Chapter 3

The Effects of Natural Disasters on Households' Preferences and Behaviours: Evidence from Thai Farmers during and after the 2011 Mega Flood

Krislert Samphantharak
University of California

Sommarat Chantarat
Australian National University

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CHAPTER 3

The Effects of Natural Disasters on Households' Preferences and Behaviours: Evidence from Thai Farmers during and after the 2011 Mega Flood

Krislert Samphantharak[*]

University of California

Sommarat Chantarat[**]

Australian National University

This paper studies the consequences of the 2011 mega flood in Thailand on subjective expectations, preferences, and behaviours of Thai farming households affected by the disaster. First, we found that the flood seemed to make households adjust upward their subjective expectations of future flood events and of possible damage caused by future floods. The flood also affected the expectations of households regarding government assistance. However, we found no evidence of moral hazard arising from the government's implicit insurance through disaster assistance. Second, the 2011 mega flood was positively associated with higher risk aversion and more risk averse households were more likely to adopt strategies that mitigate the severity and the damage of future floods. Finally, we found that the households that were directly hit by the flood seemed to be less altruistic. These findings shed light on the credibility of government assistance in the aftermath of widespread natural disasters and the role of governments and insurance markets in future natural disaster risk management.

[*] School of International Relations and Pacific Studies, University of California, San Diego. Email: krislert@ucsd.edu.

[**] Crawford School of Economics and Government, Australian National University, Email: sommarat.chantarat@anu.edu.au.

1. Introduction

Natural disasters have crucial implications for economic development. Not only do they generally cause damage to an economy's physical and human capital as well as its institutions, disasters can also lead to changes in people's behaviour.[1] Largely unexpected and severe disasters could induce a revision of subjective expectation of risk exposure by affected households. Experiencing or observing disasters may also alter the risk, time, and social preferences of households and these may in turn result in changes in their behavioural choices.

Several recent studies have shown empirical evidence that disasters can cause changes in risk, time, and social preferences. Regarding risk preference, Eckel, *et al.* (2009) found that experiencing hurricane Katrina affected risk preferences of the hurricane evacuees. Cameron and Shah (2012) found that individuals who had recently suffered a flood or earthquake in Indonesia exhibited greater risk aversion than individuals living in similar but unaffected villages. Cassar, *et al.* (2011) showed that the 2004 Indian Ocean tsunami in Thailand resulted in higher risk aversion. Page, *et al.* (2012) studied the 2011 Brisbane flood in Australia and found that after a large negative wealth shock, those directly affected became more willing to adopt riskier options in their decision-making process. Regarding time preference, Callen (2011) showed that exposure to the Indian Ocean Earthquake tsunami affected a patience measure in a sample of Sri Lankan wage workers. Regarding social preference, Castillo and Carter (2011) found that the large negative shock caused by Hurricane Mitch in 1998 affected altruism, trust, and reciprocity in small Honduran communities. Research undertaken by from Cassar, *et al.* (2011) showed that the 2004 Indian Ocean tsunami in Thailand also resulted in higher altruism.[2]

Such changes in risk, time, and social preferences could affect household behaviours in various ways. For example, an increase in risk aversion could induce households to invest in more conservative projects while an increase in risk tolerant behaviour may induce a higher demand for gambling and risky

[1] For a survey of literature on the effects of natural disasters on the economy, see Samphantharak (2014).

[2] There is also literature on the effects of traumatic and catastrophic civil conflicts on preferences. For example, see Voors, *et al.* (2012); Cassar, *et al.* (2013); and Callen, *et al.* (2013).

behaviours or more aggressive investment in risky ventures. A change in time preference could affect intertemporal decisions of households, such as savings. Likewise, an increase in altruism may lead to a reduction in public goods exploitation. Most importantly, for poor households in developing economies, changes in preferences may have significant impacts on their safety nets. As Sawada (2014) summarised, various mechanisms provide strategies for households to manage or cope with natural disaster risks. The first mechanism is household-level strategies, which include self-insurance through savings and consumption reallocation, as well as diversification of household income. The second mechanism is market-based strategies through credit and insurance contracts. The third mechanism is insurance against risk through community, including informal assistance among family members and friends. And finally, the fourth mechanism is public assistance from the government. On the one hand, behavioural changes induced by changes in preferences following natural disasters can induce households to engage in various mechanisms. For example, increasing risk aversion may lead to a reduction in risk behaviours and higher demand for insurance. Similarly, increasing patience could cause an increase in savings and increasing altruism could enhance social risk sharing. On the other hand, as in any insurance arrangement, disaster safety nets could also create moral hazard. For example, public disaster relief may lead to excessive risk taking and crowd out demand for self insurance or private insurance. In such cases, the government's provision of safety nets serves as a substitute for private insurance rather than as a complement.

This paper aims to contribute to this growing literature by studying the consequences of the 2011 mega flood in Thailand on the subjective expectations, preferences, and behaviours of Thai farming households affected by the disaster. Understanding these consequences has crucial policy implications regarding risk management and risk coping strategies of agricultural households in a rural economy. Like other East Asian countries, natural disasters are common in Thailand. Due to the country's location in the tropic, the most common natural disasters experienced in Thailand have been floods. According to the Emergency Events Database (EM-DAT), Thailand experienced 59 flood events during 1980-2010, averaging approximately two events per year. Although floods occurred frequently during this period, they did not generally result in high numbers of people killed, with the cumulative death toll from all flood events during 1980-2010 less than one death per flood

event on average.[3] In most cases, the damage was also geographically limited, with the exception of severe floods. The most recent one was the mega flood of 2011, one of the deadliest and most destructive natural disasters in Thailand's history.

The 2011 mega flood was the largest flood to hit Thailand in over half a century. It eventually claimed over 800 lives, making it the second deadliest natural disaster in Thailand's recent history, only ranked behind the 2004 Indian Ocean Tsunami. The flood was initially caused by a series of heavy rains combined with multiple tropical storms that began in May and lasted through October. Excessive rainwater eventually exceeded the capacity of the country's key dams and drainage systems, causing rapid downstream flows from the north to the central plain. The flood affected 12.8 million people, 19,376 ha of agricultural land, and 9,859 factories. In total, the flood covered approximately one-third of Thailand, affecting 66 out of 77 provinces in all regions of the country. It affected the agricultural sector in at least 26 provinces in the northern, central, and northeastern regions (World Bank 2012). In particular, the flood inundated the key rice growing areas in the Chao Phraya and Thachin river basins. The Thai government spent more than USD 3 billion on relief, of which approximately 8 percent went to rice farmers. The total loss and damage was estimated at USD 46.5 billion, or 14 percent of gross domestic product (GDP).

Given its rarity and severity, the 2011 mega flood serves as an ideal natural experiment for a study of how households cope with a largely unexpected natural disaster and how the disaster affects households' preferences and behaviours. Although the 2011 mega flood also affected industrial areas, this study will focus only on the effects of the flood on rice farming households, because most of the areas directly affected by the flood were farmland, especially for rice cultivation, and these farms were operated by relatively poor households whose access to risk management and risk coping mechanisms was limited. The flood, therefore, impacted the livelihood of many farming households in a substantial way and had crucial policy implications regarding

[3] These statistics are based on the Emergency Events Database (EM-DAT), one of the most comprehensive databases on disasters maintained by the Centre for Research on the Epidemiology of Disasters (CRED) at the University of Louvain in Belgium. For a more detailed discussion on the impact of the 2011 mega flood on the Thai economy, see Samphantharak (2014).

safety nets of poor and vulnerable households.[4] To achieve the goals of this study, we will first explore how farming households in Thailand coped with the mega flood in 2011. Second, we will study how the flood affected the subjective expectations of Thai farmers regarding future flood events, flood damage, and disaster relief provided by the government and the community. Third, we will explore how experiencing the flood affected risk, time, and social preferences of farming households. Finally, the study will analyse how households prepare themselves for possible future flood events, and whether the expectation of public assistance crowds out private efforts in disaster prevention and insurance. We conclude the paper with policy implications regarding the roles of household, market, community, and government on natural disaster risk management and risk coping strategies.

