Chapter 7

Economic and Welfare Impacts of Disasters in East Asia and Policy Responses: The Case of Vietnam

Le Dang Trung
Indochina Research and Consulting (IRC), Vietnam

December 2012

This chapter should be cited as
Le Dang Trung (2012), 'Economic and Welfare Impacts of Disasters in East Asia and Policy Responses: The Case of Vietnam', in Sawada, Y. and S. Oum (eds.), *Economic and Welfare Impacts of Disasters in East Asia and Policy Responses*. ERIA Research Project Report 2011-8, Jakarta: ERIA. pp.205-245.

CHAPTER 7

Economic and Welfare Impacts of Disasters in East Asia and Policy Responses: The Case of Vietnam

LE DANG TRUNG

Indochina Research and Consulting (IRC)

Although Vietnam has seen remarkable economic achievements over the last twenty-five years, the country is still one of the poorest countries in the world. Unfortunately, the country is prone to many natural hazards. Vietnam is located in one of the five cyclone centers on the planet. It is estimated that Vietnam is hit by 4.3 storms and more than 3 floods per year.

Though the aftermaths of natural hazards are sizable, estimating their impacts is challenging, yet crucial for policy development. This chapter aims to conduct a scientific assessment of the impact of a natural catastrophe to help understand the multidimensional costs of disasters, and to draw lessons on how the impacts of natural disasters can be properly assessed. In addition, it provides an overview of the management of natural disasters and climate change in Vietnam, to see how the policy system has been working to deal with the risk of natural disasters and climate change. Finally, it identifies possible options for Vietnam to move forward to an effective disaster risk management system.

Keywords*:* Natural hazards, Storms, Floods, Impact evaluation, Matched sampling, Disaster management.

1. Introduction

Although Vietnam has seen remarkable economic achievements over the last twenty-five years, the country is still among the poorest countries in the world. The economic growth rate had been nearly 8% per annum for the period from 1990 to 2008 but it started to slow down 5 years ago. The GDP annual growth rate was 5.3%, 6.8% and 5.9% in 2009, 2010 and 2011, respectively. The global financial and economic crises and domestic macro-economic policies are cited as the main sources of the economic growth decrease. Currently, GDP per capita of Vietnam is reported at USD 722.8 at 2000 constant prices. It is estimated that more than 13 million people are living with less than USD1.25 per day.[1]

The economy is heavily dependent on agriculture, with 70 % of the population living in rural areas. The share of rural population has been shrinking due to a rapid urbanization process in recent years. Nevertheless, the rate of decrease is steady and low. The share of rural population was 69.83% in 2010, decreased from 72.9% in 2005. The contribution of agriculture to GDP has been decreasing rapidly over the last two decades. In 1990, agriculture contributed 39% to total GDP. In 2000, the share of agriculture was down to 20.5%.

The World Bank has recently affirmed that Vietnam stands at the top in the list of countries most vulnerable to climate change in the world (Dasgupta, *et al.* 2009). According to this research, Vietnam is ranked number 2 by the percentage increase in storm surge zones when compared to current surge zones. By absolute impacts of sea level rise and intensified storm surges, Vietnam is number 3 on the list after Indonesia and China. At the city level, Vietnam is also dominant in the list of cities at risk from storm surges.

While the risk of climate change is potentially dangerous, natural disasters have always been disastrous and deadly. Vietnam is located in one of the five storm centers on the planet. It is estimated that Vietnam is hit by 4.3 storms per year. Vietnam is also prone to floods and other natural disasters. The government's official data show that between 1990 and 2010 Vietnam experienced 74 flood catastrophes. Storms and floods almost always come with severe aftermaths. For

[1] The World Bank's Poverty and Population estimates are available at: http://data.worldbank.org

instance, Typhoon Damrey, whose impact will be assessed in section 2.2, caused 68 human deaths, devastated 118,000 houses and destroyed 244,000 hectares of rice. The aftermath statistics might, moreover, just reflect the shot-term impacts of such disasters. Natural catastrophes can cause long-term and persistent impacts on households and the economy if, for instance, they destroy investment and lock people into a poverty trap and chronic poverty.

This research has several goals. Its first aim is to provide a thorough review of the circumstances of natural disasters in Vietnam by bringing together the existing research literature and utilizing the best data available to date. Section 2.1 addresses this goal. Its second goal is to conduct a scientific assessment of the impact of a natural catastrophe in order to help understand the multidimensional costs of disasters and draw lessons on how the impacts of natural disasters can be properly assessed. This goal is in the subject of section 2.2. The third goal of this chapter is to present an overview of the management of natural disasters and climate change in Vietnam, to see how the policy system has been working to deal with the risk of natural disasters and climate change, and identify possible options for Vietnam to move forward to an effective disaster risk management system. Section 3 is dedicated to this third goal. Based on the analyses of the previous sections, together with lessons learnt from other countries, Section 4 is written for the purpose of providing recommendations, at the national level as well as in the context of regional collaboration, for Vietnam to move forward. Section 5 concludes.

2. Impact of Disasters on Households and Poverty Reduction in Vietnam

2.1. Overview of Natural Disasters in Vietnam

Vietnam lies between the latitudes 8°27’ and 23°23’ North, and the longitudes 102°8’ and 109°27’ East on the Indochinese Peninsula. The terrain is flat in coastal areas but relatively elevated in the midland and the mountainous regions of the Central Highlands, North East and North West. Vietnam can also be recognized as having an S-shape on maps, with narrow parts in the middle and wide parts in the two tails, in particular the upper tail of the land. Its climate is characterized by monsoon winds, blowing northeast and carrying considerable moisture is the climate is, however, diversified across regions. Based on climatic characteristics, Vietnamese meteorologists classify the country into seven regions, namely; Red River Delta, Northern Uplands, North Central Coast, South Central Coast, Central Highlands, South East and Mekong River Delta.

Being located in the center of the South China Sea, one of the Earth's 5 typhoon centers, Vietnam is prone to natural disasters. To briefly describe the context of natural disasters in Vietnam, Shaw (2006) has written:

> Due to the co-occurrence of the typhoon and rainy season in the narrow and low plains, high mountains, floods and typhoons have been very frequent during the past three decades, and seem to have a greater severity. Floods and typhoons have been a constant threat to the life and productivity of the Vietnamese people. Currently, 70% of the 73 million people of Vietnam live in disaster-prone areas, with the majority of the people residing in the Central region. These people's lives and livelihoods very much depend on the country's natural resources. Losing crops and homes in floods and storms keeps many rural Vietnamese trapped in a cycle of poverty. This has been intensified in the recent years with major floods occurring more frequently.

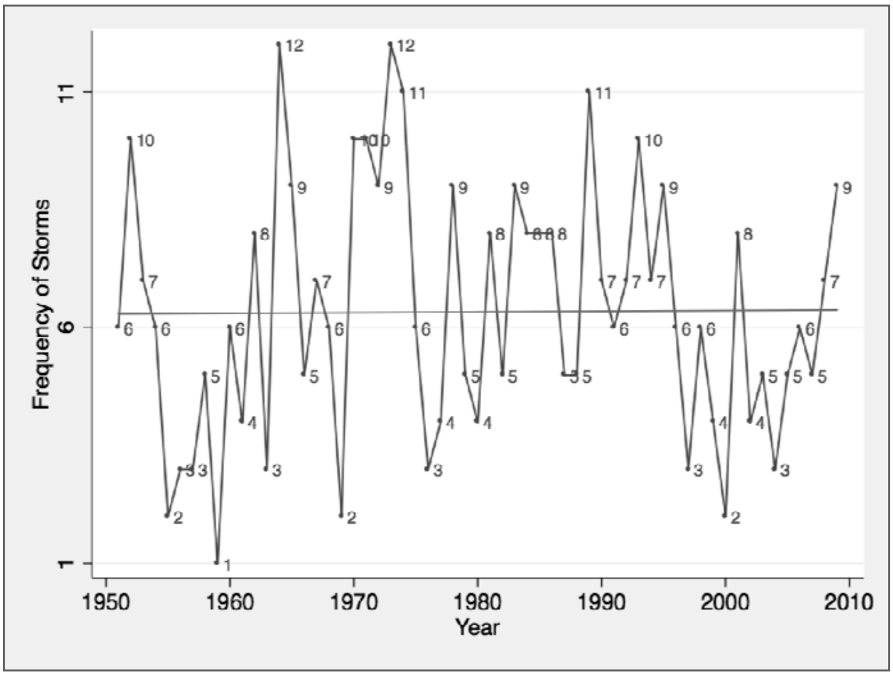
Utilizing a unique comprehensive database on natural disasters occurring since 1989 as well as complete storm archive since 1951 we will describe the situation of natural disasters in Vietnam in the rest of this section. The comprehensive database has been maintained by the Central Committee for Flood and Storm Control (CCFSC) of the Government of Vietnam for the last two decades. It collects a wide range of information on the identification of disasters and their aftermaths and impacts. The data is available at the provincial level. The storm archive contains information on every storm that occurred since 1951. The archive has been maintained and provided free of charge by Japan Meteorological Agency.

Tropical storms and typhoons

Tropical storms are the most frequent and disastrous natural disaster in Vietnam. In Figure 1 we show the yearly frequency of storms that made landfall in the boundary of Vietnam for the period from 1951 to 2009. A scary observation is that over the period, Vietnam was hit by at least one storm every year. There are several years in which the number of storms exceeded ten, making almost a storm per month. On average, Vietnam was hit by 4.3 storms annually.

A number of research papers have suggested that climate change may result in an increase in the frequency of storms in Vietnam (Hoang Tri, *et al.* 1998; Pham and Furukawa, 2007). Fortunately, our regression analysis indicates that the increase has not yet taken place in Vietnam. The line in Figure 1 visualizes the fitted values of the regression of the number of storms on a time trend. The fact that it is a flat line suggests that the effect of the time trend is not significantly different from zero. Strikingly, if we run a regression of the number of storms on the time trend for the period from 1980 to present, the coefficient is -0.016 and statistically significant at 10%, meaning that the frequency is even lower since 1980, although the size of decrease is marginally meaningful.

