



An indicator-based approach to quantifying the adaptive capacity of urban households: The case of Da Nang city, Central Vietnam



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ABSTRACT

Municipal governments have to contend with climate change dynamics with household-level adaptive capacity becoming an increasingly important component to the urban setting. However, methods in the quantification of adaptation, and what factors may drive adaptation at the urban household level, remain poorly resolved. In this study, we proposed an empirical approach and a set of 17 adaptive indicators to assess the adaptive capacity of urban households to climate change. The adaptive indicators were tested from three urban districts of the Da Nang city, Vietnam. A household survey using socioeconomic data was conducted in 617 urban households. The empirical results showed that inherent capacity of urban households was relatively high in term of wealth, housing condition and durable assets, and low for livelihood diversity and knowledge to climate change. Six components, consisting of household economy, social relation, human capital, adaptation practices, municipal services and urban governance, and livelihood protection were extracted from the adaptive indicators. Of these, household economy, social relation, and adaptation practices were major factors determining the adaptation of urban households to climate change. The adaptive indicators present here, with appropriate modification, could be used to assess adaptive capacity of urban households to climate change from other coastal areas.

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1. Introduction

Vietnam's annual mean temperature is reported to increase approximately 0.5 °C over the past 50 years (MONRE, 2012). As a consequence of climatic warming, rainfall is projected to decrease in the northern Vietnam and increase in the southern region (MONRE, 2012). The coastal zone of Vietnam is likely to experience a rise in sea level of c. 3 mm per year. According to MONRE (2012), a 1 m sea level rise (SLR) is predicted to flood 39% of the Mekong delta and 10% of the Red River delta. As a result, c. 10.8% of Vietnam's population would be impacted by the projected SLR. Climate change also induces severe disasters such as typhoons, droughts, coastal erosion, and salt intrusion in coastal areas. In terms of disaster impacts, Vietnam coastal areas have dense urban populations which are particularly susceptible to powerful typhoons and floods, requiring

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both short- and long-term disaster risk assessment and reduction, and adaptation (ACCCRN, 2009a). Therefore, climate change will be a critical issue which requires urban communities and stakeholders to resolve for sustainable development.

The increasing threat of climate change requires human society to look more toward mitigation and adaptation to disasters (Solecki et al., 2011). Mitigation pertains to abating, moderating or alleviating impacts, as in reducing vulnerabilities and effects from disasters and climate change (Smit and Pilifosova, 2003). Adaptation is defined as the ability of a system to adjust to climate change and associated extreme events. Adaptation can be used to assess the vulnerability of the system, moderate potential damages, develop response options and cope with the consequences or take advantage of opportunities (Wall and Marzall, 2006; Thorn et al., 2015). Therefore, the field of adaptation to climate change studies is rapidly growing in the recent years (O'Brien et al., 2008; Engle, 2011; Burney et al., 2014). Numerous studies have aimed to develop theoretical/hypothetical frameworks for assessing adaptive capacity (Smit et al., 1999; Adger et al., 2009; Gupta et al., 2010). Yet, few empirically-based studies have examined what determines adaptive capacity to climate change at the community – (Wall and Marzall, 2006; Paton et al., 2008) and household-level (Below et al., 2012). Additionally, many studies have focused on assessing the adaptive capacity of rural communities (Wall and Marzall, 2006; Morton, 2007; Paavola, 2008; Van Aalst et al., 2008; Below et al., 2012), whereas there is relatively little study on assessing the adaptive capacity of urban areas (Tanner et al., 2009; Leichenko, 2011). Studies on the main driving forces affecting adaptive capacity at the urban household-level, and how this can be quantitatively measured are also limited. Thus, such research is fundamental to gaining a better understanding of the indicators and processes that affect, and provides options for, a greater portion of the human population for adaptability to climate change.

In the present study, we hypothesized that adaptive capacity of urban households highly depend on the inherent capacity of the household (Mycoo, 2014) and municipal capacity, including services, infrastructure and governance (Adger et al., 2005; Engle, 2011). Thus, indicators for measuring the adaptive capacity of urban households to climate change are needed. The objectives of the present study are (1) to develop indicators for quantitatively measuring the adaptive capacity of urban households to climate change and (2) to determine the main driving forces affecting adaptation at the urban household-level. Results from the present study will contribute an approach for assessing the adaptive capacity of urban households to climate change that can be transferable to other urban areas. The case study will furthermore provide valuable information for targeting adaptation policies and municipal governance of Da Nang city, Vietnam.

2. Adaptive capacity framework

Adaptive capacity is the ability to cope with future climate change stimuli. The adaptive capacity of a social system can be influenced by many socioeconomic variables, or adaptive capacity determinants (Yohe and Tol, 2002). Moreover, the quantification of determinants can in-turn provide important data to assess adaptation (Smit et al., 1999; Smit and Wandel, 2006) and to develop efficient strategies to successfully respond to climate stimuli (Adger et al., 2003). Over the last two decades, several conceptual frameworks have been presented on adaptive capacity determinants for both generic (Yohe and Tol, 2002; Smit and Pilifosova, 2003) and specific (Wall and Marzall, 2006; Below et al., 2012) contexts. Yohe and Tol (2002) proposed eight generic determinants of adaptive capacity of a system, sector and region, including technology options, resources, institutions, human capital, social capital, risk controlling, information management, and the public's perception to exposure. Smit and Pilifosova (2003) further examined five generic determinants affecting the adaptive capacity of communities and regions, consisting of economic resources, technology, information and skills, infrastructure, and institutions. With respect to climate change, adaptation processes of urban systems have been assessed for several sectors, including participatory urban planning (Broto et al., 2015) and water supply (Ruth et al., 2007). However, these studies did not address the adaptive capacity of the urban households to climate change.

The adaptive capacity of the rural household has been associated with wealth, production factor, gender of household head, economic potential and infrastructure of the area, and social and financial capital (Below et al., 2012), and household perception to climate change (Bohensky et al., 2013).

In the present study, we developed a set of 17 indicators to evaluate the socioeconomic condition of urban households, representing for inherent capacity and the municipal services and stability and security of the urban areas, representing for municipal capacity (Table 1). Inherent capacity can be examined by socioeconomic variables that affect the potential and capability of a household to adapt to climate change stimuli and disasters (Smit et al., 1999). The adaptive capacity variables of inherent capacity are wealth, employment, livelihood diversity, housing condition, durable assets, insurance coverage, education, preparedness measures, skills and experiences, knowledge, knowledge sharing, social organizations, and social support networks. It is widely accepted that the stronger inherent capacity of the urban households is better prepared to cope with the climate change stimuli and bear the cost of adaption (Yohe and Tol, 2002; Bohensky et al., 2013). Municipal capacity represents the resource availability of the urban areas, including health services, electricity supply, water sources, and urban stability and security that directly or indirectly affect the adaptive capacity of urban households to climate change (Table 1).

The adaptive indicator scores denote how well or poorly a given urban household may adapt to climate change stimuli, and can be used to quantifiably profile and compare which variables relate to the coping range of a household (Below et al., 2012), community (Wall and Marzall, 2006) or society. Moreover, quantification can be spatially explicit. Thus one set of adaptive indicators can provide a potential approach for other systems or areas (Wall and Marzall, 2006).

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