2. Data

The data used in this study are from a recent survey of rice farming households in Thailand. The survey was conducted between January and April 2014 in four provinces: Pitsanulok in the northern region, Suphanburi in the central region, and Khonkaen and Nakorn Ratchasima in the northeastern region. For each province, two additional stratifications were used in our sampling strategy: (1) whether the farm was flooded in 2011 and (2) whether the farm was generally prone to floods in normal years. First, we utilised the discontinuity generated by the 2011 flood to construct a variation in flood experience. This discontinuity allowed us to compare farmers who were directly hit by the flood with those who did not directly experience the flood. A satellite map of the 2011 flood was used to initially identify flooded areas. Phone calls to village heads and subsequent field visits further allowed us to identify flooded and non-flooded households.[5] Second, we identified flood-prone farms as those

[4] In a recent study, Poaponsakorn and Meethom (2012) compared household data from Thailand's socioeconomic surveys in 2009 and 2011 and mapped them with the flooded areas by using satellite images. They showed that the 2011 mega flood in Thailand had a large negative impact on farm profits of some middle-income households in the flooded provinces.

[5] It is important to note that most, if not all, households in Thailand were affected by the 2011 mega flood in one way or another. Even the households that were not directly hit by the flood were affected indirectly. In this sense, it is unavoidable that there were spillover effects on the non-flooded households. These effects include, but are not limited to, new information about the flood and the management of flood by the government perceived by the farmers. Disruptions of local, regional, and national economic activities affected prices

who had been flooded more than three times in the past five years. Our sample contains a total of 426 sampled households. The sample size for each of the sampling categories by province is shown in Table 3.1. Note that, although we originally intended to collect balanced samples for all categories, the sample size was largely unbalanced for Pitsanulok (97 flooded farms versus 25 non-flooded farms) since the majority of rice farms in the province were flooded in 2011. For the other three provinces, the numbers of flooded and non-flooded farms were relatively similar.

Table 3.1: Sample Size of the Survey

Suphanburi

		Flood Prone		Total
		No	Yes	
2011 Mega	No	38	10	48
Flood	Yes	32	24	56
Total		70	34	104

Pitsanulok

		Flood Prone		Total
		No	Yes	
2011 Mega	No	15	10	25
Flood	Yes	54	43	97
Total		69	53	122

Khonkaen

		Flood Prone		Total
		No	Yes	
2011 Mega	No	47	3	50
Flood	Yes	35	19	54
Total		82	22	104

Nakorn Ratchasima

		Flood Prone		Total
		No	Yes	
2011 Mega	No	37	13	50
Flood	Yes	29	17	46
Total		66	30	96

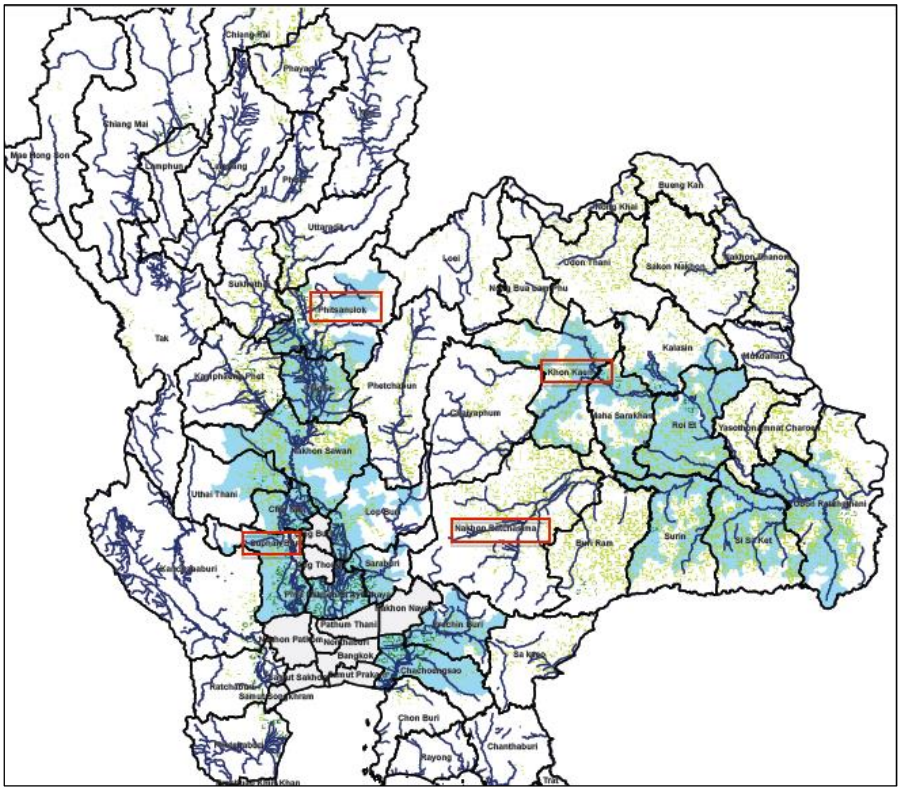
The four provinces were intentionally selected to provide variations in the nature of flood exposure and severity of flooding. As shown in Figure 3.1, Suphanburi and Pitsanolok are located in the Chao Phraya and Thachin River Basin Group while Khonkaen and Nakorn Ratchasima are in the Mekong Tributary Basin Group.[6] Within the Chao Phraya-Thachin River Basin Group, Pitsanulok is located upstream in the Nan River Basin while Suphanburi is located downstream in the Thachin River Basin. In the northeast, Khonkaen is located in the upstream area of the Chi River Basin while Nakorn Ratchasima is in the upstream area of the Mun River Basin. Both the Chi and the Mun Rivers flow into the Mekong River. As summarised in Table 3.2, the 2011 flood

of goods and services as well as incomes of many households in the non-flood areas. The effects, however, should bias our results toward finding no differences of preferences and behaviours between the farmers who were directly hit by the flood and the similar farmers whose farms were not flooded.

[6] Based on the classification of Thailand's National Committee on Hydrology, there are 25 distinct hydrological units, or basins, in Thailand. The basins are then regrouped into nine basin groups. The Chao Phraya-Thachin River Basin Group consists of the basins of the rivers Ping, Wang, Yom, Nan, Chao Phraya, Sakae Krung, Pasak, and Thachin. The Mekong Tributary Basin Group consists of the basins of the rivers Mekong, Kok, Chi, Mun and the Tonle Sap.

hit upstream Pitsanulok earlier (around July-August) while downstream Suphanburi experienced the flood more than a month later (around September). The flood in Pitsanulok lasted for 81 days on average whereas it lasted for 97 days in Suphanburi (although the median flood days were 90 for both provinces). Anticipating the floodwater flowing down, farmers in Suphanburi in principle had more time to prepare and cope with the disaster than those in Pitsanulok. However, revenue losses from the 2011 flood were similar in both provinces, averaging 182,000 baht per household (the median revenue loss was slightly higher in Pitsanulok, at 136,800 baht, as compared with Suphanburi, at 118,752 baht). Finally, the nature of the flood in the northeast was different from the Chaophraya-Thachin area. Both Khonkaen and Nakorn Ratchasima experienced the flood later, in October. The duration of the flood for both provinces was also shorter, averaging 45-47 days. Consequently, the damage from the flood in terms of revenue loss was smaller, amounting to an average of 77,249 baht for Khonkaen and 101,615 baht for Nakorn Ratchasima.[7]

Figure 3.1: Map of Studied Provinces



[7] The exchange rate during the time of the survey was approximately 32 baht per US dollar.