Figure 1: Storm Frequencies in Vietnam

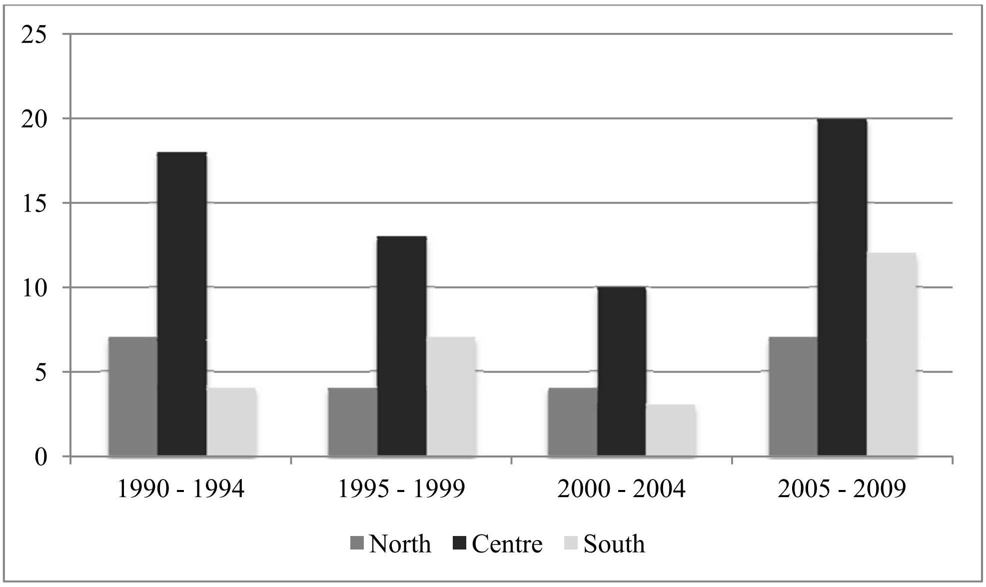


Source: Author's calculations using Japan Meteorological Agency's Storm Archives

There is, however, enormous heterogeneity in terms of storm frequencies and exposure across regions of Vietnam. As clearly shown in Figure 2, which presents the distribution of storms in three regions of Vietnam, the Centre is more frequently hit by storms in all the four periods. In the first period, the northern part appeared to be hit more frequently than the south but in the last period, the comparison has been reversed although both the two regions were hit more frequently than in the previous period.

The aftermaths of tropical storms in Vietnam are enormous, both in terms of human losses and economic impacts. Table 1 summarizes the losses due to tropical storms in Vietnam for the period from 1990 to 2010 using the data from the CCFSC database. In two decades, storms killed more than 5,700 people and caused an additional 7,000 injuries. Moreover, many households have become homeless due to storms. The period from 1995 to 1999 is remarkable in terms of losses. This single period accounts for nearly 65% of human lives lost, 36% of houses destroyed and 55% of bridges damaged. It is worth noting that in this period, the frequency of storms seems lower than the previous and the latest period. It indicates that the intensity of storms in the 1995-1999 period must have been considerable.

Figure 2: Typhoon Frequencies across Regions of Vietnam



Source: Author’s own calculation using CCSFC’s disaster database

Table 1: Impacts of Typhoons in Vietnam, 1990 – 2009

Time	People killed	People injured	Houses destroyed	Houses damaged	Bridges damaged	Tel poles damaged
1990 - 1994	710	1219	117912	5581	1892	4572
1995 - 1999	3670	2031	153148	272	5652	11359
2000 - 2004	200	350	9945	4750	738	3187
2005 - 2009	1134	3439	145214	157080	2126	16941

Source: Author's own calculations using CCFSC's database

The frequency of being hit by storms alters the expectations and awareness of the local people. Exposure to very few disasters causes people to have low expectations about being hit by disasters. Consequently, this behavior lowers the awareness and preparedness required for dealing with disasters, both in terms of formal and self-insurance. Wang, *et al*. (2012) point out that the level of risk closely relates to the acceptance of insurance against disasters. Awareness and preparedness also affect how well people mitigate the effects once disasters happen and thus affect the aftermaths of disasters. As an example, storms are very rare in the Mekong River Delta region of Vietnam. Local residents have almost no expectation of having a storm in this region. Unfortunately, in early November 1997, a storm, called Linda, swept through the farthest south communes causing historical losses, both in terms of human lives and asset losses, although Linda was not an extremely powerful storm in relative terms, as highlighted in Box 1.

Box 1: Tropical Storm Linda (1997)

Severe Tropical Storm Linda was the worst typhoon in southern Vietnam in at least 100 years, killing thousands of people and leaving extensive damage. It formed on October 31 in the South China Sea, between Indochina and the Philippines. Strengthening as it moved westward, Linda struck extreme southern Vietnam on November 2 with winds of 65 mph (100km/h), dropping heavy rainfall. Once in the Gulf of Thailand it strengthened further to minimal typhoon status, but weakened to tropical storm

strength before crossing the Malay Peninsula into the Bay of Bengal, the first storm to do so in five years. It re-strengthened in the Indian Ocean to typhoon status, but increasing wind shear and weakened steering currents caused Linda to dissipate on November 9.

The worst of Linda's impact was in Vietnam, where 3,111 people were killed, and damage totaled USD385 million (USD). Heavy rainfall caused flooding, which damaged or destroyed about 200,000 houses and left about 383,000 people homeless.

(Excerpt from Wikipedia)

Rainfall and runoff floods

Vietnam is also prone to rainfall and river-runoff floods as well as to flash floods. The CCFSC's data reveal that, over the last two decades, Vietnam has experienced more than 70 floods. Figure 3 visualizes the annual distribution of flooding and the trend of change overtime. The figure clearly indicates a five-year cyclical peak and it may well be aligned with La Niña effects.

On average, Vietnam experienced 3.4 flood events annually in the period from 1990 to 2009. More importantly, it seems that the number of floods annually has been increasing overtime. The positively sloping fitted line in Figure 3 implies an increasing trend. Fortunately, the marginal increase is neither big, nor statistically significant.

Floods are widely disastrous natural events and ranked second to storms and typhoons in Vietnam. We summarize floods' aftermaths in Table 2. Over the same period, there were 5,024 people killed by floods, and an additional 1,641 people reported missing. Floods destroyed or damaged more than 220,000 houses. There is a clear separation in terms of losses between the 1990-1009 and 2000-2009 periods. Human losses tripled in the later period and house losses doubled. The increase in the magnitude of losses may be due to increases in the intensity of floods as well as the number of the floods.

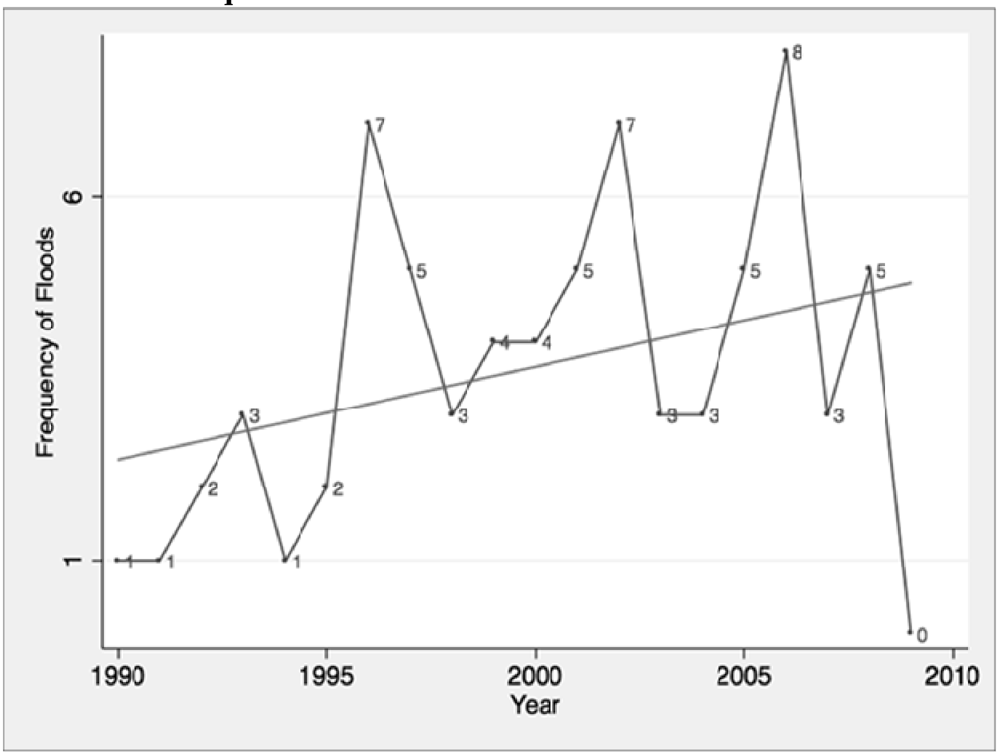
Table 2: Impacts of Floods in Vietnam, 1990 – 2009

Time	People killed	People injured	Houses destroyed	Houses damaged	Bridges damaged	Tel poles damaged
1990 - 1994	767	369	23154	510	3658	6468
1995 - 1999	757	162	48307	0	26156	239
2000 - 2004	2279	644	132332	33	14210	3228
2005 - 2009	1221	466	18246	369	2900	944

Source: Author's own calculations using CCFSC's database

Although regional distribution of floods is more even than that of storms and typhoons, the determinants of floods are still associated with regional characteristics. In the Mekong River Delta, floods are generally caused by runoff water along the Mekong River. Since this delta area is relatively flat and low-lying, runoff floods tend to stay for a very long time. In the central region, however, floods happen more often in the form of flash floods, resulting from intense rainfall, short and steep watersheds, and relatively little water storage capacity. In the Red River Delta, floods are characterized by intense rains, exacerbated by tidal effects (Pilarczyk and Nuoi, 2005).

