Drivers of flood and climate change risk perceptions and intention to adapt: an explorative survey in coastal and delta Vietnam

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ABSTRACT
This article contributes to current research about determinants of climate change and flood risk perception, and intentions to take adaptive measures. We propose a research model that distinguishes between vulnerability and severity components of perceived risks, and adds perceived adaptive capacity as a third factor to predict the intention to take adaptive measures. We used this combined model as a conceptual lens for an explorative survey among 1086 residents of coastal and delta communities in Vietnam. Pairwise analyses revealed a significant association of flood and climate change risk perceptions with individual’s flood experience, climate change knowledge, frequency of community participation and socio-demographic factors. However, in multivariate analysis, the influence of most socio-demographic factors became weak or patchy. Flood experience was the most influential driver of flood-related risk perceptions but weak for climate change-related risk perceptions and behavioural intentions. Knowledge strongly increased the intention to adapt to flood and climate risks and the perceived vulnerability to and severity of climate change risks, but reduced the perceived capacity to adapt to climate risks. Frequency of community participation increased the perceived vulnerability and severity of climate change risks, the intention to adapt to both climate and flood risks and the perceived capacity to adapt to flood risks, but reduced the perceived capacity to adapt to climate risks. Our research confirms earlier findings that individuals’ knowledge, place-specific experience and social-cultural influences are key predictors of both flood and climate change risk perceptions and intentions to take adaptive measures. These factors should therefore receive ample attention in climate risk communication.

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Introduction
Climate change has been widely recognized as a long-term global driver of increasing natural hazards. Its impacts, however, are place-specific. Adequate adaptation responses will typically
require social coordination based on a shared understanding of climate risks and the benefits of adaptation. Though potentially affected populations are often familiar with local natural hazards (e.g. flood risks), they are often less aware of risks associated with a changing climate or they do not associate perceived hazards with climate change (Spence, Poortinga, and Pidgeon 2012; Lebel et al. 2013; Chinh et al. 2014). Such inadequate risk perceptions will likely hamper or delay mitigation and adaptation measures.

Adaptation to climate change has received increasing attention since the Intergovernmental Panel on Climate Change Fourth Assessment Report (Grothmann and Patt 2005; IPCC 2007). This includes a wide range of measures from policy making and social-economic development planning to infrastructure improvement, capacity building, education and communication. Public awareness and understanding of climate change risks are important to secure support for public measures and to encourage and enable spontaneous adaptation by households, community groups and private enterprises (Moser 2010; Moser and Dilling 2011; Chinh et al. 2014). However, effectively communicating the distant, complex, and uncertain phenomenon of climate change is difficult, in particular when aiming to empower the most vulnerable communities (Lebel et al. 2013).

For effective risk communication, understanding the perceptions of target audiences is essential (Rohrmann 1992; Moser 2010; Lebel et al. 2013). In global comparison, developing Asia is the region with the smallest percentage (31%) of people that consider climate change a threat (Capstick et al. 2015). At the same time, some of the most vulnerable populations are located there, in particular in densely populated low-lying delta and coastal regions, not least in Vietnam. On one hand, local populations in Vietnam’s flood and disaster prone regions have substantial experience in reducing risk and adapting to climate variability (World Bank 2011; UNDP 2007). They have developed livelihoods and lifestyles that cope with extreme climatic hazards and natural disasters. But do these experiences instil residents with confidence that they will be able to cope with climate change and feel therefore not threatened, or is it rather lack of knowledge or other factors that explain the relatively low level of concern? And how strong do past disaster experience and expected climate change impacts affect the willingness to take adaptive action?

This article aims to enhance understanding of the factors that influence flood and climate change risk perceptions and intention to take adaptive measures among inhabitants of Vietnam’s low-lying coastal and delta communities. The findings are likely to be relevant to other developing (and developed) countries with similar contextual features and will contribute to broader discussions about the determinants of climate risk perception. After a brief discussion of previous research, we introduce an encompassing exploratory model that includes individual knowledge about flood and climate change, past experience with flood and weather pattern change, frequency of community participation and socio-demographics. After explaining our methodology, we present the findings from a survey conducted in three coastal and delta cities in Vietnam. Using pairwise and multivariate analysis, we identify the most significant determinants of perceived vulnerability, severity, adaptive capacity and intention to take adaptive measures towards flood and climate change risks. The concluding section discusses our findings against the proposed research model, the contribution to current academic debates of climate risk perception and the implications of our findings for effective communication of flood and climate change risks.

Factors driving climate risk perception and risk behaviour

Risk perceptions have been theoretically and empirically studied as an ‘important predictor’ of people’s decision to cope with natural hazards (Johnston et al. 1999; Peacock, Brody, and Highfield 2004; Terpstra, Lindell, and Gutteling 2009) and technical incidents (Slovic, Fischhoff,
and Lichtenstein 1981; Nelkin 1989; Lima, Barnett, and Vala 2005). However, risk perceptions are not linked to hazards in a linear way, but result from complex socio-psychological processes. Cognitive, subconscious, affective, socio-cultural, and individual factors influence the perception of risks (Hillson and Murray-Webster 2005; Helgeson, Van der Linden, and Chabay 2012). Various theoretical models have been proposed to understand the determinants of risk perception and risk behaviour. Four of them are pertinent to climate risk perception: the psychometric model, value-belief-norm theory, theory of planned behaviour and protection motivation theory (PMT).

The psychometric model (Fischhoff et al. 1978) argues that risk perceptions are mainly influenced by risk characteristics, e.g. knowledgeability, controllability, dread and catastrophic potential (Slovic, Fischhoff, and Lichtenstein 1982; Slovic 1987). It explains why different types of risk are perceived differently rather than why individuals perceive risks differently and focuses on risk characteristics that shape people’s risk perceptions and risk assessments (Slimak and Dietz 2006).

The value-belief-norm theory or VBN (e.g. Stern and Dietz 1994; Stern 2000) links three theoretical models – norm-activation theory, the theory of personal values and the new ecological paradigm – to present ‘a unified explanation for environmental concern’ (Slimak and Dietz 2006). According to VBN, five characteristics explain variation in individual risk perception: personal values, a general set of beliefs (worldview), awareness of consequences, ascription of responsibility, and personal norms for pro-environmental action (Slimak and Dietz 2006).

Risk behaviour approaches often build on the theory of planned behaviour (Ajzen and Madden 1986) which focuses on ‘perceived personal and societal barriers and motivations that influence behaviour’ (Hamilton-Webb et al. 2016). It highlights the role of cognitive and affective attitudes, subjective norms and perceived behavioural control in explaining the adoption of behaviours and has been successfully tested in different practices and settings. However, it has also been criticized for neglecting the influence of experience in explaining individuals’ responses to risks (Beedell and Rehman 2000; Hamilton-Webb et al. 2016).

The PMT (Rogers 1975) provides a conceptual framework for fear appeal studies and persuasive communication (Boer and Seydel 1996). It includes four determinants of self-protection and adaptive intentions or behaviours: perceived vulnerability to a risk, perceived severity of the outcome, perceived effectiveness of available counter-measures (response efficacy) and perceived own ability to adopt effective protection (self-efficacy) (Floyd, Prentice-Dunn, and Roger 2000). Other studies confirm that higher levels of perceived risks increase peoples’ motivation for self-protection (Witte 1992; Terpstra, Lindell, and Gutteling 2009).