Table 3.2: Characteristics of the 2011 Mega Flood by Province

Variable	No. Obs.	Mean	Std. Dev.	Min	Median	Max	No. Obs.	Mean	Std. Dev.	Min	Median	Max
	Suphanburi						*Pitsanulok*					
Starting Month	56	9,02	0,13	9	9	10	97	7,67	1,08	5	8	9
Flood Length (Days)	56	97,41	44,30	10	90	180	97	80,88	39,84	15	90	180
Loss Revenue (Baht)	54	182.515	160.330	16.000	118.752	696.800	97	182.056	148.321	9.720	136.800	800.400
	Khonkaen						*Nakorn Ratchasima*					
Starting Month	54	9,59	0,86	8	10	12	46	9,89	0,71	7	10	11
Flood Length (Days)	54	45,28	22,11	10	45	90	46	46,93	26,93	14	37,5	120
Loss Revenue (Baht)	54	77.249	75.067	3.000	54.300	360.586	46	101.615	133.835	3.500	55.438	763.200

Table 3.3A presents descriptive statistics for farming households in our sample by province. The sampled households in all four provinces shared similar demographic characteristics at the time of the survey in early 2014. The average household size was four persons, with two male and two female members. Three of the four were of working age (15-60 years old) and two of the three were involved in rice farming. Slightly more than half (54-57 percent) of the households in our sample had a male head. The highest education attainment of the majority of the household heads was primary education, ranging from 75 percent in Pitsanulok to 88 percent in Khonkaen. The main differences between households across the four provinces were their occupations, income, and wealth. While households in Suphanburi and Pitsanulok heavily relied on rice farming (the percentage of household revenue from rice farming out of total revenue was 75 percent for the average household in Suphanburi and 86 percent in Pitsanulok), rice revenue contributed to less than half of total household revenue for the sampled households in the northeast (27 percent in Khonkaen and 42 percent in Nakorn Ratchasima). The households in the northeast were also poorer on average—total household income was only 95,967 baht for the median household in Khonkaen and 166,200 baht for Nakorn Ratchasima, while it was 368,000 baht for Suphanburi and 304,600 baht for Pitsanulok. Alternatively, Table 3.3B presents similar descriptive statistics for non-flooded and flooded farming households in our sample. The table shows that, on average, non-flooded and flooded households have similar demographic characteristics. The medians for almost all demographic variables for these two groups are the same. For income and asset variables, all of the means for these two groups were statistically no different

from each other with traditional levels of significance, mainly due to their large standard deviation.

Table 3.3A: Descriptive Statistics of Households by Province (as of 2014)

Variable	No. Obs.	Mean	Std. Dev.	Min	Median	Max	No. Obs.	Mean	Std. Dev.	Min	Median	Max
	Suphanburi						*Pitsanulok*					
Household size, total	104	4,25	1,93	1	4	11	122	4,06	1,44	1	4	8
Household size, male	104	2,06	1,30	0	2	7	122	1,98	1,11	0	2	5
Household size, female	104	2,19	1,22	0	2	7	122	2,08	0,97	0	2	5
Household size, 15-60	104	2,86	1,40	0	3	6	122	2,84	1,26	0	3	6
Household size, rice farmers	104	2,13	1,16	1	2	6	122	2,35	0,90	1	2	5
Household head = Male	104	0,67	0,47	0	1	1	122	0,70	0,46	0	1	1
Household head's age	104	54,44	10,58	27	56	81	122	53,73	9,25	36	53	83
Household head's education = Primary	104	0,81	0,40	0	1	1	122	0,75	0,44	0	1	1
Household head's education = Secondary	104	0,14	0,35	0	0	1	122	0,16	0,36	0	0	1
Household head's education = Vocational	104	0,02	0,14	0	0	1	122	0,07	0,26	0	0	1
Household head's education = Higher	104	0,03	0,17	0	0	1	122	0,02	0,16	0	0	1
Household revenue, rice	104	553.690	479.190	50.000	451.500	3.000.000	122	470.354	303.322	47.100	400.000	1.561.200
Household revenue, agricultural nonrice	104	157.216	582.954	0,00	0,00	5.500.000	122	12.798	75.379	0	0	800.000
Household revenue, nonagriculture	104	83.798	166.861	0,00	7200,00	1.285.000	122	73.992	169.301	0	19.100	1.440.000
Household revenue, rice (% of total revenue)	104	75,12	25,65	3,64	81,56	100,00	122	85,57	17,97	30,00	92,55	100,00
Household cost, rice	104	213.902	181.044	21000,00	150000,00	1.000.000	122	190.830	153.478	12.000	150.000	792.000
Household cost, agricultural nonrice	104	56.888	237.592	0,00	0,00	2.200.000	122	3.582	19.409	0	0	200.000
Household cost, nonagriculture	104	21.042	116.144	0,00	0,00	1.095.000	122	15.467	101.536	0	0	1.080.000
Household income, rice	104	339.789	338.442	24000,00	232500,00	2.000.000	122	279.524	187.756	-190.000	251.300	850.200
Household income, agricultural nonrice	104	100.328	358.248	-10000,00	0,00	3.300.000	122	9.216	56.459	0	0	600.000
Household income, nonagriculture	104	62.756	100.080	0,00	7200,00	420.000	122	58.525	100.844	0	17.900	786.000
Household income, total (baht)	104	502.872	506.202	44000,00	368600,00	3.428.000	122	347.265	230.624	-190.000	304.600	1.186.000
Household assets (baht)	104	1.032.724	1.541.448	24200,00	611965,00	11.500.000	122	850.952	1.008.671	48.350	690.600	9.195.000
	Khonkaen						*Nakorn Ratchasima*					
Household size, total	104	4,25	1,93	1	4	11	122	4,06	1,44	1	4	8
Household size, male	104	2,06	1,30	0	2	7	122	1,98	1,11	0	2	5
Household size, female	104	2,19	1,22	0	2	7	122	2,08	0,97	0	2	5
Household size, 15-60	104	2,86	1,40	0	3	6	122	2,84	1,26	0	3	6
Household size, rice farmers	104	2,13	1,16	1	2	6	122	2,35	0,90	1	2	5
Household head = Male	104	0,67	0,47	0	1	1	122	0,70	0,46	0	1	1
Household head's age	104	54,44	10,58	27	56	81	122	53,73	9,25	36	53	83
Household head's education = Primary	104	0,81	0,40	0	1	1	122	0,75	0,44	0	1	1
Household head's education = Secondary	104	0,14	0,35	0	0	1	122	0,16	0,36	0	0	1
Household head's education = Vocational	104	0,02	0,14	0	0	1	122	0,07	0,26	0	0	1
Household head's education = Higher	104	0,03	0,17	0	0	1	122	0,02	0,16	0	0	1
Household revenue, rice	104	553.690	479.190	50.000	451.500	3.000.000	122	470.354	303.322	47.100	400.000	1.561.200
Household revenue, agricultural nonrice	104	157.216	582.954	0	0	5.500.000	122	12.798	75.379	0	0	800.000
Household revenue, nonagriculture	104	83.798	166.861	0	7.200	1.285.000	122	73.992	169.301	0	19.100	1.440.000
Household revenue, rice (% of total revenue)	104	75,12	25,65	3,64	81,56	100,00	122	85,57	17,97	30,00	92,55	100,00
Household cost, rice	104	213.902	181.044	21.000	150.000	1.000.000	122	190.830	153.478	12.000	150.000	792.000
Household cost, agricultural nonrice	104	56.888	237.592	0	0	2.200.000	122	3.582	19.409	0	0	200.000
Household cost, nonagriculture	104	21.042	116.144	0	0	1.095.000	122	15.467	101.536	0	0	1.080.000
Household income, rice	104	339.789	338.442	24.000	232.500	2.000.000	122	279.524	187.756	-190.000	251.300	850.200
Household income, agricultural nonrice	104	100.328	358.248	-10.000	0	3.300.000	122	9.216	56.459	0	0	600.000
Household income, nonagriculture	104	62.756	100.080	0	7.200	420.000	122	58.525	100.844	0	17.900	786.000
Household income, total (baht)	104	502.872	506.202	44.000	368.600	3.428.000	122	347.265	230.624	-190.000	304.600	1.186.000
Household assets (baht)	104	1.032.724	1.541.448	24.200	611.965	11.500.000	122	850.952	1.008.671	48.350	690.600	9.195.000

Table 3.3B: Descriptive Statistics of Flood and Non-Flood Households (as of 2014)