Figure 3: Flood Frequencies in Vietnam



Source: Author’s own calculation using CCSFC’s disaster database

Box 2: Flood in the Central Region, October 2010: A Double Catastrophe

From 1 to 6 October 2010, flooding in Viet Nam caused severe loss and damage, particularly in the most isolated communes. According to VNRC damage reports to date, the floods have affected a total of 25 districts in the five provinces of Quang Binh, Ha Tinh, Quang Tri, Nghe An and Thua Thien Hue in central Viet Nam.

According to the latest reports from the Vietnamese government's central committee for flood and storm control (CCFSC), flash floods and collapsing houses have killed 66 people, and injured 86, with 18 reported missing. In these five provinces, more than 155,293 houses have been flooded, damaged or unroofed, while some 2,133 have been completely destroyed. Up to 14,395 families (57,580 people) have been evacuated to safer places.

Quang Binh and Ha Tinh are by far the two provinces most affected. In Quang Binh, all seven districts and 90 per cent of the communes have been flooded.

Province	**Damage to houses**		**Agricultural losses**		**Estimated total losses (VND billion)**
	Destroyed	Flooded/ damaged	Food/seeds (tones)	Rice/crops (hectares)	
Ha Tinh	1,882	26,350	30,000	10,400	845
Quang Binh	250	109,600	41,400	4,800	1,588
TOTAL	**2,132**	**135,950**	**71,400**	**15,200**	**2,433**

In these two provinces alone, more than 21,000 hectares of agricultural land (winter rice crop, winter corn, sweet potatoes, and peanuts) have been destroyed and more than 71,000 tons of food and seeds have been lost.

In total, the estimated loss caused by the present floods is about VND 2,758 billion (CHF 136.2 million or USD 142.5 million or EUR 101.5 million), with VND 2,433 billion of this sustained by Ha Tinh and Quang Binh provinces alone.

In Ha Tinh, the possibility of the Ho Lo hydro-power plant reservoir embankment being breached threatened some 28,000 families living in the downstream areas. VNRC assisted in the urgent evacuation of these families while flood mitigation measures were taken whereby water was released from the power plant's reservoirs through designated spillways. This action greatly contributed toward the mitigating the threat of flooding in both the Huong Khe and Cam Xuyen districts.

With official figures stating more than 152,200 houses being flooded or damaged with 2,133 completely destroyed, it is estimated that around 660,000 people (157,000 households) have been directly affected by the flood. This emergency appeal operation targets assistance to 28,500 of the most vulnerable households, representing 18 per cent of the total population affected. As described below, VNRC together with its partners in-country and other NGOs and UN agencies carried out more in-depth assessments in all five affected provinces to obtain a more clear comprehensive picture of both people affected and needs existing.

Other fundamental elements need to be taken into consideration for a thorough understanding of the situation in Vietnam. Due to the severe situation in Quang Binh and Ha Tinh in particular, the People's Aid Coordinating Committee (PACCOM) officially called for emergency assistance from international organizations for food and non-food relief items, livelihoods, health and educational materials on 13 October 2010.

The situation in this area continues to worsen as very heavy rainfall in central Viet Nam since 14 October has caused additional flooding in the provinces of Nghe An, Ha Tinh and Quang Binh.

According to the latest data from the Vietnamese government, 20 people have died and one reported missing, while some 152,200 houses have been flooded. Up to 17 October, 116,000 people have been evacuated in Quang Binh and Ha Tinh by the government with support from VNRC chapters.

Finally, with tropical storm Megi presently heading for the Philippines and gauged to make landfall there as a severe category 5 super typhoon on 18 October, there is the possibility of it affecting Viet Nam afterwards and subsequently, exacerbating the serious flood situation that already exists.

Taking into consideration the current severe situation in Quang Binh and Ha Tinh, the call by PACCOM for international assistance and the ominous weather forecast, VNRC has requested that IFRC launch an emergency appeal to assist 120,000 of the most vulnerable people (28,500 households or 18 per cent of the total affected population) through provision of food, safe water, non-food relief items, livelihood assistance and psychosocial support.

This current context based on the present disaster situation of two consecutive floods in central Viet Nam and the possibility of Megi striking Viet Nam significantly increases the probability of a greater disaster taking place in Viet Nam. Should this happen, an extension of this appeal will be made in lieu of launching a new one.

(Excerpt from IFRC's Emergency appeal MDRVN007)

Other Hazards

In addition to storms and floods, Vietnam is prone to several other types of natural disaster. The CCFSC's disaster database has documented five other disasters, namely drought, cold wave, land collapse, flood-tide and tornado/hailstorm. Of these disasters, drought is also an awful natural event that several provinces, particularly in the southern part of Vietnam, have experienced. Fortunately, the frequency and intensity of the disasters mentioned above are not as substantial as those of storms and floods. Accordingly, the consequences of these disaster types are less when compared to the consequences of floods and storms, although they are clearly visible. As seen in Table 3, over the 20-year period from 1990 to 2009, 2253 people had been killed by cold wave, land collapse, flood-tide and tornado/hailstorm.

Table 3: Impacts of Other Natural Hazards in Vietnam, 1990 – 2009

Time	People killed	People injured	Houses destroyed	Houses damaged	Bridges damaged	Tel poles damaged
1990 - 1994	783	90851	7211	23692	350	201
1995 - 1999	373	575	5277	19620	600	10
2000 - 2004	548	708	15286	133379	1599	606
2005 - 2009	549	558	3285	75364	814	988

Source: Author's own calculations using CCFSC's database

2.2. Impact of Disasters on Households and Poverty Reduction in Vietnam

The analysis using the CCFSC data is informative and useful but it must be subject to several caveats. First, measurement errors can be huge due to the way the data collection system was organized. Secondly, there is a likely possibility that respondents or victims might exaggerate the impact and aftermath of a disaster because they have learnt that they might be given more support from donors or charity organizations. Thirdly, the aftermath statistics might not reflect the medium- and long-term impacts of disasters. To investigate the extent to which disasters affect households' welfare and livelihoods in a causal manner, we conduct below an impact evaluation of a disastrous tropical storm that hit Vietnam in September 2005. The typhoon was named Damrey by the World Meteorological Organization.

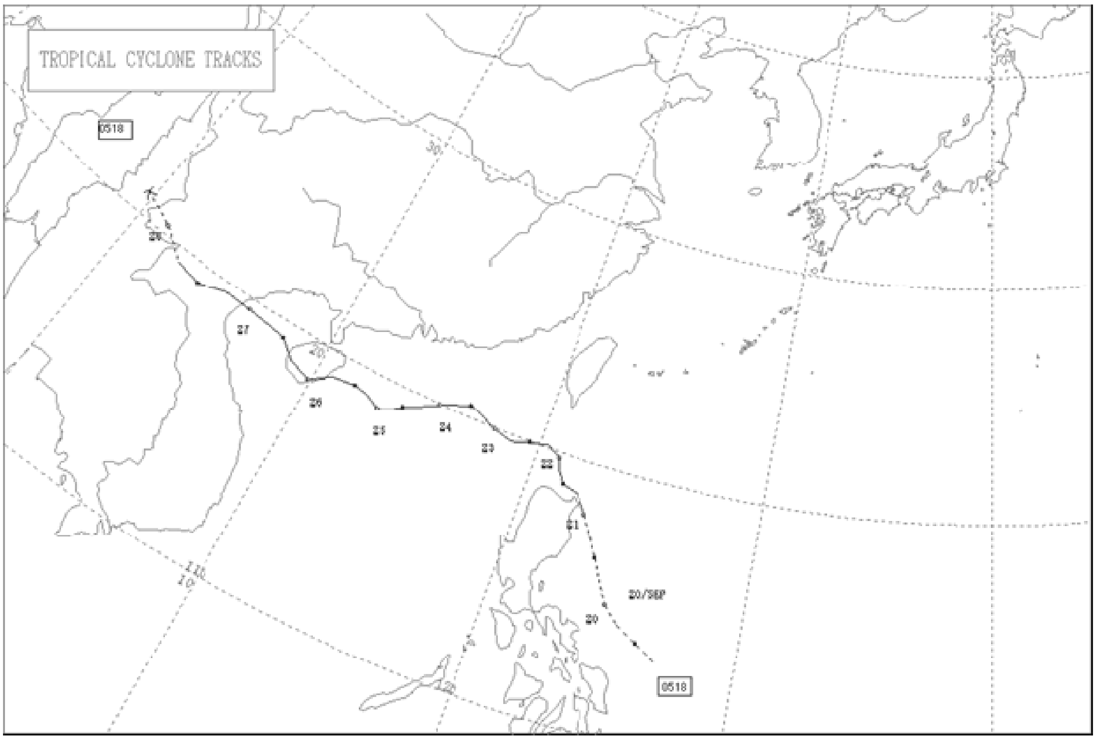
2.2.1. Typhoon Damrey

Damrey was the international name of tropical storm number 7 in 2005 in Vietnam. Damrey was born from Tropical Depression 17W (named by the Joint Typhoon Warning Center) on September 20, 2005. At 0:00 on that day, Damrey's eye was centered at latitude 18.7N and longitude 122.2E with a maximum wind speed of 34 knots. It became stronger in the following days and made landfall at Wanning, in the Hainan province of China at 4:00am on September 26 local time, with a sustained maximum wind speed of 75 knots. Damrey kept moving west towards Vietnam with somewhat lower intensity. In the early morning of September 27th, Damrey made landfall in coastal areas of Thai Binh, Nam Dinh, Thanh Hoa and Hai Phong provinces with a wind speed of 60 knots. After about 15 hours devastating a large area of Vietnam, Damrey attenuated and disappeared in Laos on the following day. The path of Damrey's motion is depicted in Figure 4.

According to meteorological specialists, Typhoon Damrey was the most powerful storm in Vietnam over the period 1996 to 2005. CCFSC statistics on the aftermath of Damrey, summarized in Table 4, reveal horrific human and asset losses. In less than a day of its life, Damrey killed 68 people and caused 28 others to be injured. To mitigate the aftermath of Damrey, more than 38,000 households, or more than 150,000 people, had to evacuate. In addition, Typhoon Damrey completely destroyed or badly damaged a wide range of physical assets and investments, such as agricultural crops, irrigation dykes, schools and hospitals.