Building on the various approaches, Van der Linden (2015) developed an integrative social-psychological model, the comprehensive climate change risk perception model (CCRPM). It proposes that the perception of climate change risks is a function of four main factors stemming from psychological processes, the cultural context, and personal background (Helgeson, Van der Linden, and Chabay 2012): (1) cognitive factors, (2) experiential processing, e.g. affective evaluations and personal experience, (3) socio-cultural influences, e.g. social norms and broad value orientations and (4) socio-demographic control variables, e.g. age, gender, education, political affiliation. In a national sample (N = 808) of the U.K. population, these four factors could explain ‘nearly 70% of the variance in risk perception’ (Van der Linden 2015, 112), confirming findings from earlier studies about the explanatory power of these factors.

Inspired by the CCPRM, we have identified sets of factors that could explain variation in climate risk perception and intention to take adaptation measures in countries such as Vietnam. We will now elaborate on each of the model’s four factors.

1) Knowledge: Knowledge influences how climate change risks are judged (Sundblad, Biel, and Gärling 2007). However, knowledge is not an objective characteristic or resource of individuals. According to schema theory (Anderson, Spiro, and Anderson 1977), knowledge ‘should be seen as an elaborate network of abstract mental structures that represent an individual’s understanding of the external world’ (Helgeson, Van der Linden, and Chabay 2012, 2). These mental structures are the changeable result of cognitive processes, which are ‘the way
individuals process and organize incoming information as an interrelated network of mental structure’ (Helgeson, Van der Linden, and Chabay 2012). Most studies find that climate change knowledge is significantly and positively associated with risk perception (e.g. O’Connor, Bord, and Fisher 1999; Sundblad, Biel, and Gärling 2007; Hidalgo and Pisano 2010; Milfont 2012; Reser et al. 2012; Van der Linden 2015). A study in Sweden found that ‘both cognitive risk judgements (of probability) of serious negative consequences and affective risk judgements (worry) were predicted by knowledge of causes and knowledge of consequences of climate change’ (Sundblad, Biel, and Gärling 2007, 97). However, a study in Germany found that respondents who displayed more accurate knowledge of climate change perceived it as less hazardous; in contrast, those who merely claimed to have good knowledge of climate change perceived higher climate risks than those with a lower self-ascribed level of climate knowledge (Menny et al. 2011).

(2) Personal experiences: The concept of experiential processing is rooted in experiential learning theory (ELT). Kolb (1984, 41) defines experiential learning as ‘the process whereby knowledge is created through the transformation of experience’. Studies on the influence of personal experience on climate risk perceptions found ambivalent results. For example, U.K. citizens who had experienced flooding – the country’s most widespread impact linked to climate change – differed very little from others in their perception of and response to climate change, while experience of air pollution was a more significant influence (Whitmarsh 2008). Conversely, another study in the U.K. identified personal experience with extreme weather events as one of several ‘significant predictors’ of climate risk perception, with people’s experience having a stronger influence than cognitive or socio-demographic factors (Van der Linden 2015). Similarly, Dessai and Sims (2010) found that people in southeast England who had directly suffered from drought were more willing to accept restrictions in water consumption and more concerned about climate change. Spence et al. (2011) argue that the lack of ‘first-hand experience’ of potential climate change impacts could explain low perception of climate change risks since those who have experienced flooding were more concerned about climate change and more willing to take mitigation action. However, a study in Sweden found that men who had experienced more incidents in their lifetime perceived risks as less severe in a range of risk domains (e.g. fire, drowning, violence, natural disaster) than other respondents (Sund, Svensson, and Andersson 2015). This would suggest that personal risk experience could be an important determinant of individuals’ perception of climate change risks and their adaptation behaviour if sufficient insights can be gained into how their experiences affect their perceptions (e.g. better understanding their mental models and how their thinking may have changed as a result).

(3) Socio-cultural influences: Cognitive and experiential explanations of (climate) risk perception have been criticised for neglecting the role of ‘competing social and cultural structure in shaping individual risk perceptions’ (Jackson, Allum, and Gaskell 2006). In Van der Linden’s (2015) U.K. sample socio-cultural factors influenced risk perceptions stronger than cognitive or socio-demographic factors. One important factor here are social norms, which can be broadly defined as ‘expectations of how people are supposed to act, think or feel in specific situations’ (Popenoe 1983, 598). Various studies confirm a significant association between people’s social and political norms and practices and their climate change risk perceptions (e.g. O’Connor, Bord, and Fisher 1999; Dunlap and McCright 2008; McCright 2010; McCright and Dunlap 2011; Spence et al. 2011). Depending on the context, such norms can be assessed through, for example, political party affiliation, membership of community organizations, or participation in voluntary social activities. For example, in the U.S.A., in the context of polarized public opinion on the issue, party affiliation correlates significantly with climate change beliefs even when statistically controlled for key demographic variables such as gender, age, ethnicity, income, and education (e.g. Dunlap and McCright 2008; McCright and Dunlap 2011; Spence et al. 2011). Other studies found that political ideology and worldviews influenced climate change risk perceptions stronger than knowledge (Stevenson et al. 2014; Mayer, Adair, and Pfaff 2013; Kahan et al. 2012). A survey among 387 respondents in North Carolina, U.S.A. showed that respondents with a communitarian worldview
more likely agreed that anthropogenic global warming is happening than individualistic respondents (Stevenson et al. 2014). Kahan et al. (2012) found hierarchical individualists more skeptical about climate change than egalitarian communitarians.

(4) Socio-demographic factors: Various studies have explored how social and demographic factors influence risk perceptions – with varying results (Hamilton and Keim 2009). Gender has significant association with risk perception in hazardous activities and technological hazards (e.g. Slovic 1999; O’Connor, Bord, and Fisher 1999; Sundblad, Biel, and Gärling 2007; Brody et al. 2008). Regarding climate change risks, women also tend to be more concerned than men (Finucane et al. 2000; Sund, Svensson, and Andersson 2015). Van der Linden (2015) identifies gender as a ‘significant predictor’ of climate change risk perception. Controlling for political, social and other demographic variables in a regression model, U.S. women were found more concerned about climate change than men (McCright 2010; Hamilton 2011). For other demographic factors (e.g. education, age, income), no consistent or significant relationships with climate risk perception were found (e.g. Sjöberg 2000; Sundblad, Biel, and Gärling 2007; Brody et al. 2008; Milfont 2012). Spence et al. (2011) found no concrete evidence that living in areas vulnerable to climate change (i.e. the physical location) affected people’s perception of climate change risks. In contrast, a study in the U.S. that examined the relationship between physical vulnerability and public perceptions of global climate change suggested that actual and perceived risk was driven by specific types of physical conditions (Brody et al. 2008). Importantly, socio-demographic factors are not necessarily independent; for example geography is typically linked to factors like actual risk exposure (e.g. living in a flood-prone area) or socio-cultural influences (e.g. more liberal or conservative political geographies). A study on public awareness and risk perception about climate change in 199 countries found no major difference in people’s awareness about climate change across countries worldwide when controlling for educational attainment; while climate change risk perceptions varied by region (Lee et al. 2015).