Variable	No. Obs.	Mean	Std. Dev.	Min	Median	Max	No. Obs.	Mean	Std. Dev.	Min	Median	Max
	Non-Flood Households in 2011						*Flood Households in 2011*					
Household size, total	173	3,81	1,62	1	4	9	253	4,47	1,79	1	4	12
Household size, male	173	1,82	1,05	0	2	5	253	2,29	1,31	0	2	7
Household size, female	173	1,99	1,13	0	2	7	253	2,18	1,12	0	2	9
Household size, 15-60	173	2,51	1,41	0	2	6	253	3,01	1,40	0	3	10
Household size, rice farmers	173	2,08	0,90	1	2	6	253	2,32	1,03	1	2	6
Household head = Male	173	0,61	0,49	0	1	1	253	0,70	0,46	0	1	1
Household head's age	173	55,54	10,58	30	56	83	253	54,55	10,18	27	53	84
Household head's education = Primary	173	0,85	0,36	0	1	1	253	0,77	0,42	0	1	1
Household head's education = Secondary	173	0,13	0,33	0	0	1	253	0,17	0,37	0	0	1
Household head's education = Vocational	173	0,01	0,11	0	0	1	253	0,04	0,20	0	0	1
Household head's education = Higher	173	0,01	0,11	0	0	1	253	0,02	0,14	0	0	1
Household revenue, rice	173	260.311	398.987	0	115.200	3.000.000	253	350.135	339.495	0	266.400	2.000.000
Household revenue, agricultural nonrice	173	54.637	186.012	0	0	1.400.000	253	47.907	354.599	0	0	5.500.000
Household revenue, nonagriculture	173	97.590	152.598	0	43.200	1.440.000	253	116.028	245.333	0	48.000	3.010.900
Household revenue, rice (% of total revenue)	171	52,29	36,70	0	51	100	253	63,76	35,14	0	77	100
Household cost, rice	173	125.504	295.392	0	55.500	3.521.403	253	152.553	149.406	4.800	100.000	792.000
Household cost, agricultural nonrice	173	19.252	79.292	0	0	720.000	253	16.730	142.133	0	0	2.200.000
Household cost, nonagriculture	173	9.748	83.706	0	0	1.080.000	253	26.040	176.995	0	0	2.500.000
Household income, rice	173	134.806	397.189	-3.445.119	70.000	2.000.000	253	197.582	220.248	-190.000	140.000	1.300.000
Household income, agricultural nonrice	173	35.384	125.246	-36.000	0	1.000.000	253	31.177	216.760	-240.000	0	3.300.000
Household income, nonagriculture	173	87.842	111.502	0	43.200	504.400	253	89.988	131.443	-8.000	39.600	786.000
Household income, total (baht)	173	258.033	450.327	-3.324.119	176.000	2.800.000	253	318.747	314.468	-190.000	254.000	3.428.000
Household assets (baht)	173	641.287	1.021.638	20.000	374.700	11.500.000	253	843.901	1.082.638	19.000	610.000	9.358.800

3. Empirical Results

3.1. Risk Coping Activities during the 2011 Mega Flood

The first set of our empirical results focuses on how households coped with the mega flood in 2011. The survey asked each of the flooded households whether they engaged in any of the following activities: (1) selling assets; (2) reducing household consumption; (3) postponing new asset purchases; (4) having household members work more; (5) receiving crop insurance indemnity; (6) borrowing from financial institutions (formal loans); (7) requesting helps from relatives (informal gifts and loans); (8) receiving assistance from the government (including assistance in the forms of cash, pesticide, and seeds), and (9) receiving debt moratorium (conditional on already having debt before the flood). Activities (1) to (4) are collectively grouped as self-insurance mechanisms. Activities (5) and (6) are what Sawada (2014) refers to as market mechanisms, while activities (7) to (9) are non-market mechanisms provided by community and government.[8] Note that these activities were not mutually exclusive and some households engaged in multiple activities at the same time.

[8] Since agricultural loans were largely from the government-run Bank of Agriculture and Agricultural Cooperatives (BAAC), we classify debt moratorium as one type of government assistance in this study.

Table 3.4 presents the descriptive statistics of the activities the flooded households adopted during the 2011 mega flood. The table shows the variations in activates across provinces, although two salient mechanisms were adopted widely in all of the provinces: borrowing from financial institutions and receiving cash assistance from the government. Specifically, 71 percent of flooded households in Pitsanulok reported that they responded to the 2011 flood by borrowing money from financial institutions, while 60 percent received cash assistance from the government. The relative importance of these two activities was opposite for Khonkaen where 78 percent of flooded households received cash assistance from the government while 30 percent borrowed money from financial institutions. In the other two provinces, Suphanburi and Nakorn Ratchasima, about half of the flooded households reported that they had borrowed money from financial institutions and about half of the flooded households had received cash assistance from the government.

Table 3.4: Descriptive Statistics of Risk Coping Strategies during the 2011 Mega Flood by Province

Variable	No. Obs.	Mean	Std. Dev.	Min	Median	Max	No. Obs.	Mean	Std. Dev.	Min	Median	Max
	Suphanburi						*Pitsanulok*					
Sell assets	56	0,04	0,19	0	0	1	97	0,04	0,20	0	0	1
Reduce household consumption	56	0,13	0,33	0	0	1	97	0,29	0,46	0	0	1
Postpone new asset purchase	56	0,13	0,33	0	0	1	97	0,01	0,10	0	0	1
Have household members work more	56	0,02	0,13	0	0	1	97	0,09	0,29	0	0	1
Receive crop insurance indemnity	56	0,00	0,00	0	0	0	97	0,00	0,00	0	0	0
Borrow from financial institutions	56	0,46	0,50	0	0	1	97	0,71	0,46	0	1	1
Request helps from relatives	56	0,13	0,33	0	0	1	97	0,12	0,33	0	0	1
Receive financial assistance from government, cash	56	0,46	0,50	0	0	1	97	0,60	0,49	0	1	1
Receive financial assistance from government, pesticide	56	0,00	0,00	0	0	0	97	0,00	0,00	0	0	0
Receive financial assistance from government, seeds	56	0,05	0,23	0	0	1	97	0,05	0,22	0	0	1
Receive debt moratorium, conditional on having debt	44	0,73	0,45	0	1	1	89	0,88	0,33	0	1	1
	Khonkaen						*Nakorn Ratchasima*					
Sell assets	54	0,04	0,19	0	0	1	46	0,07	0,25	0	0	1
Reduce household consumption	54	0,13	0,34	0	0	1	46	0,15	0,36	0	0	1
Postpone new asset purchase	54	0,09	0,29	0	0	1	46	0,02	0,15	0	0	1
Have household members work more	54	0,19	0,39	0	0	1	46	0,07	0,25	0	0	1
Receive crop insurance indemnity	54	0,13	0,34	0	0	1	46	0,13	0,34	0	0	1
Borrow from financial institutions	54	0,30	0,46	0	0	1	46	0,48	0,51	0	0	1
Request helps from relatives	54	0,22	0,42	0	0	1	46	0,11	0,31	0	0	1
Receive financial assistance from government, cash	54	0,78	0,42	0	1	1	46	0,48	0,51	0	0	1
Receive financial assistance from government, pesticide	54	0,00	0,00	0	0	0	46	0,00	0,00	0	0	0
Receive financial assistance from government, seeds	54	0,02	0,14	0	0	1	46	0,00	0,00	0	0	0
Receive debt moratorium, conditional on having debt	30	0,47	0,51	0	0	1	43	0,23	0,43	0	0	1

Some other interesting findings are as follows: First, the majority of government assistance came in the form of cash. Only a small fraction of flooded households received non-cash assistance from the government

(pesticide and seeds). Second, crop insurance did not exist in Suphanburi and Pitsanulok, but about 13 percent of flooded households in the northeast received insurance indemnity following the 2011 flood. This finding reflects the low take-up of crop insurance in Thailand in general. Third, the majority of households did not rely on their own self-insurance mechanisms during the 2011 flood, although reducing household consumption and having household members work more were not negligible. Finally, among the flooded households who had debt prior to the 2011 flood, most of the households in the Chao Phraya-Thachin area got debt moratorium (88 percent in Pitsanulok and 72 percent in Suphanburi), while less than half of the households in the northeast received such assistance (47 percent in Khonkaen and 23 percent in Nakorn Ratchasima). This is consistent with the fact that damage from the flood was less severe in the northeast, as shown above in Table 3.2.

