The impact of natural disaster on households' decision in Vietnam
-Analysis of food consumption and migration decision-

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Chapter 1 Introduction

1.1. Background

1.1.1. Natural disasters in Vietnam

In addition to being a developing country that reduced its poverty with rapid economic growth, Vietnam is also known as a country frequently attacked by natural disasters, ranked the seventh most disaster-prone country worldwide (Fock, 2017). Located in the eastern part of the Indochinese Peninsula in the "S" shape, Vietnam has a long seaside bordered by the South China Sea, a part of the Pacific Ocean. This geographical location makes Vietnam highly exposed to ENSO-related climate shocks known as El Niño and La Niña, which are cyclical; typically, every four years, the phenomena recurs, usually lasting for a long period of nine to twelve months or longer (Sutton et al., 2019); Vietnam is often affected by tropical storms or typhoons since the country has a 3,260 km length of coast (Vietnam Government Portal).

Moreover, while global warming has emerged as a noticeable issue for scientists and governments worldwide, in Vietnam this has attracted more attention because of its remarkable vulnerability to climate change which is projected to increase disaster impacts, especially in term of the timing, frequency, severity, and intensity of hydro-meteorological events. Vietnam is ranked second after China by the percentage increase in surge zones when compared to current surge zones, with 35.1%, and ranked third after Indonesia and China by the absolute impacts of sea level rise and intensified storm surges on land and coastal populations (5,432 km^2 and 4.4 million) in the East Asia and Pacific region (Dasgupta et al., 2009).

Tropical storms and typhoons are the most frequent and disastrous natural risks in Vietnam. Using information from the Japan Meteorological Agency through the storm archive on each storm that has occurred since 1951, Trung's (2013) calculation result showed that Vietnam experienced 4.3 storms annually. Similar information is shown in reports on annual natural hazards on the website of the Vietnam Disaster Management Authority, with at least 60 storms or typhoons causing significant losses in Vietnam from 2006 to 2019. Tropical storms and typhoons usually affect central Vietnam, the major coastal region. Sometimes, they attack coastal provinces in the Mekong

Delta region. Storms and typhoons often bring torrential rain, which causes floods in the affected regions. Thus, following storms, floods stand second in the list of common natural disasters occurring in Vietnam.

In addition to heavy rains following storms causing floods, La Niña, which usually increases rainfall, is another flood sourc. Flash floods often occur in the northern and central parts of Vietnam while river runoff floods occur every year in the Mekong Delta region because of delta region's relatively flat and low-lying topography. These river runoff floods tend to remain for months. In the Red River Delta, floods are mainly caused by intense rain, exacerbated by tidal effects (Pilarczyk & Nuoi, 2005).

Floods also occur, however, after heavy rains because of the problem in the drainage system due to unplanned urban development in big cities such as Ho Chi Minh City. From 1990 to 2009, Vietnam faced about 3.4 flood events every year, and the number of floods seemed to be higher over time (Trung, 2013). This is clarified again through reports on the annual natural disaster damage of the Vietnam Disaster Management Authority. Between 2006 and 2019, there were more than 85 flood events that resulted in a loss in Vietnam. This means that, on average, at least six floods occur annually in Vietnam during this period.

Severe droughts have not often occurred in Vietnam. However, in recent years, droughts have emerged as a need to pay attention to the effects of global warming and sea level rise, especially when El Niño occurs. Sutton et al. (2019) studied ENSO in Vietnam and mentioned that there were four severe droughts among six El Niño years 1997-1998, 2004-2005, 2010, and 2014-2016 based on historical data. Crucial droughts occurred in the Central Highlands, while serious salt-water intrusion occurred in coastal provinces located in the South Central and Mekong Delta regions. In contrast, since the mountains and hills, which are generally low altitude, cover three-fourths of Vietnam's mainland (Vietnam Government Portal), the country is also prone to landslides. Northern uplands and central highlands are exposed to this kind of disaster, while the Central Coast and the South usually experience coastal and river erosion. In addition, Vietnam often faces damage from other natural hazards such as cold waves, tornadoes, and hailstorm.

According to the Ministry of Agriculture and Rural Development, in the past 20 years, regions across the country have suffered from almost all types of natural disasters (20 out of 21 types of natural disasters, excluding tsunamis), causing heavy loss of life, property, facilities, and infrastructure, adversely affecting the living environment, production, and business of the Vietnamese. Moreover, natural disasters tend to increase abnormally. The number of occurrences and intensity is increasing, especially strong storms, heavy rains, floods, inundation, flash floods, landslides, extreme cold, harmful cold, hot weather, droughts, and salt-water intrusion.

Efforts for disaster risk reduction and mitigation have become the prior actions that Vietnam needs to implement.

1.1.2. Government reaction

At the Conference organized by the Central Committee for Disaster Prevention and Control/Ministry of Agriculture and Rural Development and the World Bank aimed at helping Vietnam manage disaster risks, the World Bank (2017) remarked that Vietnam is highly prone to natural hazards, with over 70 percent of the population exposed to natural risks, while only about 5% of assets in the country are covered by insurance. According to the acting Country Director for the World Bank in Vietnam, natural disasters can destroy decades of development, and the cost of rebuilding could be more than the cost of investment in disaster resilience.

Having a similar opinion, the Vietnamese government has made considerable efforts to respond to climate disaster risks. Vietnam has developed and implemented policies and set up legal frameworks for disaster risk management, such as the National Strategy for Natural Disaster Prevention, Response and Mitigation, and the Law on Natural Disaster Prevention and Control. Vietnam established the Vietnam Disaster Management Authority under the Ministry of Agriculture and Rural Development. Moreover, considering the dangers of climate change and natural disasters as a national threat, the Government of Vietnam also established a specialized agency, the National Steering Committee for National Disaster Prevention and Control to control and coordinate the entire system with 37 members from different ministries, organizations, and unions, with the Deputy Prime

Minister acting as Chairman.

Vietnam has commanding committees for natural disaster prevention and control, and search and rescue at the ministry-level, provincial level, and communal level. In addition to the National Strategy for Natural Disaster Prevention, Response and Mitigation, Vietnam also set up the Ministerial and Provincial Plans for Natural Disaster Prevention, Response and Mitigation.

Vietnam categorizes disasters into four levels. The National Steering Committee for National Disaster Prevention and Control will direct and coordinate disaster response and recovery on a national scale. It directs the response of disaster levels 3 or 4 and coordinates and supports localities in responding to disaster levels 1 or 2.

According to the Ministry of Agriculture and Rural Development, the implementation of the National Strategy on Natural Disaster Prevention, Control, and Mitigation has made great strides, such as being more comprehensively organized for all types of natural disasters. Disaster prevention and control activities are implemented in three basic steps: prevention, response, and remediation. There has been a positive change in the awareness of the authorities at all levels and in the populace. Natural disaster prevention and control has changed from passive response to proactive prevention, taking prevention as the key, and simultaneously deploying synchronous solutions such as forecasting with a longer time range, more accurate forecast quality, more timely warning and communication with proactive and thoughtfully-prepared response plans. Construction systems have been implemented.

There were more drastic and timely response and direction measures, especially the evacuation of people. Information and propaganda work have been carried out extensively. Although natural disasters in ten years between 2008 and 2017 are more diverse, with 20 types of occurrences, greater intensity, and extremes than the previous ten years, from 1998 to 2007, the damage caused by natural disasters in the last ten years was significantly smaller than in the previous ten years. The average number of dead and missing people per year in the last 10 years was 317, a 38% reduction compared to the average of the previous ten years with 509 people. The annual material damage in the later period was 688 million USD, which was 29% lower than that in the previous period (967 million

USD per year).

1.2. Review of literature

1.2.1. Migration

Since the mid 20th century, global warming has become a notable issue attracting the attention of a great number of scientists. In addition to observing and measuring the status of global warming, its effects have also led to an increasing number of researchers. Several empirical studies have indicated that global warming resulted in regional changes in worldwide climatic variables and influences natural hazards. Climate is one of the major determinants of population distribution. Combined with the continuous increase in concern about global warming and its influences, a crucial amount of research on the relationship between natural hazards, climate-related disasters, and migration has been conducted, and a review article with empirical evidence on their links has been published (Berlemann & Steinhardt, 2017).

These studies vary in many aspects, such as estimation strategies, types of disasters, or migration. Which econometric estimation techniques are chosen depends on the data to be used and the definition of migration. Poot et al. (2016) applied the gravity model, while Ruyssen and Rayp (2014) employed the quasi-maximum likelihood estimator, while others used a logit model or regression (Henry et al., 2004; Reuveny & Moore, 2009; Gray & Mueller, 2012; Gray & Wise, 2016; Jha et al., 2018). The types of disasters investigated are diverse, including temperature anomalies, precipitation, rainfall deficits, floods, droughts, typhoons, hurricanes, earthquakes, etc. Migration has been studied in general or distinguished in different details, for example, short-term and long-term or permanent or emigration, internal and international, or to rural, to urban or abroad, labor and non-labor, male and female.

Due to human activities that affect the natural environment and climate change, it is increasingly difficult to forecast such disasters to avoid loss, resulting in instability in household income, especially farming households whose income significantly comes from agricultural production, which almost depends entirely on weather and climate. Therefore, diversifying income sources becomes an important issue to be considered for many households, and migration is a popular choice.

Kleemans (2015) also showed that migration increases after contemporaneous negative income shocks and an accumulation of preceding positive shocks. Other research has also clarified that livelihood risk factors induced by climate change are one of the major drivers of farmers' migration (Jha et al., 2018). In addition, as found in Koubi et al. (2016), sudden environmental events, such as floods, induce internal migration of household members. Remittance, therefore, is a major coping measure for households damaged by natural disasters (Koubi et al., 2016; Halliday, 2006). Gröger and Zylberberg (2016) stated that following a massive decrease in income, households cope mainly through labor migration to urban areas and that households with settled migrants ex ante receive more remittances, while non-migrant households react by sending new members away.

However, as indicated by Mozumder et al. (2009) and Sawada & Shimizutani (2008), private transfer, which is the remittance from non-household members, is another important coping measure as the ex-post risk management strategy, especially in the case that the news about the massive natural disaster is widely reported by the media.

Beine and Parsons (2015) investigated the relationship between urbanization and natural disasters. The authors found a positive effect of total natural disasters on internal migration towards urban areas, especially in developing countries; however, there was no effect of rainfall shortages on urbanization, while excess temperatures had a slight negative influence.

Bohra-Mishar et al. (2014) found a nonlinear permanent migration response to climatic variations, but a minimal response to disasters in Indonesia. The authors concluded that although both temperature and precipitation had nonlinear effects on emigration, temperature was strongly affected. Meanwhile, they could not find a systematic effect of disasters such as floods, earthquakes, or volcanic eruptions. Only landslides showed evidence of systematic effects on emigration.

Dillon et al. (2011) also showed evidence that higher temperatures increase the probability of households sending migrants in northern Nigeria. In contrast, Ezra and Kiros (2001) conducted a household survey on the major reasons for outmigration from drought-prone areas of Ethiopia and drought was named by a very small fraction of households with migrants while almost two-thirds of

all cases mentioned marriage as the primary reason.

Coping with risk from natural disasters, especially with a massive impact on geographically close areas, is another challenge for the agriculture-based economy in Vietnam. Previous studies recognize migration as an important risk-coping measure, but private transfer, which is temporal income, is expected to have a different function in the household decision to send migrants. Understanding the factors behind sending migrants allows policy makers to enact policy options to close the income gap created by natural disasters. The purpose of this analysis is to investigate the impact of private transfers, or remittances from non-members, on the migration decisions of households compared to that of remittances from household members.

1.2.2. Food consumption and diversity

Food diversity has attracted a large amount of research worldwide, even in developed or developing countries or regions trapped in poverty. Bidisha et al. (2017) investigated the relationship between credit, food security, and dietary diversity in Bangladesh. The findings show that households with accessible credit have food consumption scores higher than those without, and suggested policies supporting accessibility to credit for poor households. From an economic perspective, Clements and Si (2018) employed data from the World Bank's International Comparison Program for 31 items of food in more than 150 countries and found that rich countries have substantially more diverse diets than those of the poor. They suggest that using volumes to measure the inequality of diversity is a more appropriate method. Based on the luxury-necessity distinction of consumption, they clarified that the quality of the food basket increases with income, with little elasticity.

In contrast, food security and household consumption patterns in Slovakia were investigated by Rizov et al. (2014). Their results indicate that the demand for meat and fish, and fruits and vegetables are elastic to own-price in this country, and that households in rural areas with low income are more sensitive to price and more vulnerable to income and uncertainty effects than those in urban areas with high income. In addition, there is empirical evidence proving that, while the development of technology may have improved human living circumstances, food diversity is not always greater over time. Using data on Canadian family food expenditure, Drescher and Goddard (2011) found that

the demand for food diversity in 1996 and 2001 was lower than in 1984, with a greater decline over time for households in the middle quantiles.

Moreover, household size, real income and age have stronger effects on low-diversified households, especially those in the lower 10% quantile of the distribution, while Canadian diversity demand has similar determinants to those of other developed countries in simple ordinary least square regressions. Huang and Tian (2019) analyzed food accessibility, diversity of agricultural production, and dietary patterns in rural China and found that food accessibility has a higher impact on dietary quality for those not engaged in agricultural production. Their estimation also showed that food accessibility raises the consumption of oil while reducing the consumption of cereals, potatoes, beans, fruits, vegetables, and salt.

The demand for food diversity may differ according to gender or generation. Thiele and Weiss (2003) proved that household income and the population of children in age from 7 to 17 have positive impacts on the demand for food diversity in Germany; a smaller variety of food is consumed by single male households and a higher variety in big city households in East Germany; and the variety of food that households consume will decrease if the housekeeper works full-time. Larson et al. (2019) argued that nearly half of the children are stunted, while more than two-thirds of women are disempowered and lack adequate dietary diversity in western Honduras.

In contrast, when women have access to credit or control over income, their households have higher diet diversity and less experience of moderate to severe food insecurity. Mishra and Ray (2009) found a slight improvement in calorie intake and dietary diversity during the period 1997/1998–2004 among non-poor households over poor households in Vietnam, indicating that urbanization and improvement in education levels have positive effects on dietary diversity and nutrient intake increase; however, they also showed evidence of intense differences in calorie intake and calorie costs by region.