Representational imbalance

So far, most empirical studies on climate risk perceptions were conducted in developed countries, in particular the U.S. (Bostrom et al. 1994; Lorenzoni and Pidgeon 2006; Carlton et al. 2015), the U.K. (Lorenzoni, Pidgeon, and O’Connor 2005; Whitmarsh 2008; Dessai and Sims 2010), or Sweden (Sund, Svensson, and Andersson 2015; Sundblad, Biel, and Gärling 2007). There is limited research on the perception of climate change risks and its determinants in developing countries, which are often more vulnerable to climate change impacts. The representational ‘imbalance in the literature’ constrains understanding of climate change perception around the globe (Capstick et al. 2015). Available research in developing countries differs in focus and has found diverse determinants. For example, a recent survey among rural farmers in Vietnam by Cullen and Anderson (2016) shows that respondents perceived both ‘short- and long-term climate anomalies and trends’ and were concerned about negative impacts on their livelihood. A study in West Africa found that people displayed awareness of changes in weather patterns (e.g. increased temperature and declined precipitation) and confirmed the importance of experiential factors when participants with long occupation in farming were more likely to notice climate change (Maddison 2007). While communities in Sahel were found to have a high awareness of climate issues, historical understanding about climate, shaped by indigenous beliefs, influenced responses to questions about climate (Mertz et al. 2009). Respondents in Bangladesh displayed understanding of specific local risks, climate variability (e.g. temperature and precipitation), changes in flood patterns, and identification of negative impacts of climate change on health, livelihood, and agriculture (Haque et al. 2012).
**Knowledge gap**

Depending on the conceptual model, the factors found to influence climate risk perception and adaptive responses are varied and some studies even arrive at conflicting conclusions. The relationship between climate change risk perceptions and knowledge about climate change, experiential processing, socio-cultural and socio-demographic factors therefore deserves further inquiry, initially through explorative studies that include a broad range of factors that might influence climate risk perceptions. The relative lack of studies in developing countries might unintentionally tilt theoretical considerations towards factors that are more prominent in developed countries. The study presented here aims to address both issues through an exploratory survey on climate risk perceptions in three flood-prone cities in Vietnam that included a comprehensive set of determinants.

**Study context and design**

**Research context: Climate change and risk perceptions in Vietnam**

Located in Southeast Asia and facing the Pacific, Vietnam is regularly affected by weather-related disasters due to its exposed location and physical characteristics with a long coastline and two low delta regions. On average, between 1999 and 2010, weather-related natural disasters caused economic damage equivalent to 1.5% of the country’s Gross Domestic Product (GSO 2017). The flooding in the Mekong Delta in 2000 caused devastation across the region (CCFSC, n.d.). In the Central Coast of Vietnam, floods associated with major typhoons regularly cause serious losses (CCFSC, n.d.). Vietnam has also been recognized as one of the countries likely to be most affected by climate change and associated sea level rise, given the large populations living in coastal and low-lying delta areas (MONRE 2012; World Bank 2011; UNDP 2007). According to climate change scenarios by Vietnam’s Ministry of Natural Resources and Environment, sea level rise is projected to cause particularly serious challenges for the Mekong delta and the coastal plains (MONRE 2012). In recent decades, Vietnam has already experienced extreme weather irregularities including unusual cold and heat waves, prolonged drought, torrential rainfall, ‘super-typhoons’ and devastating floods (MONRE 2012).

Floods, typhoons, storm surges and sea level rise represent significant risk management challenges, from developing early warning systems through seasonal preparedness to strategic planning for future risks. Previous work on coastal and delta communities in Vietnam has highlighted the importance of local knowledge that has developed over time and that further evolves through experience of and adaptation to (changing) local flood regimes (Shaw 2006; Sinh, Lebel, and Tung 2009; Tran et al. 2009). Climate change in interaction with human interventions in delta and upstream areas create complex and potentially novel impacts on flood attributes and risks (Le et al. 2007; Chinh et al. 2014). Creating more awareness of potential impacts of climate change requires to address the determinants of inadequate climate change risk perceptions. So far research about risk perception on natural disasters and climate change in Vietnam has been limited to surveys conducted by various non-governmental organizations aiming to set up a baseline for project-based communication interventions (e.g. by ARC et al. 2013; OXFAM, MCD, and AMDI 2013; MCD and AMDI 2016).

**Conceptual framework**

Our conceptual framework, inspired by the CCRPM (Van der Linden 2015), includes indicators of the four groups of determinants of climate risk perception: cognitive factors, experiential
processing, social-cultural and socio-demographic factors. Considering the available survey dataset, we constructed a simplified set of independent variables compared to the CCRPM model: individual knowledge, past experience, frequency of community participation and socio-demographics. Compared to previous studies, we include a broader set of dependent variables than merely risk perception. The reason is that in the end we are interested in risk perceptions as a determinant of the intention to take measures to adapt to climate change-related risks. Following PMT (Rogers 1975) and the extended parallel processing model (EPPM, Witte 1992), this intention will be influenced by perceived vulnerability to climate risks, their perceived severity and the perceived capacity to successfully carry out adaptive measures (perceived adaptive capacity):

- Perceived vulnerability (also labelled susceptibility) is defined as an individual’s subjective perception of the likelihood of facing a threat or risk.
- Perceived severity refers to an individual’s subjective perception of the magnitude of the threat or risk (Smith, Ferrara, and Witte 2007).
- Perceived adaptive capacity refers to an individual’s subjective perception of his or her ability to successfully perform recommended responses and the perceived effectiveness of the response.

Figure 1 shows the full model. Individual knowledge, past experience, frequency of community participation and socio-demographics influence the perceived severity of climate change risks, the perceived own vulnerability and the self-ascribed adaptive capacity, which in turn influence the intention to take or support adaptive measures. The ambition in this study is to explore the relative importance of these influences among the population in our case study areas.
**Methodology**

**Data collection**

Our analysis builds on a survey among inhabitants of three flood-prone cities in Vietnam. Data were collected through face-to-face interviews by trained data collectors in late 2012 as part of the project ‘Communicating climate change risks for adaptation in coastal and delta communities in Vietnam’. The survey was designed to create a baseline for designing communication interventions. It included respondents’ perceptions of local flood and climate change risks as well as the measures they have taken and can take to adapt to future risks. The survey consisted of 101 questions about respondents’ livelihoods; perceptions of flood (causes, magnitude, tendency and frequency in the future); impacts of flood on their livelihoods and well-being; disaster preparedness; knowledge of climate change; personal observations of climate variability and participation in community activities, intended flood and climate adaption measures and demographic information. A short version of the questionnaire for the purpose of this research, developed from the full questionnaire, is in Supplementary online information, Appendix S2.

**Research sites**

The survey was conducted in eight peri-urban municipalities in three cities in Vietnam: Quy Nhon, Da Nang, and Can Tho. These three sites were selected because they all represent examples of coastal and low-lying areas frequently affected by floods but differ in terms of geographical location, type of natural hazards, climate features and socio-economic conditions. Quy Nhon and Da Nang are coastal cities located in the central part of Vietnam. The local climate is characterized by strong influences of the southwest and the northeast monsoon with a rainy and a dry season. Both communities are affected by typhoons, flash floods and sea level rise. Located in the Mekong Delta, Can Tho has a tropical and monsoonal climate with hot and humid weather all year. As the majority of the city area is only 0.5–1 m above sea level (UBND 2010), Can Tho suffers from flooding, sea level rise and saline intrusion (Figure 2).

