

5 Farmers' perceptions of and responses to annual flood events in the Vietnamese Mekong River Delta

Adapting to climate change impacts

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Introduction

Regions around the globe with a monsoon climate experience large inter-seasonal variations of river flows (FAO, 2009). One of the world's largest river basins, the Mekong River, is a shared water resource of great social, economic and environmental importance to the six countries (Myanmar, China, Laos, Thailand, Cambodia and Vietnam) through which it flows (Moglia *et al.*, 2008). Optimizing the sustainable use of the basin's water is considered the best approach to improving welfare and realizing the Millennium Development Goals of poverty alleviation (*ibid.*). Inhabitants of the Mekong River Basin (MRB) are mostly rural farmers/fishers and are among the poorest in the world with a third of the population living on less than US\$2 per day (FAO, 2011; MRC, 2012).

In the Mekong River Basin, rapidly increasing population and urbanization are placing pressure on food, water and energy needs (MRC, 2012; Huong and Pathirana, 2013). In this region, the impacts of climate change and climate variability increasingly occur. Stern (2006, 2007) and Garnaut (2008) predict that global climate change impacts will lead to sea level rise, coastal erosion, spreading vector borne diseases and more frequent and intense extreme events, i.e. cyclones, heat waves, storm surges and flooding events.

This chapter focuses on the impact of more frequent and extreme flooding events in the Mekong River Delta (MRD). Such floods have direct implications for Vietnam's rice crop, which relies heavily on the waters of the MRD to sustain annual production. While flood events occur annually from July to November in the MRD, increasing flood variability can be seen as a reflection of changing precipitation and land use patterns (Moglia *et al.*, 2008, 2012; WMO, 2009). Flood events have inherently localized impacts, yet are interdependent and almost fully reliant on the interaction between social systems and their technical and ecological contexts (Alexander *et al.*, 2010; Alexander and West, 2011).

Chapter 1 describes this book's overarching analytical framework (see Ch. 1, Figure 1.1), which can be used to highlight the complexity of water

resources management, particularly in terms of adapting to the impacts of climate change. Without effective mitigation strategies, increasing climate change impacts such as flooding will have consequences at the local level, directly affecting the environment, equity and livelihood security of impacted communities. Capacity building for communities and local practices, coupled with capacity building for institutions and policy-making, is required to enable communities to adapt to the increasing risks and hazards of variable annual flooding exacerbated by climate change.

This chapter reflects on the importance of local perceptions of flooding events and household adaptive capacity and coping strategies used to prepare and respond to annual flooding in the MRD. In particular, flood events in 1978 and 2000 were the most notable in this region, as the floods submerged and destroyed many village houses and drowned many fishermen, women, children and livestock. With climate change predictions indicating more frequent and intense extreme weather events, support for local adaptation strategies is critical for this region. By understanding how local villagers perceive, prepare for and respond to flood threats, the authors suggest that local knowledge – in the form of human and social capital – can inform policy and help secure the necessary financial capital to support adaptive capacity and resilience in the face of increasingly variable floods (Scoones, 2009).

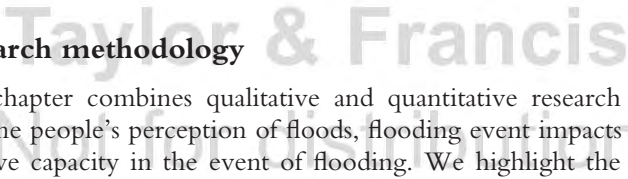
Research methodology

This chapter combines qualitative and quantitative research approaches to examine people’s perception of floods, flooding event impacts and household adaptive capacity in the event of flooding. We highlight the environmental impacts, equity in terms of those most affected and livelihood security issues experienced by those threatened by annual flooding. Adaptive strategies and local capacity are also highlighted and the role of perceptions in responses to flooding events. Several key approaches used included: surveys, focus group discussions with people from different socio-economic groups, in-depth interviews with key informants living in flood-prone areas, field observations and archived newspaper reports.

Three communities are highlighted, representing three different levels of natural flooding in the Mekong River Delta (Figure 5.1). The first site is located in the highest flood-prone region (Phu Duc commune, Tam Nong district, Dong Thap province). The second is located in a moderate flood-prone region (Thanh My Tay commune, Chau Phu district, An Giang province). The third location is Trung An commune, Co Do district, Can Tho city, which is less flood prone.

At each research site four focus group discussions were conducted for information on perception of floods in terms of flood discourse, its impacts on household assets and household adaptive capacity to the annual flood season. A case study is presented that is based primarily on these discussions, a household survey and ten in-depth interviews with key informants.