Although the aftermath statistics might be subject to measurement errors, the losses are undeniably huge.

Figure 4: Path of the Motion of Damrey's Eye



Source: Japan Meteorological Agency. Time is in UTC

Table 4: Summary of Aftermath of Typhoon Damrey

Loss	Unit	Number
Human deaths	Person	68
Human injured	Person	28
Households evacuated	Household	38,317
Houses collapsed or swept away	House	4,746
Houses damaged	House	113,523
Schools collapsed, swept away or damaged	School	4,080
Hospital collapsed or swept away	Hospital	197
Paddy areas submerged or damaged	Hectare	244,619
Vegetable areas submerged or damaged	Hectare	62,507
Trees collapsed	Tree	1,106,263
Dykes collapsed, swept away or damaged	Meter	88,950
Length of roads damaged	Kilometer	267

Source: CCFSC Disaster Database

2.2.2. Evaluation Methodology

Although responsible organizations in Vietnam made detailed records in the aftermath of the typhoon, the statistics provided do not necessarily show the true impact of the typhoon, for a number of reasons. First, the data might be subject to enormous measurement errors. The responsible organizations acquire the aftermath statistics via a reporting system, starting from commune to district and finally to the province's level of authority. It is really difficult to imagine that such a complicated system as this has no problems during the data collection process. In addition, victims of the disasters, or relief agencies, have a tendency to exaggerate the effects of disasters in order to get more aid and support. This is a well-known problem in the literature (Taylor, 1979; Pelling, 2003; Guha-Sapir, *et al.* 2004).

Secondly, the statistics may only reflect the short-term aftermath of disaster, while the disasters can cause long-term negative impacts on livelihood and poverty. In the worst cases, disasters can trap people into persistent poverty (Carter, *et al.* 2007).

Evaluating the impact of such an event as Typhoon Damrey is very challenging. The first challenge is to identify the affected areas. One solution might be to rely on the media or storm tracking agencies. As storms are deadly and highly frequent disasters, a number of meteorological agencies have been paying attention to capturing, tracking and archiving the data for both forecasting and analysis purposes. The tracking data are very good in terms of providing the maximum wind speed and the path of the eye. Nevertheless, they do not identify affected localities precisely enough to link with micro data such as household surveys.

Another way to identify affected areas is through interviews with respondents in a household survey. This technique has long been employed to evaluate the impact of natural disasters (Morris, *et al.* 2002; Alvi and Dendir, 2011; Patt and Schröter, 2008). Unfortunately, this approach is not always feasible because it is very expensive to conduct household surveys with adequate sampling characteristics and observations to capture the information. In addition, such an identification strategy can be subjectively biased by respondents due to forgetting and a tendency to self-interest.

Figure 5: Typhoon Damrey, September – October, 2005

Source: Author's estimation

The second challenge we have to face when evaluating the impact of storms is that natural disasters are surprisingly not random events. As we have seen in the review above, storm frequencies are very much different from place to place, which lead to differences in the likelihood of being hit by a storm, expectations of storms and awareness and preparedness for dealing with them. All of these factors accumulate overtime to cause the economic background of the places to alter. In other words, there is selection endogeneity in the types of intervention made in storm-affected areas.

Our method of evaluating the impact of Typhoon Damrey aims at overcoming both these two challenges. For the first challenge, which is to identify the areas affected by Damrey, we have successfully developed a method that allows us objectively to identify communes (the smallest administrative division in Vietnam) hit by Typhoon Damrey with the minimum wind speed of 35 knots. The result is shown in Figure 5 and the algorithm is summarized as follows.

The core activity is to construct a trail following the path of the Typhoon's eye in which the wind speed is no less than 35 knots. An attempt to do this was made at the Division of Early Warning and Assessment of the United Nations Environment Program (Mouton and Nordbeck, 2005). This work utilizes the wind prediction model suggested by Holland (1980) but improves it further by taking into account the asymmetric nature of storm winds. Holland's model allows us to estimate the distance from the eye of a cyclone given a level wind speed. This model, however, assumes that the wind profile is symmetric, which is never the case (Australian Bureau of Meteorology). In really, in the Northern Hemisphere, wind speed on the right side of the eye is higher than wind speed on the left side. In the Southern Hemisphere, this relationship is reversed (Mouton and Nordbeck, 2005).

We follow the routine described in Mouton and Nordbeck (2005) with special concentration on preparing the data from storm archives for the best identification of the trail. The output of this routine is a geo-referenced shape-file that can be over-laid with a commune shape-file to identify affected communes.

It is worth noting that the process has been done for every severe storm that hit Vietnam between 1955 and 2010, rather than just for Typhoon Damrey. This is necessary because we need to obtain a measure of the long-term likelihood of being hit by storms to address potential selection biases.

In addition, to eliminate the potential selection biases, we employ a "matched-sample regression" strategy when estimating the impact of Damrey. This method involves two steps. First, we construct a better sample by selecting the most comparable households in the unaffected households using a propensity score matching, as pioneered by Rosenbaum and Rubin (1985).

Secondly, once the most relevant control group has been identified, we employ the following specification to estimate the impact of Damrey:

$$Y_{ci} = \alpha + \beta D_c + \gamma PS_c + \delta X_{ci} + \varepsilon_{ci} \qquad (1)$$

where:

- Y_{ci} is an outcome indicator of household i in commune c. Outcome indicators include food expenditure, total expenditure, total income, house repair expenses, and rice production.
- D_c is a dummy variable which takes a value of unity of commune c was hit by Typhoon Damrey and zero otherwise.
- PS_c is the propensity score used to construct the matched sample.

- X_{ci} is a set of control variables of household i in commune c, including demographic variables, education and employment variables.

The coefficient β captures the impact of Damrey. Since we will be fitting the model with the matched sample as well as controlling for the propensity score to being hit by Damrey, we are strongly convinced that biases will be eliminated to make β an unbiased estimate of the impact of Damrey.

2.2.3. Data and Empirical Results

Data used to fit the model above come from the Vietnam Household Living Standard Survey (VHLSS) 2006. The VHLSSs have been conducted by the General Statistics Office (GSO) of Vietnam since 2002 with technical and financial supports from the World Bank. The survey's questionnaire follows the structure employed by the Living Standards Measurement Study (LSMS) advocated by the World Bank since the early 1990s, and been conducted in a number of developing economies. The VHLSSs have been considered one of the highest quality surveys and are used in several research papers (Katsushi, *et al.* 2011; Nguyen Viet, 2011; Nguyen and Winters, 2011; Sepehri, *et al*. 2011; Mergenthaler, *et al.* 2009).

The VHLSS 2006, like the other VHLSSs, collected information on various aspects of households such as demographics, education, health, expenditure, economic activities and income sources. The VHLSS 2006 interviewed 9189 households in 3063 communes, which account for approximately one third of all the communes in Vietnam. The survey covered both rural and urban communities. The ratio of rural communes to urban communes is 2294/769, unsurprisingly close to the corresponding population ratio.

In this chapter we focus on the rural household sample. The rural households are much more vulnerable to natural disasters, both in terms of self-defense capacity and in terms of livelihood. The main livelihood of the rural households is agricultural activity, which is substantially fragile to storms. The rural sample comprises 6,882 households in 2,294 communes.

This sample is then merged with the commune-level data set containing a measure of Damrey and the long-term likelihood of being hit by a storm in a one-year period that we have described earlier. We are unable to match all of the communes in the two data sets, however, although most of them can be perfectly matched. Out of the 6,882 households in the rural sample, we can merge up to 6,831 households in 2,277 communes. This is the sample we will be working on.

There are 816 households in the sample, from 272 communes hit by Typhoon Damrey. The remaining 6,015 households were unaffected by Typhoon Damrey.[2] The 6,015 unaffected households were located in 2,005 communes. The sample of 275 Damrey communes and 2,005 non-Damrey communes form the sample (hereafter referred to as the Damrey dataset) that we will rely on to identify a "matched sample", used tomeasure the effects of Damrey at the commune level. We employ the propensity score method pioneered by Rosenbaum and Rubin (1985) and later adopted and developed further by many researchers ((Rubin and Thomas, 1996), (Smith and Todd, 2001), (Jalan and Ravallion, 2003)). The estimation of a propensity score has been officially supported by Stata Software since 2002 thanks to (Becker and Ichino, 2002).[3]

Table 5 presents basic statistics of several variables we have in the Damrey dataset. The variable "Probability of being hit by storm" measures the long-term likelihood that the commune is hit a storm with wind speeds at least 34 knots. It is constructed using the following formula:

$$Pstorm = 1 - e^{-\lambda} \quad (2)$$

where λ is the expected number of storms that hit the commune annually.

The parameter λ is the mean of yearly storms calculated over the last 30-year period. In fact, it is the key variable, and we are convinced that once we control for it we can eliminate most (if not all) of the potential biases. This is because this variable actually captures a many factors affecting storm exposure. For instance, coastal areas are subject to many more storms than inland areas, since storms will quickly lose their strength once they make landfall; the "long-term probability of being hit by a storm" variable also reflects very well the north/south regional divide

[2] Unaffected households are households in communes in which wind speeds due to Damrey were lower than 34 knots.
[3] The Stata command is pscore.

since, as we have seen earlier, storms do not happen frequently in the southern part of Vietnam.

We estimate the Propensity Score of impact by Damrey using the "pscore" routine in Stata. Basically, the score is the series of fitted values of the following logistic model:

$$Damrey_c = \alpha_0 + \alpha_1 Pstorm_c + \alpha_2 X_c + \varepsilon_c \quad (3)$$

where:

- $Damrey_c$ is a dummy variable which takes a value of unity if commune *c* were hit by Damrey and zero otherwise.
- $Pstorm_c$ is the long-term likelihood of being hit by a storm in a one-year period of commune *c*, estimated using the data on all storms in the last 30 years.
- X_c is a set of control variables for commune *c*.
- ε_c is the error term.