**Participants**

Based on official mandatory municipality household registration data, every household in each site was coded with a number. The sample was selected using a random number generator. According to local custom, the survey team contacted village leaders and arranged for household visits during daytime. Interviews were conducted with one adult in each selected household and lasted approximately 60 min. The aim of at least 300 interviews per city was met: Quy Nhon, \( n = 367 \); Can Tho, \( n = 358 \); Da Nang, \( n = 361 \) (\( N = 1086 \)). The response rate was above 90% due to collaborative attitudes, support from village leaders (not present during the interview) and repeat visits in case of absence.

Respondents were aged 16 to 90, with 49% of the sample 50 years and older. About 60% of respondents were female. About one third had at most primary school education. The sample composition reflects that in Vietnam rural women usually stay at home during the daytime while men typically work on fields, in factories or other workplaces. Furthermore, younger people tend to leave the countryside and move to the cities for work or study. In the sample communities, most respondents obtained income from agriculture or aquaculture. About 30% lived below the national poverty line and nearly half in temporary or semi-permanent houses. 65.2% of respondents reported flood experiences in the past 10 years. In tune with a national pattern, 72% of the sample were members of voluntary community organizations (e.g. women, farmers, or youth groups). Detailed respondents’ socio-demographic characteristics are reported in Appendix S1.
Measures
The variables from our model were reconstructed from the baseline survey dataset. Response scales include multiple choice, single choice and ‘yes-no’ questions; for details see Appendix S2. Based on previously validated questionnaires (e.g. Chinh et al. 2014; Haque et al. 2012; Kievik and Gutteling 2011; Spence, Poortinga, and Pidgeon 2012) a set of questions asked respondents about their knowledge about flood and climate change, experience with flood and weather pattern change, frequency of community participation in their communities and socio-demographics. We also constructed a set of questions to ask respondents about their perceived vulnerability, severity, adaptive capacity and intention to take adaptive measures to flood and climate change risks which aligned with other research (e.g. Chinh et al. 2014; Haque et al. 2012; Kievik and Gutteling 2011; Spence, Poortinga, and Pidgeon 2012). The measures are presented in Table 1.

Results
This section first presents a descriptive analysis of respondents’ knowledge and concern about flood risks and climate variability. Then we report the results of a pairwise analysis to test significant effects of all independent and control variables on flood and climate change risk perceptions. Finally, we present the results of a multivariate regression analysis of the relative influence of determinants to respondents’ perception of flood and climate change risks and behaviour.

Individual knowledge and risk perceptions
Data were collected in communities with regular floods where many residents’ livelihoods depend on agri- and aquaculture. Accordingly, the perception of flood risks was high. 87.6% of respondents named at least one cause of flooding in their area. (The multiple choice options for
causes of flooding had been selected by review of national reports (MONRE 2012; CCFSC, n.d.) and consultation with local flood experts.). Regarding perceived vulnerability to flood risk, 45.8% of respondents described the risk as ‘high’ and a further 31.3% as ‘relatively high’. 94.5% believed that floods had negative impacts on their livelihood, indicating high perceived severity. 84.0% described flood levels as ‘higher’ than in the past, indicating an increasing severity of flood. 63.2% said that they took action to cope with flood before the rainy season by taking at least one preparatory measure (indicating a high sense of adaptive capacity). However, only 54.9% said that they would take longer-term preparations for coping with future floods (moderate intention to take adaptive measures). Of these, 87.4% would reinforce their houses, 12.6% would relocate to a safer area, 12.4% buy safety equipment, 4.6% change the seasonal farming calendar, 4.3% seek more information about floods, and 1.3% would purchase insurance (see Appendix S3).

| Measure                      | Question                                                                 | Explanation                          |
|------------------------------|--------------------------------------------------------------------------|--------------------------------------|
| Socio-demographics           | City                                                                     | Single choice, 3-options             |
|                              | Gender                                                                   | Single choice, 2-options             |
|                              | Housing condition                                                        | Single choice, 4-options             |
|                              | Age                                                                      | Single choice, continuous            |
|                              | Education                                                                | Single choice, 5-options             |
|                              | Economy conditions                                                       | Single choice, 4-options             |
|                              | Income sources                                                           | Multiple choices                     |
| Individual knowledge         | What do you know about the causes and impacts of floods?                 | Multiple choices                     |
|                              | What do you know about the impacts of climate change?                     | Multiple choices                     |
|                              | Are you aware of causes of climate change?                               | Yes-No                               |
| Flood experience             | Did you experience a flood in your area in the last 10 years?            | Yes-No                               |
|                              | Do you think that the long-term trends in weather are changing?          | Yes-No and then follow-ups           |
|                              | Do you think that the rain occurred more frequently in the dry season in the past decade or more? | Yes-No                               |
| Community participation      | Do you regularly participate in community activities?                     | Yes-No                               |
| Perceived vulnerability      | Is your house located in an area affected by flood risk?                 | Single choice, 4-options             |
|                              | What do you think about the trend of flood frequency in the next decade? | Single choice, 4-options             |
|                              | Do you think, in a decade or so the trend in floods will stay for longer? | Single choice, 4-options             |
|                              | What do you think the impact of climate change will be on your livelihood? | Multiple choices                     |
| Perceived severity           | Do you think the flood level will be higher in the next decade?          | Single choice, 4-options             |
|                              | Does flood cause negative impacts on your livelihood?                    | Single choice, 4-options             |
|                              | Are you concerned about climate change?                                  | Single choice, 3-options             |
| Perceived adaptive capacity  | Before the flood season, do you prepare anything to cope with flood?    | Yes-No                               |
|                              | How do you prepare?                                                      | Multiple choices                     |
|                              | Do you know what can be done to adapt to climate change?                 | Multiple choices                     |
| Intention to take adaptive measure | Are you doing any longer-term preparations for future flooding?       | Yes-No                               |
|                              | What will you do?                                                        | Multiple choices                     |
|                              | Are you willing to learn more about climate change including mitigation and adaptation? | Single choice, 3-options             |

Table 1. List of measures.
When respondents were asked about their perception of climate change risks, 64.0% answered that they were concerned about climate change and 59.9% mentioned at least one cause of climate change. (The causes of climate change had been selected by review of national reports (MONRE 2012) and consultation with local climate change experts.) 96.9% affirmed their perception that the weather was changing and that patterns in rainfall, timing of seasons or temperature had changed over the past decade. 67.1% said climate change had negative effects on their livelihoods (high sense of vulnerability). But only 46.7% were much concerned about climate change while 35.9% were little concerned and 17.4% were not concerned (relatively low sense of severity). Only 17.4% of respondents could name at least one action to adapt to climate change impacts (of which 22.1% would change crop varieties, 15.8% change the seasonal farming calendar and 59.5% build their house in a higher place), 82.6% answered that they did not know how to adapt (low sense of adaptive capacity). However, 88.9% said that they were willing to learn more about climate change and prepare to adapt in the future (see Appendix S3).

Overall, most respondents recognised both flood and climate change risks. This is possibly linked to the communities’ dependence on agriculture and their location in areas with high flood frequencies and/or impacts of climate change. However, sense of severity and vulnerability, sense of adaptive capacity, and intention to take adaptive measures were significantly lower for climate change risks than for flood risks, indicating both knowledge and motivation differences.