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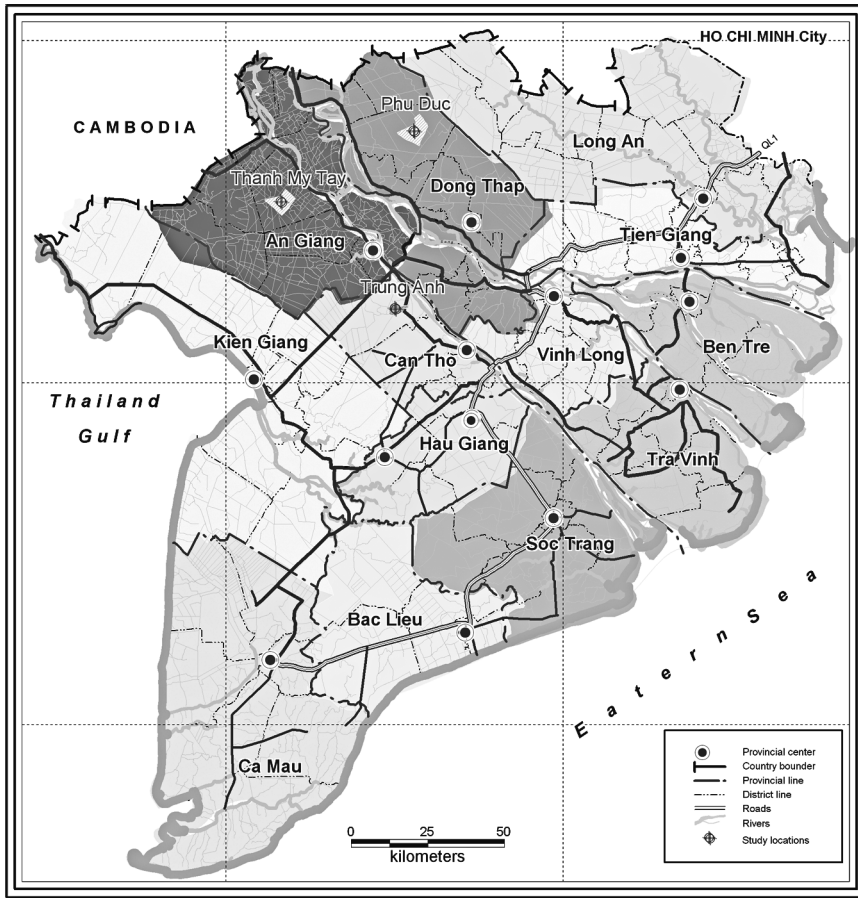


Figure 5.1 Map of study sites in the Mekong River Delta of southern Vietnam (source: Pham Van Quang (2012)).

The survey included 459 household representatives in the three study sites and focused on understanding local capacity, livelihood security and responses to flooding events. Three socio-economic groups were identified (poor, middle and better-off households) and differences in adaptation strategies and coping behaviours explored. This sampling approach has been widely accepted in rural development and natural hazard studies (Smith *et al.*, 2001; Phùng Trần *et al.*, 2008). Narrative and thematic approaches were used for analysing qualitative data from focus group discussions and in-depth interviews. Statistical analysis indicated the significance of differences in perception of floods and coping strategies of participants from different socio-economic groups.

Content analysis of archived local and national newspaper articles related to floods (1996–2011) was used to explore trends in the perceptions that local authorities and the national government had of annual flood events. Analysis of perception and responses to natural hazards reported in newspapers is a recognised approach (Needham and Nelson, 1977; Rashid, 2011). Six main newspapers were used in this analysis (*Tuoi tre, An Giang, Dai Doan Ket, Can Tho, Thanh Nien and Nong Nghiep*), which were produced by local, regional and national media organizations.

Flood regimes in the Mekong Delta

In the Mekong Delta, seasonal flooding over a large area usually occurs from June through December. Floods vary in depth from 0.5 to 4 m and in timing from 3–6 months (Delta Alliance, 2011). According to Vietnamese statistics from the last 60 years, there have, on average, been high-level flooding events every two years (*ibid.*). Floodwaters typically start to recede in early October through November.

There are many environmental factors that are implicated in the level of the annual flooding. For example, upstream flows have been increasingly impacted by hydropower reservoirs built between 1971 and 2010 including four reservoirs in Laos built between 1998 and 2010, three reservoirs in China built between 1993 and 2010 and four reservoirs in Vietnam, built between 2001 and 2009 (*ibid.*). More hydropower reservoirs are planned, which will further impact flood variability in wet and dry seasons. The magnitude of floods is linked to saltwater intrusion in the Mekong Delta, as upstream floodwaters push the salt back to the estuaries. Saltwater intrusion also depends on dry season water flows, paddy production and timing of the rainy season (*ibid.*).

Introduction to perception of floods

The term ‘flood’ often implies an ‘abnormality’ in the English language. Many researchers have seen ‘flood’ as adversity or a cost to human society (White, 1945, 1964, 1974a, 1974b). Human perceptions and adjustments to floods have been studied by natural hazard researchers in the United States since the 1940s (Harding and Parker, 1974; Islam, 1974; Kates, 1962, 1963, 1971; White, 1945, 1964, 1974a). Among these researchers, the perception of floods was first studied by White (1945) who examined factors affecting human adjustments to floods. However, understanding flood perception still focused on physical conditions such as the frequency and magnitude of flood occurrence and flood damage. During the 1970s, White and his colleagues produced a series of research papers on perceptions of floods. The term ‘perception’ is defined as ‘the individual organization of stimuli relating to an extreme event or a human adjustment’ (White, 1974b). This concept attempts to understand ‘how people talk and view the occurrence of extreme

1 events and their coping strategies with such events' (White, 1974).
 2 However, this concept is presented in a narrow, extreme context and the
 3 negative effects of such events are paramount. In Bangladesh, Paul (1984)
 4 describes the characteristics of floods in terms of timing (early, usual, late),
 5 magnitude (below, normal, abnormal) and duration (shorter, normal, longer
 6 than normal).