1.2.3. Natural disaster and consumption

Once natural disasters occur, food supply is affected, threatening food security and the problem may remain due to disaster losses, even though food supply recovers. Kianersi et al. (2021)

investigated the effects of Hurricane Matthew in Haiti and concluded that hurricanes are associated with long-term (one year later) food insecurity at the individual and household levels, implying that microfinance programs might be helpful in improving post-hurricane long-term food security. A household survey in Bangladesh revealed that 80% of damaged households chose to reduce food intake (Ahamad & Khondker, 2010). India's results show that drought lowers household diet diversity by reducing consumption (Carpena, 2019).

Another important aspect of weather shocks is their heterogeneous impact on females and males. India's results indicate that the wage for female labor was reduced by 15%. This heterogeneous impact lowers women's empowerment at home (Mahajan, 2017). The impact of weather shocks on children has also been investigated (Chaudhury et al.,2006; Marchetta et al., 2019; Oryoie and Alwang, 2018). Marchetta et al. (2019) found that rainfall shock shifts students from attending school to working, and the impact is larger for females than for males.

In Andhra Pradesh and Telangana, India, among children and adolescents, pro-boy disparities in dietary diversity are present at all ages except for 12-year-olds and the gap is remarkable at 15 years of age; mid-adolescent girls consume less eggs, legumes, root vegetables, and fruits, which are rich in protein and vitamins (Aurino, 2017). Herrera-Fontana et al. (2020) studied vulnerable families living in the rural area of La Punta after the earthquake in Ecuador in 2016. Their findings show that all households had high diversity scores, however, most of the products consumed had low nutritional value; for example, rice, soft drinks, and oils, while whole grains, fruits, and vegetables were less consumed. In addition, 57.1% of mothers were overweight and obese, and 40.9% and 13.6% of children under 5 years of age had chronic undernutrition and global undernutrition, respectively.

1.3. Problem statement

1.3.1. Natural disaster and food consumption

Based on the above evidence, this study aims to investigate the major reactions of households after a natural disaster. According to the Vietnam Access to Resources Household Survey (VARHS) data, reduction of consumption is one of the major reactions among household decisions to cope with natural disasters. Food diversity is one of the indicators that can be employed to trace the change in food consumption; however, the number of food items consumed by each household is not very large. The number of food items consumed by households did not change between 2014 and 2016, such that the average number of items consumed, mentioned in the survey, is 7 out of 14 items. Meanwhile, the number of items that households with losses consumed appears to be slightly reduced compared to households without losses. Since food consumption is initially not very diverse, food diversity might not be able to show much about food consumption changes under natural hazards. Therefore, this study investigates the change in food consumption by analyzing expenditure on each item. Chapter 3 focuses on food expenditure between households without loss from natural disasters and those with loss.

It is clear from Chapter 3 that food consumption, especially the composition of meat, differs significantly between households with and without natural disasters. Furthermore, this study investigates the impact of a reduction in food consumption, especially in children. In facing natural disasters, households have to manage food expenditure by shifting from expensive food to relatively inexpensive food, but simultaneously, the allocation of food expenditure is another important indicator of the impact. To reveal this, this study employs the “adult goods approach”, which assumes a trade-off between adult-only-consumed goods and expenditure on children. In this way, how much adults save their own consumption to raise their children can be estimated. Further investigation will be conducted if the impact differs between boys and girls. Child health is a long-term investment in human capital; hence, this study estimates the short-and medium-term impacts of natural disasters on human capital accumulation.

1.3.2. Push and pull factors in migration

Chapter 4 investigates how households react to improve their income levels. One of the

major coping methods of agricultural households is to send migrant labor to non-farm activities to cover the loss from agriculture. For instance, Oka, Saito, and Khuu (2020) show the farmer's reaction to the reduction of agricultural income brought about by natural disasters. They revealed that El Niño, which occurred in 2016, gradually increased the salinity level because of drought, which damaged shrimp production, and many of the farmers in the Mekong Delta suffered from debt. This damage pushed farmers or household members to migrate or seasonally migrate to the non-farm sector, such as wage labor work in the manufacturing sector near Ho Chi Minh City, the largest city in South Vietnam. Thus, non-farm activities work as insurance, and this study focuses on the migration decisions of households damaged by natural disasters.

Migration in Vietnam has received significant research attention. However, studies focus on the wage difference between rural and urban areas, and these wage differences induce households to send migrant labor to urban areas. These movements can be recognized as a "pull" factor. The development of non-farm sector, such as manufacturing, and service sectors, provides wages that are attractive enough for rural farmers to migrate and get a job in non-farm sectors. The labor supply decisions of rural households in the urban non-farm sector have been investigated by estimating the shadow price of agricultural labor (Jacoby, 1993; Skoufias, 1994; Le, 2009; Abdulai and Regmi, 2000; Almeida and Bravo-Ureta, 2019).

By contrast, environmental migration, which is described by Oka et al. (2020), can be recognized as a push factor. Recent environmental migration literature investigates household's decision to migrate (Adamo and Izazola, 2010; Arouri, Nguyen and Youssef, 2015; Chapagain and Gentle, 2015; Dasgupta, Hossain, Huq, and Wheeler, 2016; Dun, 2011; Gray and Mueller, 2012; Koubi, Spilker, Schaffer, and Bernauer, 2016; Phuong, Biesbroek, Sen, and Wals, 2018; Piguet, 2010). Hence, these push factors occurred in rural Vietnam, and the natural environment has become another factor in pushing farmers from rural to urban areas. Excess supply of labor in urban areas may lead to unbalanced economic development, and higher population density creates various problems in mega cities, such as development in the informal sector, expansion of the poor population, and political instability.

In summary, this study aims to investigate the impact of natural disasters on household food consumption and the decision to send migrants. In particular, this study investigates the demand for adult goods, particularly beer and rice wine, in both normal and emergency situations. It allows for investigation of the influence of climate-related hazards on children, based on food-allocation decisions. Furthermore, the effect of weather shock on the gendered allocation of food consumption was analyzed. Finally, this study examines the role of private transfers (i.e., remittances from non-members) on households' migration decisions compared to remittances from household members under the impact of natural disasters.

Chapter 2 Natural disaster and impact on households in Vietnam

2.1. Description of the damage of the natural disaster

The loss induced by natural disasters in Vietnam from 2006 to 2019 is shown in Table 2-1. The share in total loss indicates the percentage share of loss in total annual GDP in Vietnam. Loss from disaster varies by year, but years in 2006, 2009, and 2017 shows more than 1% of GDP was lost by natural disaster. Table 2-2 shows the number of households damaged by the different types of natural disaster, and they are calculated from household survey data of VARHS. And it indicates that drought is the most frequently encountered natural disaster followed by typhoons and floods, in 2014 and 2016. The damage from drought is 15,700 billion VND (Table 2-1), which accounts for 39.5% of total loss from natural disasters in 2016. Drought brings serious damage to households' livelihood, and the impact is exacerbated by El Nino phenomena in 2016.

Table 2-1 Annual Loss due to Natural Disasters in Vietnam

	GDP (billion VND	Total Loss (million VND)	Share in Total Loss on GDP (%)	Loss in Agriculture (million VND)	Overcome (million VND)	Drought Loss (million VND)
2006	1,061,565	18,565,661	1.75	954,690		
2007	1,246,769	11,520,197	0.92	432,615		
2008	1,616,047	13,299,389	0.82			
2009	1,809,149	23,667,053	1.31	66,000		
2010	2,157,828	16,062,290	0.74			
2011	2,779,880	13,506,774	0.49			
2012	3,245,419	15,935,421	0.49		35,213	
2013	3,584,262	27,852,561	0.78			
2014	3,937,856	2,828,348	0.07			
2015	4,192,862	8,113,995	0.19			
2016	4,502,733	39,726,339	0.88			15,700,686
2017	5,005,975	59,959,892	1.20			
2018	5,542,332	20,000,000	0.36			
2019	6,037,348	6,862,775	0.11			
2020	6,293,145					

Source: General Statistics Office of Vietnam (www.gso.gov.vn) and Vietnam Disaster Management Authority (phongchongthientai.mard.gov.vn)

Table 2-2 Number of household experienced natural disaster (n = 2,518)

Type of shock	2014			2016		
	Freq.	Percent	Cum.	Freq.	Percent	Cum.
Floods	64	18.5	18.50	29	9.1	9.12
Drought[1)]	156	45.1	63.59	200	62.9	72.01
Typhoons, and other natural disasters	126	36.4	100	89	28.0	100
Total	346	100.0		318	100	

Source: Vietnam Access to Resources Household Survey, 2014 and 2016

Note 1) Data file has some mistype, but we assume it mentions as "drought".

Note 2) Table2-2 show the cases of natural disaster, while Table 2-3 indicates households damaged by any of these natural disasters. Thus, the number are slightly different each other.

Note 3) Strong impact of El Niño happened in 2016.

2.2. Outline from VARHS data

Households survey data of Vietnam Access to Resources Household Survey (VARHS) include agricultural production such as land holdings, access to irrigation, cost, investment, wage and hired labor. Household samples were chosen in all social economic regions in Vietnam, except the Southeast in which Ho Chi Minh city and its surrounding provinces which attract a significant number of migrants in the country are located. Household samples were not chosen from national cities such as Ha Noi, Ho Chi Minh City, Hai Phong, Da Nang, and Can Tho. More than 90% of household samples are in rural areas.

Food diversity, migration and remittance are also covered in the survey. In chapter 3 and 4, panel data are constructed, using 2014 and 2016 results, to investigate the impact of natural disasters, especially the serious impact of El Niño that happened in 2016. The surveys in 2014 and 2016 are chosen in order to examine whether the influences on households of natural disasters with and without the occurrence of El Niño have any differences. It can be said that natural disasters that appeared in Vietnam in 2014 are seasonal or accidental. Meanwhile, beside seasonal and random disasters, under the extreme El Niño in 2016 the effects of some certain disasters such as droughts and salinity intrusion probably become wider and severer. Especially when the impacts of climate change on the country tend to increase, this may induce the change of environment and raise the frequency and intensity of various natural disasters. Household choice of measures to cope with risks might vary if these differences are realized. Chapter 3 employs the food diversity survey from 2,482 households and investigates the food expenditure. Chapter 4 analyzes the impact of remittance and private transfer on households experiencing loss from natural disaster. In this case, 2,518 households are used. Number of households differ in chapter 3 and 4 since the availability of those corresponding questions differ by missing observation.

In the 2,518 households, survey households are extracted from 12 provinces (Table 2-3), and the number of households damaged by drought is 153 among 343 (44.6%) in 2014, and 196 among 311 (63.0%) in 2016. Damage from drought became more severe in 2016 than 2014 because of the El Niño phenomena. And Nghe An province in 2014 and Dak Lak province in 2016 showed the highest number of damaged households from drought. Dak Lak is located in Central Highlands, one of the 18

most severely affected provinces. Nghe An is not one of the 18 most severely affected provinces but is located in Coastal Central, also severely affected (Figure 2-1).

Table 2-3 Damaged households by province (Chapter 4, n = 2,518)

Province	#HH	2014								2016							
		Flood	share (%)	Drought	share (%)	Others	share (%)	Total	share (%)	Flood	share (%)	Drought	share (%)	Others	share (%)	Total	share (%)
Ha Tay	536	8	12.5	8	5.2	11	8.7	27	7.9	5	17.9	4	2.0	1	1.1	10	3.2
Lao Cai	98	5	7.8	25	16.3	7	5.6	37	10.8			20	10.2	12	13.8	32	10.3
Phu Tho	354			3	2.0	2	1.6	5	1.5	1	3.6	3	1.5	6	6.9	10	3.2
Lai Chau	130	10	15.6	25	16.3	11	8.7	46	13.4	5	17.9	14	7.1	25	28.7	44	14.1
Dien Bien	116	8	12.5	11	7.2	23	18.3	42	12.2	3	10.7	3	1.5	25	28.7	31	10.0
Nghe An	198	19	29.7	36	23.5	19	15.1	74	21.6	8	28.6	9	4.6	9	10.3	26	8.4
Quang Nam	306	4	6.3	10	6.5	43	34.1	57	16.6			21	10.7	4	4.6	25	8.0
Khanh Hoa	106	1	1.6	5	3.3			6	1.7			5	2.6			5	1.6
Dak Lak	158	6	9.4	16	10.5	4	3.2	26	7.6	6	21.4	76	38.8	1	1.1	83	26.7
Dak Nong	131			3	2.0			3	0.9			26	13.3	1	1.1	27	8.7
Lam Dong	73			10	6.5	2	1.6	12	3.5			5	2.6	3	3.4	8	2.6
Long An	312	3	4.7	1	0.7	4	3.2	8	2.3			10	5.1			10	3.2
	2,518	64	18.7	153	44.6	126	36.7	343		28	9.0	196	63.0	87	28.0	311	

Source: Vietnam Access to Resources Household Survey, 2014 and 2016

Note 1) Table 2-2 show the cases of natural disaster, while Table 2-3 indicates households damaged by any of these natural disasters. Thus, the number are slightly different each other.

Note 2) Strong impact of El Niño happened in 2016.

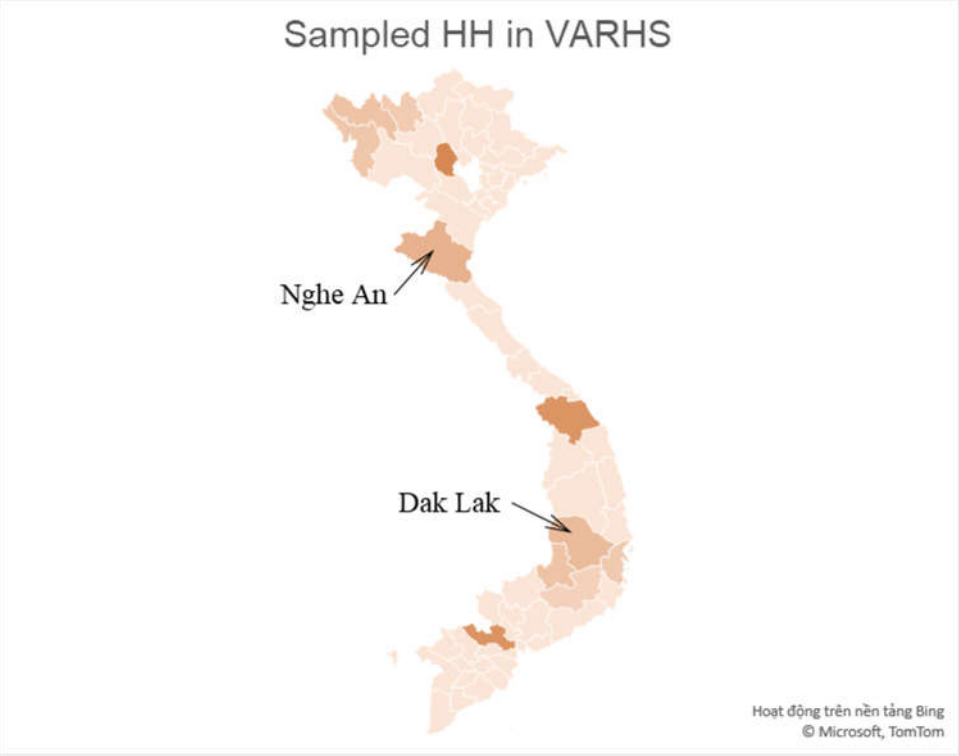

Figure 2-1 Surveyed provinces of VARHS

2.2.1. Reaction of households

There are several coping strategies to risks. Table 2-4 and 2-5 indicate the household reaction to the natural disaster. In both cases (chapter 3 and 4), reducing consumption is the most frequent reaction except doing nothing. 39.8% (45.1%) of the households reduced consumption in 2014 (2016) in chapter 3 cases, which are followed by “use savings” and “sold livestock”. This indicates that investigating the consumption pattern reveals household reaction to the natural disasters.