**Factors influencing respondents’ perceptions of flood and climate change risks: a Chi-square test**

Flood risk perception (see Table 2): Pairwise analysis using a Chi-square test confirmed significant effects of all independent and control variables (socio-demographic, individual knowledge and frequency of community participation as well as flood and weather change experience) on flood perception and intended behaviour. Individual knowledge about flood risk, flood experience and frequency of community participation were all significantly associated with respondents’ perception of flood vulnerability, severity, adaptive capacity, and intention to take adaptive measures. Specifically, the strong positive correlations between individual knowledge and perceived vulnerability ($r = 0.192$, $p < .01$), perceived adaptive capacity ($r = 0.144$, $p < .01$), and intention to take adaptive measures are significant.

| Flood risk                          | Perceived vulnerability | Perceived severity | Perceived adaptive capacity | Intention to take adaptive measure |
|-------------------------------------|-------------------------|-------------------|-----------------------------|-----------------------------------|
| Socio-demographics                  |                         |                   |                             |                                   |
| Age                                 | n.s                     | n.s               | 0.073**                     | 0.061*                           |
| Gender                              | n.s                     | n.s               | -0.138**                    | -0.118***                        |
| Education                           | -0.154***               | -0.145***         | -0.090**                    | n.s                              |
| Household’s vulnerability status     | 0.079**                 | n.s               | n.s                         | n.s                              |
| City of residence                   | n.s                     | n.s               | 0.180**                     | 0.161***                         |
| Income source                       | 0.186***                | 0.314***          | 0.180**                     | 0.161***                         |
| Poverty status                      | -0.115***               | -0.108**          | n.s                         | n.s                              |
| City of residence                   | -0.087***               | -0.426***         | -0.201**                    | -0.144***                        |
| Individual knowledge                | 0.192***                | -0.099**          | 0.144**                     | 0.215***                         |
| What do you know about the causes of flood? | 0.364***            | 0.091**          | 0.241**                     | 0.227***                         |
| Flood experience                    |                         |                   |                             |                                   |
| Did you experience a flood in your area in the last 10 years? | 0.197***                | 0.152***          | 0.237***                     | 0.280***                         |
| Community participation             |                         |                   |                             |                                   |
| Participation in commune activities |                         |                   |                             |                                   |

Note: ***,**, * are significant at the 0.01; 0.05; 0.1 level; n.s. is not significant.
measures ($r = 0.215, p < .01$) indicate that individual knowledge increases flood risk perception. Similarly, the results show strong positive correlations of flood experience with perceived vulnerability ($r = 0.364, p < .01$), perceived severity ($r = 0.091, p < .05$), perceived adaptive capacity ($r = 0.241, p < .01$), and intention to take adaptive measures ($r = 0.027, p < .01$). Similarly, frequency of community participation is positively correlated with perceived vulnerability ($r = 0.197, p < .01$), perceived severity ($r = 0.152, p < .05$), perceived adaptive capacity ($r = 0.237, p < .01$), and intention to take adaptive measures ($r = 0.280, p < .01$). However, individual knowledge of flood risks was negatively correlated with their perceived severity ($r = -0.099, p < .05$). Among the socio-demographic variables, income source and city of residence, which reflect a household’s exposure to floods, had significant effects on flood risk perceptions. Poverty status had significant effects on perceived flood vulnerability and severity, but not on adaptive capacity and intention to take adaptive measures. In contrast, higher age and male gender increased the perceived adaptive capacity and intention, but had no significant effect on flood risk perception. Higher levels of education reduced the perceived vulnerability and severity of flood risks, but were also associated with lower perceived adaptive capacity. The presence of at least one vulnerable dependent (children, elderly, disabled) in the household had only a weak statistical influence on flood risk perception (see Table 2).

Climate change risk perception (see Table 3): Similar to the patterns for flood risk perception, the Chi-square test showed significant positive statistical effects of individual knowledge, personal experiences and frequency of community participation on the perceived vulnerability to and severity of climate change risks, the perceived adaptive capacity and the intention to take adaptive measures. Specifically, knowledge of climate change was strongly correlated with perceived vulnerability ($r = 0.241, p < .01$), perceived severity ($r = 0.325, p < .01$), perceived adaptive capacity ($r = 0.302, p < .01$), and intention to take adaptive measures ($r = 0.190, p < .01$). The results also show strong positive correlations of individual experience of changing weather patterns with perceived climate change vulnerability ($r = 0.125, p < .01$), severity ($r = 0.158, p < .01$), adaptive capacity ($r = 0.068, p < .01$), and intention to take adaptive measures ($r = 0.179, p < .01$). Similarly, more frequency of community participation increases perceived climate change vulnerability ($r = 0.188, p < .01$), severity ($r = 0.341, p < .01$), adaptive capacity ($r = 0.163, p < .01$), and intention to take adaptive measures ($r = 0.247, p < .01$). Among the socio-demographic control variables, city of residence and income source were significantly associated with all four – perceived climate change vulnerability, severity, and adaptive capacity as well as intention to take adaptive measures. Higher education and male gender were also positively associated with all four dependent variables.

Table 3. Pairwise correlation coefficients between socio-demographics, individual knowledge, climate change experience, community participation and perception of climate change vulnerability, severity, adaptive capacity and intention to take adaptive measures.

| Climate change risk | Perceived vulnerability | Perceived severity | Perceived adaptive capacity | Intention to take adaptive measure |
|---------------------|------------------------|-------------------|-----------------------------|-----------------------------------|
| Socio-demographics  |                        |                   |                             |                                   |
| Age                 | n.s                    | n.s               | n.s                         | -0.055*                           |
| Gender              | -0.086**               | -0.234**          | -0.216**                    | -0.072**                          |
| Education           | 0.135***               | 0.215***          | 0.145***                    | 0.167***                          |
| Vulnerable status   | n.s                    | n.s               | n.s                         | -0.063**                          |
| Income source       | 0.062**               | 0.091***          | 0.087***                    | 0.075**                           |
| Poverty status      | 0.139***               | 0.174***          | 0.193***                    | n.s                               |
| City of residence   | -0.069***              | -0.171***         | -0.219***                   | -0.067***                         |
| Individual knowledge|                        |                   |                             |                                   |
| Do you know about   | 0.241***               | 0.325***          | 0.302***                    | 0.190***                          |
| the causes of climate change? |          |                   |                             |                                   |
| Climate change experience |                  |                   |                             |                                   |
| Do you think weather is changing more drastically in recent year? | 0.125*** | 0.158*** | 0.068** | 0.179*** |
| Community participation |                        |                   |                             |                                   |
| Participation in commune activities | 0.188*** | 0.341*** | 0.163*** | 0.247*** |

Note: ***, **, * are significant at the 0.01; 0.05; 0.1 level; n.s. is not significant.
Poverty status had positive statistical associations with perceived vulnerability, severity, and adaptive capacity, but not with adaptive intention. The statistical effects of respondents' age and the existence of vulnerable household members were weak (see Table 3).

**Multivariate analysis: Factors influencing respondents’ perception of flood risks and behaviours**

After the bivariate analyses, (Chi-square tests) had supported the potential relevance of all factors in our model – for the perception of both flood risks and climate change risks – we used multivariate analysis to separate the effect of each independent variable in our exploratory model.

