ongoing reform process and the implied changes in economic, social, cultural and political terms, while being also considered a global hot spot of exposure to natural hazards and the expected climate change impacts. Urban areas deserve increased attention in this respect given that they are typically the forefront of transformation processes with growing demographic and economic importance and with a particularly complex fabric of actors and interests.

Against this background, the study presented here has a two-fold objective. Firstly, it aims to advance the conceptual framing and theoretical explanation of vulnerability and adaptation dynamics, focusing especially on the linkages and feedbacks between the two under conditions of socio-economic and political transformation and environmental change. Secondly, the study seeks to fill existing knowledge gaps on household level vulnerability profiles and the adaptive capacity of state and non-state actors towards current and projected natural hazards in Vietnam's cities. Specifically Can Tho City, as the demographic and economic centre of the highly flood- and typhoon-prone Mekong Delta, serves as case study providing the major source of empirical data.

The research process is based on a mixed methods approach, combining qualitative and quantitative methods and building on the interaction of inductive and deductive reasoning in the process of knowledge generation and theory development. Altogether, the work draws on 14 months of field work in Vietnam. Primary empirical data was generated through 55 semi-structured household interviews, complemented by participatory urban appraisal activities, as well as two household surveys covering a total of 742 households. In addition, 71 expert interviews were conducted with decision makers from the national to the local level in the party-state bureaucracy as well with Vietnamese researchers and stakeholders from other national and international organizations. The discussion of preliminary results and the promotion of science-policy-interaction were achieved through five stakeholder workshops in Can Tho City.

The research allowed for developing an advanced conceptual model of the causal structures and processes linking vulnerability and adaptation dynamics. This model draws on earlier achievements from within the three strands of vulnerability, adaptation and resilience research but it is mainly nurtured by the identification of remaining ontological and even epistemological gaps within as well as between these schools. By bridging the divides, the model makes a contribution to connecting the existing theoretical perspectives, thereby, not only facilitating the formulation of synchronized policy recommendations but also enabling scientific engagement with the blind spots that can be identified in hitherto approaches. That is, the model allows for unpacking the black box of adaptation processes because it mirrors adaptive capacity directly to the factors constituting vulnerability, i.e. exposure, susceptibility and the lack of capacity to cope. Therefore specific and generic adaptive capacity is

differentiated, depending on their reach and scope. In contrast to the normatively guided approaches predominant in the existing conceptual literature, the model allows for the analysis of internal conflicts, trade-offs and limits in adaptation processes which can result from contradictory effects on the individual vulnerability factors. Yet, the model rejects an oft-applied deterministic notion of the relationship between adaptive capacity and adaptation action. Rather, it draws on action- and structuration-theory to include agentic and structural factors which, in interaction, can enable but also inhibit the accumulation of adaptive capacity and/or its activation into adaptation action. Given this level of detail, the model facilitates dynamic analytical perspectives, focusing on the shifts in the fabric of vulnerability and adaptation along with wider societal transformation processes. This aspect is heavily neglected to date given the snapshot character predominant in most of the published vulnerability assessments.

The framework, in conjunction with the mixed methods approach, allowed for an integrative empirical analysis in Can Tho City. The findings show that the ongoing socio-economic and political transformation process has ambiguous and socially differentiated effects on the potential for reducing vulnerability through adaptation. These ambiguities result from the fact that, in many respects, the country's reform process yields contradictory effects on the different factors for vulnerability and adaptation considered in the conceptual model. The macro-economic growth since the beginning of Vietnam's reform process (*đổi mới*) has not automatically lead to a general reduction in vulnerability towards natural hazards in Can Tho City but to increasing risk disparities. The changing political economy has resulted in shifts in the way risk management is negotiated and shared between state and non-state actors. Despite the continued paternalistic rhetoric of the party-state apparatus as care-taker, considerable mismatches between state and non-state adaptation action have been found. They cause increasing difficulties for some groups to compensate for the lack of public support through individualized risk reduction measures. Self-reinforcing effects that deteriorate vulnerability conditions can therefore be observed, especially in low-income groups. Yet, the findings underscore that a purely neo-classical explanation on adaptive capacity assets would fall short of recognizing the agentic factors (e.g. around risk perception and prioritization) and the structural factors (e.g. around institutional security and the access to resources) that shape adaptation decisions and the question of whether and how adaptive capacity can be accumulated and turned into adaptation action. Both domains have been found to be heavily transformed by the reform process, often resulting in new barriers for effective adaptation.

The findings enabled the formulation of practical recommendations which not only suggest options to improve specific adaptation measures, but which also call for adaptive changes in the deeper institutional fabric of risk governance paradigms applied in the country. Given the country's contested political framework, these recommendations will not be easy to implement. However, the research findings clearly reveal that palliative solutions that ignore these more fundamental dimensions will not be sufficiently capable of tackling the deeper root causes that currently perpetuate and re-produce social vulnerability in Can Tho and in Vietnam's cities more generally.

At conditions of modern climatic changes the cooperation of meteorologists and physicians remains one of the priority areas in development of medical meteorology. Either atmosphere or human organism is very complex system. Famous mathematician Van Newman noted that the human being is most complex system, for complexity the atmosphere comes after it. The changes and atmospheric events expected in quantities of this meteorological factors in medical-meteorological forecasts prepared in table form are shown. If the forecast is given in text form by giving the brief features of expected weather conditions the certain medical-meteorological type of weather is given. Other observed climate changes include changes in the Arctic, widespread changes in precipitation amounts, ocean salinity, wind patterns and aspects of extreme weather including droughts, heavy precipitation, heatwaves and the intensity of tropical cyclones. The temperature increase is widespread over the globe and is greater at higher northern latitudes. In January 2013 the European Environment Agency (EEA) published its latest report on 'Climate change, impacts and vulnerability in Europe 2012'. The presents evidence on climate trends and impacts in Europe, and future projections. Among the report's main findings are Vulnerability and adaptation between climate change and transformation dynamics in Can Tho City, Vietnam. Vol 15. Megacities and global change. Steiner, Stuttgart. Google Scholar. Garschagen M (2015) Risky change? Vietnam's urban flood risk governance between climate dynamics and transformation. Haasnoot M, Kwakkel JH, Walker WE, ter Maat J (2013) Dynamic adaptive policy pathways: a method for crafting robust decisions for a deeply uncertain world. *Glob Environ Chang* 23:485-498. doi: 10.1016/j.gloenvcha.2012.12.006 CrossRef. Google Scholar. Haasnoot M, van Deursen WPA, Guillaume JHA, Kwakkel JH, van Beek E, Middelkoop H (2014) Fit for purpose? Building and evaluating a fast, integrated model for exploring water policy pathways.