Table 2-4 Household reaction to the natural disaster (Chapter3, n = 2,482)

Household reaction	2014			2016		
	Freq.	Percent	Cum.	Freq.	Percent	Cum.
Nothing	152	44.8	44.8	121	38.7	38.7
Reduced consumption	135	39.8	84.7	141	45.1	83.7
Use savings	24	7.1	98.5	19	6.1	98.7
Sold livestock	3	0.9	85.5	8	2.6	86.6
Borrowed money from bank	2	0.6	89.4	8	2.6	91.4
Got assistance from relatives or friends	7	2.1	87.9	3	1.0	87.6
Work more	3	0.9	91.4	4	1.3	92.7
Got assistance from Government	2	0.6	88.5	4	1.3	88.8
Borrowed from others	3	0.9	90.2			
Sold other assets	1	0.3	85.8			
Got assistance from NGO	1	0.3	88.8			
Got insurance payment	1	0.3	90.5			
Sold land				1	0.3	84.0
Other	5	1.5	100.0	4	1.3	100.0
Total	339	100		313	100	

Source: Vietnam Access to Resources Household Survey, 2014 and 2016

Note) Strong impact of El Niño happened in 2016.

Table 2-5 Household reaction to the natural disaster (Chapter 4, n = 2,518)

Household reaction	2014			2016		
	Freq.	Percent	Cum.	Freq.	Percent	Cum.
Nothing	156	45.1	45.1	122	38.4	38.4
Reduced consumption	137	39.6	84.7	145	45.6	84.0
Use savings	25	7.2	98.6	19	6.0	98.7
Sold livestock	3	0.9	85.6	8	2.5	86.8
Borrowed money from bank	2	0.6	89.3	8	2.5	91.5
Got assistance from relatives or friends	7	2.0	87.9	3	0.9	87.7
Work more	3	0.9	91.4	4	1.3	92.8
Got assistance from Government	2	0.6	88.5	4	1.3	89.0
Borrowed from others	3	0.9	90.2			
Sold other assets	1	0.3	85.9			
Got assistance from NGO	1	0.3	88.7			
Got insurance payment	1	0.3	90.5			
Sold land				1	0.3	84.3
Other	5	1.5	100.0	4	1.3	100.0
Total	346	100		318	100	

Source: Vietnam Access to Resources Household Survey, 2014 and 2016

Note) Strong impact of El Niño happened in 2016.

2.2.2. Food diversity

Table 2-6 demonstrates the number of households consuming each food item, and Table 2-7 illustrates food diversity and mean income of households. Calculation from the survey data show a similar result in food diversity in both 2014 and 2016. In 2014, the average number of food items consumed by households in the last 4 weeks is 7.3 out of 14 items, and it becomes 7.4 out of 14 items if the households without loss from natural disasters are counted. However, the mode value in 2014 is 6 items for households without loss, and 5 items for loss. And they are lower than the mean. It indicates that in general households consume relatively less diverse food, and only a few households consume diverse kinds of food.

In contrast, the mode value is higher than the mean in 2016, which implies a better diversification on food consumption among households, and fewer households have less various food types. Despite that, in both years, the gap between mode value and the mean is small. This means food diversity does not distribute seriously biased, and food diversity becomes balanced.

Table 2-6 Number of households consuming each of food item

			Food Item															Mean of number of items consumed	Mean of net income per person (in ths. VND)	Number of Poor Household (with certificate)
			Pork	Beef	Chicken	Fish	Shrimp	Fruit	Candy or Cookie	Powdered or Canned Milk	Liquid Milk	Beer	Rice Wine or Local Alcoholic Drink	Coffee	Industrial Beverage	Eating/Drinking outside or Processed Food			
2014	With Loss (306)	Consumed	302	85	195	280	74	229	106	49	59	72	236	34	65	209	6.5	19,541	68
		share (%)	98.7	27.8	63.7	91.5	24.2	74.8	34.6	16.0	19.3	23.5	77.1	11.1	21.2	68.3			
		Not	4	221	111	26	232	77	200	257	247	234	70	272	241	97			
	Without Loss (2,176)	Consumed	2,153	958	1,644	2,082	902	1,809	1,054	534	699	747	1,210	364	526	1,389	7.4	27,200	257
		share (%)	98.9	44.0	75.6	95.7	41.5	83.1	48.4	24.5	30.3	34.3	58.4	16.7	24.2	63.8			
		Not	23	1,218	532	94	1,274	367	1,122	1,642	1,517	1,429	906	1,812	1,650	787			
	Total (2,482)	Consumed	2,455	1,043	1,839	2,362	976	2,038	1,160	583	718	819	1,506	398	591	1,598	7.3	26,256	325
		share (%)	98.9	42.0	74.1	95.2	39.3	82.1	46.7	23.5	28.9	33.0	60.7	16.0	23.8	64.4			
		Not	27	1,439	643	120	1,506	444	1,322	1,899	1,764	1,663	976	2,084	1,891	884			
2016	With Loss (283)	Consumed	282	95	216	238	73	200	109	71	67	89	218	60	60	162	6.9	22,967	54
		share (%)	99.6	33.6	76.3	84.1	25.8	70.7	38.5	25.1	23.7	31.4	77.0	21.2	21.2	57.2			
		Not	1	188	67	45	210	83	174	212	216	194	65	223	223	121			
	Without Loss (2,199)	Consumed	2,187	1,016	1,629	2,045	872	1,788	838	464	762	980	1,227	317	565	1,542	7.4	30,042	238
		share (%)	99.5	46.2	74.1	93.0	39.7	81.3	38.1	21.1	34.7	44.6	55.8	17.1	25.7	70.1			
		Not	12	1,183	570	154	1,327	411	1,361	1,735	1,437	1,219	972	1,822	1,634	657			
	Total (2,482)	Consumed	2,469	1,111	1,845	2,283	945	1,988	947	535	829	1,069	1,445	437	625	1,704	7.3	29,235	292
		share (%)	99.5	44.8	74.3	92.0	38.1	80.1	38.2	21.6	33.4	43.1	58.2	17.6	25.2	68.7			
		Not	13	1,371	637	199	1,537	494	1,535	1,947	1,653	1,413	1,037	2,045	1,857	778			

Source: Vietnam Access to Resources Household Survey, 2014 and 2016

Note) Strong impact of El Niño happened in 2016.

In a range of 14 food items surveyed (Table 2-7), pork is consumed most widely by about 99% of households despite with or without loss in both 2014 and 2016, and followed by fish, fruit, chicken, eating outside or processed food, and rice wine or local alcoholic drink. Consequently, major protein intake comes from pork, followed by fish and chicken. Still, milk products ranked 10th among 14 food items in both years regardless of environmental damage of households. On the contrary, there are 18 (and 23) households consuming all 14 items in 2014 (and in 2016). Although diet diversity in 2016 is somewhat a little improved compared to 2014, food variety, which is 7 out of 14 items, in both years seems not very adequate.

Households with loss experience in both years slightly reduced the number of consumed items on average, 6.5 in 2014 and 6.9 in 2016. Again, the mode value is smaller than the mean, and the gap is even greater in 2016. This means weather shock induced a major part of households to lessen their range of choices for food consumption. There is no household with loss consuming all of 14 food items in both 2014 and 2016. Pork is still consumed most widespread among loss households, fish ranked second, followed by rice wine, fruit, processed food, chicken, and cookies in 2014. Similarly, it is chicken, fruit, processed food, and cookies followed by rice wine in 2016. The "adult goods" rice wine is consumed broadly when households have a loss. These estimates indicate food diversity is worsen by natural disasters.

Table 2-7 Food diversity and mean income

		#HH	Number of Food Item Consumed														Mean of number of items consumed	Mean of net Income per person (in ths. VND)	Number of Poor Household with certificate (share)
			1	2	3	4	5	6	7	8	9	10	11	12	13	14			
2014	With Loss	306	1	5	18	37	55	49	46	30	26	19	14	5	1	0	6.5	19,541	68 (22.2%)
	Without Loss	2,176	4	34	87	166	232	336	323	278	245	193	118	98	44	18	7.4***	27,200	257 (11.8%))
	Total	2,482	5	39	105	203	287	385	369	308	271	212	132	103	45	18	7.3	26,256	325 (13.1%)
2016	With Loss	283	0	3	20	40	38	37	35	33	26	20	19	6	6	0	6.9	22,967	54 (19.1%)
	Without Loss	2,199	4	53	124	176	202	278	297	311	245	194	148	106	38	23	7.4***	30,042	238 (10.8%)
	Total	2,482	4	56	144	216	240	315	332	344	271	214	167	112	44	23	7.3	29,235	292 (11.8))

Source: Vietnam Access to Resources Household Survey, 2014 and 2016

Note 1) *** indicate significant difference between groups of with/without loss.

Note 2) Strong impact of El Niño happened in 2016.

Chapter 3 Impact of natural disaster on allocation of food expenditure in Vietnam households

3.1. Introduction

Once the food supply is affected by the natural disaster, food security becomes a serious situation, especially in developing countries. The household survey in Bangladesh revealed that 80% of damaged households chose to reduce food intake among several risk coping strategies such as borrowing food or skipping meals (Ahamad & Khondker, 2010). India results show that drought brings household diet diversity lower by reducing consumption of fruits, vegetables, and animal-source foods, hence, emergency food supply needs to consider balanced food supply (Carpena, 2019). Given these previous findings, this study investigates the change in food consumption between non-damaged households and damaged households in terms of animal-sourced food supply and other food items.

Another important aspect of the weather shocks is the heterogeneous impact on females and males. India results indicate wage of female labor reduced 15% because of the different role of female and male in agricultural production. This heterogeneous impact lowers the women empowerment at home (Mahajan, 2017). The impact of weather shock on children was also investigated (Chaudhury et al., 2006; Marchetta et al., 2019; Oryoie & Alwang, 2018). Marchetta et al., (2019) finds that rainfall shock shifts schoolers from attending school to working, and the impact is larger for female rather than male children.

In this study, the impacts of natural disasters on children are analyzed, based on a food allocation decision called the adult goods approach (Deaton, 1989; Rothbarth, 1943). Assuming that adult consumers in households reduce their consumption of adult-only-consumed goods such as alcohol beverage, tobacco, adult clothes, adult shoes, eating outside foods, entertainment, gambling, ect. which are not consumed by children once they have a child, and if the degree of reduction is greater for boys, households have preference favored to boys. And the specific question needs to be investigated in this study is the impact of weather shock on this gendered allocation of consumption. This is the empirical question, meaning that the consequences are theoretically unknown. Employing the household survey data, this study investigates the demand for adult goods, specifically beer and

rice wine, in both normal period, and emergency situations.

The remainder of this study is organized as follows. Adult goods approach is briefly explained, and empirical models are shown in Section 3.2, and description of household's consumption pattern and the impact of weather shock are presented in Section 3.3 with the outline of data. Estimated results are discussed in Section 3.4 and the conclusions and relevant policy implications are mentioned in Section 3.5.

3.2. Analytical Framework

3.2.1. Adult goods approach

Considering the change in expenditure provides important information about child health, Rothbarth (1943) measured the opportunity cost of children as the reduction in expenditure of the adult-only-consumed goods (hereafter, adult goods), such as tobacco or alcohol, which is brought by the presence of one more additional child. This concept assumes that there is a trade-off relationship between the cost of children and expenditure on adult goods of the households, hence, investigating the expenditure reveals the impact of household decisions over the child's health. This is specifically called the "adult goods" approach (Deaton, 1989; Fuwa, 2014; Koohi-kamali, 2011).

Adult goods approach is derived from the concept of the Engel curve, which traces the relationship between change in income and induced change in certain goods consumed by households or individuals. Figure 3-1 shows the indifference curves of the adult couple between adult goods and expense on children specifically explains the trade-off between them. The dotted straight line indicates income-demand curve, which trace the two levels of expenditure, I^0 and I. Case of $e = 1$, which means the constant income elasticity, shows the neutral case, and as the expenditure level goes up from I^0 to I, the couple in this household expend their expenditure at the same share on both adult goods and children. In other words, this couple does not save expenditure on adult goods for investing more on raising children. Other two curved cases indicate biased cases toward children. In this case, income elasticity of adult goods is *in*-elastic ($0 < e < 1.0$), meaning that the couple give up some of the consumption of adult goods and spend that income on their child.

These income-demand curves are further divided into the girls' case and boys' case, which are corresponding to the indifference curves of U^G and U^B, respectively. Since U^B is further away from the neutral case, this couple spends more on the child if their child is a boy, rather than the girl's case, U^G. The resulting Engel-curve, which traces the relationship between income (expenditure) and number of children this couple desire to have, is displayed in Figure 3-2. Two Engel-curves for girls and boys show a higher demand for boys than girls given the same level of income, which indicates stronger preference for boys.