Flood risk perception: Table 4 presents the results of the logistic regression analysis for the estimation of the effects of the independent variables on respondents' perception of flood vulnerability and severity, adaptive capacity, and intention to take action to reduce flood risks.

Table 4. Logistic regression analysis – flood risk perception.

| Dependent variables | Perceived vulnerability (OR) | Perceived severity (OR) | Perceived adaptive capacity (OR) | Intention to take actions for reducing flood risks (OR) |
|---------------------|-----------------------------|------------------------|----------------------------------|--------------------------------------------------|
| Socio-demographics  |                             |                        |                                  |                                                  |
| Age                 |                             |                        |                                  |                                                  |
| under 30            | 1.00                        | 1.00                   | 1.00                             | 1.00                                             |
| 30–39               | 1.158                       | 0.449                  | 0.488*                           | 1.092                                           |
| 40–49               | 0.713                       | 0.517                  | 0.680                            | 1.222                                           |
| 50–59               | 0.763                       | 0.287                  | 0.748                            | 1.261                                           |
| > =60               | 1.441                       | 0.243                  | 0.786                            | 2.286**                                         |
| Gender              |                             |                        |                                  |                                                  |
| male                | 1.00                        | 1.00                   | 1.00                             | 1.00                                            |
| female              | 0.973                       | 3.223**                | 0.805                            | 0.935                                           |
| Education           |                             |                        |                                  |                                                  |
| never gone to school| 1.00                        |                        | 1.00                             | 1.00                                            |
| Primary             | 0.374                       | 1.150                  | 0.920                            | 1.849                                           |
| Secondary           | 0.346                       | 1.451                  | 0.835                            | 2.128*                                          |
| High school and higher | 0.380                  | 1.000                  | 0.764                            | 2.076                                           |
| Income source       |                             |                        |                                  |                                                  |
| waged employment    | 1.00                        | 1.00                   | 1.00                             | 1.00                                             |
| small traders or casual labour | 2.195***        | 3.443**                | 1.621**                          | 1.357                                           |
| aquaculture         | 12.882**                    |                        | 2.565**                          | 1.466                                           |
| agriculture         | 4.618***                    | 18.230**               | 4.278***                         | 1.928**                                         |
| Poverty status      |                             |                        |                                  |                                                  |
| non-poor            | 1.00                        | 1.00                   | 1.00                             | 1.00                                            |
| poor and near poor  | 0.708                       | 1.173                  | 0.654*                           | 1.067                                           |
| Individual knowledge|                             |                        |                                  |                                                  |
| no flood knowledge  | 1.00                        | 1.00                   | 1.00                             | 1.00                                            |
| flood knowledge     | 1.486                       | 1.029                  | 1.052                            | 2.113***                                         |
| Flood experience    |                             |                        |                                  |                                                  |
| no flood experience | 1.00                        | 1.00                   | 1.00                             | 1.00                                            |
| flood experience    | 2.173**                     | 0.295**                | 1.575**                          | 1.429*                                          |
| Community participation |                         |                        |                                  |                                                  |
| Participation in community activities | 1.00            | 1.00                   | 1.00                             | 1.00                                            |
| rarely              | 1.389                       | 1.509                  | 0.681                            | 0.865                                           |
| occasionally        | 0.872                       | 2.354                  | 2.189***                         | 2.477***                                         |
| frequently          | 1.163                       | 11.959***              | 2.095***                         | 2.371***                                         |
| Constant            | 5.577***                    | 38.576***              | 1.279***                         | 0.085***                                         |
| Number of obs.      | 694                         | 423                    | 711                              | 712                                             |
| Pseudo $R^2$        | 0.3228                      | 0.3128                  | 0.1448                           | 0.1380                                           |

Note: ***, **, * statistically significant at 1%, 5%, 10% level.
risks. In contrast to the bivariate analysis, in the logistic regression analysis most socio-demographic variables did not show strong associations with respondents' flood risk perceptions and intentions. Age was only significantly associated with the intention to take adaptive measures, with those 60 years and older more likely to contemplate action compared to younger age groups (odds ratio (OR) of 2.286 at 5% significance level). The only statistically significant effect of gender was that female respondents were more likely concerned about flood severity (OR: 3.223 at 5% significance level). Respondents’ educational level and poverty status had no significant relationship with risk perception and behaviour. In contrast, respondents’ income source showed significant association with perceived flood risks and capacity; at 1% significance level, respondents whose income relied on agriculture were more concerned about flood vulnerability (OR: 4.618) and considered having more adaptive capacity to flood risks (OR: 4.278) compared to waged employees (see Table 4).

Compared to the bivariate analysis, the effects of respondents’ knowledge were much weaker. The only significant influence found was that respondents with knowledge about flood risks were more inclined to contemplate adaptive measures (OR: 2.113 at 1% significance level) compared to respondents without flood knowledge.

In contrast, flood experience showed strong effects on flood risk perception. Respondents who had experienced flood in the past were more concerned about flood vulnerability (OR: 2.173 at 1% significance level) but less concerned about flood severity (OR of 0.295 at 5% significance level) compared to respondents without flood experience. They believed to have more adaptive capacity (OR: 1.575 at 5% significance level) compared to respondents without a flood experience and were more inclined to take adaptive measures.

Respondents’ frequency of community participation had little statistical effect on perceived flood vulnerability, with the exception that respondents who frequently participate in community activities were more concerned about flood severity (OR: 11.959 at 1% significance level). In contrast, both occasional and frequent participation in community activities had strong positive effects on perceived adaptive capacity (OR: 2.189 (occasionally) and 2.095 (frequently) at 1% significance level) and intention to take action (OR: 2.477 (occasionally) and 2.371 (frequently) at 1% significance level) compared to respondents who said they never participated in community activities.

**Multivariate analysis: Factors influencing respondents’ perception of climate change risks and behaviours**

Table 5 presents the results of the multivariate regression analysis for the estimation of independent variables on respondents’ perception of climate change vulnerability, severity, adaptive capacity, and behavioural intention. As with the perception of flood risks, most socio-demographic variables showed an even weaker influence than in the bivariate analysis. Respondents’ age, gender, and poverty status had little significant statistical effect on climate risk perceptions, with two exceptions: those 60 and older were more concerned about climate change severity compared to younger age groups (OR: 7.545 at 5% significance level); and poor and near poor respondents felt a lower ability to adapt to climate change risks (OR: 0.499 at 5% significance level). In contrast, respondents’ educational level had some significant effects: respondents with high educational level (high school or more) were more concerned about climate change severity (OR: 16.576 at 1% significance level) and more likely to intend to take adaptive measures (OR: 11.782 at 1% significance level) compared to respondents who never went to school. The effect of income source was weaker than for flood risk perceptions. Other than for flood risk perceptions, respondents whose main income source was aquaculture did not significantly differ in their climate risk perceptions from those who mainly depend on waged employment. Respondents who mostly rely on agriculture for their income showed a higher
concern about climate change severity (OR: 24.089 at 5% significance level) than those relying on waged employment.