7 For those living around the waterways of flood-prone regions in the Viet-
 8 namese part of the MRD, the floods are known as the 'rising water season'.
 9 Some people refer to such events as 'he returns' (*ông về*), indicating the signif-
 10 icance and expectation of the annual flooding event.

11 As in scientific reports and many government documents, we use the term
 12 'flood' for the sake of simplicity (Ngô Trong Thuan, 1995; Nguyễn Hồng
 13 Bình, 1995; Nguyễn Như Khuê, 1995; SIWRPM, 2000; Đào Công Tiến,
 14 2001; Đặng Quang Tính and Phạm Thanh Hằng, 2003; MARD, 2004).

15 Findings: 'flood' or the 'rising water season' from 16 national to local perspectives

17 Flood (*lũ*) has been used in newspapers to describe a large inundation water
 18 event, otherwise termed 'dangerous floods' (*lũ giết*) or 'big flooding' (*lũ lụt*
 19 *lớn*), or 'flood season' (*mùa lũ*) in reference to abnormally large annual flood-
 20 ing events. The 'water rising season' (*mùa nước nổi*) has been more commonly
 21 used to describe moderate or small flood events. The term 'flood' was mostly
 22 used in local news before the historic flood in 2000. Up until 2008, it was
 23 still very common for newspapers to refer to the 'flood season' using 'military
 24 language', implying that floods are an enemy or a threat through phrases such
 25 as 'fighting the flood as fighting an enemy' (*An Giang* local newspaper).

26 In the past, local government staff and media would often employ the term
 27 'flood' negatively without acknowledging the possible benefits of floods.
 28 More recently, there has been a shift in the perception of flooding events by
 29 local government authorities. The term 'flood' has changed into 'rising water
 30 season' when cited in provincial government policy documents because local
 31 government perceives that floods are seasonal and can be beneficial. The
 32 Vietnamese term 'water rising season' means that the water season is a 'friend
 33 of humans', not necessarily a 'disaster' and may bring resources to maintain
 34 rural livelihoods. Local governments in An Giang province recognize the
 35 benefits of the water season so they have instigated the development of pol-
 36 icies and programmes to empower farmers to exploit the natural benefits of
 37 the water season (An Giang People's Committee, 2006). In particular, many
 38 farmers in Thanh My Tay commune of Chau Phu district have engaged in
 39 flood-based farming as they have identified the significant benefits of the
 40 floodwater.

41 Local people in the three study sites positively described the 'water rising
 42 season' as a natural annual feature of their lives. Conversely, the term 'flood
 43 season' indicated a situation that could be problematic to rural livelihoods.
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Farmers appreciated the ‘water rising season’ in order to capture fish, to raise prawns and fish and to grow vegetables (*Neptunia prostrate*), activities to maintain their livelihood security.

A moderate flood is considered the most ‘beautiful’ water season, while the occasional occurrence of a smaller or larger than usual flood tends to disrupt rural livelihoods. In particular, the flood events in 1978 and 2000 were the most memorable because the floods submerged and destroyed many houses in villages and drowned many fishermen, women, children and live-stock. Figure 5.2 shows the peak flood depth in 2000, indicating the dramatic changes in river height when inundated by floods.