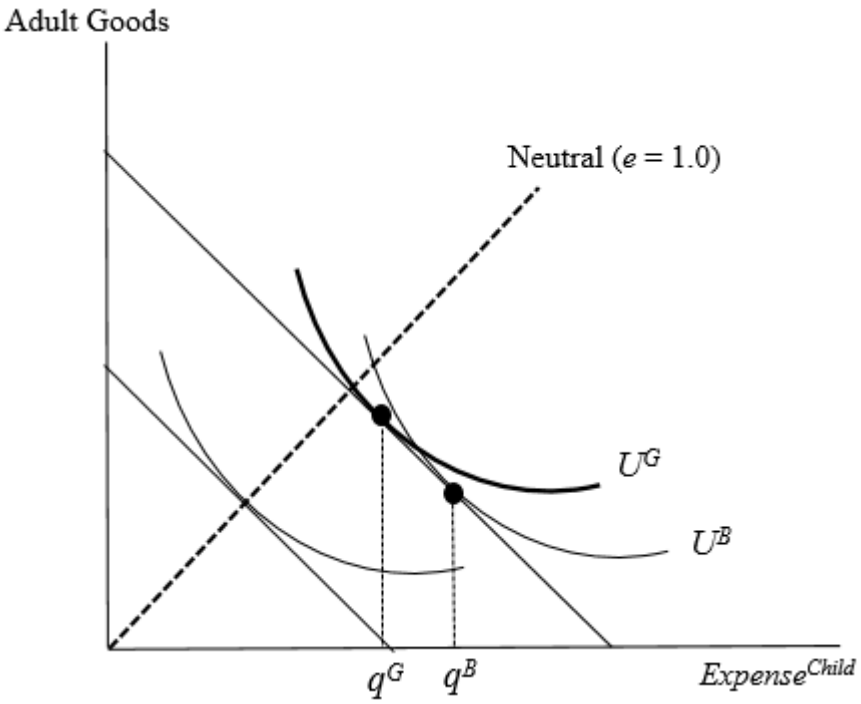

Figure 3-1 Income-demand curve

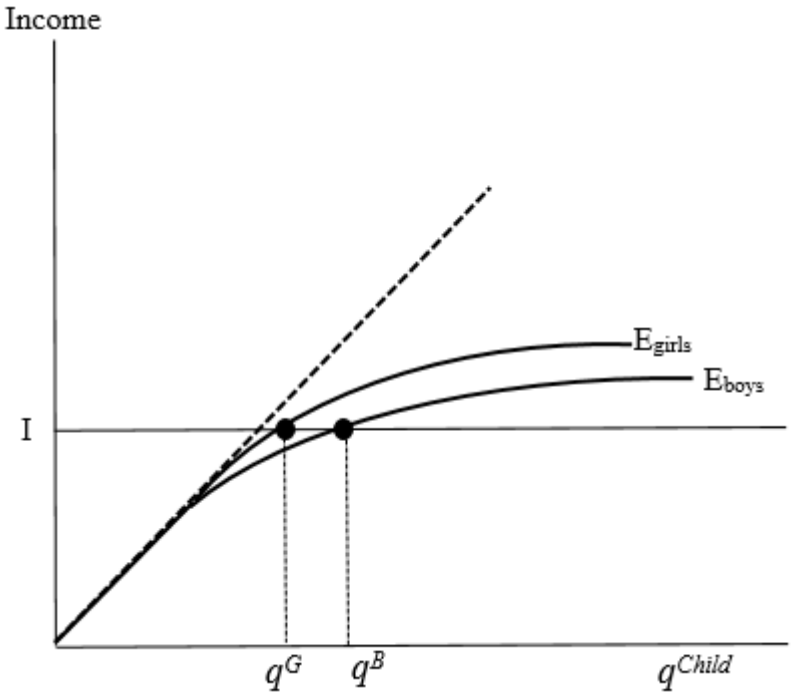

Figure 3-2 Engel Curve

3.2.2. Econometric model

Based on the adult goods approach, Deaton (1989) introduced an econometric method which investigates the influence of change in household structure on the share of expenditure of adult goods to verify the presence of child gender bias in the household. The econometric model of Engel curve form is as follows (Deaton, 1989; Fuwa, 2014).

$$w_{ij} = \frac{p_j q_{ji}}{x_i} = \alpha_j + \beta_j \log(\frac{x_i}{n_i}) + \eta_j \log n_i + \sum_{k=1} \gamma_{jk} \frac{n_{ik}}{n_i} + \mathbf{\theta'_j Z_i} + u_{ij}, \quad (1)$$

Where w_{ij} is the expenditure share of adult good j in household i, and p_j and q_{ji} are the price and quantity of that adult good, respectively. Variable x_i is the total food expenditure of 14 items, n_i is the number of household members, and n_{ik} is the number of household members in the kth age-gender category. $\mathbf{Z}_i$ is a vector of household characteristics such as age and education of the household head. $\alpha_j, \beta_j, \eta_j, \gamma_{jk}, and\ \mathbf{\theta'_j}$, are the parameters to be estimated. Specifically, the parameter of γ_{jk} shows the impact of additional children on the consumption of adult good j.

3.2.3. Empirical model with natural disaster

In order to investigate the impact of natural disaster, we incorporate the loss dummy in each age-gender category, as well as the fixed effect of each household.

$$w_{ij} = \frac{p_j q_{ji}}{x_i} = \alpha_j + \tau_j d\_loss_i + \beta_j \log(\frac{x_i}{n_{i_h}}) + \eta_j \log n_i + \sum_{k=1} \gamma_{jk} \frac{n_{ik}}{n_i} + d\_loss_i \sum_{k=1} \tau_{jk} \frac{n_{ik}}{n_i} + \mathbf{\theta'_j Z_i} + \omega_i + \epsilon_{ij} \quad (2)$$

Where d_loss_i is the dummy variable indicating the household i experienced loss from natural disaster, and $\tau_j, and\ \tau_{jk}$ are the parameters infer the additional effect from natural disaster on expenditure share of adult good j. Fixed effect of each household is also incorporated in this model as ω_i since preference of the food demand can be varied by households, and those unobserved preferences may correlate with the expenditure for adult good j, consequently demand for children. The remaining heterogeneous errors is ϵ_{ij}.

3.3. Data

3.3.1. Vietnam Access to Resources Households Survey (VARHS)

This analysis employs household survey data, namely, Vietnam Access to Resources Households Survey (VARHS), specifically the year of 2014 and 2016. By constructing the panel data, fixed effects are able to be introduced, which can represent the unobserved factors affecting household consumption patterns such as specific preference or local conditions. The number of households available in two consecutive surveys is 2,482, and extracted from 12 provinces.

3.3.2. Difference between households with/without natural disaster

The difference of food consumption between households which are affected by natural disasters and those which are not, is shown in Table 3-1 and 3-2. Table 3-1 shows the expenditure in VND and quantity in grams, and those corresponding shares, and similarly in protein, lipid and calories in Table 3-2. The rate of change is calculated as (value of loss – value of no loss) / value of no loss, hence, a large negative number implies the large reduction of the corresponding items in households with loss.

3.3.3. Animal-source products

Reduction in both expenditure and quantity are shown in Table 3-1, and the difference between households with/without loss are all significant. In facing the natural disaster, households reduce consumption of meats and fishes. However, the *change* in share of expenditure is negative in beef and shrimp such as 9% to 6% in beef and 6% to 3% in shrimp, while it is positive in pork and fish such as 40% to 44% in pork and 21% to 19% in 2014. In the case of chicken, it is negative in 2014, but it becomes positive in 2016. This indicates, households facing natural disaster generally reduce the spending on beef and shrimp, and raise on pork and fish. As shown in Table 3-1, Vietnam households share most of its expenditure on pork approximately around 40-46%, and the same as in fish around 23-28%. The expenditure share in beef is 6-10%, and 3-6% in shrimp. Pork and fish are frequently consumed in Vietnam households, and unit price per kilogram is relatively cheaper than beef or shrimp. When households experience income loss from natural disasters, they adjust their consumption composition toward more pork or fish, and away from beef and shrimp (Figure 3-3).

Pork and fish are often available in local open markets, which is still a main grocery shopping place in rural environments. Since the possession rate of refrigerators in rural Vietnam is 56% in 2016, and frozen meat is not very common yet in rural households. Shoppers go grocery shopping daily and buy meat, especially pork, in cut small pieces. Chicken, on the other hand, is often sold whole or alive in the market, unit price per kilogram is cheap, but price of whole chicken is relatively costly. Thus, households with damage shift its meat preference from beef or shrimp to pork and fish, and lesser to chicken meat.

Table 3-1 Difference between households with/without natural disaster, expenditure and quantity on average

			2014					2016					2014 and 2016				
			No Loss (a)	Loss (b)	Difference (b)-(a)	Rate of change (%)		No Loss (a)	Loss (b)	Difference (b)-(a)	Rate of change (%)		No Loss (a)	Loss (b)	Difference (b)-(a)	Rate of change (%)	
Pork	Expenditure	VND	83,073	72,270	-10,803	-13.0	***	97,323	78,233	-19,090	-19.6	***	90,240	75,121	-15,119	-16.8	***
	Share of Expenditure	Ratio	0.40	0.44	0.039	9.8	***	0.42	0.46	0.034	8.0	***	0.41	0.45	0.036	8.8	***
	Quantity	g	1,047.7	847.2	-200.5	-19.1	***	1,172.9	936.2	-236.8	-20.2	***	1,111	890	-221.0	-19.9	***
	Share of Quantity	Ratio	0.37	0.39	0.018	4.7	*	0.42	0.45	0.032	7.5	***	0.40	0.42	0.023	5.8	***
Beef	Expenditure	VND	26,328	12,767	-13,561	-51.5	***	30,626	22,821	-7,806	-25.5	*	28,490	17,574	-10,916	-38.3	***
	Share of Expenditure	Ratio	0.09	0.06	-0.04	-38.2	***	0.10	0.07	-0.03	-30.2	***	0.10	0.07	-0.03	-34.3	***
	Quantity	g	132.7	64.1	-68.7	-51.7	***	147.5	126.8	-20.7	-14.0		140.1	94.1	-46.1	-32.9	***
	Share of Quantity	Ratio	0.04	0.03	-0.02	-41.8	***	0.05	0.04	-0.01	-21.0	***	0.05	0.03	-0.01	-31.4	***
Chicken	Expenditure	VND	49,644	36,357	-13,287	-26.8	***	54,003	46,195	-7,808	-14.5	***	51,836	41,060	-10,776	-20.8	***
	Share of Expenditure	Ratio	0.21	0.19	-0.01	-6.2		0.21	0.24	0.03	14.9	***	0.21	0.22	0.01	3.9	
	Quantity	g	515.3	348.8	-166.5	-32.3	***	526.7	450.7	-76.0	-14.4	**	521.0	397.6	-123.5	-23.7	***
	Share of Quantity	Ratio	0.17	0.15	-0.02	-9.2	**	0.18	0.20	0.02	11.8	***	0.17	0.17	0.00	0.9	
Fish	Expenditure	VND	50,140	46,808	-3,332	-6.6	*	50,522	39,113	-11,409	-22.6	***	50,332	43,129	-7,203	-14.3	***
	Share of Expenditure	Ratio	0.24	0.28	0.03	14.2	***	0.21	0.20	-0.01	-6.4	*	0.23	0.24	0.01	5.3	**
	Quantity	g	1,119.8	1,010.1	-109.7	-9.8	**	926.3	687.3	-239.0	-25.8	***	1,022	856	-166.7	-16.3	***
	Share of Quantity	Ratio	0.38	0.41	0.03	8.7	***	0.32	0.29	-0.03	-9.1	***	0.35	0.35	0.00	1.4	
Shrimp	Expenditure	VND	15,226	6,962	-8,265	-54.3	***	15,717	8,614	-7,103	-45.2	***	15,473	7,751	-7,722	-49.9	***
	Share of Expenditure	Ratio	0.06	0.03	-0.02	-43.8	***	0.05	0.03	-0.02	-37.1	***	0.05	0.03	-0.02	-40.6	***
	Quantity	g	123.1	62.2	-61.0	-49.5	***	120.1	72.2	-47.9	-39.9	***	121.6	67.0	-54.7	-44.9	***
	Share of Quantity	Ratio	0.04	0.02	-0.02	-43.4	***	0.04	0.03	-0.01	-32.4	***	0.04	0.02	-0.01	-38.1	***

Source: Vietnam Access to Resources Household Survey, 2014 and 2016

Note 1) *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Note 2) Rate of change shows difference in value of households with/without loss.

Note 3) All values are per person in the household in the latest 4 weeks.

Note 4) Difference = Loss - No Loss, and Rate of change = (Difference/No Loss).

Note 5) Strong impact of El Niño happened in 2016.

Table 3-2 Difference between households with/without natural disaster, protein, lipid, and calories