We have estimated Model **(3)** with several sets of control variables, such as distance to coast, and elevation, so as to seek for the specification that gives us the best matching result. The model is then determined to include no control X. This result does not surprise us, however. In fact, as we discussed above, the $Pstorm$ variable has already captured the information of elevation and distance to the coast, and it captures the information in a better way. Other infrastructure measures play insignificant roles because most of the communes have the infrastructure. In the end, '*pscore*' determines that 6 is the optimal number of blocks of the propensity score, so that the balancing property is satisfied (within each block).

Table 5: Summary Statistics of Damrey Dataset

Variable	Mean	N	SD	Min	Max
Probability of being hit by a storm	0.27	2226	0.15	0.00	0.58
Distance to coast	79627.89	2226	79543.66	78.92	453339.80
Elevation	136.32	2226	261.12	-6.93	1844.85
Coastal commune	0.07	2280	0.26	0.00	1.00
Delta commune	0.53	2280	0.50	0.00	1.00
Commune has car road	0.87	2280	0.33	0.00	1.00
Commune has market	0.64	2280	0.48	0.00	1.00
Commune has post office	0.87	2280	0.34	0.00	1.00

Source: Author's Calculations

Table 6 shows a summary of the two samples: the Unmatched sample (Damrey sample) and the matched sample. The matched sampling proves to be highly significant in terms of finding a more comparable control group. The gaps in $Pscore$ and $Pstorm$ between Damrey communes and non-Damrey communes in the unmatched sample are very high.

As we expect, Damrey communes have much higher scores for both two variables because Damrey communes are located in storm-prone areas. The matched sampling has narrowed down the gaps significantly. The average $Pscore$ in Damrey communes is 0.249 and 0.229 in the non-Damrey communes in the matched sample.

Table 6: Mean Comparison of Damrey versus Non-Damrey Communes

	Pscore	Pstorm	Distance to Coast	Elevation
Unmatched sample				
Non-Damrey communes	0.102	0.251	86596.528	149.723
Damrey communes	0.249	0.420	28498.465	37.999
All communes	*0.120*	*0.271*	*79627.892*	*136.322*
Matched sample				
Non-Damrey communes	0.229	0.408	69863.744	79.899
Damrey communes	0.249	0.420	28498.465	37.999
All communes	*0.234*	*0.411*	*59254.205*	*69.152*

Source: Author's own calculations

The matched sample contains 3,123 households in 1,041 communes, of which 801 households in 267 communes were hit by Damrey. Table 7 presents summary statistics of the variables we will use in the model used to estimate the impact of Damrey (Model **(1)**). We will estimate the impact of Damrey on 6 outcome measures, namely i) household expenditure measured in log, ii) household food expenditure measured in log, iii) household total income measured in log, iv) percentage of house repair expenses in total household expenditure and v) the quantity of rice harvested in the summer-autumn season. It is worth noting that the number of observations for house repair expenses and rice production variables are smaller because those households who did not repair houses or did not grow rice were not included in the summary.[4] Table 8 summarizes the results of the mean-difference tests of the key variables between Damrey-affected hosueholds and Damrey-unaffected households in the matched sample.

Table 7: Summary Statistics of the Matched Sample

Variable	Mean	N	SD	Min	Max
Log household expenditure	9.64	3123	0.55	7.44	11.53
Log food expenditure	8.94	3123	0.51	6.45	10.68
Log household income	9.80	3123	0.71	7.10	12.59
% house repair expenses in total household expenditure	0.25	492	0.47	0.00	4.59
Summer paddy production	987.62	379	1192.56	60.00	20000.00
Log head's age	3.86	3123	0.27	2.83	4.57
Head's gender	0.80	3123	0.40	0.00	1.00
Minority ethnicity	0.14	3123	0.35	0.00	1.00
Head's education is college	0.20	3123	0.40	0.00	1.00
Head worked for firms	0.08	3123	0.28	0.00	1.00
Household size	4.08	3123	1.55	1.00	15.00
% of children	0.21	3123	0.21	0.00	0.80
% of elderly	0.14	3123	0.29	0.00	1.00
% of members with college degree	0.17	3123	0.24	0.00	1.00
% of members working for wages	0.20	3123	0.22	0.00	1.00

Source: Author's Calculations

Table 8: Comparison of Control Variables

Control variable	Non Damrey	Damrey
Log head's age	3.848***	3.880***
Head's gender	0.793**	0.828**
Minority ethnicity	0.152***	0.102***
Head's education is college	0.202	0.186
Head worked for firms	0.086	0.076
Household size	4.117**	3.973**
% of children	0.214	0.210
% of elderly	0.142	0.154
% of members with college degree	0.179***	0.151***
% of members working for wages	0.206	0.197

Source: Author's calculations; Asterisks for mean-difference test: * significant at 10%; ** significant at 5%; *** significant at 1%.

[4] Actually, these household should have a value of zero for the variables.

A conventional approach to estimating the impacts of Typhoon Damrey using the matched sample is to simply compare the mean of the affected households with that of the unaffected households. However, one can make use of the propensity score as a regressor in regressions that estimate the impacts (Imbens, 2004). This way of exploiting the propensity score is relevant for our case since Damrey is identified in the same way to all the households in a commune and is exogenous to all household characteristics. In other words, household characteristics are still useful in explaining the outcome indicators of interest and thus should be controlled for.

We present results of the regressions that estimate the impacts of Damrey on rice production, household income, food expenditure, household expenditure and house repairs in Table 9, Table 10, Table 11 Table 12, and Table 13, respectively. In these tables, the first column shows the estimate of β with no controls. It can be considered the treatment effects estimated by the conventional matching method. In the subsequent columns, we gradually add more controls to see how robust the estimates of β are to the controls included.

Impact of Damrey on Rice Production

Typhoon Damrey was active during the last days of September 2005. This period overlapped with the Summer-Autumn rice season in Vietnam. The CCFSC data shows that 244,619 hectares of rice were damaged due to Damrey. Our analysis allows us to quantify the impact of Damrey in terms of the quantity of rice loss which is a much more precise measure of the aftermath.

Table 9: Dependent Variable: Summer-Autumn Rice Production

VARIABLES	(1)	(2)	(3)	(4)
Damrey	-1,343.60***	-1,168.62***	-1,207.04***	-1,711.54***
	(364.038)	(357.570)	(360.757)	(433.152)
Pscore		-8,970.23***	-9,055.49***	828.48
		(1,547.068)	(1,574.033)	(1,463.447)
Log head's age		373.27*	1,304.52***	621.08**
		(201.343)	(404.086)	(289.664)
Head's gender		220.25	272.32*	214.95
		(151.293)	(161.255)	(149.368)
Head's education is college or above		-3,396.41***	-3,420.08***	-1,237.18**

VARIABLES	(1)	(2)	(3)	(4)
		(793.076)	(779.195)	(488.526)
Head works for firms		-141.54	-49.75	-214.26
		(188.028)	(224.493)	(216.671)
Household size		53.52	328.23	-109.82
		(220.198)	(218.820)	(217.167)
Head's ethnicity is minority		185.19***	106.65**	98.32**
		(55.029)	(49.958)	(45.253)
% of children			521.02	-18.69
			(485.834)	(438.259)
% of elderly			-1,371.38***	-1,093.10***
			(380.293)	(317.818)
% with college or higher degree			-442.71	185.67
			(368.853)	(335.849)
% wage workers			-1,395.14***	-331.51
			(448.595)	(316.009)
Region fixed-effects	N	N	N	Y
Constant	-2,345.20***	-2,373.43**	-5,269.23***	-6,889.82***
	(455.579)	(932.213)	(1,707.959)	(1,988.132)
Observations	3,123	3,123	3,123	3,123
Pseudo R-squared	0.00777	0.0438	0.0481	0.134

Note: Robust standard errors in parentheses, clustered at commune level;
*Meaning of asterisks: *** p<0.01, ** p<0.05, * p<0.1*

Table 9 presents the regression results that show the impact of Damrey on rice production. These results come from the Tobit version of Model **(1)** because for those households who do not grow Summer-Autumn rice the dependent variable will have a value of zero. This means that the variable is left-censored at zero. The coefficient of Damrey is highly significant and robust. Its sign is negative suggesting that Damrey negatively affected rice production. Specifically, Damrey caused a loss of about 1.5 tons of rice for the affected households. This amount of rice loss is 60% of the average Summer-Autumn rice harvested by Summer-Autumn rice farmers.

Impact of Damrey on Total Household Income

Damrey caused impacts on household income via rice losses and through other channels. We investigate the impact by fitting Model **(1)** with the OLS procedure since the dependent variable is uncensored. The regression result is shown in Table 10. The coefficient of Damrey is negative and strongly significant in all the specifications of the regression. In terms of the order of magnitude, the coefficient ranges from 0.05 to 0.16, meaning that Damrey-affected households experienced from 5% to 17% reduction in income compared with unaffected households.