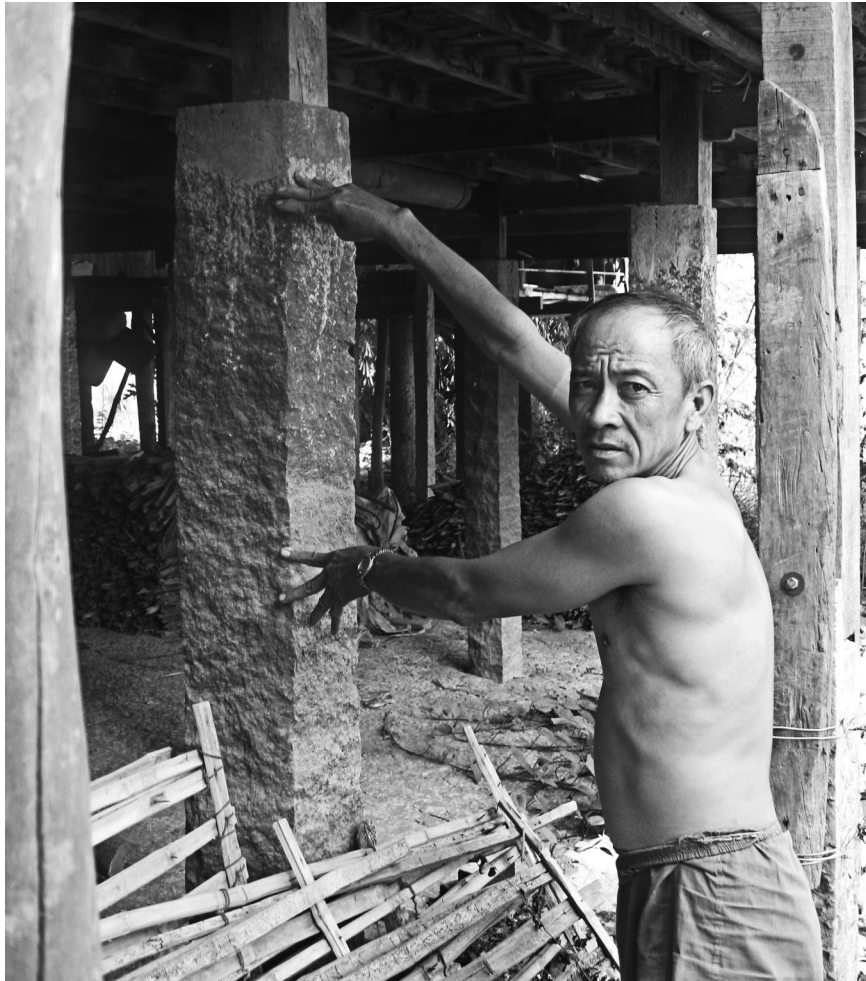


Figure 5.2 Farmer indicating the difference between the high 2000 flood and the usual flood year (photo by Nguyen Van Kien (2010)).

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1 The following section illustrates the many perceptions of the nature and
 2 impacts of flooding as expressed by participants.
 3

4 **Findings: flooding events**

5
 6 Focus group discussions and interviews provided examples of differences in
 7 the degree of regional flooding. For example, very few respondents referred
 8 to a ‘flood season’ in lower inundation regions, as they experience a ‘rising
 9 water season’ not considered to be dangerous floods. The ‘rising water season’
 10 in the moderate flood-prone region referred to events less disastrous than
 11 those termed ‘flooding’. A participant described the ‘water season’ as follows:
 12

13 Every year, there is a ‘water season’ (*mùa nước*), not a ‘flood’. From the
 14 water rising period to water receding period, it is about three to four
 15 months. The water reaches a peak in about 15 days. The water season
 16 does not cause any damage or submerge houses, so people here call it the
 17 ‘water season’.
 18

19 Men were more likely to use the term ‘water season’ or ‘income season’ from
 20 fishing activities, acknowledging associated benefits from increased flows,
 21 when fish can be caught in flooded rice fields. Women used the term ‘flood
 22 season’ and are variously engaged in somewhat restricted domestic activities.

23 The timing of the flood is of interest in the flood discourse, often referred
 24 to as early or late floods (*lũ sớm hoặc* or *lũ muộn*). Generally, waters in this
 25 region in the rivers and canals rise slowly (*xoay nước*) in early May and claim
 26 the rice fields in early July, peak (*phân động*) in the second week of August for
 27 approximately three weeks, then gradually start to recede in early October. In
 28 response, farmers in the three study sites use their traditional knowledge to
 29 adjust their rice-farming calendar according to gradual inundation in order to
 30 harvest their crop before full inundation in August. Notably, small and/or late
 31 floods negatively impact the livelihoods of many poor people in flood-prone
 32 regions, because these reduce the availability of fish and fish harvests from
 33 flooded paddies. If the flood arrives early in the season, poor farmers can
 34 harvest fish and improve their livelihoods.
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36 **Findings: perceptions of flood severity**

37 *Mythology and water events*

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 39 Some local people mentioned the ‘myth of the Water Genie and Mountain
 40 Genie’ related to the timing of flooding events. The story recounts a fight
 41 between the Water Genie and Mountain Genie who compete to marry a
 42 princess. The story describes a continuous and consuming conflict between
 43 the Water and the Mountain. At times, the Water wins and the Mountain
 44 fails. Eventually, the Mountain won and married the princess. According to
 45

focus group discussions, most people in the Phu Duc village were aware of the myth. Their stories indicated that the 13th of October was the most dangerous day of the flood season because that is when the floodwater peaks and the storms often occur. They said that the word 13th (*mười ba*) rhymes with the word (*tha*) in the myth (*ông không tha, bà không tha*), which is recited in rhyming couplets. While floods often peak in August in the highest flood-prone area (Dong Thap province) and in September (Can Tho city and lower part of An Giang province) this myth refers to the second peak, which may occur in October due to the occurrence of a storm. Farmers call this the last severe event, which signals the receding of the flood season. People know of this myth because it impacts their livelihoods each year. Widespread knowledge of this proverbial story serves as warning of the dangerous period and the need to be prepared for floods.

Locally identified indicators of flood severity

Assessment of flood severity assists the development of appropriate adaptation and coping strategies during and after flood events. In focus group discussions at the three study sites, participants agreed on four key indicators of flood severity, listed from least to most significant by participants:

- 1 flood duration
- 2 flood depth
- 3 flood with strong winds
- 4 suddenness of water rising

Flood duration was perceived as an important factor by all communities because of the links to local livelihoods, described above. It was not, however, perceived as a threat to personal safety because people have accustomed themselves to living with the flood season. The depth of the flood was also considered important, restricting some livelihood activities and creating hazardous conditions. Local interviewees expressed concerns about floods accompanied by strong winds and the suddenness of rising water which can create hazardous situations, an indication of flood severity. For example, results from our household surveys (*N*=459) indicated that strong winds in the flood season cause house damage or disrupt fishing activities, causing great anxiety for householders.