			2014					2016					2014 and 2016				
		unit	No Loss	Loss	Difference	Rate of change (%)		No Loss	Loss	Difference	Rate of change (%)		No Loss	Loss	Difference	Rate of change (%)	
Pork	Protein	mg	172,873	139,791	-33,082	-19.1	***	193,535	154,466	-39,069	-20.2	***	183,265	146,807	-36,458	-19.9	***
	Share of Protein	Ratio	0.344	0.364	0.020	5.7	**	0.389	0.420	0.031	8.0	***	0.367	0.391	0.024	6.5	***
	Lipid	mg	225,258	182,152	-43,106	-19.1	***	252,182	201,274	-50,908	-20.2	***	238,800	191,294	-47,506	-19.9	***
	Share of Lipid	Ratio	0.663	0.688	0.024	3.7	**	0.687	0.696	0.009	1.3		0.675	0.692	0.016	2.4	**
	Calories	Kcal	2724.1	2202.8	-521	-19.1	***	3,050	2,434	-616	-20.2	***	2,888	2,313	-574	-19.9	***
	Share of Calories	Ratio	0.528	0.549	0.021	3.9	**	0.566	0.587	0.020	3.6	**	0.548	0.567	0.020	3.6	***
Beef	Protein	mg	28,540	13,776	-14,764	-51.7	***	31,705	27,256	-4,449	-14.0		30,132	20,221	-9,911	-32.9	***
	Share of Protein	Ratio	0.051	0.029	-0.021	-41.8	***	0.058	0.045	-0.013	-22.2	***	0.054	0.037	-0.017	-32.0	***
	Lipid	mg	14,204	6,856	-7,348	-51.7	***	15,779	13,565	-2,214	-14.0		14,996	10,063	-4,932	-32.9	***
	Share of Lipid	Ratio	0.041	0.027	-0.015	-35.7	***	0.046	0.035	-0.011	-24.2	***	0.043	0.030	-0.013	-30.1	***
	Calories	Kcal	241.6	116.6	-125	-51.7	***	268.4	230.7	-37.7	-14.0		255.1	171.2	-83.9	-32.9	***
	Share of Calories	Ratio	0.045	0.027	-0.017	-38.8	***	0.050	0.038	-0.012	-23.2	***	0.047	0.033	-0.015	-31.1	***
Chicken	Protein	mg	104,606	70,812	-33,794	-32.3	***	106,926	91,501	-15,426	-14.4	**	105,773	80,703	-25,070	-23.7	***
	Share of Protein	Ratio	0.189	0.171	-0.018	-9.3	**	0.194	0.217	0.023	11.8	***	0.191	0.193	0.002	0.9	
	Lipid	mg	67,504	45,696	-21,808	-32.3	***	69,002	59,047	-9,954	-14.4	**	68,257	52,080	-16,178	-23.7	***
	Share of Lipid	Ratio	0.187	0.168	-0.019	-10.3	**	0.184	0.194	0.010	5.7		0.185	0.180	-0.005	-2.7	
	Calories	Kcal	1025	694	-331	-32.3	***	1,048	897	-151	-14.4	**	1,037	791	-246	-23.7	***
	Share of Calories	Ratio	0.185	0.166	-0.019	-10.2	**	0.186	0.201	0.015	8.1	**	0.185	0.183	-0.003	-1.5	
Fish	Protein	mg	203,809	183,842	-19,966	-9.8	**	168,589	125,085	-43,504	-25.8	***	186,095	155,750	-30,345	-16.3	***
	Share of Protein	Ratio	0.380	0.415	0.035	9.2	***	0.319	0.291	-0.028	-8.9	***	0.349	0.355	0.006	1.8	
	Lipid	mg	30,235	27,273	-2,962	-9.8	**	25,010	18,557	-6,454	-25.8	***	27,607	23,106	-4,502	-16.3	***
	Share of Lipid	Ratio	0.105	0.116	0.011	10.5	**	0.080	0.073	-0.007	-9.2	*	0.093	0.095	0.003	3.1	
	Calories	Kcal	1,086.2	979.8	-106.4	-9.8	**	898.5	666.7	-231.9	-25.8	***	991.8	830.1	-161.7	-16.3	***
	Share of Calories	Ratio	0.223	0.246	0.023	10.4	***	0.179	0.161	-0.018	-10.0	**	0.201	0.205	0.005	2.3	
Shrimp	Protein	mg	21,674	10,945	-10,729	-49.5	***	21,136	12,701	-8,435	-39.9	***	21,403	11,785	-9,619	-44.9	***
	Share of Protein	Ratio	0.037	0.021	-0.016	-43.1	***	0.039	0.026	-0.013	-32.4	***	0.038	0.024	-0.014	-37.9	***
	Lipid	mg	1108.3	559.7	-549	-49.5	***	1,081	649	-431	-39.9	***	1,094	603	-492	-44.9	***
	Share of Lipid	Ratio	0.003	0.002	-0.001	-38.2	***	0.003	0.002	-0.001	-31.2	***	0.003	0.002	-0.001	-34.9	***
	Calories	Kcal	101.0	51.0	-50	-49.5	***	98.5	59.17	-39	-39.9	***	99.7	54.9	-45	-44.9	***
	Share of Calories	Ratio	0.019	0.011	-0.008	-40.4	***	0.019	0.013	-0.006	-31.8	***	0.019	0.012	-0.007	-36.3	***

Source: Vietnam Access to Resources Household Survey, 2014 and 2016

Note 1) *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Note 2) Rate of change shows difference in value of households with/without loss.

Note 3) All values are per person in the household in the latest 4 weeks.

Note 4) Difference = Loss - No Loss, and Rate of change = (Difference/No Loss).

Note 5) Strong impact of El Niño happened in 2016.

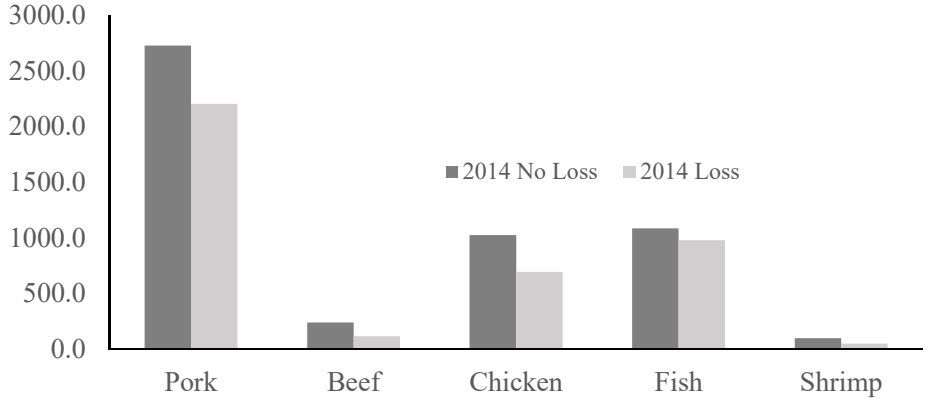

Figure 3-3 Reduction in calorie by meat types

3.3.4. Nutrition intake

Change in nutrition is shown in Table 3-2, and calorie intake is displayed in Figure 3-4. Calorie, protein, and lipid intakes are calculated based on nutrition information, based on the quantity demanded. Thus, reduction in quantity directly means reduction in nutrition intake. As shown in Figure 3-4, reduction of mean calories intake per person per day from pork increased from 521.3 kcal in 2014 to 615.6 kcal in 2016 (Table 3-2). In 2014, the reduction rate of calorie intake was highest in beef (51.7%) and shrimp (49.5%), followed by chicken (32.3%). Calories from pork (19.1%) and fish (9.8%) also decreased, but to a somewhat lesser degree.

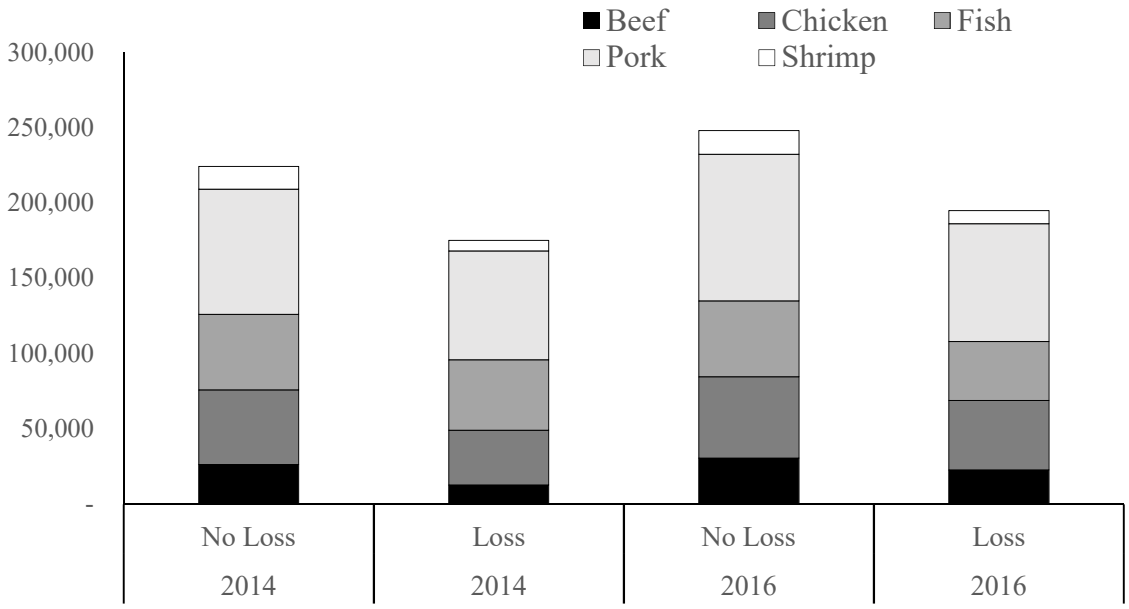

Figure 3-4 Expenditure of meat and fish items in VND

3.3.5. 14 items

Table 3-3 shows the expenditure and quantity consumed in both with/without loss from natural disaster in fourteen food items. Most of the food items, except rice wine, show the reduction in households with loss, and they are significant. The largest reduction in share was found in liquid milk in both 2014 and 2016 years. Liquid milk is not common for adults to drink, that is, liquid milk is recognized as the child drink, especially the young children. Once households experience income loss, they reduce the consumption of liquid milk, and it may harm the child's health, especially the small children.

On the other hand, expenditure is significantly higher for households with loss, in case of rice wine. Table 3-3 shows the 17.2% increase in expenditure per person in 2014, and even higher in 2016, 34.7%. Changes in expenditure include price effect, but quantity consumed also increased in households with loss such as 19.1ml, and 45.6 ml in 2014 and 2016, respectively. On the contrary, beer, another major alcohol drink in Vietnam, shows a reduction in both expenditure and quantity. Beer has become popular recently, especially in urban consumers, while rice wine is more traditional and consumed in rural consumers. When households experience loss from natural disaster, they demand more of alcohol drinks, especially rice wine.

Table 3-3 Difference between households with/without natural disaster, in 14 items

			2014					2016					2014 and 2016				
		unit	No Loss	Loss	Difference	Rate of change (%)		No Loss	Loss	Difference	Rate of change (%)		No Loss	Loss	Difference	Rate of change (%)	
Pork	Share of Expenditure	Ratio	0.239	0.275	0.035	14.8	***	0.256	0.286	0.030	11.6	***	0.248	0.280	0.032	13.0	***
	Expenditure	VND	82,896.1	72,037.4	-10,858.7	-13.1	***	96,998.4	78,116.4	-18,882.0	-19.5	***	89,988.9	74,944.3	-15,044.6	-16.7	***
	Quantity	g	1,045.4	844.5	-200.9	-19.2	***	1,169.0	934.6	-234.4	-20.1	***	1,107.6	887.6	-220.0	-19.9	***
Beef	Share of Expenditure	Ratio	0.053	0.033	-0.020	-37.7	***	0.057	0.044	-0.014	-23.6	***	0.055	0.038	-0.017	-30.8	***
	Expenditure	VND	26,333	12,726	-13,607	-51.7	***	30,515.8	23,214.3	-7,301.5	-23.9	**	28,436.7	17,741.3	-10,695.4	-37.6	***
	Quantity	g	132.8	63.9	-68.9	-51.9	***	146.9	129.0	-18.0	-12.2		139.9	95.0	-44.9	-32.1	***
Chicken	Share of Expenditure	Ratio	0.130	0.127	-0.003	-2.0		0.124	0.157	0.033	26.8	***	0.127	0.141	0.015	11.6	***
	Expenditure	VND	49,586.9	36,240.1	-13,346.8	-26.9	***	53,807.6	46,032.5	-7,775.1	-14.4	***	51,709.7	40,922.7	-10,787.0	-20.9	***
	Quantity	g	514.8	347.7	-167.1	-32.5	***	524.8	449.2	-75.7	-14.4	**	519.9	396.2	-123.6	-23.8	***
Fish	Share of Expenditure	Ratio	0.143	0.175	0.032	22.2	***	0.126	0.130	0.003	2.4		0.135	0.153	0.018	13.7	***
	Expenditure	VND	50,030.8	46,657.4	-3,373.4	-6.7	*	50,371.5	39,116.4	-11,255.1	-22.3	***	50,202.2	43,051.4	-7,150.8	-14.2	***
	Quantity	g	1,117.3	1,006.9	-110.4	-9.9	**	923.4	686.6	-236.8	-25.6	***	1,019.8	853.7	-166.1	-16.3	***
Shrimp	Share of Expenditure	Ratio	0.032	0.018	-0.015	-45.7	***	0.030	0.021	-0.009	-29.0	***	0.031	0.019	-0.012	-37.9	***
	Expenditure	VND	15,238.2	6,939.1	-8,299.0	-54.5	***	15,660.2	8,934.2	-6,726.0	-42.9	***	15,450.4	7,893.1	-7,557.3	-48.9	***
	Quantity	g	123.1	62.0	-61.1	-49.7	***	119.7	73.7	-46.0	-38.4	***	121.4	67.6	-53.8	-44.3	***

Table 3-3 Difference between households with/without natural disaster, in 14 items (continued)

			2014					2016					2014 and 2016				
		unit	No Loss	Loss	Difference	Rate of change (%)		No Loss	Loss	Difference	Rate of change (%)		No Loss	Loss	Difference	Rate of change (%)	
Fruit	Share of Expenditure	Ratio	0.072	0.057	-0.014	-20.1	***	0.067	0.048	-0.019	-28.4	***	0.069	0.053	-0.016	-23.8	***
	Expenditure	VND	30,206	17,762	-12,444	-41.2	***	31,223	16,539	-14,684	-47.0	***	30,718	17,177	-13,541	-44.1	***
Candy or Cookie	Share of Expenditure	Ratio	0.026	0.018	-0.009	-32.8	***	0.018	0.019	0.001	7.9		0.022	0.019	-0.004	-16.3	***
	Expenditure	VND	11,046	5,613	-5,433	-49.2	***	8,982	6,208	-2,774	-30.9	***	10,008	5,898	-4,110	-41.1	***
Powdered of Canned Milk	Share of Expenditure	Ratio	0.040	0.026	-0.014	-34.1	***	0.032	0.030	-0.002	-6.5		0.036	0.028	-0.008	-21.9	**
	Expenditure	VND	22,162	10,578	-11,585	-52.3	***	19,675	12,563	-7,113	-36.2	***	20,912	11,527	-9,385	-44.9	***
Liquid Milk	Share of Expenditure	Ratio	0.028	0.014	-0.014	-49.0	***	0.033	0.019	-0.014	-42.1	***	0.031	0.017	-0.014	-45.6	***
	Expenditure	VND	13,045	4,937	-8,108	-62.2	***	17,381	7,030	-10,351	-59.6	***	15,226	5,938	-9,288	-61.0	***
Beer	Share of Expenditure	Ratio	0.019	0.014	-0.005	-24.7	**	0.028	0.022	-0.006	-20.1	**	0.023	0.018	-0.005	-22.8	***
	Expenditure	VND	9,336	6,677	-2,659	-28.5	**	16,198	9,292	-6,906	-42.6	***	12,787	7,927	-4,860	-38.0	***
	Quantity	ml	546.7	400.0	-146.7	-26.8	**	743.6	592.9	-150.7	-20.3	*	645.7	492.2	-153.5	-23.8	***
Rice Wine or Local Alcoholic Drink	Share of Expenditure	Ratio	0.029	0.050	0.020	69.3	***	0.028	0.054	0.026	94.4	***	0.029	0.052	0.023	81.2	***
	Expenditure	VND	9,051	10,604	1,553	**17.2**	**	9,313	12,543	3,230	**34.7**	***	9,183	11,532	2,349	25.6	***
	Quantity	ml	503.6	599.9	96.3	**19.1**	**	459.4	669.1	209.7	**45.6**	***	481.4	633.0	151.6	31.5	***
Coffee	Share of Expenditure	Ratio	0.009	0.006	-0.003	-34.1	***	0.009	0.019	0.010	116.4	***	0.009	0.012	0.003	36.1	*
	Expenditure	VND	4,761	2,970	-1,791	-37.6	**	4,730	18,147	13,417	283.6	*	4,746	10,227	5,482	115.5	
	Quantity	g	57.5	30.1	-27.4	-47.7	***	70.2	185.7	115.5	164.7		63.8	104.5	40.6	63.6	
Industrial Beverage	Share of Expenditure	Ratio	0.014	0.013	0.000	-2.4		0.014	0.010	-0.004	-31.4	***	0.014	0.012	-0.002	-16.4	**
	Expenditure	VND	7,942	6,120	-1,822	-22.9	**	7,140	4,555	-2,585	-36.2	***	7,538	5,372	-2,167	-28.7	***
Eating/Drinking outside or Processed Food	Share of Expenditure	Ratio	0.165	0.174	0.009	5.4		0.178	0.141	-0.037	-20.7	***	0.172	0.158	-0.013	-7.8	*
	Expenditure	VND	95,012	78,124	-16,888	-17.8	**	113,330	77,594	-35,736	-31.5	***	104,223	77,870	-26,353	-25.3	***

Source: Vietnam Access to Resources Household Survey, 2014 and 2016

Note 1) *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Note 2) Rate of change shows difference in value of households with/without loss.