In stark contrast to the findings for flood risk perception, respondents’ knowledge had a strong influence on their climate risk perception and intention to take adaptive measures. At 1% significance level, respondents with knowledge about climate change were more concerned about climate vulnerability (OR: 3.923) and severity (OR: 6.461) and more likely to intend to take action for reducing climate change risks (OR: 4.580) than respondents without climate change knowledge. In contrast, climate change knowledge strongly reduced the perceived capacity to adapt to climate change (OR: 0.225 at 1% significance level) compared to those without knowledge.

Again in stark contrast to flood risk perception, experience of changing weather patterns had a weak influence on perceived climate vulnerability, severity, adaptive capacity, and intention to take measures to adapt to climate change.

Similar to flood risk perceptions, frequency of community participation had a strong and positive influence on the perceived climate risk vulnerability and severity, and on the intention

| Table 5. Logistic regression analysis – climate change risk. |
|-------------------------------------------------------------|
| Dependent variables                                    | Perceived | Perceived | Perceived adaptive | Intention to take |
|                                                   | vulnerability (OR) | severity (OR) | capacity (OR) | actions for reducing |
| Socio-demographics                                      |            |            |                | flood risks (OR)   |
| Age                                                   |            |            |                |                  |
| under 30                                               | 1.000      | 1.000      | 1.000          | 1.000             |
| 30–39                                                  | 1.345      | 2.107      | 1.167          | 0.354             |
| 40–49                                                  | 1.062      | 2.901      | 1.035          | 2.804             |
| 50–59                                                  | 1.588      | 2.114      | 1.220          | 1.021             |
| > =60                                                  | 1.300      | 7.545***   | 1.054          | 1.900             |
| Gender                                                 |            |            |                |                  |
| male                                                   | 1.000      | 1.000      | 1.000          | 1.000             |
| female                                                 | 1.829      | 2.045      | 1.317          | 2.802*            |
| Education                                              |            |            |                |                  |
| never gone to school                                   | 1.000      | 1.000      | 1.000          | 1.000             |
| primary                                                | 0.452      | 4.374**    | 0.600          | 2.747             |
| secondary                                              | 0.683      | 4.728**    | 0.673          | 4.842**           |
| high school and higher                                 | 0.867      | 16.576***  | 0.517          | 11.782****        |
| Income source                                           |            |            |                |                  |
| waged employment                                       | 1.000      | 1.000      | 1.000          | 1.000             |
| small traders or casual labour                         | 0.948      | 0.844      | 0.910          | 1.411             |
| aquaculture                                            | 2.432      | 1.510      | 1.577          | 4.467             |
| agriculture                                            | 2.614*     | 24.089***  | 1.063          | 1.930             |
| Poverty status                                          |            |            |                |                  |
| non-poor                                               | 1.000      | 1.000      | 1.000          | 1.000             |
| poor and near poor                                     | 1.410      | 1.491      | 0.449**        | 0.867             |
| Individual knowledge                                   |            |            |                |                  |
| Climate change knowledge                               |            |            |                |                  |
| no CC knowledge                                        | 1.000      | 1.000      | 1.000          | 1.000             |
| with CC knowledge                                      | 3.923***   | 6.461***   | 0.225***       | 4.580***          |
| Climate change experience                              |            |            |                |                  |
| no CC experience                                       | 1.000      | 1.000      | 1.000          | 1.000             |
| with CC experience                                     | 2.510      | 2.237      | 0.693          | 6.076*            |
| Community participation                                |            |            |                |                  |
| Participation in community activities                  |            |            |                |                  |
| never                                                  | 1.000      | 1.000      | 1.000          | 1.000             |
| rarely                                                 | 2.018      | 1.998      | 0.500          | 5.241*            |
| occasionally                                           | 1.294      | 2.428*     | 0.573*         | 4.843***          |
| frequently                                             | 2.503**    | 16.211***  | 0.424**        | 3.385**           |
| Constant                                               | 0.281      | 0.025      | 121.938***     | 0.038             |
| Number of obs.                                         | 596        | 596        | 596            | 566               |
| Pseudo R²                                               | 0.1342     | 0.3236     | 0.1888         | 0.2908            |

Note: ***, **, * statistically significant at 1%, 5%, 10% level.
to take adaptive measures, but a negative influence on the perceived adaptive capacity. The effect on perceived climate risk vulnerability and severity was significant only for higher frequency of community participation (OR: 2.503 at 5% significance level, OR: 16.211 at 1% significance level respectively). Perceived adaptive capacity was negatively affected by frequent participation (OR: 0.424 at 5% significance level). A positive effect of participation on the intention to take measures to adapt to climate change was visible for respondents who either occasionally participated in community activities (OR: 4.843 at 1% significance level) or who frequently participated (OR: 3.385 at 5% significance level).

**Influence of risk and capacity perceptions on adaptive behaviour**

The third and final step in our analysis looked at the influence of perceived vulnerability, severity, and adaptive capacity of flood and climate change risks on the intention to take adaptive measures, as represented on the right hand side of Figure 1. For this purpose, we conducted another regression analysis. The results, shown in Table 6, confirm only parts of our model. They also reveal striking differences between the intention to take adaptive measures against flood risks and climate change risks. First, for neither risk is the intention to take adaptive measures significantly determined by the level of perceived vulnerability. In contrast, perceived severity of both flood and climate change risks was strongly and positively associated with the intention to take adaptive measures (at 5% significance level, OR: 2.299 and 2.183 for some and a lot concern over flood severity, and OR: 5.325 and 18.367 at 1% significance level for some and a lot concern over the severity of climate change risks). Third, perceived adaptive capacity was strongly and positively associated with the intention to take adaptive measures against flood risks (OR: 18.117 at 1% significance level), while there was no significant statistic effect of perceived capacity to adapt to climate change on the actual intention to take measures to adapt to climate change.

**Discussion**

Our analysis confirms the usefulness of an exploratory approach with a broad set of variables to understand the determinants that influence flood and climate change risk perceptions and behavioural intentions to take adaptive measures in vulnerable communities in developing countries. Inspired by the CCRPM (Van der Linden 2015), we explored the role of knowledge, personal experience, frequency of community participation and socio-demographic factors on
a broadened set of dependent variables (perceived vulnerability, severity, adaptive capacity and intention to take adaptive measures). We also compared risk perceptions and determinants for flood and climate change risks.

With three flood-prone communities in Vietnam as the research context, our data indicate that most respondents recognized they were residing in high flood risk areas and anticipated that floods would be more severe in the future (high sense of vulnerability). The majority of respondents believed that floods would have negative impacts on their livelihood and health (high sense of severity) and confirmed that they took action to respond to flood before disaster season (indicating a high sense of adaptive capacity). However, fewer respondents said that they would adopt longer-term preparations for future flooding (moderate intention to take adaptive measures). This finding reveals an intention gap to take more long-term adaptive measures which is important to address in risk communication.

When asked about climate change risks, most respondents affirmed their perception that the weather was changing and a majority had heard about climate change and experienced its impacts on their livelihoods (high perceived vulnerability). However, only a small proportion of respondents was concerned about climate change (low perceived severity) and a very low proportion said they knew how to deal with it (low sense of adaptive capacity). A majority of respondents confirmed that they were willing to learn and prepare to adapt to future climate change impacts (high intention to consider adaptive measures).