Participants in the focus group in Thanh My Tay commune recalled the two most extreme flood events that occurred in 1978 and 2000. As the waters rose very quickly, villagers were not well prepared to cope with the sudden extreme situation. Consequently, their houses were submerged and some collapsed or were swept away during these flooding events. In addition, the floating rice crop (*lúa mìa*) was completely destroyed by the flood in 1978, forcing temporary evacuation (for survival) during and after the flood event.

Perception of local flood severity by region, socio-economic group and sex

Flood depth was perceived as the second most serious flood indicator in focus group discussions among local communities across all three study sites.

To assist in the analysis of flood severity indicators, the perceptions of household survey respondents were compared relative to flood depth and overall flood size (big, moderate and small) and responses were found to be statistically significant for each flood-prone region. Poor households were more likely to perceive the peak of the big flood as higher than perceptions by the middle and better off households ($p < 0.001$). The poor were also more likely to perceive the peak of moderate and small flood as higher than perceptions by the middle and better off households ($p < 0.05$). This can be interpreted to mean that poor people, who are more likely to pursue their livelihoods in the floodplain during the flood season, tend to perceive the floods as higher than members of wealthier social groups. It is also possible that fear of livelihood losses affects the perception of the flood height.

In general, females were more likely to perceive the depth of moderate and small floods as higher than males' perception ($p < 0.05$). Women expressed nervousness about the floods. It is possible that fear of floods affects the perception of the flood height. The age of the respondent did not influence perception of peak flood height.

Floods tend to peak in August and September and householders confirmed that floods are considered as serious during those months due to possible inundation of their homes. Adopting adaptation strategies, coping behaviours and risk communications about the negative impacts of flood events is important leading up to and during this period. Respondents from the highest flood-prone region (Phu Duc commune) were more likely to perceive August to be the most serious month, while September was perceived as the most serious flood month in the moderate and low-flood regions. This implies that preparedness activities should be undertaken before August in the highest flood-prone region and before September in the moderate and lowest flood-prone regions.

Perception of flood risks in the media

Content analysis from archived newspapers indicates that media commentary on the annual flood event is more likely to appear during big flood events and in the peak flood months than in the small or moderate flood events and at the beginning or receding flood months. In particular, the floods in 1978, 1996, 2000 and 2011 were seen as 'big floods' or 'disasters' as described by the local *An Giang* newspaper, the regional *Can Tho* newspaper and the national *Tuoi Tre* newspaper. Most of the news was published in the high intensity flood months of September, October and November (second peak

flooding, may occur after September due to storms). In 1996, for example, there were two articles on flooding news in September, 11 articles in October and three articles in November in the *An Giang* newspaper. After the 1996 flood, there were 12 articles giving flood news during the flood season in the *An Giang* newspaper in 1997. Very little flood news was presented about the small flood in 1998. This means that the local and national media are more likely to present the disastrous events in the big flood years than in the moderate flood years.

Reported news for local people tended to detail anxieties over small flood events threatening livelihoods and the actual impacts on local livelihoods. Fishermen were concerned about losing their fishing benefits in the small flood years because there tend to be fewer fish available in the insufficiently flooded rice paddies. Rice farmers were also concerned about the extent of weed infestation of rice fields after flooding events, causing higher management costs for winter–spring rice crop production. Figure 5.3 depicts local fishermen affected by smaller flood events presented in the *Can Tho* newspaper in 2010.



Figure 5.3 Examples of small floods in the MRD (photo by Nguyen Van Thai for *Can Tho* newspaper (2010)).

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1 Finally, while there is information available about positive aspects of flood
2 events, it is not likely to be communicated by the media. This creates misun-
3 derstandings about water events in the MRD and leads to valuable informa-
4 tion about the benefits of water events not being included in flood
5 communications.
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7 **Findings: household adaptation and coping strategies** 8 **during flood events in the Mekong River Delta** 9

10 Responses have been separated into two categories and presented in the fol-
11 lowing section defined as:

- 12 • adaptation strategies – allow for adjustments to new conditions and build
13 local resources in the face of climate change;
- 14 • coping strategies – activities applied to maintain resources and minimize
15 harmful flooding effects.
16