Note 3) All values are per person in the household in the latest 4 weeks.

Note 4) Difference = Loss - No Loss, and Rate of change = (Difference/No Loss).

Note 5) Strong impact of El Niño happened in 2016.

3.4. Results

3.4.1. Parameter Estimates

Given the descriptive analysis of consumption change of households with income loss, the empirical model of (2) is estimated. Among 14 items, four items namely beer, rice wine or local alcoholic drink, coffee, and eating/drinking outside or processed food are chosen as adult goods, and estimated parameters are shown in Table 3-5 while descriptive statistics of variables used in estimation are shown in Table 3-4. All models are estimated by ordinary least square (OLS) regressions with fixed effect of households. The discussion will be focused on the two adult goods beer and rice wine since it is hard to find the relationship between the consumption share of the two other items, coffee and eating outside, from the result shown in Table 3-5. As shown in Table 3-3, coffee shares the least, almost less than 1%, among total consumption of 14 food items. In addition, eating outside should not be considered as 100% adult good because there are several restaurants and food services for children customers on the market nowadays.

3.4.2. Income effect

In the beer case, expenditure per person is positively significant, while it is negatively significant in the rice wine case. This means that beer is defined as “normal goods”, while rice wine is defined as “inferior goods”. Once income increases, households raise consumption of beer, while they reduce rice wine. In Vietnam, beer is recently available for consumers, especially for the businesspersons in urban areas. Table 3-6 shows total income is higher in beer consumers than rice-wine consumers, such as 34,817 thousand VND for the former, while 26,900 thousand VND for the latter. Total expenditure and item-specific expenditure per person are also high for beer consumers. Hence, beer is demanded more by the consumers with higher income. On the other hand, rice wine is more traditional and demanded by lower income households. Farmers produce rice wine by themselves, and probably consumed more in rural areas. Rice wine is consumed less once income goes up.

3.4.3. Trade off

a) Rice wine case

In Table 3-5, most of the generation coefficients of both female and male are negative in rice

wine, meaning that additional children push household adult members to reduce consumption of rice wine. However, coefficients are not significant for females, while those for males are significant. This reveals that reduction in consumption is large once the household has a boy rather than a girl. Although coefficients for females are not significant, they are smaller than boy cases such as -0.028 for females and -0.05 for males, for ages 2-3 children. Similar trend is observed in ages 6-10, and 11-14. This means that reduction in consumption is larger when they have a boy rather than a girl, and this decision of the household means parents often sacrifice their consumption and save money for children, especially for boys. Vietnam households show stronger preference for boys, in normal situations.

The impact of income loss can be found from the cross terms of each gender generation with loss dummy. The coefficients of girls show negative significance indicating that adult members reduce consumption of rice wine once they face income loss, and it is significant if they have female children.

In the normal situation, adult members reduce consumption when they have male children, but once they face an emergency situation, they start reducing consumption of rice wine when they have female children. In other words, having *female* children does not affect the consumption pattern of adult goods in normal situations, but once they face income loss, having female children changes the consumption pattern and reduces the demand for rice wine. On the other hand, having *male* children affects the consumption pattern in the normal situation, but having male children does not further reduce the demand for rice wine in emergency situations. In the normal situation, households' consumption patterns are unbalanced and more favored to male children, however, under the emergency situation, households change consumption patterns to be more balanced between female and male children, and become less favored to male children.

Households even raise the demand for rice wine if they have male children aged 2-3 or 11-14. These somewhat counter intuitive results need explanation. In the emergency situation, demand for rice wine becomes positive, since parameters of "male age_2-3" and its interaction with loss dummy are, $(-0.05+0.1) > 0$ for the 2-3 age case, and $(-0.052+0.116) > 0$ for the 11-14 age case. Other generation cases show negative, which means households still *reduce* the consumption of rice wine, while households having male children aged 2-3 and 11-14 *raise* the consumption. Financial pressure

of having children for households are different by age. Small baby such as age 0-1 requires cost, and age higher than 15 requires additional education fee for university entrance. Financial pressures of having children aged 2-4 and 11-14 may be relaxed and easier than those having children in other generations. This is probably the reason why households raise the consumption of rice wine even under the emergency situation.

b) Beer case

Households with beer consumption are higher in income. For those households, having a female child gives incentive to reduce consumption of beer, and it is significant for children aged 2-3, and higher than 6, under normal situation, but not significant further reduction under emergency situation except aged 0-1. Only the households with female babies are reduced further in emergency situations for beer consumption, since children aged 0-1 are vulnerable and require care, especially under emergency situations. Hence, households care more about those vulnerable female children. Having male children also shows negative, but not significant in normal situations, yet it becomes negative once they face an emergency situation, especially for the households with male children aged 4-5, and 11-14.

This result contradicts the result from rice wine. Under the normal situation, having male (female) children reduces rice wine (beer) consumption, while households reduce demand for rice wine (beer) if they have female (male) under emergency situations. Households with beer consumption have access to the labor market in urban areas, which often provide working opportunities for females in the non-agricultural sector. Thus, those households invest more on female children than rice-consumer households by reducing the adult goods consumption. On the other hand, households with rice wine consumption are often located in rural areas, and less working opportunities for female children, thus, not enough incentive to invest in female children.

However, once an emergency situation occurs, they become more balanced between female and male children. It is reasonable that in facing income loss, households try to compensate for those losses by balancing consumption patterns between female and male, and become less favored to the children who were favored under normal situations. This balanced consumption pattern is only

observed in emergency situations, and we are not able to predict how long this pattern continues. However, it is important to investigate the longer impact of the income loss from natural disasters, in terms of human capital accumulation such as child health and education opportunities.

Table 3-4 Descriptive statistics of variables used in estimation

Variable	Obs	Mean	Std.Dev.	Min	Max
share of expenditure (Beer)	4,964	0.022	0.040	0	0.476
share of expenditure (Rice Wine)	4,964	0.031	0.056	0	1.000
share of expenditure (Coffee)	4,964	0.009	0.027	0	0.341
share of expenditure (Eat Outside)	4,964	0.170	0.191	0	0.961
d_loss	4,964	0.119	0.323	0	1
ln food expenditure per person	4,964	435.400	327.900	16	5713
ln number of household member	4,964	4.124	1.732	1	14
Household head age	4,964	53.280	14.350	18	100
Household head education	4,964	7.578	3.659	0	12
Ratio of each generation					
female age 0_1	4,964	0.007	0.037	0	0.333
female age 2_3	4,964	0.011	0.047	0	0.500
female age 4_5	4,964	0.012	0.050	0	0.500
female age 6_10	4,964	0.029	0.080	0	0.667
female age 11_14	4,964	0.026	0.078	0	0.667
female age 15_17	4,964	0.023	0.072	0	0.500
female age 18_21	4,964	0.034	0.088	0	1.000
female age 22 and older	4,964	0.375	0.196	0	1.000
male age 0_1	4,964	0.007	0.037	0	0.400
male age 2_3	4,964	0.012	0.050	0	0.667
male age 4_5	4,964	0.014	0.054	0	0.500
male age 6_10	4,964	0.036	0.089	0	0.667
male age 11_14	4,964	0.030	0.083	0	0.667
male age 15_17	4,964	0.020	0.068	0	0.500
male age 18_21	4,964	0.035	0.092	0	0.667
Interaction of d_loss and Ratio of each generation					
female age 0_1	4,964	0.001	0.014	0	0.333
female age 2_3	4,964	0.001	0.015	0	0.250
female age 4_5	4,964	0.001	0.017	0	0.333
female age 6_10	4,964	0.003	0.028	0	0.500
female age 11_14	4,964	0.004	0.031	0	0.500
female age 15_17	4,964	0.004	0.030	0	0.500
female age 18_21	4,964	0.005	0.033	0	0.500
female age 22 and older	4,964	0.040	0.124	0	1.000
male age 0_1	4,964	0.001	0.013	0	0.250
male age 2_3	4,964	0.002	0.018	0	0.500
male age 4_5	4,964	0.001	0.018	0	0.500
male age 6_10	4,964	0.005	0.036	0	0.500
male age 11_14	4,964	0.003	0.028	0	0.500
male age 15_17	4,964	0.003	0.025	0	0.500
male age 18_21	4,964	0.006	0.041	0	0.667

Source: Vietnam Access to Resources Household Survey, 2014 and 2016

Table 3-5 Parameter estimates

	Beer		Rice Wine or Local Alcoholic Drink		Coffee		Eating/Drinking Outside or Processed Food	
d_loss	0.001	(0.011)	-0.001	(0.012)	0.004	(0.007)	0.074	(0.045)
ln food expenditure per person	0.005 ***	(0.001)	-0.009 ***	(0.002)	0.001	(0.001)	0.126 ***	(0.006)
ln number of household member	0.002	(0.005)	-0.004	(0.005)	0.005	(0.003)	0.080 ***	(0.019)
Household head age	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)	0.002 *	(0.001)
Household head education	0.001 **	(0.001)	-0.002 ***	(0.001)	0.000	(0.000)	-0.002	(0.002)
Ratio of each generation								
female age 0_1	-0.018	(0.026)	-0.025	(0.029)	-0.030 *	(0.017)	-0.159	(0.106)
female age 2_3	-0.048 **	(0.023)	-0.028	(0.026)	-0.018	(0.015)	-0.156 *	(0.094)
female age 4_5	-0.034	(0.022)	-0.038	(0.025)	-0.005	(0.015)	0.020	(0.092)
female age 6_10	-0.036 *	(0.021)	-0.028	(0.024)	-0.003	(0.014)	-0.021	(0.088)
female age 11_14	-0.043 **	(0.020)	-0.019	(0.023)	-0.009	(0.014)	0.011	(0.084)
female age 15_17	-0.052 ***	(0.019)	-0.032	(0.022)	-0.030 **	(0.013)	-0.004	(0.079)
female age 18_21	-0.037 **	(0.015)	-0.016	(0.017)	-0.018 *	(0.010)	0.101	(0.063)
female age 22 and older	-0.023 **	(0.011)	-0.025 *	(0.013)	-0.010	(0.007)	0.017	(0.046)
male age 0_1	0.015	(0.025)	-0.004	(0.028)	-0.009	(0.017)	-0.079	(0.104)
male age 2_3	-0.011	(0.023)	-0.050 *	(0.026)	-0.008	(0.015)	0.030	(0.095)
male age 4_5	-0.019	(0.022)	-0.032	(0.025)	0.005	(0.015)	0.009	(0.092)
male age 6_10	-0.003	(0.020)	-0.048 **	(0.023)	0.015	(0.014)	-0.070	(0.084)
male age 11_14	-0.012	(0.020)	-0.052 **	(0.023)	0.000	(0.014)	-0.075	(0.084)
male age 15_17	-0.021	(0.019)	-0.012	(0.021)	-0.014	(0.012)	0.008	(0.076)
male age 18_21	-0.028 **	(0.014)	0.005	(0.016)	-0.003	(0.009)	0.096 *	(0.057)
Interaction of d_loss and Ratio of each generation								
female age 0_1	-0.152 **	(0.062)	0.022	(0.070)	0.000	(0.042)	-0.007	(0.256)
female age 2_3	0.067	(0.056)	-0.177 ***	(0.063)	-0.061 *	(0.037)	-0.333	(0.229)
female age 4_5	0.018	(0.050)	-0.024	(0.057)	-0.001	(0.034)	-0.236	(0.207)
female age 6_10	0.034	(0.033)	-0.055	(0.037)	-0.006	(0.022)	-0.040	(0.135)
female age 11_14	-0.023	(0.030)	-0.082 **	(0.034)	-0.020	(0.020)	-0.137	(0.124)
female age 15_17	0.045	(0.032)	0.032	(0.036)	0.023	(0.021)	-0.208	(0.131)
female age 18_21	-0.027	(0.032)	0.005	(0.036)	-0.012	(0.021)	0.117	(0.131)
female age 22 and older	-0.005	(0.020)	-0.006	(0.022)	0.002	(0.013)	-0.080	(0.081)
male age 0_1	-0.012	(0.065)	-0.094	(0.073)	-0.004	(0.043)	-0.371	(0.268)
male age 2_3	-0.011	(0.049)	0.100 *	(0.056)	-0.006	(0.033)	-0.071	(0.204)
male age 4_5	-0.089 *	(0.049)	0.050	(0.055)	0.000	(0.032)	0.004	(0.200)
male age 6_10	-0.020	(0.029)	0.012	(0.033)	0.017	(0.020)	0.035	(0.121)
male age 11_14	-0.060 *	(0.032)	0.116 ***	(0.037)	-0.014	(0.022)	-0.053	(0.134)
male age 15_17	0.002	(0.038)	-0.045	(0.042)	0.016	(0.025)	0.186	(0.155)
male age 18_21	0.011	(0.026)	-0.012	(0.029)	0.012	(0.017)	-0.172	(0.106)
_cons	-0.010	(0.019)	0.144 ***	(0.021)	-0.007	(0.012)	-0.763 ***	(0.077)
FE of Households	Yes		Yes		Yes		Yes	
obs.	4,964		4,964		4,964		4,964	
R squared	0.035		0.118		0.007		0.203	
F value	1.886		2.692		1.070		15.200	

Source: Vietnam Access to Resources Household Survey, 2014 and 2016

Note 1) *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Note 2) Inside parenthesis shows standard error.