Table 10: Dependent Variable: Log Household Income

VARIABLES	(1)	(2)	(3)	(4)
Damrey	-0.163***	-0.146***	-0.129***	-0.053*
	(0.031)	(0.028)	(0.027)	(0.028)
Pscore		0.574***	0.515***	0.335**
		(0.132)	(0.125)	(0.147)
Log head's age		-0.192***	-0.140**	-0.110**
		(0.047)	(0.056)	(0.055)
Head's gender		0.087**	0.134***	0.136***
		(0.034)	(0.032)	(0.032)
Head's education is college or above		-0.298***	-0.275***	-0.306***
		(0.038)	(0.035)	(0.044)
Head works for firms		0.364***	0.053	0.062
		(0.031)	(0.038)	(0.038)
Household size		0.202***	0.093**	0.087**
		(0.039)	(0.036)	(0.036)
Head's ethnicity is minority		0.202***	0.186***	0.188***
		(0.010)	(0.011)	(0.010)
% of children			-0.278***	-0.251***
			(0.073)	(0.072)
% of elderly			-0.369***	-0.394***
			(0.057)	(0.057)
% with college or higher degree			0.749***	0.741***
			(0.064)	(0.063)
% wage workers			0.196***	0.146***
			(0.053)	(0.053)
Region fixed-effects	N	N	N	Y
Constant	9.847***	9.500***	9.348***	9.295***
	(0.018)	(0.191)	(0.221)	(0.224)
Observations	3,123	3,123	3,123	3,123
R-squared	0.011	0.301	0.382	0.399

Note: Robust standard errors in parentheses, clustered at commune level;
Meaning of asterisks: *** p<0.01, ** p<0.05, * p<0.1

Impact of Damrey on Food Expenditure

We also rely on the OLS procedure to estimate the impact of Damrey on the food expenditure of the households (measured in log). The regression results are presented in Table 11. In all the specifications, the coefficient of Damrey is always strongly significant and negative, suggesting a negative impact of Damrey on food expenditure. The size of the coefficient ranges from 0.038 to 0.104 showing that food expenditure in the affected households was 3.9% to 11% lower than in the unaffected households.

Table 11: Dependent Variable: Log Household Food Expenditure

VARIABLES	(1)	(2)	(3)	(4)
Damrey	-0.104***	-0.095***	-0.086***	-0.038*
	(0.023)	(0.020)	(0.019)	(0.020)
Pscore		0.582***	0.550***	0.210**
		(0.086)	(0.080)	(0.102)
Log head's age		-0.135***	-0.053	-0.035
		(0.029)	(0.037)	(0.037)
Head's gender		0.118***	0.149***	0.151***
		(0.022)	(0.020)	(0.020)
Head's education is college or above		-0.140***	-0.124***	-0.138***
		(0.027)	(0.025)	(0.030)
Head works for firms		0.196***	0.008	0.014
		(0.019)	(0.023)	(0.023)
Household size		0.145***	0.075***	0.081***
		(0.027)	(0.027)	(0.026)
Head's ethnicity is minority		0.191***	0.176***	0.179***
		(0.007)	(0.008)	(0.007)
% of children			-0.206***	-0.186***
			(0.044)	(0.043)
% of elderly			-0.336***	-0.347***
			(0.037)	(0.036)
% with college or higher degree			0.441***	0.428***
			(0.045)	(0.044)
% wage workers			0.098***	0.061*
			(0.035)	(0.035)
Region fixed-effects	N	N	N	Y
Constant	8.965***	8.437***	8.200***	8.249***
	(0.013)	(0.116)	(0.144)	(0.145)
Observations	3,123	3,123	3,123	3,123
R-squared	0.009	0.436	0.509	0.528

Note: Robust standard errors in parentheses, clustered at commune level;
Meaning of asterisks: *** p<0.01, ** p<0.05, * p<0.1

Impact of Damrey on Total Expenditure

According to Table 12, which summarizes the results of regressions used to investigate the impact of Damrey on total expenditure, Typhoon Damrey caused significant welfare losses to the affected households. The impact coefficient ranges from -.0147 to -0.074 suggesting that, due to Damrey, the affected households expenditure levels lower than unaffected ones by 7.4% to 15.8%.

Table 12: Dependent Variable: Log household Expenditure

VARIABLES	(1)	(2)	(3)	(4)
Damrey	-0.147***	-0.134***	-0.117***	-0.074***
	(0.025)	(0.022)	(0.020)	(0.022)
Pscore		0.600***	0.560***	0.244**
		(0.105)	(0.096)	(0.118)
Log head's age		-0.107***	-0.079*	-0.064
		(0.035)	(0.045)	(0.044)
Head's gender		0.094***	0.130***	0.132***
		(0.025)	(0.022)	(0.022)
Head's education is college or above		-0.243***	-0.228***	-0.213***
		(0.033)	(0.031)	(0.039)
Head works for firms		0.262***	-0.030	-0.022
		(0.024)	(0.026)	(0.026)
Household size		0.238***	0.169***	0.172***
		(0.034)	(0.033)	(0.033)
Head's ethnicity is minority		0.181***	0.168***	0.170***
		(0.009)	(0.009)	(0.009)
% of children			-0.300***	-0.285***
			(0.053)	(0.052)
% of elderly			-0.369***	-0.383***
			(0.043)	(0.042)
% with college or higher degree			0.692***	0.680***
			(0.053)	(0.052)
% wage workers			0.004	-0.035
			(0.041)	(0.041)
Region fixed-effects	N	N	N	Y
Constant	9.647***	9.057***	9.033***	9.099***
	(0.015)	(0.143)	(0.176)	(0.175)
Observations	3,099	3,099	3,099	3,099
R-squared	0.014	0.358	0.460	0.476

Note: Robust standard errors in parentheses, clustered at commune level;
Meaning of asterisks: *** p<0.01, ** p<0.05, * p<0.1

Impact of Damrey on House Repair Expenses

The aftermath in the form of shelter damage is particularly interesting to look at. Although households in storm-prone areas have a tendency to invest in more durable shelters, huge damage can easily occur during severe storms. To investigate whether this was the case with Damrey, we estimate Model **(1**) with the dependent variable being the expense incurred in house repairs. Since there are households who happened to have no spending on house repair over the last 12 months, the variable is left-censored at zero. Therefore, we will employ the Tobit procedure to estimate the coefficients.

As we have seen, the impacts of Damrey on income and consumption are very significant and robust (Table 13). We therefore expected Damrey to have a strong impact on houses as well. As it turns out, the coefficient of Damrey in all the specifications is strongly significant and the sizes are very robust. The coefficient's sign is positive, suggesting that households affected by Damrey had to raise their spending on house repairs. Specifically, due to Damrey, they had to spend from 12% to 14% of total expenditure on repairing their houses. These expenses contribute to the reasons why households had to reduce food and other consumption.

Table 13: Dependent Variable: House Repairs (% in total expenditure)

VARIABLES	(1)	(2)	(3)	(4)
Damrey	0.13***	0.13***	0.13***	0.13***
	(0.042)	(0.042)	(0.042)	(0.045)
Pscore		0.08	0.06	-0.09
		(0.206)	(0.206)	(0.233)
Log head's age		0.05	-0.09	-0.10
		(0.072)	(0.099)	(0.098)
Head's gender		0.06	0.06	0.06
		(0.053)	(0.055)	(0.054)
Head's education is college or above		-0.07	-0.06	-0.04
		(0.059)	(0.059)	(0.072)
Head works for firms		0.06	0.02	0.02
		(0.050)	(0.062)	(0.062)
Household size		0.01	-0.05	-0.05
		(0.061)	(0.063)	(0.063)
Head's ethnicity is minority		0.01	0.02*	0.02*
		(0.012)	(0.014)	(0.015)
% of children			-0.24**	-0.24**

VARIABLES	(1)	(2)	(3)	(4)
			(0.112)	(0.112)
% of elderly			0.09	0.10
			(0.102)	(0.102)
% with college or higher degree			0.13	0.12
			(0.119)	(0.120)
% wage workers			0.21**	0.21**
			(0.084)	(0.085)
Region fixed-effects	N	N	N	Y
Constant	-0.75***	-1.06***	-0.58	-0.49
	(0.087)	(0.328)	(0.397)	(0.394)
Observations	3,123	3,123	3,123	3,123
Pseudo R-squared	0.00438	0.00734	0.0137	0.0147

Note: Robust standard errors in parentheses, clustered at commune level;
Meaning of asterisks: *** p<0.01, ** p<0.05, * p<0.1

3. Disaster Risk Management in Vietnam

3.1.Policy Responses

The Government of Vietnam has considered the dangers of climate change and natural disasters to be a national threat, and established a specialized agency to control and coordinate the whole system. In Vietnam, several ministries take part in the national system, including the Ministry of Natural Resources and Environment (MONRE), the Ministry of Agricultural and Rural Development (MARD), the Ministry of Transport (MOT), the Ministry of Health (MOH), the Ministry of Construction (MOC), the Ministry of Industry and Trade (MOIT), the Ministry of Investment and Planning, the Ministry of Finance (MOF) and the Ministry of Education and Training (MOET).

National Targeted Program to Respond to Climate Change (NTPRCC)

The NTPRCC was initiated in 2008, after a decade of preparation and gradually increasing international cooperation. The Program has specified 8 national objectives, including:

1. Assessing the extent and impacts of climate change in Vietnam in the context of global climate change;

2. Identifying measures to respond to climate change;
3. Enhancing research activities to develop scientific and practical foundations for measures to respond to climate change;
4. Enhancing and strengthening institutional, organizational policies and capacities on climate change issues;
5. Raising awareness and a sense of responsibility of the population and strengthening human resources;
6. Enhancing international cooperation and promoting low-emission development
7. Integrating climate change issues into socio-economic, sectoral and local development strategies, plans and planning; and
8. Developing and implementing the action plans of ministries, sectors and localities in responding to climate change.

The NTRPC has so far been operational for nearly four years, with encouraging achievements. Five years ago, policies on climate change were vague and overlapped across ministries and sectors. As of today, according to Mr. Naoki Mori of the Japan International Cooperation Agency (JICA), efforts in responding to climate change have resulted in achievements in "designing and developing policies and legal frameworks; promoting policy discussions; strengthening coordination; identifying financing sources for climate change projects and mobilizing various resources" (MONRE, 2012).