3.2. Subjective Expectations

Our survey incorporated expectation questions for eliciting subjective probabilities of future flood events, flood damage, and disaster relief provided by the government. Subjective probabilities were elicited for the occurrence of flood events in the next ten years (no flood, mild floods, or severe floods similar to the 2011 mega flood).[9] Table 3.5 presents descriptive statistics of the responses from the households in our sample, stratified by their experience of the 2011 mega flood (directly hit by the flood versus not directly hit by the flood) *and* their exposure to floods (being in a flood-prone area versus not being in a flood prone area), in the 2x2 matrix.

[9] In the field, ten one-baht coins were used as visual aids to express the probabilistic concept since we were afraid that it might be too abstract to ask respondents for a probability directly. Table A in Appendix 1 was presented to a farmer on a sheet of paper, while he/she was asked to allocate ten one-baht coins into the given intervals. Each coin represents one chance out of ten. The allocation of coins thus expresses the strength of belief a particular farmer has about the likelihood of a specific event happening.

Table 3.5: Descriptive Statistics of Subjective Expectations

Variable	No. Obs.	Mean	Std. Dev.	Min	Median	Max	No. Obs.	Mean	Std. Dev.	Min	Median	Max
	Mega Flood = 0, Flood Prone = 0						*Mega Flood = 0, Flood Prone = 1*					
Prob (Mild flood)	137	0,33	0,27	0	0,3	1	36	0,54	0,25	0	0,5	1
Prob (Partial damage | Mild flood)	137	0,38	0,35	0	0,4	1	36	0,40	0,33	0	0,4	1
Prob (Total damage | Mild flood)	137	0,10	0,18	0	0	1	36	0,16	0,25	0	0	1
Prob (Government assistance | Mild flood)	137	0,33	0,34	0	0,3	1	36	0,41	0,28	0	0,5	1
Prob (Severe flood)	137	0,16	0,19	0	0,1	1	36	0,24	0,19	0	0,2	1
Prob (Partial damage | Severe flood)	137	0,22	0,28	0	0	1	36	0,16	0,24	0	0	1
Prob (Total damage | Severe flood)	137	0,47	0,42	0	0,5	1	36	0,63	0,42	0	0,8	1
Prob (Government assistance | Severe flood)	137	0,69	0,35	0	0,8	1	36	0,82	0,28	0	1	1
Household able to cope with future flood (0=no, 1=partially, 2=totally)	137	1,15	0,84	0	1	2	36	0,69	0,79	0	0,5	2
Community able to cope with future flood (0=no, 1=partially, 2=totally)	137	1,22	0,72	0	1	2	36	0,92	0,65	0	1	2
Government able to cope with future flood (0=no, 1=partially, 2=totally)	137	1,24	0,75	0	1	2	36	1,03	0,74	0	1	2
	Mega Flood = 1, Flood Prone = 0						*Mega Flood = 1, Flood Prone = 1*					
Prob (Mild flood)	150	0,47	0,24	0	0,45	1	103	0,55	0,25	0	0,5	1
Prob (Partial damage | Mild flood)	150	0,47	0,28	0	0,5	1	103	0,45	0,30	0	0,5	1
Prob (Total damage | Mild flood)	150	0,25	0,27	0	0,2	1	103	0,31	0,32	0	0,2	1
Prob (Government assistance | Mild flood)	150	0,40	0,34	0	0,5	1	103	0,39	0,35	0	0,4	1
Prob (Severe flood)	150	0,27	0,21	0	0,2	1	103	0,30	0,21	0	0,3	1
Prob (Partial damage | Severe flood)	150	0,17	0,26	0	0	1	103	0,14	0,23	0	0	1
Prob (Total damage | Severe flood)	150	0,80	0,31	0	1	1	103	0,82	0,28	0	1	1
Prob (Government assistance | Severe flood)	150	0,83	0,26	0	1	1	103	0,77	0,32	0	1	1
Household able to cope with future flood (0=no, 1=partially, 2=totally)	150	0,57	0,69	0	0	2	103	0,36	0,57	0	0	2
Community able to cope with future flood (0=no, 1=partially, 2=totally)	150	0,65	0,63	0	1	2	103	0,60	0,62	0	1	2
Government able to cope with future flood (0=no, 1=partially, 2=totally)	150	0,96	0,70	0	1	2	103	0,79	0,67	0	1	2

When the households were asked about the likelihood of no flood, mild floods, or severe floods in the next ten years, it makes intuitive sense that the households not living in flood-prone areas (left panel) had lower subjective expectations of future mild floods. The subjective expectations were higher for those located in flood-prone areas (right panel). The table also suggests that being directly hit by the 2011 mega flood increased the subjective expectation of future mild floods (top versus bottom panels). Specifically, the 2011 mega flood corresponded to the subjective expectation of future mild floods of 0.47 (much higher as compared to 0.33) for those not in flood-prone areas, and 0.55 (only slightly higher as compared with 0.54) for those located in flood-prone areas. Although the subjective expectations of future severe floods were lower for all four groups of sampled households, a similar pattern was found for the subjective expectations of future severe floods across four groups of households. In particular, households in flood-prone areas had higher subjective expectations compared with to those in non-flood prone areas, and being directly hit by the 2011 mega flood resulted in a higher subjective expectation of future severe floods for both flood-prone and non-flood-prone households.

Next, the survey elicited subjective expectations of loss, conditional on the incidence of mild floods or severe floods (no loss, partial damage, or total damage). The table shows that, conditional on the event of mild floods, households in the flood-prone areas had higher expectations of both partial and

total damage from future mild floods. The 2011 mega flood, however, increased the subjective expectations of- damage for both flood prone and non-flood-prone households. A similar pattern was found for the case of damage conditional on future severe floods. The main difference was that the subjective expectations of the event of total damage from severe floods were much higher than in the case of mild floods, especially for those located in the flood-prone areas. Specifically, for those not directly hit by the 2011 flood, the subjective expectations of the event of total damage conditional on severe floods were 0.47 for non-flood-prone households and 0.63 for flood-prone households. With the 2011 flood, the probabilities increased to 0.80 and 0.82 for these two groups, respectively.

Finally, the questionnaire asked what each household thought about the ability of household, community, and government to cope with future floods. The responses were on a scale of 0 to 2 (0 = not able, 1 = partially able, and 2 = totally able). The results show that, on average, the responses were higher for households in the non-flood-prone areas than for those in the flood-prone areas. However, the 2011 mega flood reduced the subjective expectations of the ability of household, community, and government to cope with future floods for both non-flood-prone and flood-prone-households.

We further analysed statistically whether the differences in subjective expectations across households in our sample were induced by the 2011 mega flood event. Columns (1) to (8) of Table 3.6 present the results from linear probability regression analyses, using the responses discussed above as dependent variables and controlling for households' characteristics as well as district (amphoe) fixed effects.[10] Intuitively, the results show that being in flood-prone areas was positively correlated with the higher subjective probability of future floods, both for mild floods (column 1) and severe floods (column 5). However, being directly hit by the 2011 mega flood was also positively associated with higher subjective expectation of future floods, suggesting that the mega flood may have induced households' higher expectations. For both mild and severe floods, the interaction term was negative (though not statistically significant for severe floods), implying that

[10] District (or amphoe) is an administrative unit in Thailand. It is smaller than province (or changwat) but larger than county (or tambon). Our sample households came from 12 districts: two in Pitsanulok, three in Suphanburi, six in Khonkaen, and one in Nakorn Ratchasima.

the effect of the mega flood on subjective probability of future floods was smaller if the households were already in the flood−prone areas. In other words, if the households were not prone to floods before the 2011 mega flood, the mega flood had a higher impact on their subjective probability of future floods than those who were acquainted with regular floods. The table also shows that the 2011 mega flood was positively associated with higher subjective expectations of both partial and total damage from mild floods (columns 2 and 3) and total damage from severe floods (column 7). Interestingly, being directly hit by the 2011 mega flood and being in the flood-prone areas were positively correlated with the subjective expectation of government assistance in case of severe floods, but not in the event of mild floods (columns 8 and 4, respectively). Surprisingly, for future severe flood events, the interaction term was negative. This finding suggested that, for the flood-prone households, experiencing the mega flood in 2011 reduced their subjective probability of government assistance. One of the explanations could be the reduced credibility of government assistance in the presence of widespread natural disasters as compared with such assistance during normal floods, probably due to a lack of resources or mismanagement at times of such rare, severe, and nationwide events.

