Government support, social capital and adaptation to urban flooding by residents in the Pearl River Delta area, China

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A B S T R A C T
Increasingly extreme weather events have resulted in massive socio-economic losses and spark great interest in minimizing the impact of such events in the context of climate change. This paper analyses data from a large-scale household survey conducted in 20 cities in the Pearl River Delta area of China to examine how government support and social capital influence urban residents’ adaptations to mitigate the effects of urban flooding. The results show that more than 90% of residents would take engineering or non-engineering measures to protect their private assets against flooding. The most popular measures are moving away their valuable goods and reducing travel during flooding. Government support, such as releasing early warning information, post-disaster services, technical assistance, financial assistance and physical support could significantly improve residents’ adoption of adaptation measures. Social capital, operationalized as having a local Hukou (citizenship) in the area where one works, is closely associated with adaptation capacity, whereas a blood relative network has no evident influence on their adaptation behaviours. In addition, household and local community characteristic have positive influence on residents’ adaptations. In summary, government support and community activities are most significant factors influencing residents’ adaptation to mitigate the impacts of urban flooding but are in great demand in the Pearl River Delta areas.

1. Introduction
Urban flooding, has caused considerable damage and loss of life (Haddad & Teixeira, 2015; Reguero, Losada, Diaz-Simal, Méndez, & Beck, 2015). Flooding events occurs at increasing frequency and larger magnitude under the influence of global climate change. There has been considerable interest in how to minimize the impact of floods in advance or amidst the disaster events (Rashid, Hider, & McNeil, 2007; IPCC, 2012; Suckail, Tompkins, & Stringer, 2014). Given that urban flooding has caused direct asset loss to residents, the household is the basic unit to take adaptation measures against flooding (Blennow & Persson, 2009; Kunreuther, 2006). However, some residents take precautions while others do not (Grothmann & Reusswig, 2006). Many scholars have paid attention to individual factors associated with adaptation to flooding (Bubeck, Botzen, & Aerts, 2012; Grothmann & Patt, 2005; Huang, Duan, Bi, Yuan, & Ban, 2010; Witvorapong, Muttarak, & Pothisiri, 2015) and found that personal characteristics, such as age, income, education level, family size, location, real estate ownership and resident’s disaster experience, all influence adaptation and mitigation behaviours (Takao et al., 2004; Blennow, Persson, Tome, & Hanewinkel, 2012; Yu, Wang, Zhang, Wang, & Wei, 2013). Many scholars have found that adaptation actions to water-related events are being undertaken by the government, nongovernment organizations, and private organizations operating at different scales (Witvorapong, Muttarak, & Pothisiri, 2015; Chen, Wang, & Huang, 2014; Pelling & High, 2005; Adger, 2003; Eakin, Eriksen, Eikeland, & Øyen, 2011). Shaw (2012) reported that both government and nongovernment organizations could implement disaster management and risk reduction programs to help...
residents cope with disasters. However, several case studies show that government support and social capital have different effects on the measures taken by residents (Eriksen & Selboe, 2012; Frank, Eakin, & Lopez-Carr, 2011; Lo, Xu, Chan, Su, 2015).

In most countries, city governments have drafted and implemented urban adaptation plans to climate change motivated by the need to protect valuable assets and reduce the city’s vulnerability (Carter et al., 2015; Milman & Warner, 2016). Though many adaptation measures are similar to planned and top-down approaches, city government is the main actor responsible for preparing for and offsetting damage from climate change hazards. For example, government develops, communicates and implements proactive and responsive adaptation strategies and creates networks between stakeholder groups. City governments also provide material and funding to cope with loss caused by disasters and organize disaster relief activities (Carter et al., 2015). Since the implementation of adaptation activities requires both horizontal coordination among city departments and vertical coordination between government and residents (Hughes, 2015), some scholars have emphasized that the interface between government and private sectors plays an important role in residents’ adaptation behaviour (Scolobig, Marchi, & Borga, 2012). Residents’ trust and expectation of government’s adaptation will shape their actions in response to floods directly (Chamlee-Wright & Storr, 2009).