Note 3) Strong impact of El Niño happened in 2016.

Table 3-6 Comparison of beer and rice wine consumers

a) 2014

	Beer (n = 819, 33.0%)		Rice Wine (n = 1,506, 60.7%)	
Total food expenditure per person (ths.VND)				
	Mean	Std. Dev.	Mean	Std. Dev.
Yes	530.0	339.3	409.3	296.4
No	354.1	244.5	416.5	283.3
Item expenditure per person (VND)				
	Mean	Std. Dev.	Mean	Std. Dev.
Yes	26,984	32,923	15,200	14,850
No	0	0	0	0
Total net income per person (ths.VND)				
	Mean	Std. Dev.	Mean	Std. Dev.
Yes	34,817	49,028	26,900	41,815
No	22,039	26,270	25,262	24,174

b) 2016

	Beer (n = 1,069, 43.1%)		Rice Wine (n = 1,445, 58.2%)	
Total food expenditure per person (ths.VND)				
	Mean	Std. Dev.	Mean	Std. Dev.
Yes	557.3	410.9	451.1	377.2
No	383.9	293.8	469.0	333.0
Item expenditure per person (VND)				
	Mean	Std. Dev.	Mean	Std. Dev.
Yes	31,765	29,948	16,640	16,624
No	0	0	0	0
Total net income per person (ths.VND)				
	Mean	Std. Dev.	Mean	Std. Dev.
Yes	35,966	37,764	29,573	32,996
No	24,144	22,740	28,765	27,188

Source: Vietnam Access to Resources Household Survey, 2014 and 2016

Note 1) Yes/No indicates if household purchase in last four weeks.

Note 2) Number of total households is 2,482.

Note 3) Strong impact of El Niño happened in 2016.

3.5. Conclusion

This analysis investigates the change in consumption pattern once households face natural disaster such as drought or flood. The result shows that the loss of household income reduces the consumption of animal-sourced products such as beef or shrimp, while they relatively increase the share of expenditure on pork and fish. Under the emergency situation, households shift the consumption pattern from high-price animal-source products to cheaper products such as pork and fish. The calorie intake also indicates the change in share of sources from beef or shrimp to pork and fish.

Another important issue under natural disaster is its impact on human capital accumulation such as child health or education opportunities. The econometric model called “adult goods approach” allows the impact of natural disaster on household expenditure on children to be examined. The econometric result indicates that in the normal situation, Vietnam households show a boy-favored consumption pattern, by reducing consumption of rice wine, while beer consumers reduce more of its consumption when they have a female child. However, in an emergency situation, the gender-bias of children becomes more balanced than normal. The emergency situation pushes households to manage to cope with risk in a short time period, thus, the consumption pattern becomes more balanced between female and male by becoming more favored to the children who were not favored in normal situations. Households lost longer-perspective decisions on human capital investment, such as child health or educational opportunity under emergency situations. It is impossible to predict how this pattern continues, but it is important to support those households with children, whether the human capital investment is sacrificed in the emergency situation.

Chapter 4 Natural disasters and migration choice in Vietnam
－Estimating the impact of EL NIÑO using household data－

4.1. Introduction

During 2014 and 2016, Vietnam was hit by severe droughts and floods under the longest and strongest EL NIÑO the country had experienced since 1998. Initially, the impact was unremarkable; however, they became significant later in mid-2015. As reported by UNDP (2016), 52 provinces, accounting for more than 80% of the country, were affected by drought and saltwater intrusion; 659 thousand hectares of cropland, including 273 thousand hectares of rice, were damaged to various degrees. Under the EL NIÑO, there was no rain between January and March of 2016 in the Mekong River Delta regions and two South Central Coastal provinces, Ninh Thuan and Binh Thuan. 18 provinces located in those regions were affected most severely by the drought and salinity intrusion, damaging 53.2% of the rice crop area; this area accounted for more than 70% of Vietnam's total rice production. Moreover, among these provinces, 10 provinces in the Mekong River Delta experienced the most extensive saltwater intrusion (UNDP, 2016) up to 90 km inland, a peak higher than 30‰ salinity in May 2016. The total loss was $674 million in the entire country (Sutton et al., 2019). The Vietnamese government declared a state of emergency and distributed 10 thousand tons of rice to these areas (FAO, 2016).

Since it is difficult to forecast such sudden environmental phenomena, household income becomes unstable, especially in agricultural households whose production depends on weather and natural climate. Therefore, diversifying income sources is important at the household level and migration is one of the major options. Kleemans (2015) showed that migration increases after contemporaneous negative income shocks. Jha et al. (2018) also clarified that income risk from climate change is one of the major drivers of farmers' migration. Dillon, Mueller, and Salau (2011) showed evidence that higher temperatures increase households' probability of sending migrants in northern Nigeria. Bohra-Mishra, Oppenheimer, and Hsiang (2014) also concluded that both temperature and precipitation had impacts on migration, but temperature affected the migration decision much more than precipitation. In contrast, Ezra and Kiros (2001) conducted a household survey on the major reasons for outmigration from drought-prone areas in Ethiopia. The authors found that drought

explained a very small fraction of the reasons for sending migrants. However, Koubi et al. (2016) found that sudden environmental events, such as floods, induce internal migration of household members; remittance is the major coping measure for households damaged by natural disasters (Halliday, 2006). Gröger and Zylberberg (2016) stated that following a decrease in income, households cope with risks mainly through labor migration to urban areas. In addition, households with settled migrants *ex-ante* receive higher remittances, while households with no migrants are induced to send the first migrant. Private transfer, which is the remittance from non-household members, is another important coping measure of ex-post risk management strategies, especially in cases of massive natural disasters (Mozumder et al., 2009; Sawada and Shimizutani, 2008).

Coping with risks from natural disasters, especially those with massive impacts on geographically proximate areas, is another challenge for agriculture-based economies such as Vietnam. Migration has been recognized as an important risk-coping mechanism; however, in the household decision of sending migrants, private transfer, as a temporary income, is expected to have a different function from the constant transfer of remittances from household members. Understanding the factors of sending migrants allows policymakers to incorporate policy options to cope with the risks from natural disasters. This study aims to investigate the impact of private transfers, that is, remittances from non-members, on households' migration decisions compared to that of remittances from household members.

The remainder of this study is organized as follows. Section 2 describes the data used in the analysis. Section 3 outlines our analytical framework. The results are discussed in section 4. Section 5 presents the conclusions and relevant policy implications of this study.

4.2. Impact of natural disasters in Vietnam

We employ data from the Vietnam Access to Resources Household Survey (VARHS) conducted in 12 provinces in the country; of these, 5 provinces were severely affected by the EL NIÑO in the 2016 survey. In this dataset, natural disasters are categorized into three types: floods, droughts, typhoons, and others. Disasters tend to occur seasonally at similar timings of the year, especially in specific areas. Therefore, farmers can anticipate their occurrence in normal years, such as in 2014. However, because of the EL NIÑO in 2016, the impact of these disasters became more severe than in normal years (UNDP, 2016) and farmers could not anticipate their occurrence in advance.

Although fewer households[1] reported losses due to natural disasters in 2016 than in 2014 (288 versus 313 households, respectively) (Table 4-1), the income loss per disaster in 2016 was 5,711 thousand VND and greater than the 5,265 thousand VND reported in 2014 (Table 4-2). This shows the severity of natural disasters in 2016.

We constructed panel data consisting of 2,518 households. More than 12% of these households (12.7% in 2014 and 12.4% in 2016) either increased the number of migrants or sent migrants for the first time (Table 4-1). This indicates the risk diversification strategy of households in post-disaster periods.

The number of households that received private transfers rose from 1,362 in 2014 to 1,519 in 2016 (Table 4-1), or from 54.1% in 2014 to 60.3% households in 2016. However, 190 out of 313 households (60.7%) that declared losses from natural disasters received private transfers in 2014, while only 130 out of 288 such households (45.1%) did in 2016. This means that in the EL NIÑO period, the number of households that received private transfers increased generally; however, the percentage of households that should be helped (i.e., declared losses from natural disasters) decreased by 15.6 percentage points from 60.7% in 2014 to 45.1% in 2016. This means that the massive natural disasters were widely broadcasted and invited a large number of private transfers through donations to regions, rather than to specific victims.

Table 4-1 Descriptive statistics of VARHS

	Definition	2014	2016
Migrant	Number of households had migrants	432	381
	Number of households had more migrants in year t (a)	321	313
	(and had loss among a, b)	(42)	(49)
	Share in all households (%, a/2,518)	12.7	12.4
Loss	Number of households had loss from natural disasters (c)	313	288
	Share of households had loss and sent more migrants (%, b/c)	13.4	17.0
	Number of households received private transfers (d)	1,362	1,519
	(and had loss among d, e)	(190)	(130)
	Share in all households (%, d/2,518)	54.1	60.3
	Share of households had loss and received private transfers (%, e/c)	60.7	45.1

Source: Vietnam Access to Resources Household Survey, 2012, 2014, and 2016

Note 1) Number of households is 2,518 in both years.

Note 2) Strong impact of El Niño happened in 2016.

Table 4-2 Descriptive Statistics of Vietnam Access to Resources Household Survey (VARHS), (thousand VND)

Year	Variables	Obs.	Mean	Std. Dev.	Min	Max
2012	Total Net Income	2,518	84,900	137,252	2,005	4,522,582
	Income per Person	2,518	21,620	28,791	1,003	584,000
	Remittance	118	18,186	36,166	500	240,000
	Share of Remittance in Income	118	0.214	0.228	0.005	0.929
2014	Total Net Income	2,518	102,178	139,588	-22,640	2,603,200
	Income per Person	2,518	26,236	35,746	-11,320	867,733
	Remittance	81	21,032	35,099	500	240,000
	Share of Remittance in Income	81	0.161	0.187	0.006	0.892
	Private Transfer	1,362	11,445	21,575	100	200,000
	Share of Private Transfer in Income	1,362	0.166	0.232	-1.209	1.467
	Loss of household income *per disaster*	273	5,265	20,894	100	316,000
2016	Total Net Income	2,518	112,099	119,509	-228,960	2,349,130
	Income per Person	2,518	29,148	30,536	-38,160	561,170
	Remittance	86	12,598	17,150	100	100,000
	Share of Remittance in Income	86	0.128	0.159	0.001	0.721
	Private Transfer	1,519	10,484	18,847	15	160,000
	Share of Private Transfer in Income	1,519	0.149	0.238	-2.725	1.883
	Loss of household income *per disaster*	264	5,711	13,034	100	120,000

Source: Vietnam Access to Resources Household Survey, 2012, 2014, and 2016

Note) Strong impact of El Niño happened in 2016.

4.3. Analytical framework and data

Following Halliday's (2006) analytical framework, we define the dependent variable of the migration model as binary, setting it to one if the household sent new migrants between periods *t* and *t*-1, and zero otherwise. This binary variable indicates the household's decision to send (additional) members to compensate for the income loss from natural disasters in these two years. Variable L_t in equation (1) indicates a household's exposure to natural disaster or private transfer in year *t*, while Z_{t-1} represents the demographic and economic condition of the household in year *t*-1. We estimated the parameters of empirical model (2) by assuming the following logistic function:

$$1(\Delta M > 0) = f(L_t, Z_{t-1}) \qquad (1)$$

The empirical model of migration decision of household *i* is specified as follows.

$$1(\Delta M > 0)_i = \alpha + \beta_1 d\_loss_t + \beta_2 d\_remit_{t-1} + \beta_3 d\_ptrans_t + \beta_4 d\_ptrans_t\_nonmigr_{t-1} + \beta_5 d\_poor_{t-1} + \beta_6 laborforce_{t-1} + \beta_7 schoolers_{t-1} + \beta_8 head\_education_{t-1} + \beta_9 head\_gender_{t-1} + e_i \qquad (2)$$

In equation (2), α and β_j are the parameters to be estimated by the logistic model, and e_i is the error term. Estimation was performed independently for two different periods using the maximum likelihood estimator.

The variables and their definitions are listed in Table 4-3. The variable d_loss_t equals one if the household reported losses due to a natural disaster in year *t*, and zero otherwise. Based on previous literature, we argue that households that experienced loss send additional migrants. Thus, the coefficient of d_loss_t is expected to be positive. If a household received remittance from a household's members in year *t*-1, d_remit_{t-1} equals one and zero otherwise. Receiving remittances in year *t*-1 implies that households have connections with the migrant society and it is easier for them to send additional migrants. However, the coefficient of d_remit_{t-1} can be either positive or negative, since the decision to send migrants also depends on the household's financial capacity.

If the household received private transfers in year t, d_ptrans_t equals one and zero otherwise. In addition, $d\_ptrans_t\_nonmigr_{t-1}$ equals one if the household had no migrants in year t-1 but was helped by private transfers from non-members in year t, and zero otherwise. Temporary income, such as private transfers, is usually used to recover from damage. Therefore, temporary income helps people to continue to stay in their residences. Private transfers, however, can also ease additional migration by covering the migration cost, especially after massive disasters. Hence, private transfers can be expected to either positively or negatively affect migration decisions. Another constraint to sending migrants is a household's connection to the migrant society. We assume that for household with no connection are less likely to send migrants than those with a connection in the previous year; however, note that the probability of sending migrants may be greater if private transfers are available. Thus, the sign of the coefficient of $d\_ptrans_t\_nonmigr_{t-1}$ is ambiguous.

Based on the standard set by the Vietnamese government, if income per person in year t-1 is up to 6,240 (7,800) thousand VND in rural (urban) areas, households are considered poor or nearly poor. The variable d_poor_{t-1} is a dummy variable used to categorize these households. These households are probably eager to send migrants to compensate for losses due to natural disasters. However, the financial constraints of covering migration expenditures may prevent them from leaving their homes. This means that the coefficient for d_poor_{t-1} may be either positive or negative.

The variable $laborforce_{t-1}$ indicates the number of household members in the working age from 15 to 60 years old in year t-1. A household is more likely to have surplus laborers with more members in their working age. Thus, a larger labor force has a positive effect on migration. The variable $schoolers_{t-1}$ represents the number of household members who were going to school in year t-1. Sending members to schools is a burden to households to some extent as they require money to afford school expenses. The higher the number of schoolers, the higher the expenditure. Therefore, this factor tends to push households to send migrants so that parameter is expected to be positive. The household head's education ($head\_education_{t-1}$) in year t-1 is measured by the grade that the household head finished. Household heads with higher education may know the importance of income diversification and have a greater capability to do so. The greater the number of years of education, the easier it is to find a place of employment. Finally, if the household head in year t-1 is female,

head_gender$_{t-1}$ equals one, and zero otherwise. In most Vietnamese households, the members who are responsible for caring for children and the elderly are usually female. If the household head is female, the head can manage these activities. Then, this household is likely to decide to send an additional migrant.