17 *Household adaptation and coping strategies during big flood events* 18

19 Household adaptation strategies for big flood events can vary from infrastruc-
20 ture preparation activities to evacuation, while coping activities are described
21 in terms of social and financial issues such as child protection through to
22 seeking spiritual support or managing debt or hunger. Data from our house-
23 hold survey showed that local people engage in at least 15 activities before or
24 during a big flood event. In terms of adaptation strategies, the majority of
25 people reinforce their house prior to the big flood (56 per cent) and elevate
26 the house floor above the annual flood level (55 per cent). Fewer people elect
27 to engage in seasonal migration (16 per cent), move to higher ground to
28 avoid the flood (13 per cent) or elevate the floor of domestic animal pens (12
29 per cent).
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31 In terms of coping strategies, people tend to stay at home to look after
32 their children (59 per cent), with a minority sending their children to mobile
33 kindergartens (3 per cent). A majority of households pray at home (54 per
34 cent), while 18 per cent of respondents go to religious sites to pray, as most
35 community members adhere to Hoa Hao Buddhist teachings. During big
36 floods fishing activities cease for 49 per cent of respondents, reducing incomes
37 and food security. Approximately a third of respondents reduce their meals
38 and food intake. To supplement livelihoods in big floods, credit is obtained
39 by borrowing money and rice from neighbours (43 per cent), borrowing
40 money from informal credit providers (24 per cent) or formal credit providers
41 (16 per cent) or just waiting for public relief (17 per cent).
42

43 Household adaptation varied significantly among the different socio-
44 economic groups. Poor people were more likely to move to higher ground
45 to avoid the flood; seasonally migrate, reinforce houses before the flood; and
elevate the house floor above flood level than were those in middle and

better-off households. Poor people were more likely to use coping strategies such as seeking credit (borrow money and rice from neighbours, borrow money from informal credit providers, or waiting for public relief). They were also likely to reduce the number of normal meals and to pray at home.

Household adaptation and coping strategies during moderate flood events

According to our survey results, during moderate floods many people engaged in adaptation strategies by strengthening their homes before the flood (41 per cent), upgrading the house floor above the flood level (19 per cent) or seasonally migrating to non-flood areas to seek employment (14 per cent). A few people would lift up the house floor (4 per cent) or secure domestic animal shelters (4 per cent).

The majority of households used coping strategies by staying at home to pray for safety (55 per cent) and to care for children while at home. Fewer people go to religious sites to pray (19 per cent) or send the children to kindergartens during moderate flood events (2 per cent). Many do not go fishing (44 per cent) and seek credit to maintain livelihoods with people borrowing rice and money from neighbours (34 per cent), borrowing money from informal credit providers (19 per cent) and borrowing money from formal credit providers (16 per cent). A third of people reduced their normal meals, while some people continue to wait for public relief (11 per cent).

There is a statistically significant difference in household adaptation and coping strategies during the moderate floods among different socio-economic groups. In particular, poor people are more likely to move to higher ground or safer places, elevate the house floor above the annual flood level, strengthen the house before the flood or seasonally migrate. They are also more likely to seek out credit to supplement their livelihoods during moderate floods and borrow money from informal credit providers, borrow money and rice from neighbours or wait for public relief. Poor people are more likely to reduce the number of normal meals and to pray at home than wealthier householders.

Household adaptation and coping behaviours during small flood events

Regarding household adaptation strategies for small flood events the proportion of activities is quite different than those undertaken in times of moderate and big floods. Fewer people reinforce their homes before the flood (22 per cent). Very few people evacuate to higher ground, elevate the floor of domestic animal pens or migrate seasonally before or during small flooding events.

Of the coping strategies, 31 per cent of people stay at home to take care of children and 25 per cent of people do not go fishing. Although a smaller proportion of people do not go fishing during the small flood, of these

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1 many go to Ho Chi Minh City to seek out non-farm jobs to provide off-
 2 farm income. Credit was obtained by borrowing money and rice from
 3 neighbours (20 per cent) and borrowing money from informal (12 per cent)
 4 and formal credit providers (11 per cent). In times of a small flood, fewer
 5 people reduce their normal meals (12 per cent), with fewer people (39 per
 6 cent) remaining at home to pray or going to religious sites to pray (11 per
 7 cent). Very few people used adaptation strategies such as seasonal migra-
 8 tion, evacuation to higher ground, or elevation of the floor of domestic
 9 animal pens during small flooding events and they were unlikely to cope by
 10 waiting for public relief.

11 In terms of adaptation strategies, even for small flood events, poor house-
 12 holds were more likely to strengthen their homes before the flood, because their
 13 houses are simply built and more vulnerable to storms and floods. They were
 14 also more likely to migrate seasonally. In contrast, wealthier householders'
 15 homes tend to be built on concrete stilts or foundations and hence they were
 16 less likely to need to reinforce their homes before the floodwaters rose.

17 While better-off and middle-income families were more likely to borrow
 18 money from formal credit providers to cope with small flood events, poor
 19 households lacked access to formal credit and tended to borrow from informal
 20 credit providers at a higher interest rate because the formal credit providers
 21 did not trust that they would re-pay their loans. Poor households were more
 22 likely than wealthier households to wait for public relief and would reduce
 23 normal meals even during small flood events. Poor households were more
 24 likely to pray for good luck during small flood events.

25 **Findings: overall household adaptation and coping** 26 **strategies for flood events**

27 Based on statistical analysis, household adaptation and coping strategies varied
 28 significantly according to the size of floods. Table 5.1 presents a comparison
 29 of household adaptation strategies of respondents in times of big, moderate
 30 and small flooding events.