Table 3.6: Regression Analysis of Subjective Expectations

	(1) Prob (Mild flood)	(2) Prob (Partial damage | Mild flood)	(3) Prob (Total damage | Mild flood)	(4) Prob (Government assistance | Mild flood)	(5) Prob (Severe flood)	(6) Prob (Partial damage | Severe flood)	(7) Prob (Total damage | Severe flood)	(8) Prob (Government assistance | Severe flood)	(9) Household able to cope with future flood	(10) Community able to cope with future flood	(11) Government able to cope with future flood
Flood 2011 = 1	0.101***	0.104***	0.147***	0.0694	0.0870***	-0.0589	0.342***	0.160***	-0.510***	-0.499***	-0.134
	(0.0324)	(0.0397)	(0.0307)	(0.0440)	(0.0266)	(0.0359)	(0.0476)	(0.0416)	(0.0974)	(0.0862)	(0.0947)
Flood prone = 1	0.169***	0.0108	0.0701	0.0983*	0.0761**	-0.0627	0.165**	0.144**	-0.348**	-0.212*	-0.0964
	(0.0472)	(0.0616)	(0.0460)	(0.0564)	(0.0368)	(0.0473)	(0.0799)	(0.0569)	(0.144)	(0.125)	(0.136)
Flood 2011 x Flood prone	-0.113**	-0.0435	-0.00253	-0.0902	-0.0425	0.0250	-0.136	-0.206***	0.140	0.180	-0.0288
	(0.0559)	(0.0720)	(0.0590)	(0.0702)	(0.0455)	(0.0565)	(0.0876)	(0.0675)	(0.162)	(0.146)	(0.159)
Household size	-0.00904	0.0123	0.00593	0.00456	0.00964	0.00931	0.00615	-0.00228	0.0384*	0.0323*	-0.0155
	(0.00725)	(0.00825)	(0.00759)	(0.00944)	(0.00605)	(0.00743)	(0.00981)	(0.00764)	(0.0200)	(0.0180)	(0.0204)
Household assets	0.0239*	0.00600	-0.0150	-0.0416**	-0.00743	0.00131	0.0117	-0.00787	0.0245	-0.0222	-0.0551
	(0.0130)	(0.0165)	(0.0129)	(0.0168)	(0.0115)	(0.0152)	(0.0187)	(0.0148)	(0.0366)	(0.0324)	(0.0337)
Household head = Male	-0.0243	-0.00409	-0.0204	0.0219	0.0279	-0.0387	0.0347	-0.0196	0.0791	0.0608	0.0786
	(0.0267)	(0.0335)	(0.0279)	(0.0360)	(0.0200)	(0.0292)	(0.0388)	(0.0308)	(0.0731)	(0.0661)	(0.0705)
Household's age	0.000277	-0.00159	0.000521	-0.00284	-0.0000227	0.00142	-0.00209	-0.00350**	0.00246	-0.000772	-0.00920**
	(0.00126)	(0.00164)	(0.00148)	(0.00174)	(0.00108)	(0.00133)	(0.00182)	(0.00163)	(0.00366)	(0.00355)	(0.00360)
Household head's eduation	-0.00286	-0.0118	-0.0124	0.00756	0.0109	-0.00874	0.0300	0.0730**	-0.117	0.0201	-0.0443
= Primary	(0.0345)	(0.0380)	(0.0350)	(0.0428)	(0.0271)	(0.0371)	(0.0460)	(0.0368)	(0.0948)	(0.0822)	(0.0911)
Constant	0.0903	0.344	0.267	0.982***	0.203	0.122	0.348	0.935***	0.523	1.307***	2.405***
	(0.180)	(0.247)	(0.181)	(0.241)	(0.171)	(0.206)	(0.273)	(0.219)	(0.531)	(0.491)	(0.497)
District fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	426	426	426	426	426	426	426	426	426	426	426

The last three columns of the table analyse the subjective expectations of household's, community's, and government's ability to cope with future flood events. The regression results show that experiencing the 2011 mega flood and being in flood-prone areas were negatively associated with expectations of the household's and community's ability (columns 9 and 10) to cope with future floods, but were not statistically correlated with expectations of the government's ability to cope with future floods (column 11).

3.3. Preferences

The survey asked hypothetical questions that allow us to elicit preferences of the farming households in our sample. Table 3.7 presents descriptive statistics of four simple measures that capture risk, time, and social preferences: (1) risk aversion, (2) loss aversion, (3) impatience, and (4) altruism.[11] Again, the sampled households were stratified according to whether the household was in a flood-prone area and whether the household directly experienced the 2011 mega flood.

Table 3.7: Descriptive Statistics of Household's Preference Measures

Variable	No. Obs.	Mean	Std. Dev.	Min	Median	Max	No. Obs.	Mean	Std. Dev.	Min	Median	Max
	Mega Flood = 0, Flood Prone = 0						*Mega Flood = 0, Flood Prone = 1*					
Risk aversion (1=min, 5=max)	120	3,99	1,15	1	4	5	32	3,63	1,45	1	4	5
Loss aversion (1=min, 5=max)	128	4,65	0,84	1	5	5	36	4,11	1,39	1	5	5
Impatience (1=min, 3=max)	137	2,18	0,79	1	2	3	36	2,31	0,79	1	2,5	3
Altruism (0=min, 1=max)	137	0,28	0,24	0	0,5	0,5	36	0,27	0,25	0	0,5	0,5
	Mega Flood = 1, Flood Prone = 0						*Mega Flood = 1, Flood Prone = 1*					
Risk aversion (1=min, 5=max)	130	4,20	0,99	1	4,5	5	92	3,92	1,19	1	4	5
Loss aversion (1=min, 5=max)	143	4,51	0,98	1	5	5	97	4,41	1,07	1	5	5
Impatience (1=min, 3=max)	150	2,24	0,77	1	2	3	103	2,27	0,72	1	2	3
Altruism (0=min, 1=max)	150	0,23	0,24	0	0,05	0,5	103	0,27	0,24	0	0,5	0,5

The table shows that our sample households were relatively risk averse. On the scale of 1 (least averse) to 5 (most averse), both the mean and the median measures of risk aversion were around 4 in all four groups. However, the findings suggest that households in flood-prone areas were slightly less risk averse than those in non-flood-prone areas.[12] The 2011 mega flood seemed to

[11] See Appendix 2 for the hypothetical questions.

[12] On the one hand, this finding may seem to reflect the endogenous choices of farmland of the households. On the other hand, rice farms in Thailand are usually inherited so location choices are typically determined by previous generations.

be associated with higher risk aversion for both flood-prone and non-flood-prone households. The results were more mixed for our measure of loss aversion. Regarding time preference, the four groups showed a similar mean and median for impatience, at around 2, on a scale from 1 (least impatient) to 3 (most impatient).[13] Finally, regarding altruism, households were asked to play a dictator game. On a scale of 0 (least altruistic) to 1 (most altruistic), the top panel shows that both flood-prone and non-flood-prone households had about the same average altruism measure—approximately 0.26. However, the mega flood seemed to affect non-flood prone and flood prone households differently. For non-flood-prone households, the average altruism measure dropped to 0.23, while the measure remained similar, at 0.27, for the flood-prone group.

Finally, Table 3.8 presents regression results when we control for household characteristics and district-fixed effects. The table shows that the 2011 mega flood was positively associated with higher risk aversion. This result is consistent with the finding in Cassar, *et al.* (2011), who found a similar result in their study of the 2004 Indian Ocean tsunami in Thailand. However, our study shows that the 2011 mega flood was associated with lower altruism, opposite to what Cassar, Healy and Kesseler found. Our finding shows that the 2011 mega flood made households become less altruistic, probably because they realised the limitation of risk sharing in the presence of aggregate shocks. Finally, our findings show that the 2011 mega flood was not statistically correlated with our measures of loss aversion and time preference.

[13] Note that our simple measure of time preference is subject to risk aversion, as preferring to accept lower instantaneous payment rather than waiting for higher future payment may reflect risk aversion to future payment in addition to time impatience.