Overall, the share of respondents perceiving vulnerability, severity, and adaptive capacity related to climate change was lower than the share perceiving severity and adaptive capacity related to floods. This is in line with previous findings that people view climate change impacts as temporally and spatially distant and therefore often view climate change impacts as personally relevant only after directly experiencing disrupted weather patterns (O’Connor, Bord, and Fisher 1999; Leiserowit 2005; Spence et al. 2011). Importantly, despite widely shared experiences with floods, only 54.9% of respondents intended to take more long-term adaptive measures. This intention was strongly determined by the perceived severity and adaptive capacity (Table 6). While these findings are significant for consideration when designing risk communication for adaptive action, our findings also suggest that the intention to take measures to adapt to climate change was much lower and affected only by perceived severity, but not perceived adaptive capacity. This lack of a statistical correlation, however, can be explained by the fact that participants with increased knowledge of climate change were more sceptical about their adaptive capacity while becoming more intent to take adaptive measures. In other words: Increased knowledge reduces the more optimistic assumptions about adaptive capacity and creates a higher sense of urgency.

Pairwise analysis showed a significant association of flood and climate change risk perceptions with individual knowledge, personal experiences and frequency of community participation. Meanwhile, socio-demographic factors – apart from respondents’ income source and city of residence, which reflect the often very place-specific climate change impacts – were no consistent predictors of perceived vulnerability, severity, adaptive capacity, and intention to take adaptive measures. This confirms similar findings in previous studies (Juliussson, Karlsson, and Gärling 2005; Bruine de Bruin, Parker, and Fischhoff 2007; Sanz et al. 2007; Stanovich and West 2008; Wolf and Moser 2011).

The multivariate analysis found that only a limited number of factors predicted the perception of flood and climate risks and the intention to take action to reduce potential impacts. The findings support the assumption that some socio-demographic factors become statistically insignificant when controlled for individual knowledge, personal experience and frequency of community participation influences. The analysis revealed that individuals’ frequency of community participation and flood experience maintained significant associations with perceived vulnerability, severity, adaptive capacity, and intention to take adaptive measures when integrating these factors in one model, while flood knowledge remained significant only for the intention to
take adaptive measures. In contrast, climate change knowledge – together with frequency of community participation – had a more consistent influence on climate risk perception and intention to take adaptive measures, while personal experience had little significant influence. This probably reflects that the more severe climate change impacts will occur in the future and that current impacts are not always attributed to climate change.

Compared against existing and recent investigations about the factors that influence flood and climate change risks, our research showed that respondents who were knowledgeable about floods were more concerned about climate vulnerability and severity, felt higher adaptive capacity and were more likely to take adaptive measures against future climate change impacts (see Table 7). Flood experience was significantly associated with higher perceived climate change severity, adaptive capacity and intention to adapt to climate change. This contrasts with studies who found that people who had experienced flooding differed very little from those who have not regarding their understanding of and response to climate change (Whitmarsh 2008; Dessai and Sims 2010; Spence et al. 2011). Finally, the results confirm the assumption that risk perceptions are strongly influenced by knowledge about the causes and consequences of climate change (Sundblad, Biel, and Gårling 2007; Brody et al. 2008; Kellstedt, Zahran, and Vedlitz 2008; Menny et al. 2011).

The findings broadly confirm association of the explanatory variables from the CCRPM with perceived climate change vulnerability and severity among the sample population in Vietnam; however, the proposed conceptual model of climate risk perception was only partly confirmed in multivariate analysis. Our research revealed some surprising complexities. In our sample, individual knowledge and frequency of community participation increased the intention to adapt to climate change but reduced the perceived capacity to do so. At the same time, experience had a weak and socio-demographic factors had an uneven influence on perceived capacity and intention to take adaptive measures to climate change. The proposed conceptual model also proved useful to understand perceptions and responses to flood risks in our sample population.

The findings from the present study are likely to be relevant to other countries with similar contextual features both in the developing and the developed world, and will contribute to broader discussions about the determinants of climate risk perception. We expect that the relative influence of the determinants will depend, inter alia, on the local exposure and visibility of climate change impacts, levels and modes of community participation, the prevalent worldviews and the type and degree of political mobilization around climate change issues. As argued above, the factors found to influence climate risk perception and adaptive responses are varied and some studies arrive at contradictory conclusions.

The present study confirms that more integrative conceptual models are important to determine the factors influencing climate risk perception and adaptive responses. The findings suggest that further explorative studies are needed that include a larger number of potential factors that might influence climate risk perceptions. Such quantitative studies should be complemented with more in-depth qualitative research to enhance our understanding how perceptions of climate change risks are embedded in local narratives. Our findings may also be useful to target interventions and communications to raise awareness of people’s perceptions and practice in

| Table 7. Correlation coefficients and association between flood risk and climate change risk perceptions. |
|---------------------------------------------------------------|
| Flood knowledge, flood vulnerability | Climate change severity | Climate change adaptive capacity | Climate change intention to adapt |
|-----------------------------|---------------------------|-----------------------------|-----------------------------|
| Flood knowledge | 0.1119*** | 0.2246*** | 0.1222*** | 0.3327*** |
| Flood experience | 0.0363 | 0.1175*** | 0.1582*** | 0.1868*** |
| Flood vulnerability | -0.0563* | -0.0012 | 0.0368 | 0.1229*** |
| Flood severity | 0.0925* | 0.0719* | -0.0266 | 0.0535 |
| Flood adaptive capacity | 0.2098*** | 0.2187*** | 0.1695*** | 0.2019*** |

Note: *, **, *** Pearson correlation test and Chi-square statistic for independent is statistically significant at 10%, 5%, 1% level
Coping with flood and climate risks, such as: reinforcing the perception of continued vulnerability by highlighting personal experiences; providing concrete examples of adaptive measures; and encouraging adaptive measures through social influences such as utilization of community organizations. Not least, the research addresses the relative lack of studies on climate change risk perception in developing countries and confirms that this geographical imbalance in available data might have the unintended effect of tilting theoretical considerations towards factors that are more prominent in developed countries.

Conclusions
The research model proposed in this article distinguishes between a vulnerability and a severity component of perceived climate change risks and adds perceived adaptive capacity as a third factor to explain the intention to take adaptive measures. We compared determinants of climate risk perception with determinants of flood risk perception and the respective intention to take adaptive measures to better understand whether the distant, complex and abstract concept of climate change affects the risk perception and adaptation in comparison to the more graspable and experiential notion of floods. We also explored the relationship between flood experience and climate risk perception and adaptation.

Altogether, our research confirms earlier findings that individuals’ knowledge, place-specific experience and vulnerability-related social-demographic factors are the most important predictors of both flood and climate change risk perceptions and intentions to take adaptive measures. Our findings suggest that combining theories of risk perception, PMT and the extended parallel processing model are a promising approach to integrate the understanding of the determinants of risk perceptions and adaptive behaviour related to climate change, but also other risks. Such a more integrated approach can have significant implications for climate change communication. However, the theoretical implications deserve further elaboration, including analysis of the statistical independence of the relatively large number of variables. Our results also indicate a need to apply a more comprehensive model in a broader range of locations to understand similarities and differences in the importance of the various factors. Furthermore, the significant differences in the relative importance of cognitive factors, experiential processing, socio-cultural and socio-demographic factors on the perception of climate risks as compared to flood risks calls for further research across different types of weather and climate-related risks.

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