Table 14: Policy Matrix: Support Program to Respond to Climate Change

ID	Objective		Agency
1	COPING	Development together with Coping with Climate Change: Enhancing Coping Capacity of Water Resources	MONRE; MARD
2		Development together with Coping with Climate Change: Enhancing General Management of Coastal Areas	MONRE
3		Development together with Coping with Climate Change: Enhancing Management of Natural Resources	MONRE; MARD
4		Development together with Coping with Climate Change: Enhancing Management of Infrastructure	MOT; MOC
5		Development together with Coping with Climate Change: Enhancing Management of Health System	MOH
6		Development together with Coping with Climate Change: Enhancing Management of Agriculture and Food Security	MARD
7	MITIGATION	Development with less Carbon Emissions: Exploiting potential Mechanisms of Economical and Efficient use of Energy	MOIT; MOT; MOC
8		Promoting Development of Renewable Energy	MOIT; MARD
9		Carbon Reservoir: Enhancing Management of Development of Forests	MARD
10		Enhancing Management of Wastes	MOC; MONRE;
11		Reducing Green House Gas Emissions in Agriculture and Food Security	MARD
12	LEGAL FRAMEWORK	Enhancing Autonomy in Designing, Prioritizing and Implementing CC Policies	MPI; MONRE; MARD
13		Enhancing Legal Framework for Financing Climate Change-Related Activities	MPI; MOF
14		Promoting Information on Climate Change for the Public	MONRE

Source: National Targeted Program to Respond to Climate Change

The Program has identified a 3-Year Policy Matrix that specifies clear objectives of responding policies and implementing agencies, focusing on three pillars, namely, coping, mitigating, and the legal framework and cross-sectoral coordination. The

Matrix has been approved by the Prime Minister and in the process of implementation. Its structure is summarized in Table 14.

To achieve an effective system for natural disaster risk management, one cannot separate disaster management and environment management. Tran and Shaw (2007) have pointed out that there is a big gap between policies and actions on disaster and environment management in Thua Thien – Hue province of Vietnam. They argue that most recent projects focus on addressing the hazard risk by building durable infrastructure to mitigate the impact of disasters, rather than looking at a broader picture having both hazard risk and environment dynamic elements.

3.2.Towards an Effective Disaster Risk Management System in Vietnam

3.2.1. Review of Disaster Risk Management Approaches

The literature has accumulated long chapters on disaster risk management approaches. Guzman (2003) has briefly summarized the most important approaches that have been discussed in the field of risk management so far. To draw focus we discuss further several approaches that are potentially relevant for Vietnam.

The "all-hazards" approach proposes to tackle many disasters in one risk management framework. The all-hazards approach has certain strengths, such as the capacity to provide similar emergency responses in response to a wide range of disasters (Cornall, 2005) and the ability to avoid the artificial divide between a physical and a social emphasis (Berkes, 2007). Nevertheless, disasters are far from homogeneous in any aspect, from consequences to responses needed, and thus require specific actions to deal with them. The approach "cannot be stretched to every potential crisis situation" as argued in McConnell and Drennan (2006).

The integrated approach involves the participation of all the stakeholders, namely government, private sectors, public and community organizations and households, into the disaster risk management system. Thus, many responses such as mitigation, preparedness, and warning can be efficiently coordinated and carried out before disasters take place (Moe and Pathranarakul, 2006).

The "vulnerability reduction" approach functions by interfering with and managing the risk exposure and coping capability components of the disaster risk. This approach seemingly assumes that the third component of the risk, namely the hazard potential or the possibility of being hit by disasters is out of human control. For instance, one can possibly argue that nobody has the ability to control when or where a typhoon will appear.

3.2.2. Total Disaster Risk Management (TDRM) Approach

This approach to disaster risk management is thoroughly documented in Guzman, 2003. The TDRM Approach originated in the Asian Disaster Reduction Center and UN Office for the Coordination of Humanitarian Affairs (OCHA) Asian Disaster Reduction Unit. Guzman (2003) outlines the core of the TDRM approach as the following:

- The foundation of this approach is based on the integration of existing knowledge and techniques on disaster reduction and response, and risk management.
- It necessarily focuses on the underlying causes of disasters, the conditions of disaster risks and the vulnerability of the community. It also emphasizes multilevel, multidimensional and multidisciplinary cooperation and collaboration, in achieving effective disaster reduction and response. This approach intends to integrate, complement, and enhance existing disaster reduction and response strategies.
- The approach promotes effective integration of stakeholders' action through multilevel, multidimensional and multi-disciplinary coordination and collaboration, a critical strategy toward improving disaster reduction and response. Also, it facilitates broad-based participation in policy and program development in disaster reduction and response as they relate with other development concerns, such as poverty reduction, land use planning, environmental protection, and food security.
- However, in adopting the TDRM Approach, accurate and reliable hazard, vulnerability and disaster risk information is vital. The approach attaches great importance to hazard mapping and vulnerability assessment as a fundamental tool for good decision-making and efficient sharing of disaster risk information.

With the outlined foundation, the TDRM approach aims at achieving 3 objects:

1. To address holistically and comprehensively the various concerns and gaps in the different phases of the disaster management cycle by considering the underlying causes of disasters (i.e. the conditions of disaster risks) and the broader set of issues and contexts associated with disaster risk and its management;
2. To prevent, mitigate, prepare for, and respond effectively to the occurrence of disasters through the enhancement of local capacity and capability, especially in disaster risk management (i.e. recognizing, managing and reducing disaster risks, and ensuring good decision-making in disaster reduction and response based on reliable disaster risk information); and
3. To promote multilevel, multidimensional and multidisciplinary coordination and collaboration among stakeholders in disaster reduction and response as they ensure the participation of the community, the integration of stakeholders' action, and the best use of limited resources.

Guzman (2003) proposes five implementation steps to achieve the three objectives as follows:

1. Achieving effective disaster reduction and response through multilevel, multi-dimensional and multidisciplinary cooperation and collaboration.
2. Making decisions based on reliable disaster risk information from hazard mapping and vulnerability assessment.
3. Enhancing coordination and integration of stakeholders' action through good communication and efficient exchange of relevant and reliable information
4. Ensuring that appropriate enabling mechanisms are in place, including policy, structure, capacity building, and resources.
5. Implementing the disaster risk management process from the national level to the community level.

A number of countries have adopted the TDRM approach and contributed good practices for other countries to draw lessons learnt. Among those countries are Armenia, India, Indonesia, Japan, Myanmar, Nepal, Singapore, Sri Lanka, and Thailand. We strongly believe that adopting the TDRM approach could be a way towards effective disaster risk management for Vietnam.

4. Policy Recommendation

4.1. National Level

Recommendation 1: Concentrate on implementing the NTPRCC

The Government of Vietnam has been very active in the fight against climate change and natural disasters. It has put these two areas among the top priorities such as poverty reduction and healthcare. The National Target Program to Respond to Climate Change (NTP-RCC) was approved by the Prime Minister in December 2008. In March 2012, the Government launched the National Strategy on Climate Change (NSCC). Issues, objectives, methods and tools have been identified; the Government now has to focus of the implementation of the NTP-RCC and the NSCC.

Recommendation 2: Stay open-minded and make necessary changes along the way

Over a relatively short period of time, from 2007 to 2011, the Government has achieved much in terms of identifying climate change and natural disasters issues; setting objectives and goals; and setting legal frameworks for measures to be implemented. Policies have been designed and stated clearly in the NTP-RCC's documents and the NSCC. However, it is likely that the context will change in the years to come, and new issues as well as challenges will emerge. The Government thus needs to stay alert, open-minded to make necessary changes on time.

Recommendation 3: Achieve objectives by taking all possible opportunities

Issues of climate change and natural disasters can be addressed by direct measures such as raising awareness, conducting research and applying research outcomes and preventing deforestation. However, the Government should not restrict itself to direct measures. The ultimate and intermediate goals of the work in relation to climate change and natural disasters can also be achieved via indirect measures. For instance, deforestation is mainly due to human activities which are driven by economic pressures. In most cases, poor people are 'forced' to go to forests and cut down trees because they have no livelihood alternatives. Thus, to prevent deforestation, the Government can instead focus on job creation programs (together with others) rather than just stressing forest-policing work. Measures like this are called indirect measures and, in many cases, indirect measures help address the issues from their root-causes.

4.2. Regional Cooperation

As a matter of fact, Vietnam is part of a global chain when dealing with natural disasters and climate change. While Vietnam has to be proactive in dealing with natural disasters and climate change issues, it can shorten the road with cooperation and assistance from other countries. This section presents recommendations that can be relevant for Vietnam in the context of regional cooperation.

Recommendation 1: Utilize the advantages of being a developing country

Although Vietnam has achieved remarkable successes in economic growth and poverty reduction over the last few decades, it is still one of the poorest countries in the world. It is fair to say that a large part of recent success is due to external support. Vietnam can become a middle-income country in the near future, but until then, Vietnam should be active in approaching the donor community to seek both technical and financial support. However, the most important thing is that Vietnam has to utilize any support in the most responsible and effective way.

Recommendation 2: Promote capacity building

Capacity building is a useful measure to achieve stated goals, because how successful the implementation of a policy will be depends on people's awareness and cooperation. The Government should intensify its capacity building activities to date (for example, community-based risk management projects) and set up channels for new activities. Another reason to promote capacity building is that it is a good selling point in seeking financial support from the donor community.

Recommendation 3: Highlight clean energy and low-emission development

A development strategy that developing countries like Vietnam are tempted to adopt is "cheap development", focusing on current and short-term economic growth and accepting a negative impact on environmental protection goals. Vietnam has already experienced the way in which such a strategy brings about increasing environmental problems (Agusa, *et al*., 2006; Jacobs, 1995; O'Rourke, 2004). It is about time for Vietnam to reconsider and make necessary changes in its development strategy. A wise choice would be to highlight and stress the use of clean energy and to target a low-emission development strategy. Doing so, Vietnam can not only ensure engines to sustain economic growth, but also could appear more “friendly” to the donor community and is more likely to receive support.

Recommendation 4: Be active in regional coordination

Vietnam should play a considerable role in the South East Asia region in the fight against climate change and natural disasters. In a recent publication, Aggarwal and Sivakumar (2011) discuss an adaptation and mitigation framework for South Asia to cooperate in climate change and food security policies and highlight the following key areas:

- Assisting Farmers in Coping with Current Climatic Risks
- Intensifying Food Production Systems
- Improving Land, Water, and Forest Management
- Enabling Policies and Regional Cooperation
- Strengthening Research for Enhancing Adaptive Capacity

The key areas are not only what Vietnam should focus on, but some of them are areas in which Vietnam can play a leading role, such as food production systems and land, water, and forest management.