Table 3.8: Regression Analysis of Preference Measures

	(1) Risk aversion	(2) Risk aversion	(3) Loss aversion	(4) Loss aversion	(5) Impatience	(6) Impatience	(7) Altruism	(8) Altruism
Flood 2011 = 1	0.302*	0.294*	-0.144	-0.108	0.0618	0.0911	-0.0659**	-0.0665**
	(0.155)	(0.152)	(0.128)	(0.126)	(0.0992)	(0.102)	(0.0314)	(0.0317)
Flood prone = 1	-0.346	-0.322	-0.501**	-0.523**	0.123	0.130	-0.0250	-0.0320
	(0.284)	(0.279)	(0.239)	(0.241)	(0.152)	(0.150)	(0.0466)	(0.0462)
Flood 2011 x Flood prone	0.0694	0.0544	0.468*	0.503*	-0.102	-0.0983	0.0759	0.0770
	(0.321)	(0.316)	(0.270)	(0.272)	(0.178)	(0.177)	(0.0557)	(0.0555)
Household size		0.0152		-0.0348		-0.0336		0.00172
		(0.0338)		(0.0267)		(0.0211)		(0.00707)
Household assets		-0.0665		-0.0118		-0.0259		0.0150
		(0.0617)		(0.0455)		(0.0406)		(0.0125)
Household head = Male		0.143		-0.234***		0.0155		-0.0458*
		(0.137)		(0.0892)		(0.0832)		(0.0260)
Household's age		0.00170		0.000110		-0.000956		-0.00123
		(0.00632)		(0.00544)		(0.00412)		(0.00127)
Household head's eduation = Primary		-0.123		0.0356		0.0694		0.0331
		(0.151)		(0.132)		(0.102)		(0.0321)
Constant	3.935***	4.650***	4.633***	5.033***	2.180***	2.625***	0.288***	0.158
	(0.114)	(0.910)	(0.0880)	(0.738)	(0.0717)	(0.593)	(0.0222)	(0.184)
District fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	374	374	404	404	426	426	426	426

Note: Robust standard errors in parentheses. * represents p<0.10, ** p<0.05, and p<0.01

3.4. Strategies for Future Floods

Given it had been over two years since the 2011 mega flood took place, our survey took advantage of this and asked each household whether they were adopting strategies that would help mitigate the severity and damage of future flood events. The strategies we asked about include: (1) accumulating assets, (2) increasing savings, (3) having household members take on additional work outside the agricultural sector, (4) diversifying crops, (5) reducing rice growing area, (6) adjusting the mode of rice growing, (7) adjusting the method of rice growing,[14] (8) digging a pond in their rice farm, (9) building a flood prevention system themselves, and (10) building a flood prevention system with the community, and (11) insuring against crop damage. Note that strategies (1) and (2) are households building their own buffer stocks. Strategies (3) to (5) are various ways of income diversification. Strategies (6) and (7) are changes in production technology. Strategies (8) to (10) are preventive measures. Finally, strategy (11) is a market-based insurance.

[14] Changes in the mode of rice growing include changing rice varieties, changing growing/harvesting time, or avoiding growing rice during particular periods. Changes in the method of rice growing include using more chemical or more organic fertilizers and pesticides.

The top panel of Table 3.9 shows that 33 percent of flood-prone households were adopting at least one of the strategies that would mitigate the severity of future floods (top right panel), while only 21 percent of the non-flood-prone households had adopted such strategies (top left panel). Compared with the top panel, the bottom panel of Table 9 presents a striking result that households directly hit by the 2011 mega flood had adopted at least one of the strategies listed above—47 percent for the non-flood prone households (bottom left panel) and 59 percent for the flood-prone households (bottom right panel). The most commonly adopted strategies were building a flood prevention system (either by the households themselves or with the community) and adjusting the mode of rice growing. Farming households also became more diversified and more likely to purchase crop insurance after being hit by the mega flood.

Table 3.9: Descriptive Statistics of Strategies for Future Floods

Variable	No. Obs.	Mean	Std. Dev.	Min	Median	Max	No. Obs.	Mean	Std. Dev.	Min	Median	Max
	Mega Flood = 0, Flood Prone = 0						*Mega Flood = 0, Flood Prone = 1*					
Have household members work additionally outside agricultural sector	137	0,04	0,21	0	0	1	36	0,06	0,23	0	0	1
Insure crops	137	0,01	0,09	0	0	1	36	0,03	0,17	0	0	1
Increase savings (deposits)	137	0,06	0,24	0	0	1	36	0,08	0,28	0	0	1
Accumulate assets	137	0,02	0,15	0	0	1	36	0,00	0,00	0	0	0
Diversify crops	137	0,03	0,17	0	0	1	36	0,03	0,17	0	0	1
Reduce rice growing area	137	0,02	0,15	0	0	1	36	0,00	0,00	0	0	0
Adjust mode of rice growing	137	0,07	0,25	0	0	1	36	0,08	0,28	0	0	1
Adjust method of rice growing	137	0,07	0,25	0	0	1	36	0,03	0,17	0	0	1
Dig pond in rice farm	137	0,01	0,12	0	0	1	36	0,06	0,23	0	0	1
Build flood prevention system by itself	137	0,07	0,25	0	0	1	36	0,11	0,32	0	0	1
Build flood prevention system with community	137	0,05	0,22	0	0	1	36	0,03	0,17	0	0	1
Have at least one future strategy = 1	137	0,21	0,41	0	0	1	36	0,33	0,48	0	0	1
	Mega Flood = 1, Flood Prone = 0						*Mega Flood = 1, Flood Prone = 1*					
Have household members work additionally outside agricultural sector	150	0,12	0,33	0	0	1	103	0,13	0,33	0	0	1
Insure crops	150	0,09	0,28	0	0	1	103	0,08	0,27	0	0	1
Increase savings (deposits)	150	0,13	0,34	0	0	1	103	0,09	0,28	0	0	1
Accumulate assets	150	0,02	0,14	0	0	1	103	0,02	0,14	0	0	1
Diversify crops	150	0,07	0,25	0	0	1	103	0,07	0,25	0	0	1
Reduce rice growing area	150	0,01	0,08	0	0	1	103	0,03	0,17	0	0	1
Adjust mode of rice growing	150	0,19	0,39	0	0	1	103	0,24	0,43	0	0	1
Adjust method of rice growing	150	0,05	0,23	0	0	1	103	0,10	0,30	0	0	1
Dig pond in rice farm	150	0,03	0,16	0	0	1	103	0,09	0,28	0	0	1
Build flood prevention system by itself	150	0,17	0,37	0	0	1	103	0,30	0,46	0	0	1
Build flood prevention system with community	150	0,23	0,42	0	0	1	103	0,20	0,40	0	0	1
Have at least one future strategy = 1	150	0,47	0,50	0	0	1	103	0,59	0,49	0	1	1

Table 3.10 presents the results from linear probability regression analyses when we control for household characteristics and district-fixed effects. The table shows that households that were directly hit by the 2011 mega flood tended to adopt at least one of the strategies that would help mitigate the severity or the damage of future floods. The table also shows that the more risk averse the households, the higher the tendency to adopt such strategies. Finally, the results from the table show that the higher probability of government assistance in the case of damage from either mild or severe floods was not statistically correlated with the adoption of such strategies, suggesting that there was no crowding out

effect of government assistance on private strategies toward future floods. In other words, there seemed to be no moral hazard problem arising from the government implicit insurance through disaster assistance. This finding is consistent with the discussion of Table 3.5 above, showing that households perceived that the government's ability to cope with future floods was in fact quite low.

