

# FLOOD VULNERABILITY AND RESILIENCE IN PERI-URBANIZING VIETNAM: A CASE STUDY FROM NINH BINH PROVINCE

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# Chapter 5

## Flood Vulnerability and Resilience in Peri-urbanizing Vietnam: A Case Study from Ninh Binh Province



Hue Le and Ly Bui Ha

**Abstract** Vietnam has experienced massive peri-urbanization in recent decades. Its level of urbanization increased from 19.6% in 2009 to 36.6% in 2016. Peri-urban areas are caught between development and conservation needs, between economic development and environmental protection, and between cultural preservation and sustainable development. In the context of more frequent extreme weather events, rapid peri-urbanization puts higher stress on local water systems and resources. This chapter examines the vulnerabilities and challenges from the flooding that communities face in the peri-urban area of the city of Ninh Binh. Qualitative and quantitative data from household interviews, group discussion, and key informant interviews found that flooding is annually 70–80 cm high and lasts up to one week in the village and its surrounding areas. Flooding forces villagers to abandon cultivated land which adversely affects incomes. Flood damage is made worse by sewage water from the Khanh Phu Industrial Zone that spreads throughout Phu Hao village, killing cattle and fish. Surface water is severely polluted during the rainy season and polluted water has caused water-borne diseases. Unplanned, unregulated building along with underdeveloped water infrastructures for supply, sanitation, storm drainage, and pollution pose severe challenges to the area's already strained adaptive capacity.

**Keywords** Flood · Vulnerability · Resilience · Peri-urbanization · Vietnam

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Like other countries in Southeast Asia, Vietnam has undergone massive peri-urbanization in recent decades. The country's level of urbanization increased from 19.6% in 2009 to 36.6% in 2016. Peri-urban areas are subject to heavy pressures because they are caught between development and conservation needs, economic development and environmental protection, and cultural preservation and sustainable development. With more frequent extreme weather events, rapid peri-urbanization can put higher stress on existing local water systems and resources, especially when flooding occurs.

Many scholars agree that marginalization is a critical concern in the governance of peri-urban areas (Allen 2010; Dávila 2006; Hudalah et al. 2007; McGranahan et al. 2007; Simon et al. 2006). Peri-urban areas have lost rural values without the benefits of more positive urban attributes. In handling the complexities of this transformation, governance is beset by administrative separatism, agencies' overlapping remits, or incompatible functional and territorial jurisdictions at the different levels. Deficits in public administration and governance can potentially erode the adaptive capacity of peri-urban populations and, especially, affect its poor and low-income households and the communities' resilience to climate change hazards and water stresses. However, these same problems are less severe and of less importance in the urban core districts which are better designed compared to peri-urban areas.

Regions of rapid peri-urbanization are characterized by marginality. More frequent extreme weather events have affected local people's water resource use, livelihoods, and health and safety—all of which vary across gender, socioeconomic status, and class. These converge with the local or meso-level politics shaping resource distribution, disaster management, and the water sector. There is a pressing need to understand the mutually reinforcing dynamics between severe climate change effects, socially differentiated vulnerabilities, and peri-urban-related water stresses that combine to affect people's capacity to adapt to climate change in their livelihoods and everyday lives.

In Vietnam, several innovative approaches have recently been developed to classify social vulnerability and explore adaptation strategies for the future, particularly for the most vulnerable regions, rural and urban communities, and households (Huynh and Resurreccion 2014; McElwee et al. 2010; McEvoy et al., 2014; Le 2007; Nghiem et al. 2009; Nguyen 2007; OXFAM 2008; Tran 2007). Nevertheless, there is little known about how people vary in their adaptation strategies to climate-related water stresses in the peri-urban areas, about the drivers and constraints shaping their vulnerabilities to these stresses, and about the opportunities shaped by the conditions in peri-urban areas.

In this chapter, we examine the vulnerabilities and challenges posed by the flooding that communities face in the peri-urban area of the city of Ninh Binh. Our analysis pays explicit attention to (a) local socioeconomic development policy and the establishment of the Khanh Phu Industrial Zone; (b) impacts caused by flooding and lack of regulations, unplanned built environments, and underdeveloped water infrastructure; and (c) the varying adaptations of different social groups of households.

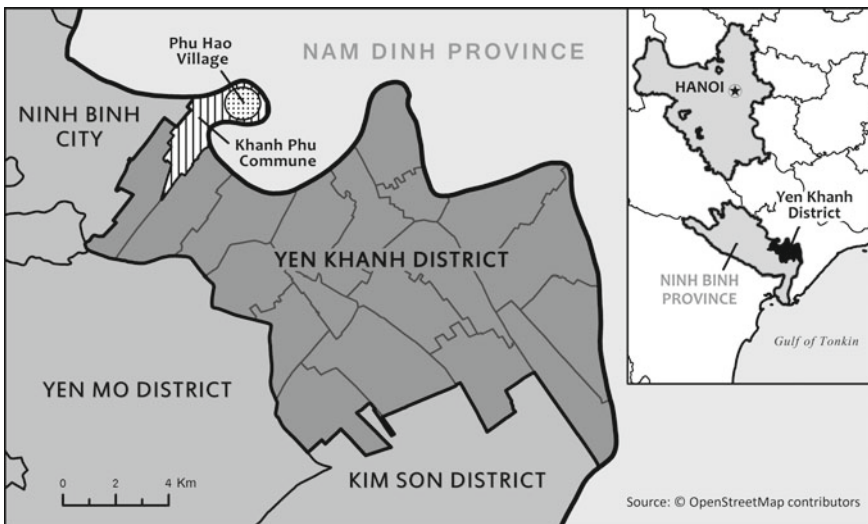
We also explore how institutional adaptation programmes and actions together with household responses have collectively determined the resilience of the system.