31 *Adaptation strategies*

32 Households were more likely to respond to big floods than to moderate and
 33 small flood events. In particular, 13 per cent of respondents move to the high
 34 ground or safer places to cope with big floods, while only 4 per cent move
 35 for moderate floods and 2 per cent of respondents for small floods. This is
 36 because moderate and small floods are considered less likely to affect their
 37 homes, so evacuation is not seen as necessary. More respondents wait for
 38 public relief, reduce the number of normal meals, engage in seasonal migra-
 39 tion, reinforce the house before the flood season, elevate the floor above the
 40 flood level after the flood season and elevate the floor of animal pens in rela-
 41 tion to big flood events as compared with moderate and small floods.
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Coping strategies

More people borrow money and rice from neighbours and borrow from informal and formal credit providers in big floods than in moderate and small floods. In particular, 43 per cent of respondents stated that they borrow rice from neighbours during big flood events, while only 34 per cent and 20 per cent do so for moderate and small flood events respectively. Some 24 per cent of the respondents said they draw on informal credit in big flood events, whereas this is only 19 per cent and 12 per cent for moderate and small floods respectively. More respondents wait for public relief as the floods become larger. More respondents reduce the number of normal meals during sizable flooding events.

While 49 per cent of respondents cease fishing during the big flood, 44 per cent cease fishing during moderate floods and 25 per cent cease fishing during small floods. This can be explained as farmers are likely to migrate to other non-flood areas to seek jobs for off-farm income in response to fewer fish available during larger flooding events.

Taking care of children is very important during the flood season, as most fatalities occur from child drowning (ILS, 2011). Hence, more respondents stay at home to look after the children during big floods (59 per cent) than

Table 5.1 Percentage of households engaging in adaptation and coping strategies by flood level (N=459)

Household adaptation and coping behaviours	Flood level		
	Big	Moderate	Small
Adaptation strategies			
Reinforce house before flood season	56	42	22
Elevate the floor above flood level after flood season	55	19	8
Engage in seasonal migration (for off-farm income)	17	14	7
Move to high ground (evacuation, schools, pagodas)	13	4	2
Elevate floor of domestic animal pens	12	4	1
Coping strategies: Financial security			
Borrow money and rice from neighbours	43	34	20
Borrow money from informal credit providers	24	19	12
Borrow money from formal credit providers	16	16	11
Wait for public relief	17	11	7
Coping strategies: Food security			
Reduce the number of normal meals	30	22	12
Coping strategies: Human security			
Stay at home to take care of children	59	51	31
Do not go fishing	49	44	25
Send children to mobile kindergartens	3	2	2
Coping strategies: Spiritual support			
Pray at home	54	55	39
Pray or worship at nearby pagodas or religious sites	18	19	10

1 during moderate floods (51 per cent) or small floods (31 per cent). This indi-
2 cates that households prioritize protecting their children during big flood
3 events, necessary to reduce child drowning.
4

5 **Leverage points: effectiveness of current and proposed** 6 **adaptation strategies** 7

8 The future of rice production in this region involves land use, with viable
9 and available aquatic environments harmoniously interacting with human set-
10 tlements to enable productivity. Climate change predictions indicate that
11 effective strategies for adaption to changing environmental conditions are
12 required.

13 For rice farmers and their families, annual flooding requires anticipation
14 and decision-making in preparation for flooding events. Farming com-
15 munities have less need to prepare for small to moderate floods where the risk
16 of inundation is usually seasonally and geographically determined and liveli-
17 hoods can be maintained. However, our research indicates that local farmers
18 make a greater investment in the range of adaptation and coping strategies to
19 deal with big floods, which is more evident for the poor and marginalized as
20 they struggle to survive inundation and livelihood losses.

21 Adaptation strategies used in response to flooding have been analysed
22 using Meadow's framework (1999) by identifying different types of
23 leverage points through which to intervene in complex socio-ecological
24 systems. In this framework, high leverage, effective adaptation strategies
25 are those creating significant positive changes through relatively little
26 effort, where a small change can lead to a large shift in behaviour (ibid.).
27 Adaptation strategies with high leverage evident from this research have
28 been ranked below from the most to least effective according to Meadow's
29 framework (1999).
30

31 ***Mindset out of which the system arises*** 32

33 Working at the level of paradigm or the 'mindset out of which the system
34 arises', the highest leverage point could be employed if the media proactively
35 described the benefits of flooding events and documented innovative prac-
36 tices and livelihood advantages, instead of exclusively emphasizing loss and
37 negative effects on livelihoods. A shift could occur from viewing all floods as
38 negative, to viewing small annual floods as a positive occurrence and devel-
39 oping opportunistic livelihood activities.
40

41 ***Power to add, change, evolve or self-organize system structure*** 42

43 In this research study 'self-organization' was an important point of leverage,
44 especially for poorer households who engaged in migration to cities to
45 provide off-farm incomes when traditional livelihoods were under threat

from flooding. This ability to supplement incomes provides a mechanism to better manage indebtedness and hunger associated with flooding events. Urban migration can be a means of ensuring livelihood security, particularly to sustain marginalized poor farmers.