Table 3.10: Regression Analysis of Strategies for Future Floods

	(1) future_strategy	(2) future_strategy	(3) future_strategy	(4) future_strategy
Flood 2011 = 1	0.213***	0.178***	0.179***	0.184***
	(0.0538)	(0.0628)	(0.0638)	(0.0642)
Flood prone = 1	0.0891	0.125	0.126	0.121
	(0.0845)	(0.0914)	(0.0929)	(0.0958)
Flood 2011 x Flood prone	0.0132	0.00664	0.00419	0.0139
	(0.102)	(0.110)	(0.112)	(0.114)
Risk aversion		0.0341*	0.0344*	0.0386**
		(0.0191)	(0.0191)	(0.0196)
Loss aversion		-0.0198	-0.0197	-0.0230
		(0.0252)	(0.0254)	(0.0260)
Impatience		-0.0194	-0.0203	-0.0211
		(0.0302)	(0.0299)	(0.0304)
Altruism		0.0293	0.0346	0.0193
		(0.0968)	(0.0965)	(0.0983)
Prob (Government Assistance | Mild Flood)			-0.0723	-0.0557
			(0.0717)	(0.0737)
Prob (Government Assistance | Severe Flood)			0.0252	0.0189
			(0.0786)	(0.0804)
Household size				-0.0171
				(0.0124)
Household rice revenue (%)				0.000115
				(0.000843)
Household assets				0.0297
				(0.0240)
Household head = Male				-0.0484
				(0.0515)
Household head's age				0.00104
				(0.00229)
Household head's education = Primary				0.0266
				(0.0612)
Constant	0.247***	0.265	0.271	-0.0981
	(0.0374)	(0.162)	(0.167)	(0.397)
District fixed effects	Yes	Yes	Yes	Yes
Number of observations	426	355	355	353

Note : Robust standard errors in parentheses. * represents p<0.10, ** p<0.05, and p<0.01.

4. Policy Implications

The empirical findings discussed in the previous sections show that being directly hit by the 2011 mega flood did affect some household's subjective expectations, preferences, and behaviours. Firstly, the flood seemed to make the Thai farming households adjust upward their subjective expectations of future flood events, for both mild and severe floods. The flooded households also had higher expectations of possible damage caused by future floods. For households located in the non-flood prone areas, the 2011 mega flood led to higher subjective expectations of government assistance in case of severe floods, but not in the event of mild floods. However, for flood-prone households, experiencing the mega flood in 2011 actually reduced their subjective expectation of government assistance. Related, we also find that there was no crowding out effect of government assistance on private strategies for the management future flood risk and there seemed to be no moral hazard problem arising from the government implicit insurance through disaster assistance. These findings shed light on the credibility of government assistance in the event of widespread natural disasters as compared with such assistance during normal floods received by these households in the past. Lack of resources or mismanagement at times of such rare and severe nationwide events could be an explanation for this decrease in subjective expectations. The Yingluck government had proposed a comprehensive plan of water management for the whole country, and a similar plan was declared a national agenda and committed to by the National Council for Peace and Order (NCPO) following the 2014 coup d'état. If eventually implemented, the plan may help ensure a more effective government role in preventing or mitigating future floods.

Secondly, the 2011 mega flood was positively associated with higher risk aversion. This finding is consistent with the findings that the flood caused households to adopt strategies to mitigate the severity and the damage of future floods and that more risk averse households were more likely to adopt such strategies. Given that most households have already tended to insure themselves through various mechanisms, the government could supplement their initiatives by providing technical assistance regarding switching to rice varieties that are more resistant to flood water, adjusting modes of rice

production based on seasonal weather forecasts, or constructing flood prevention infrastructures. The government could also facilitate households' access to nonagricultural occupations, thus providing them with opportunities to diversify their incomes.

Finally, the mega flood was negatively correlated with our measure of altruism. The households that were directly hit by the flood seemed to be less altruistic. Although possible explanations are mere speculation, the mega flood may have made them realise the limitations of risk sharing in the event of aggregate shocks. Under such circumstances, the government, especially through the Bank of Agriculture and Agricultural Cooperatives (BAAC), may encourage farming households to purchase crop insurance contracts that would help them insure their outputs beyond their local informal insurance.

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Appendix 1: Survey Questionnaire for Subjective Expectation

Table A: The elicitation of subjective expectations

<table>
<tr><td colspan="7">Question: The likelihood that the following flood events will occur in the next 10 years</td></tr>
<tr><td>No flood
  </td><td colspan="3">Mild flood [F_2]
  </td><td colspan="3">Severe flood [F_3]
  </td></tr>
<tr><td>$P(F_1)$
(coins)</td><td colspan="3">$P(F2\ \ )$
(coins)</td><td colspan="3">$P(F_3)$
(coins)</td></tr>
<tr><td rowspan="5"></td><td colspan="3">Q2: The likelihood that the occurrence of mild flood will affect rice production</td><td colspan="3">Q3: The likelihood that the occurrence of severe flood will affect rice production</td></tr>
<tr><td>No damage</td><td>Partial damage</td><td>Total damage</td><td>No damage</td><td>Partial damage</td><td>Total damage</td></tr>
<tr><td>$P(D_1|F_2)$
(coins)</td><td>$P(D_2|F_2)$
(coins)</td><td>$P(D_3|F_2)$
(coins)</td><td>$P(D_1|F_3)$
(coins)</td><td>$P(D_2|F_3)$
(coins)</td><td>$P(D_3|F_3)$
(coins)</td></tr>
<tr><td rowspan="3"></td><td colspan="2">Q4: The likelihood that farmer will receive relief when mild flood occurs</td><td rowspan="3"></td><td colspan="2">Q5: The likelihood that farmer will receive relief when severe flood occurs</td></tr>
<tr><td>Yes</td><td>No</td><td>Yes</td><td>No</td></tr>
<tr><td>$P(Yes|F_2)$
(coins)</td><td>$P(No|F_2)$
(coins)</td><td>$P(Yes|F_3)$
(coins)</td><td>$P(No|F_3)$
(coins)</td></tr>
</table>

Appendix 2: Survey Questionnaires for Risk, Time, and Social Preferences

A.2.1 Risk Aversion

Suppose there are seven rice varieties and each variety gives a different yield. Some varieties give a low yield but are resistant to disease, pests, and natural disasters. Some varieties give a higher yield but are not resistant to disease, pests, and natural disasters, and give very low yields when disease, pests, or natural disasters occur. If you did not know whether such disasters would happen next year, but you knew that the chances that such disasters would or would not happen are even, which variety of rice would you choose to grow?

Rice Variety	Yield (Output per Rai) in the year that disease, pests, or natural disasters occurred	Yield (Output per Rai) in the year that disease, pests, or natural disasters did not occur
1	700	700
2	630	1,330
3	560	1,680
4	420	2,100
5	280	2,240
6	140	2,660
7	0	2,800

A.2.2 Loss Aversion

Suppose you had to choose between two choices. If you opted for choice A, you would certainly lose money. But if you opted for choice B, there would be a coin toss—you would lose 2,000 baht in case of head but you would lose nothing in case of tail. Which choice would you pick in each of these scenarios?

Scenario	Choice A	Choice B	Your Choice
1	Lose 1,200 baht	Lose 2,000 baht if head Lose nothing if tail	
2	Lose 1,000 baht	Lose 2,000 baht if head Lose nothing if tail	
3	Lose 700 baht	Lose 2,000 baht if head Lose nothing if tail	
4	Lose 500 baht	Lose 2,000 baht if head Lose nothing if tail	
5	Lose 200 baht	Lose 2,000 baht if head Lose nothing if tail	

A.2.3 Time Preference

Suppose you had to choose between two choices. If you opted for choice A, you would receive 1,000 baht in cash tomorrow. But if you opted for choice B, you would receive more than 1,000 baht in cash in 2 weeks and 1 day (15 days). In each scenario, which choice would you select?

Scenario	Choice A	Choice B	Your Choice
1	Receive 1,000 baht tomorrow	Receive 1,000 baht in 15 days	
2	Receive 1,000 baht tomorrow	Receive 1,010 baht in 15 days	
3	Receive 1,000 baht tomorrow	Receive 1,020 baht in 15 days	
4	Receive 1,000 baht tomorrow	Receive 1,050 baht in 15 days	
5	Receive 1,000 baht tomorrow	Receive 1,100 baht in 15 days	
6	Receive 1,000 baht tomorrow	Receive 1,400 baht in 15 days	
7	Receive 1,000 baht tomorrow	Receive 1,700 baht in 15 days	
8	Receive 1,000 baht tomorrow	Receive 2,000 baht in 15 days	

A.2.4 Altruism

Suppose we gave you 1,000 baht in cash today and matched you with another farmer from your village, but you did not know who the other farmer was and the other farmer did not know who you were. If we gave you a chance to give the other farmer a part or a total of the 1,000 baht while keeping your decision confidential, would you give the other farmer any money? And if so, how much?