## 5.1 Research Methodology

### 5.1.1 Research Site

Ninh Binh province is located in the south of the Red River Delta/Northern Delta. Bordered by Ha Nam and Nam Dinh in the east and northeast, and Thanh Hoa and East Sea in the south, Ninh Binh province has two cities and six districts including Ninh Binh and Tam Diep city and Hoa Lu, Gia Vien, Nho Quan, Yen Khanh, Yen Mo, and Kim Son districts. Yen Khanh district is located in the southeast side of Ninh Binh city. In the city's development plan to 2020 with a vision toward 2030, Khanh Phu is one of two communes of Yen Khanh district that will be merged into Ninh Binh city's area (Truc Quyen 2016). It is the commune we focus on, especially Phu Hao village. Figure 5.1 illustrates the area.

Khanh Phu commune is located in the north of Yen Khanh district, Ninh Binh province, 5 km from the city centre. The total area of Khanh Phu is 5.92 km<sup>2</sup>. It has a population of 5,500 people. This commune has eight villages, including Phu An, Phu Long, Phu Tan, Phu Hai, Phu Cuong, Phu Son, Phu Binh, and Phu Hao. Khanh Phu is bordered by Khanh Hoa, Ninh Phuc (Ninh Binh city), and Khanh An (Yen Khanh



**Fig. 5.1** Location of the research site (Source: OpenStreetMap contributors; adapted from 2008 atlas map by Truong Dao)

district). Ninh Phuc Port, located in Khanh Phu, is the major port serving Khanh Phu Industrial Zone. Khanh Phu Industrial Zone lies on two communes—Ninh Phuc (Ninh Binh city) and Khanh Phu (Yen Khanh district). This zone occupies three-quarters of Phu Hao village, covering almost all of the village (Khanh Phu People's Committee 2016).

The region has a tropical monsoon climate with four different seasons. There are two dominant monsoon winds—the southwest wind during the summer and northeast wind in winter. Summer and autumn in this region have high temperatures and humidity. From May to October, typhoons and storms occur with strong winds and heavy rains. The volume of rainfall in summer and autumn from May to October is significantly higher than in the winter and springtime from November to April ([ninhbinh.gov.vn](http://ninhbinh.gov.vn), 2018).

Since the early 2000s, the Ninh Binh People's Committee planned to establish several industrial zones located in Gia Vien, Hoa Lu, Nho Quan, Yen Mo, and Yen Khanh districts to promote industrial and economic development. In 2004, Khanh Phu commune, Yen Khanh district, transformed 351 ha (including agriculture and residential land) into an industrial area, creating a new Khanh Phu Industrial Zone (IZ). In 2005, the industrial zone started operation. A glass-manufacturing factory was the first to move there, then others followed later. Currently, the zone is almost filled with factories, which are quite diverse—from shipbuilding, steel productions, and advanced material processing to fertilizer manufacturing, garment factories, warehouses, and logistic services.

Since the factories of the Khanh Phu industrial zone commenced operations, Phu Hao villagers have lost productive land and livelihoods. They have also experienced high rates of unemployment and a polluted environment. According to key informants, the polluted water resources and air have caused the death of cattle and fish and lower crop yields. Phu Hao village has sunk because it is surrounded by the Day River dyke and the elevated area of the factories. This makes Phu Hao a suitable area for carrying out research on peri-urban vulnerability to climate-related hazards, including floods, water-borne diseases, and health problems.

### 5.1.2 *Research Approach*

To analyze vulnerability and resilience to floods in a peri-urban area we follow the Climate Resilience Framework (CRF) developed by the Asian Cities Climate Change Resilience Network (ACCCRN) (Tyler and Moench 2012). According to the framework, three elements of urban resilience—namely, systems, social agents, and institutions—should be considered along with exposure to understand the flood vulnerability of peri-urban communities. *Exposure* denotes the nature and degree to which a population or system is subject to environmental or socio-political hazards (Adger 2006), and can be indicated by the magnitude and frequency of the hazards that the population experiences (Luers 2005). Regarding *systems*, we explore the conditions of the natural and built (infrastructure) environment that affect the flood

impacts. *Agent capacities* are assessed by examining different social groups' capacity for preparedness, response, and recovery. Finally, we carry out an institutional analysis to investigate the strengths and weaknesses of institutions (laws, policies, and organizations) that enable or constrain agents' abilities to adapt to flood and water-related hazards (Tyler and Moench 2012).