Rules of the system

Many people expect public relief funding in response to flooding, particularly after major flooding events. The conditions under which public relief funding is granted relates to the leverage point discussed by Meadows (1999) as the ‘rules of the system’, whereby modifying this expectation could bring about different coping and adaptation strategies and more resilience in the face of hazardous flooding events. The poor and marginalized rely more on public relief funding and generally require more support in times of big flood events, borrowing and incurring debts. Harnessing community capacity to increase equity in terms of compensation funding, community collaboration or government regulations around public funding could be considered to enhance adaptation capacity. More proactive mechanisms to introduce equitable and timely distribution of government or aid funding would enhance adaptation capacity of those more severely affected by flooding events.

Structure of information flows

The media is in a position to support adaptation and coping strategies as local newspapers report on local concerns and experiences in relation to flooding events. Such intervention through ‘information flows’ draws on an important leverage point discussed by Meadows (1999) concerning who does and does not have access to information. The media is in a position to broadcast flooding levels and livelihood issues, to allow for timely adaptation activities to occur. Furthermore, the government and media have a role in proactively describing adaptation strategies that support livelihoods when under threat from hazardous floods.

Structure of material stocks and flows

The main adaptation strategies surrounding ‘stock-and-flow structures’ concern modifications to housing and infrastructure in defence of flooding events. This is an example of the intersection of ecological and physical systems as seen in structural modifications to housing and animal shelters. Socio-economic status generally determined the capacity of individuals to engage in these infrastructure-strengthening activities. Poorer households were more at risk of inundation, yet lacked affordable access to credit to maintain infrastructure during inundation events.

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Constants, parameters, numbers

Public relief subsidies, which can be viewed as ‘numbers’ in Meadows’ framework, were an effective leverage point, considered an important coping strategy by all socio-economic groups, particularly in times of big floods. Access to relief subsidies is important to supplement livelihood security by providing funding when financial losses were incurred from structural damage to housing and loss of income from reduced livelihood activities and crop and stock losses. Poorer households were more likely to require relief subsidies in times of moderate and big floods and were less likely to access affordable credit during these flooding events.

Conclusions and recommendations

More frequent storms, inundation, strong winds and erosion of river banks in the Mekong River Delta mean the potential loss of productive land, inundation of river settlements and systemic changes in landscapes, ecosystems and resource availability, as well as changes in the nature, distribution, frequency and severity of climate-related hazards (Brookes *et al.*, 2009). In this study region, adaptation and coping strategies are devised in response to extreme events such as local area flooding at the individual level through their perception of risk, analysis of consequences and implications and response to increasing uncertainty of peak water flows.

In response to flood events, rural households have a variety of adaptation and coping strategies that can be grouped according to sex, socio-economic level and size of the flood. The extent and usefulness of local knowledge in adaptation efforts to annual floods can and should be leveraged to build adaptive capacity throughout the Delta. Dealing with big floods necessitates engaging in a broader range of adaptation strategies and coping behaviours with a tendency to go into debt, go without food and seek alternative income sources. This affects the poor and marginalized more so than other socio-economic groups.

Based on Meadows’ framework (1999), this research has pointed to several leverage points for intervention in the socio-ecological system of the MRD. These can be leveraged by communities, the media and the government to aid in building resilience to flooding events that can undermine livelihood security. Based on our understanding of the MRD, we recommend that:

- The media illustrate the potential benefits to be gained from annual flooding events and influence adoption of opportunistic activities to supplement livelihoods, particularly in times of smaller floods. This high leverage approach could set off significant positive changes with relatively little effort, as it affects the mindset out of which the system arises.
- Communities and the government should further support temporary migration by systematically building relationships with labour-intensive city

industries and links to accommodation to further facilitate the need for off-farm income during moderate and big floods. Community support for families who have out-sourced their labour should be developed with innovative income-generating activities in rural towns and villages to further improve livelihood security. Finding ways to support poorer households is needed as they tend to be more affected by hazardous flooding events and often lack the capacity to engage in temporary migration.

- The government should develop supportive policies and systems of financial relief to supplement livelihoods during unmanageable inundation events. Formal and informal funding available within the community should also be explored to determine an equitable means for accessing much needed funds by those in need. Community banks providing rice, livestock and credit should be established to meet the needs of the impoverished.
- Access to information has improved through telecommunications and mobile phones. We recommend equitable and timely access to flooding forecasts to allow appropriate preparedness activities to be undertaken before August in the highest flood-prone region and before September in the moderate and lowest flood-prone regions. Understanding predicted flooding regimes will also provide opportunities for innovative livelihood activities during lower flows.
- International and community organizations and the government should strengthen physical infrastructure to help provide a defence in times of inundation risk, especially through financing, goods, services and labour for lower-income households that are regularly subject to inundation. Such support would increase resilience and capacity to secure livelihoods throughout the flood season.

Annual flooding in the MRD can rejuvenate the environment, but can also cause destruction and losses for the communities that rely on its waters. These communities are exposed to variable flooding events, including smaller floods that can be utilized to support livelihoods and bigger floods that require preparation and restriction of activities to try to ensure safety and livelihoods. Climate change trends make it especially important that the government, media, communities and international organizations work in concert to implement high leverage adaptation strategies to build local and institutional capacity and help ensure environmental health and livelihoods in the Delta.

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