Table 4-3 Descriptive statistics of variables used in estimation

Variables	Definition	2014	2016	Difference
1(ΔM>0)	Sent new migrants between *t* and *t*-1	0.127	0.124	-0.003
		(0.33)	(0.33)	
d_loss_t	Experienced loss by natural disasters	0.124	0.114	-0.010
	in *t*	(0.33)	(0.32)	
d_remit_{t-1}	Received remittances in year *t*-1	0.047	0.032	-0.015***
		(0.21)	(0.18)	
d_ptrans_t	Received private transfers in year *t*	0.541	0.603	0.062***
		(0.50)	(0.49)	
$d\_ptrans_t\_nonmigr_{t-1}$	Received private transfer in year *t*, no	0.429	0.506	0.077***
	migrant in year *t*-1	(0.50)	(0.50)	
d_poor_{t-1}	Poor or near-poor	0.138	0.087	-0.051***
		(0.35)	(0.28)	
$laborforce_{t-1}$	Number of labor force in household	2.79	2.75	-0.04***
	in year *t*-1	(1.5)	(1.5)	
$schoolers_{t-1}$	Number of household members in	0.97	0.90	-0.07***
	school in year *t*-1	(1.0)	(1.0)	
$head\_education_{t-1}$	Grade that household head finished	8.16	7.33	-0.83***
	in year *t*-1	(3.3)	(3.7)	
$head\_gender_{t-1}$	Female-headed household	0.202	0.222	0.020***
		(0.40)	(0.42)	

Source: Vietnam Access to Resources Household Survey, 2012, 2014, and 2016

Note 1) Number in parenthesis indicate standard deviation.

Note 2) Number of households in this sample is 2,518 in both years.

Note 3) *** indicates significance at 1%.

Note 4) Strong impact of El Niño happened in 2016.

4.4. Results and discussion

4.4.1. Impact on migration decision

The estimated parameters and marginal effects are listed in Table 4-4. Although the loss due to the natural disaster itself did not have a significant impact on pushing migration in 2014, the signs of all estimated parameters follow our expectations and are significant. Furthermore, we find that the loss induced by weather-related disasters in 2016 increased the number of migrants. The marginal effect of loss in 2016 was 0.037 and significant, which means that households which experienced losses due to disasters were 3.7% more likely to send additional migrants. Since the impact of natural disasters, especially droughts, was very severe in 2014-2016, there was a greater impact than the 2012-2014 period. As shown in Table 4-1, the number of households reporting loss due to natural disasters in 2016 was lower than that in 2014; however, as shown in Table 4-2, the lost value per disaster was significantly large. Therefore, the natural disaster had a more severe impact on household income in 2016 than in 2014; thus, they were more likely to send migrants.

Indeed, households that received remittances in the previous year sent additional migrants in 2016 and the marginal effect was higher in 2016 than in 2014. This implies that a household's connection with the migrant network is important in households' decisions to send migrants. This also indicates that to ensure their consumption and income, sending laborers is an important coping method for those households which experienced a loss. Households that suffered losses from natural disasters may try to further diversify their income risk by sending additional migrants and raising the income share of remittances.

The coefficient of private transfers was positive and significant in both 2014 and 2016. Private transfers can be recognized as temporary income. These transfer did increase the likelihood by 7% by helping households afford migration costs. For households that had no migrants in the previous year, that is, those with no connections with the migrant society, the probability of sending additional migrants was lower. The marginal effect is smaller in 2016 (-0.044) than in 2014 (-0.080). This emphasizes the importance of a household's connection with the migrant society. Without connections, new migrants may find it difficult to obtain jobs or save costs for job-seeking and accommodation.

Together with the effect of private transfers and remittances, financial constraints are expected to be critical in households' decision to send migrants. This constraint was also observed in poor and near-poor households. Households categorized as poor or near-poor in the previous year showed a lower probability of sending additional migrants in both periods, but significantly in 2016 (-0.073); thus, the marginally lower in 2016. Migration can be recognized as an important *ex-post* risk-coping measure by stabilizing the income stream over the years; however, this is not an option for these poor and near-poor households. Moreover, it was marginally worse in 2016. Migration has associated costs in advance and poor households are not able to afford them. This implies that natural disasters expand the income gap among households, especially worsening the situation of the poor. Hence, it is important to provide an *ex-ante* risk-coping program, especially for those in poverty.

4.4.2. Household demographic conditions

Most demographic variables were positive and significant, especially in 2016. They are also marginally higher in probability, except for the labor force. Households with a greater number of school goers, with longer years of education of household heads, and with female household heads, sent additional migrants. The effects of these factors were exaggerated in 2016 after the natural disasters. Households with these factors are relatively advantageous for coping with risk. Nevertheless, households without these factors suffered from natural disasters. Thus, expanding working opportunities or education is important as an *ex-ante* risk-coping measure.

Table 4-4 Estimated parameters

	2014		2016	
	Coef.	Margins	Coef.	Margins
d_loss_t	-0.091	-0.017	0.207**	0.037**
	(0.104)	(0.019)	(0.103)	(0.019)
d_remit_{t-1}	0.192	0.035	0.303*	0.055*
	(0.158)	(0.029)	(0.178)	(0.032)
d_ptrans_t	0.391***	0.071***	0.400***	0.072***
	(0.103)	(0.019)	(0.114)	(0.020)
$d\_ptrans_t\_nonmigr_{t-1}$	-0.439***	-0.080***	-0.245**	-0.044**
	(0.109)	(0.020)	(0.114)	(0.021)
d_poor_{t-1}	-0.124	-0.023	-0.403***	-0.073***
	(0.103)	(0.019)	(0.148)	(0.027)
$laborforce_{t-1}$	0.261***	0.048***	0.233***	0.042***
	(0.025)	(0.005)	(0.026)	(0.005)
$schoolers_{t-1}$	0.191***	0.035***	0.223***	0.040***
	(0.033)	(0.006)	(0.034)	(0.006)
$head\_education_{t-1}$	0.018*	0.003*	0.053***	0.010***
	(0.011)	(0.002)	(0.010)	(0.002)
$head\_gender_{t-1}$	0.049	0.009	0.206**	0.037**
	(0.094)	(0.017)	(0.090)	(0.016)
cons	-2.366***		-2.698***	
	(0.141)		(0.149)	
Log likelihood	-843.36		-832.91	
Observations	2,518		2,518	

Source: Vietnam Access to Resources Household Survey, 2012, 2014, and 2016

Note 1) *, **, *** indicate significant at 10%, 5% and 1%.

Note 2) Inside parenthesis shows standard error.

Note 3) Strong impact of El Niño happened in 2016.

4.5. Conclusion

This study analyzed the impact of massive natural disasters on households' decisions to send (additional) migrants. We find that climate-related disasters induce migration and push households to choose migration as an important measure to cope with risks with the aim of stabilizing their income, and thus, their consumption. Moreover, even households that decide to send migrant laborers are constrained by their financial capability to afford migration costs and their connection with the migrant society. Therefore, both remittances from (1) non-household members, and (2) household members before the disaster, which functions as a connection to migrant society, have a positive effect on migration when disaster occurs. In addition, low-income households had lower accessibility to migration opportunities, especially in 2016. This means that natural disasters may widen the income gap among households. Therefore, it is important for policymakers to support poor households by providing *ex-ante* risk-coping programs. Expanding education and working opportunities is an important measure.

Influenced by climate change, the EL NIÑO in 2016 had the most significant impact in recorded history. Although the severity of EL NIÑO is hard to predict, the phenomena itself is cyclical (Sutton et al., 2019). Therefore, it is reasonable to expect that similar or even more severe natural disasters will occur in the coming years. If households face a situation similar to that in 2016, they may send more migrants and even move to urban areas in the future. Policy measures is an urgent matter to prevent further migration from rural Vietnam.

Footnote

1) The number of households employed for analysis was 2,518, of which 367 in 2014 (14.6%) and 479 (19.0%) in 2016 were non-agricultural households.

Chapter 5 Conclusion

5.1. Climate change and summary of each chapter

Because of its geographical characteristics, with a long seaside by the Pacific Ocean, Vietnam is one of the most regularly facing natural disaster countries in the world. Vietnam is also one of the most vulnerable countries to climate change. Under the occurrence of climate change, natural disasters tend to become more diverse and increase in frequency, severity, and intensity, even change in timing. Groen and Jacobs (2012) used to warn that Vietnam can be severely affected by climate change resulting in natural hazards such as droughts might increase in number and severity in the near future even though they did not occur very often in the past.

It became true in 2016 when Vietnam experienced the historic severe drought and salinity intrusion under the occurrence of the longest and strongest El Niño (from 2014 to 2016). It had impacts on more than 80% regions in Vietnam with 52 provinces were affected in which 18 provinces were severely affected and 10 out of 13 provinces in Mekong Delta region announced an emergency. While the country had not completely recovered from the hazard yet, the year 2017 followed with a record number of disasters across regions and regions in Vietnam from the North, Central, to the South. Vietnam experienced heavy rains lasting for months causing floods, landslides, faced historical storms and typhoons and there were regions near the sea or major rivers the situation exceeded the historical record. Not only cyclical events like ENSO or seasonal natural hazards such as floods or storms, Vietnam had some disasters that came earlier or later than usual or emerged in different regions as a noticeable issue in recent years. For example, while landslides used to occur most in the Northern Uplands, river erosions and coastal erosions have happened more frequently and broadly in the Mekong Delta region and coastal provinces in the country.

Natural disaster prevention, response and mitigation has become more important and indispensable than ever before. Not only improvement in disaster forecast or in infrastructure is necessary, understanding the impacts of natural disasters on people's life and how people respond and cope with these hazards play an important role in developing and implementing policies and setting up effective strategies and plans for natural disaster prevention, response and mitigation too.

This study examines the impact of natural disasters on children, based on food allocation decisions called adult goods approach and investigates the impact of weather shock on the gendered allocation of consumption. This is an empirical question, the consequences are theoretically unknown. Using the household survey data this study analyzes the demand for adult goods, represented by beer and rice wine, in both normal periods and emergency situations.

On the other hand, natural disastrous events bring different extent of losses to affected households. In this situation, reducing consumption, usually including consumption of food, is generally chosen most frequently as one of people's first reactions. Therefore, to recover consumption, especially necessary consumption, households need to find more sources of income and migration is a popular choice among households' corresponding coping mechanisms to respond to climate-related disasters.

There have been an increasing number of studies on climate-induced migration, but the findings have been contradictory. Notably, along with migration, remittances are also a major concern with respect to natural disasters. However, research on the role of remittances during disasters is limited. This study offers additional evidence on the relationship between natural disasters and migration, and differentiates the role of remittances from household members and non-members. Using household data from the Vietnam Access to Resources Household Survey (VARHS) during the two periods of 2012-2014 and 2014-2016, when Vietnam was hit by the El Niño, this study analyzes the household decision of sending additional migrants by applying a logistic function.

5.2. Conclusion

The results indicate that reduction in consumption is the first strategy to cope with natural disasters, and 2016 is more severe than 2014. Food diversity study shows reduction of animal-sourced protein and most of the food item consumption. Furthermore, the investigation on the impact on children points out that boys are preferred in normal situations, but it becomes balanced in emergency situations. This is because total consumption is reduced in households, and they have to manage the emergency situation, so they are not able to look further into the future of children, such as education

for children or health conditions of children. Thus, even if the allocation of food consumption becomes balanced, it is under the reduced consumption situation. Balanced consumption between boys and girls is not a welcoming outcome in an emergency situation.

In the analysis of migration, we found that El Niño pushed households to send more migrants. Furthermore, a household's connection with the migrant society and the financial ability to cover migration costs both significantly affect this decision. Households that received remittances from household members in the previous period are more likely to send more migrants in the following period when the El Niño occurred. Regarding the connection to migrant society, private transfers also provided financial support for migration. Poor households that are constrained by financial resources face difficulty in sending migrants. This may expand the income gap between these households and those who can send migrants. Therefore, it is important to expand working opportunities and education as ex-ante risk-coping measures, especially for the poor.

Under the emergency situation, children or poor households are more affected by natural disasters, thus, policy makers should consider those vulnerable populations when they consider the coping policy for natural disasters in Vietnam.

Government policy support instance support right after the natural disasters, but not longer perspectives. And the amount victims received is very small, so it is hard for them to re-start planting or reconstructing their life. Government should support longer periods for the people with damage from natural disasters by agricultural insurance. Although it is not very popular now, insurance or any kind of mutual support system should be provided to farmers.

This study result indicates that El Niño caused households to send additional migrants while Koubi et al. (2016) research pointed out that individual perceptions of long-term environmental events, like droughts, significantly decrease migration. It might not contradict results but the reason might be due to people's awareness and perception of the hazards, not due to the hazards themselves. Wang et al. (2012) concluded that there is a close relationship between the level of risk and the acceptance of insurance against disasters. Trung (2013) also agreed that awareness and preparedness have effects on

how well people mitigate the impacts once natural disasters occur and thus affect the aftermath of disasters. A storm called Linda that affected the Mekong Delta region in Vietnam in 1997 was mentioned in this research as an example for the role of people's awareness and preparedness. In this case the local residents had almost no expectation of having storms in the region. Because of this the storm caused historical losses, both in terms of human lives and asset losses, although it was not an extremely powerful storm compared to other storms Vietnam used to be hit.

The response of Vietnamese households on the drought and salinity intrusion under the El Niño in 2016 may come from their perception on the situation of this hazard. Sutton et al. (2019) distinguished ENSO (including El Niño and La Niña) and climate change as two separate phenomena that have several similarities and some major differences. According to them both phenomena are slow onset climate events that may not be quickly perceived by farmers or the society. ENSO is cyclical so their impacts will come and go, while climate change impacts are more permanent and are predicted to become worse over time. Hence, climate change may make regions previously suitable for agriculture become unsuitable. Moreover, climate change may make regions drier and scarcer of water, gradually making those regions more vulnerable to El Niño.

Therefore, this study results suggest that strategies and plans for natural disaster prevention, response and mitigation should not be based only on the type of disasters but need to be based on their nature and characteristics, seasonal or cyclical events or climate change effects. In addition, developing strategies and plans for natural disaster prevention, response and mitigation should not focus only on instant aftermaths but need to aim for longer effects too. In this study, households who had losses from natural disasters reduced their food consumption while these disasters hit in the same year or in one or two previous years.

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