Recommendation 5: Seek for more bilateral cooperation

Besides regional cooperation, Vietnam should also intensify existing bilateral partnerships and expand to new relationships. Bilateral collaborations such as the Norwegian-Vietnamese Scientific Cooperation on Climate Change should be expanded to take opportunities from developed countries.

5. Conclusion

After two decades achieving high and steady economic growth, in the midst of global financial and economic crises, the economy of Vietnam has started to slow down significantly. Vietnam’s economic structure is still heavily dependent on agriculture with nearly three quarters of the population currently living in rural areas. The country is therefore very vulnerable to natural disasters and climate change.

Unfortunately, natural disasters are real threats to the country. Storm and flood are deadly disasters that occur very frequently, killing many people and devastating huge amounts of assets every year. Vietnam is also considerably vulnerable to climate change. Under the scenario that the sea level rises by 100 cm, nearly one quarter of Ho Chi Minh city, Vietnam's largest city and its major economic driving force, will be submerged and 13% of the Mekong River Delta, the major rice producing region, will be under the water.

The Government of Vietnam has been actively engaged in the fight against natural disasters and climate change. It has set climate change at the top of its priorities. At the same time, the Government is also very active in regional and international cooperation related to climate change. Nevertheless, the country has much to do to prepare for challenges in the years to come and help its people adequately mitigate and cope with natural disasters and climate change.

This chapter is an attempt to provide an evidence-based assessment of natural disasters and recommendations to policies makers to help the country move toward effective disaster risk management. It finds that storms greatly affect household welfare and livelihoods. The finding suggests that while short-term aftermaths are tremendously high, the impact of natural disasters can persist, bringing down living standards for some time.

Based on a review of existing studies, the chapter suggests an array of recommendations with the hope that they can make positive contributions to the policy making process in Vietnam, so as to achieve its declared goals. The recommendations focus on measures and approaches relevant for national implementation as well as regional collaboration.

References

Aggarwal, P., and M. V. K. Sivakumar (2011), 'Global Climate Change and Food Security in South Asia: An Adaptation and Mitigation Framework', in Lal, R. M.V.K. Sivakumar, S.M.A. Faiz, M. Rahman and K.R. Islam (eds.), *Climate Change and Food Security in South Asia*, pp.253-275.

Agusa, T., T. Kunito, J. Fujihara, R. Kubota, T. B. Minh, P. T. Kim Trang, and S. Tanabe (2006), 'Contamination by Arsenic and other Trace Elements in Tube-well Water and its Risk Assessment to Humans in Hanoi, Vietnam', *Environmental Pollution* 139(1), pp.95-106.

Alvi, E. and S. Dendir (2011), 'Weathering the Storms: Credit Receipt and Child Labor in the Aftermath of the Great Floods (1998) in Bangladesh', *World Development* 39(8), pp.1398-1409.

Australia Government Bereau of Meteorology (n.d.). *Tropical Cyclones Frequently Asked Questions.* Australia Government Bereau of Meteorology . http://www.bom.gov.au/cyclone/faq/ (accessed on April 22, 2012)

Becker, S. O. and A. Ichino (2002), 'Estimation of Average Treatment Effects based on Propensity Scores', *Stata Journal* 2(4), pp.358-377.

Berkes, F. (2007), 'Understanding Uncertainty and Reducing Vulnerability: Lessons from Resilience Thinking', *Natural Hazards* 41(2), pp.283-295.

Carter, M. R., P. D Little, T. Mogues and W. Negatu (2007), 'Poverty Traps and Natural Disasters in Ethiopia and Honduras', *World Development* 35(5), pp.835-856.

Cornall, R. (2005), 'New Levels of Government Responsiveness for ‘All-Hazards’: the Management of Natural Disasters and Emergencies', *Australian Journal of Public Administration* 64(2), pp.27-30.

Dasgupta, S., B. Laplante, S. Murray, and D. Wheeler (2009), *Sea-level Rise and Storm Surges : A Comparative Analysis of Impacts in Developing Countries*, Washington D.C.: The World Bank.

Guha-Sapir, D., D.Hargitt, P. Hoyois, R. Below, and D. Brechet (2004), *Thirty Years of Natural Disasters 1974-2003 : The Numbers*. Brussels: University of Louvain Presses.

Guzman, E. M. de. (2003), *Towards Total Disaster Risk Management Approach*, Asian Disaster Reduction Center and United Nations Office for the Coordination of Humanitarian Affairs- Asian Disaster Response Unit. Bangladesh: Nirapad.

Hoang Tri, N., W. N. Adger, and P. M. Kelly (1998), 'Natural Resource Management in Mitigating Climate Impacts: The Example of Mangrove Restoration in Vietnam', *Global Environmental Change* 8(1), pp.49-61.

Holland, G. J. (1980), 'An Analytic Model of the Wind and Pressure Profiles in Hurricanes', *Monthly Weather Review* 108(8), pp.1212-1218.

Imbens, G. W. (2004), 'Nonparametric Estimation of Average Treatment Effects Under Exogeneity: A Review', *Review of Economics and Statistics* 86(1), pp.4-29.

Jacobs, J. W. (1995), 'Mekong Committee History and Lessons for River Basin Development', *Geographical Journal* 161(2), pp.135-148.

Jalan, J., and M. Ravallion (2003), 'Estimating the Benefit Incidence of an Antipoverty Program by Propensity-Score Matching', *Journal of Business & Economic Statistics* 21(1), pp.19-30.

Katsushi, I., G. Raghav, and K. Woojin (2011), 'Vulnerability and Poverty Dynamics in Vietnam', *Applied Economics* 43(25), pp.3603-3618.

McConnell, A., and L. Drennan (2006), 'Mission Impossible? Planning and Preparing for Crisis1', *Journal of Contingencies and Crisis Management* 14(2), pp.59-70.

Mergenthaler, M., K. Weinberger, and M. Qaim (2009), 'The Food System Transformation in Developing Countries: A Disaggregate Demand Analysis for Fruits and Vegetables in Vietnam', *Food Policy* 34(5), pp.426-436.

Moe, T. L., and P. Pathranarakul (2006),'An Integrated Approach to Natural Disaster Management: Public Project Management and Its Critical Success Factors', *Disaster Prevention and Management 15*(3), pp.396 - 413.

MONRE (2012), *Chính sách biến đổi khí hậu đã có nhiều thay đổi tích cực.* (in Vietnamesse). Hanoi: NTPRCC. http://ntprcc.gov.vn/index.php?option=com_content&view=article&id=231 (accessed on May 5, 2012)

Morris, S. S., O. Neidecker-Gonzales, C. Carletto, M. Munguía, J. M. Medina, and Q. Wodon, (2002), 'Hurricane Mitch and the Livelihoods of the Rural Poor in Honduras',*World Development* 30(1), pp.49-60.

Mouton, F. and O. Nordbeck (2005), 'Cyclone Database Manager--A Tool for Convering Point Data from Cyclone Observations into Tracks and Wind Speeed Profiles in a GIS', (GRIDG Division of Early Warning and Assessment (DEWA), Trans.). Geneva: United Nations Environment Programme (UNEP).

Nguyen, M. C., and P. Winters (2011), 'The Impact of Migration on Food Consumption Patterns: The Case of Vietnam', *Food Policy 36*(1), pp.71-87.

Nguyen Viet, C. (2011), 'Poverty Projection Using a Small Area Estimation Method: Evidence from Vietnam', *Journal of Comparative Economics 39*(3), pp.368-382.

O'Rourke, D. (2004), *Community-driven Regulation: Balancing Development and the Environment in Vietnam*, Cambridge: The MIT Press.

Patt, A. G., and D. Schröter (2008), 'Perceptions of Climate Risk in Mozambique: Implications for the Success of Adaptation Strategies', *Global Environmental Change* 18(3), pp.458-467.

Pelling, M. (2003), *The Vulnerability of Cities : Natural Disasters and Social Resilience*. Sterling: Earthscan Publications.

Pham, H. T. T., and M. Furukawa (2007), 'Impact of Sea Level Rise on Coastal Zone of Vietnam', *Bulletin of the College of Science. University of the Ryukyus* 84, pp.45-59.

Pilarczyk, K. W. and N. S. Nuoi (2005), 'Experience and Practices on Flood Control in Vietnam',*Water International* 30(1), pp.114-122.

Rosenbaum, P. R. and D. B. Rubin (1985), 'Constructing a Control Group using Multivariate Matched Sampling Methods that Incorporate the Propensity Score', *The American Statician* 39(1), pp.33-38.

Rubin, D. B. and N. Thomas (1996), 'Matching Using Estimated Propensity Scores: Relating Theory to Practice', *Biometrics* 52(1), pp.249-264.

Sepehri, A., S. Sarma, and U. Oguzoglu (2011) ,'Does the Financial Protection of Health Insurance Vary across Providers? Vietnam's Experience', *Social Science & Medicine* 73(4), pp.559-567.

Shaw, R. (2006), 'Community-based Climate Change Adaptation in Vietnam: Inter-linkages of Environment, Disaster, and Human Security', in Sonak, S. (ed.), *Multiple Dimension of Global Environmental Changes*. New Delhi: TERI Publication, pp. 521-547.

Smith, J. A., and P. E. Todd (2001), 'Reconciling Conflicting Evidence on the Performance of Propensity-Score Matching Methods', *The American Economic Review* 91(2), pp.112-118.

Taylor, A. J. (1979), 'Assessment of Victim Needs', *Disasters* 3(1), pp.24-31.

Tran, P., and R. Shaw (2007), 'Towards an Integrated Approach of Disaster and Environment Management: A Case Study of Thua Thien Hue Province, Central Viet Nam', *Environmental Hazards* 7(4), pp.271-282.

Wang, M., C. Liao, S. Yang, W. Zhao, M. Liu, and P. Shi (2012), 'Are People Willing to Buy Natural Disaster Insurance in China? Risk Awareness, Insurance Acceptance, and Willingness to Pay', in Greenberg, M. R. (ed.) *Risk Analysis* 32 (7).