Coleman (1990) understands social capital as a largely unintentional outcome of social interactions and organization, and Putnam (1995) defined social capital as an enabler of collective action: “features of social life—networks, norms, and trust that enable participants to act together more effectively to pursue shared objectives.” Lin (2008) defined social capital as a community- and individual-level attribute related to the resources and information an individual has as a result of his or her social relationships. Pretty and Ward (2001) believe there are four critical aspects of social capital, relations of trust, reciprocity, and exchange; common rules, norms and sanctions; and connectedness, networks, and groups. Many scholars have found that social capital among members of a community is a key determinant of the community’s vulnerability and resilience to environmental changes and uncertainties. For example, Adger (2003) believed that the structure and quality of social relations select which impending change to act upon and determine the type and range of options for coping with (environmental) changes. The relationships between persons within the community will shape individual’s perception of climate change and related disasters. Frank, Eakin, and Lopez-Carr (2011) found that people’s relation with their community will influence their understanding and response to climate-related threats, and Goulden, Adger, Allison, and Conway (2013) found that social capital could give people more opportunity to mitigate and spread the risk of environmental change. However, some scholars believe that the accumulation of social capitals is not necessarily a social good and may create perverse incentives, undermining adaptive capacity. They found norms and trust may perpetuate social relations that will delay or be counter-productive to adaptation to condition changes (Wolf, Adger, Lorenzoni, Abramson, & Raine, 2010). Thus, the structure of social relations and practice has a mixture of impacts on individual adoption measures, and the relationship between social capital and adaptation to climate change is complex and not invariably a positive one (Lo et al., 2015; Pelling, 2011).

The Pearl River Delta (PRD) area in South China has long been recognized as highly sensitive to sea level rise and extreme weather events, such as storm surges and hurricanes. The area’s special geographic location and physical environment make it vulnerable to urban flooding caused by heavy rainfall, storm tides and sea level rise accompanied by low human adaptive capacity and high exposure (MOST, CMA, & CAS, 2011; Chan, Mitchell, Adekola, & Mcdonald, 2012; Yang, Scheffran, Qin, & You, 2015; Wang, Liu, Wang, & Wang, 2014; Fuchs, Conran, & Louis, 2011; Du, Rompaey, Shi, & Wang, 2015). In addition, as one of the most rapidly urbanizing areas in China (China Daily, 2015), large areas of land of the PRD are covered by buildings and cement that are resistance to rainwater absorption, thereby increasing surface runoff and rainwater accumulation contributing to urban flooding (Yang et al., 2015). The rapid urbanization of the PRD area has also resulted in a large floating population settlement in newly built-up areas, leading to social fragmentation, instability in social capital and lack of community cohesion (Liu, He, Wu, & Webster, 2010; Wang, Wang, & Wu, 2009). This means that it is more difficult to understand the factors influencing the efforts at disaster preparation and mitigation in the PRD than in other regions.

In China, government-dominated urban management can be assumed to be primarily responsible for managing flood risks. In most situations, the government is responsible for investing and sustaining public hydraulic engineering projects, such as reservoirs, water-gates and embankments. Beyond disaster engineering prevention and reduction projects, the government has also stressed the role of non-engineering projects in disaster prevention and reduction such as information collection systems and flooding forecast and controlling systems (He, Yang, & Li, 2010). It is, therefore, vital to examine how residents have adapted to the risk of urban floods and consider how the government provides support and social capital influence on adaptation. What anti-flood measures did residents take in the PRD area? Did the government’s support and social capital facilitate resident’s adaptation efficiently? This research will help improve our understanding of how government and community activity influence individual behaviour and hence help the government improve disaster prevention and mitigation measures.

This study is organized as follow. Firstly, we outline the design of the survey and the sources of data. Then, we describe the protective measures residents have taken to cope with floods. Thirdly, we analyse how government support and social capital influence protective behaviour using qualitative and quantitative techniques. Finally, we discuss the policy implications of our findings and provide proposals for improving residents’ capacity to mitigate flood.

2. Study area and methodology

The PRD is located in the south-central part of the Guangdong Province in Southern China (Fig. 1). Guangdong is one of the most vulnerable provinces to urban flooding caused by heavy rain and storm surges in China. Over the past half century, Guangdong has witnessed multiple storm surges annually. Each storm surge caused serious urban flooding and economic loss (Chen, 1999; Yang, Chen, & Hu, 2013).

The data were obtained from a large-scale survey conducted in 20 cities of the PRD between July 5th and July 15th of 2013. In the survey, four locations that had suffered from flooding in the past three years were chosen in each city according to previous home investigation and research. Most of the locations are in the old city and fringe areas and are vulnerable to water-logging due to fast rain water accumulation combined with poor local drainage. At least 15 households in each location were interviewed. As a result, we obtained a total of 1209 complete questionnaires.

The aim of the survey was to investigate the influence of climate change on individual life and how residents have adapted to and coped with it. We collected data on demographic characteristics, location, economic status, social networks, damage caused by urban flooding, prevention and mitigation measures, and material or
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