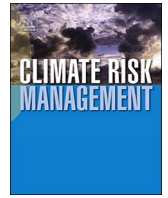


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# Multi-scale assessment of social vulnerability to climate change: An empirical study in coastal Vietnam

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## ABSTRACT

Climate change poses significant threats to the livelihoods of people living in coastal areas, especially in the developing world. There is a critical need to assess vulnerability to inform both scientific debates and policy makers in facilitating adaptation and coping strategies at different scales. This study advances existing approaches to assessing vulnerability by focusing on both household and collective scales in a coastal district in Vietnam: Ngu Hanh Son district. A mixed-method approach was used including 100 household questionnaires, 12 key informant interviews and data from direct observations. At household scale, results indicate large variation in the degree of vulnerability to climate change among households in the same agro-climate zone. These differences are attributable to variations in socio-economic household characteristics and ability to access livelihood assets. Diversifying livelihoods and reducing poverty are important in contributing to the resilience of households. At a collective scale, qualitative data indicates a lack of multi-directional flows of information and highlights gaps in the current governance system. Findings suggest the need to bridge the governance gaps and establish an effective communication system to reduce collective vulnerability in the district. Findings also highlight the need to promote social equity, equality and democracy in formulating climate policies in an effort to reduce the overall vulnerability to climate change.

## 1. Introduction

Climate extremes and sea level rise related to climate change significantly threaten the livelihoods of people in coastal areas, especially in the developing world. According to the Intergovernmental Panel on Climate Change (IPCC, 2001), an increase in frequency and magnitude of typhoon events accompanied by 9–88 cm of sea level rise is projected by the year 2100. While climate change is a global phenomenon, how its consequences manifest in the human and physical environment will differ across scales. Together with development of scientific understanding on the nature of and physical exposure to climate change, there is a critical need to investigate the social vulnerability and capacity of populations to prepare for short-term and long-term adjustment to these future changes at different scales (Lemmen and Warren, 2004).

Vulnerability can be defined as a function of exposure, sensitivity and adaptation capacity regarding a specific risk (IPCC, 2007). Vulnerability and resilience are often presented as opposites (Cutter et al., 2008; Reed & Stringer, 2016), although this has been critiqued because depending on the particular risks, a system can be both resilient and vulnerable at the same time (Dixon and Stringer, 2015). *Resilience* refers to the capacity of the population or system to cope with the change in hazard exposures (Cutter et al., 2008).

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Before vulnerability can be addressed, it is vital to identify who is vulnerable. Vulnerability assessments offer insights into this, allowing investigation of the complex relationships between humans and their socio-physical environments (Fraser et al., 2011; Antwi-Agyei et al., 2012). Social vulnerability explicitly concentrates on all socioeconomic and demographic factors affecting the magnitude of impacts of environmental stress on a given population (Tierney et al., 2001; Heinz Center, 2002). According to Adger (2006), social vulnerability consists of two distinct aspects: collective and individual vulnerability, which differ in their indicators and scales. Collective vulnerability is often analysed at community, national or regional scale, while individual vulnerability is linked to the household and individual scale. Most social vulnerability assessments adopt top-down approaches which rely on existing national scale data for analysing collective vulnerability. Nevertheless, empirical evidence on the factors that influence individual vulnerability at household scale remains limited, despite that households are connected to wider socio-economic processes in the community and have great influence in making decisions about climate change adaptation (Yaro, 2006). There is so far no generally agreed method of measuring vulnerability to climate change, and limited literature considers this issue at household scale. This study targets these gaps by assessing vulnerability at both household and collective (city) scales in a coastal district in Vietnam, building on and extending existing vulnerability assessment approaches.

The overall aim is to explore the factors that influence both individual and collective vulnerability to climate change in Ngu Hanh Son District. Collective vulnerability is analysed at city scale and individual vulnerability assessment is considered at household scale. We:

- Identify the factors associated with individual *household vulnerability* and develop a household vulnerability to climate change index;
- Explore the major factors that influence *collective vulnerability* regarding the current governance structure and institutional capacity in Da Nang city; and
- Analyse both *individual household* and *collective vulnerability*, identifying the political and socio-economic characteristics that both increase and decrease the overall vulnerability of the district.

Section 2 presents our methodology. The results of the household vulnerability and collective vulnerability analyses are provided respectively in Sections 3 and 4. The final section presents our discussion and conclusion.

## 2. Research design and methodology

### 2.1. Study area: Da Nang city and Ngu Hanh Son district

Ngu Hanh Son District (NHSD) is located in Da Nang city, in coastal south-central Vietnam. NHSD has a population density of 1890 people/km<sup>2</sup>, and covers an area of 39.12 km<sup>2</sup>, divided into four wards: My An, Khue My, Hoa Hai and Hoa Quy (Da Nang Statistical Year Book, 2011). Average summer warming for the South-east Asia region in which NHSD is located is projected to increase by 4.5 °C by 2100 (World Bank, 2013). NHSD's proximity to the coast, topography, and its present levels of economic development, make it highly vulnerable to climate change. Projected climate change stressors include: long-term sea level rise, coastal floods, increased typhoons intensity, saline intrusion and erosion (World Bank, 2013). Among these, the most severe impact to the district is likely to be caused by the increase in intensity and frequency of typhoons (General Statistics Office, 2012).

NHSD's economy is under a formal and sophisticated governance system. According to the Da Nang's People Committee (2014), there are four levels in Vietnam's administrative structure: i) central, ii) provincial/municipal, iii) district and iv) commune/ward. At each level, the People's Council and People's Committee are the highest authorities, responsible for all long-term and short-term development plans. The People's Committee is the executive agency of the People's Council. In Da Nang City, all power is in the hands of the central and corresponding authorities with more adaptable and flexible systems devolved to the lower levels. Each sector department at the lower level reports vertically to the higher authorities, as well as horizontally to the People's Committee.

### 2.2. Data collection and analysis

A mixture of qualitative and quantitative approaches were used in this study (Table 1).

#### 2.2.1. Quantitative methods for assessing individual household vulnerability

Vulnerability assessments have shifted from qualitative assessment based on conceptual frameworks to more quantitative measures based on indices. In particular, vulnerability indices have gained prominence in the literature related to climate change (Moss et al., 2002; O'Brien et al., 2004; Brooks et al., 2005). Quantitative methods were employed to calculate our social vulnerability to climate change index at individual household level. My An ward and Hoa Quy ward were chosen for data collection as they are the most resilient and vulnerable ward in NHSD respectively, according to secondary data from Da Nang governmental reports (Appendix A, Table A1). Vulnerability assessment in the most resilient and most vulnerable areas allows comparisons to be made between households within the same agro-climatic zone (Antwi-Agyei et al., 2012).

Data collection took place in July 2015 and began with transect walks with two community members (leaders of My An and Hoa Quy wards). These provided an overview of important social and physical characteristics of these communities through conversations and direct observation. Data were noted down or audio-recorded with permission of the participants.

Quantitative household questionnaires including basic questions about households' capital assets and livelihoods were then

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