### 5.1.3 Data Collection

We collected data in March and December 2017. We used mixed methods of data collection, including desk study, stakeholder consultation meetings, key informant interviews, household interviews, focus group discussions, and field observation.

**Desk study:** We collected relevant information from various resources such as data from governmental organizations at levels from the province to communes including published reports/documents from the provincial, district, and commune People's Committees and from research institutions. These data includes social, financial, economic, and environmental reports.

**Stakeholders meeting:** We organized a meeting with various stakeholders in Ninh Binh Province, such as the People's Committee of Ninh Binh city (PCC); the Department of Natural Resources and Environment (DONRE); the Department of Science and Technology (DOST); Department of Construction (DOC); Department of Education and Training (DOET); Provincial Union of Science and Technology Associations (PUSTAS); and the representatives from several communes and wards of Ninh Binh city. In that meeting we aimed to identify the groups most vulnerable to climate change and the climate hazards with the most impacts on stakeholders, which warrant further study. We found that heavy and sudden rains and high temperature in the rainy season had the most impact on local communities.

**Household interviews:** A sample of 103 households, including rich, upper-middle class, middle-class, and poor households in Phu Hao village was selected for semi-structured interviews (Table 5.1). We conducted semi-structured interviews with the head or spouse of the head of each of 103 households sampled. In the household surveys, we raised questions related to different assets to understand how local people access available local resources and how they use them to cope with flooding. Extreme weather events within the last 50 years were also identified and benchmarked for discussion and investigation.

**Key informant interviews:** We used this method to obtain and gather needed information about Phu Hao community. The informants were from the Ninh Binh provincial Department of Planning and Investment, Department of Natural Resources and Environment, Department of Construction, Department of Industry and Trade, Department of Science and Technology, and the Ninh Binh Industrial Zone Authority. Those informants not only have in-depth understanding of the study's issues but also were knowledgeable about Phu Hao community, and the Khanh Phu Industry Zone which is directly polluting Phu Hao village.

**Table 5.1** Number of sampled households in the field research

Village	Rich	Upper middle class	Middle class	Poor	Not answered	Total
Phu Hao, Khanh Phu Commune, Yen Khanh District	5	34	59	5	0	103

Source: Field research, 2017

We used the personal interview technique with guiding questions as a semi-structured interview. There were twenty key informants selected for interviews. They were provincial, district, and commune authorities; village heads; heads of civic organizations such as the Women’s Union, Youth Union, Farmers Association, and elderly villagers.

**Focus group discussions:** We conducted three group discussions with ten people in each, including a women-only group, a mixed group with both men and women, and a group with members of the Village Management Board and representatives from civic organizations, such as the Women’s Association, the Farmers’ Association, the Veterans Association, and the Youth Union. We also conducted a wealth ranking.<sup>1</sup> The other topics we examined included: local people’s livelihood and occupation, rights and reproductive health, use and dependence on resources for daily living (water, energy, transportation, and other natural resources), use of time, personal autonomy, and social networks. We also discussed involvement in public and civil organizations involved in rehabilitation and preparedness for disaster.

**Field observation:** Based on the information collected from interviews, we tried to figure out the actual living conditions as well as the environmental conditions of the community by taking photos. Those photos serve as evidence to support research findings that inform proposed recommendations.

## 5.2 Research Findings and Analysis

### 5.2.1 Descriptive Statistics

The study surveyed 103 respondents from Phu Hao village, all of whom were household heads or their spouses. Twenty of these households (19.4%) were led by women. The average household size surveyed was 3.5 persons, which is lower than the aver-

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<sup>1</sup>Group discussion with ten people from different social groups of households helped us to understand the criteria for rich, upper-middle class, middle-class, and poor households—what their main livelihoods were and what their housing looked like as well as other challenges people faced in the village.

**Table 5.2** Past flood events in Phu Hao village

Year	Event
June 1968	Heavy rain and storms occurred. In the heaviest one, 17 houses collapsed but no one was killed. The state gave people some baskets of potatoes to help them survive while they were rebuilding their houses. At that time, house walls were made of mud mixed with soil. No rice was given.
1980	Heavy rain caused severe flood, resulting in loss of potatoes and other crops. Fields were covered with water. The cooperative lost all its fish.
2016	Heavy rain occurred twice. The highest water level in relation to ground level reached between 70 and 80 cm and lasted up to two weeks. Sewage water from Khanh Phu Industrial Zone was spreading throughout Phu Hao village and causing death to cattle and fish. Surface water was heavily polluted in rainy season.
August 2017	Heavy rain caused flood. The highest water level in relation to ground level reached 35 cm and lasted less than two days, but lead to loss of crops and rice.

Source: Key informant interviews in the field, April and December 2017

age household size of the entire country (3.8), but equivalent to the figures of both rural and urban areas of the Red River Delta (3.5) (General Statistic Office 2015). There were 184 males and 176 female members, denoting a sex ratio of approximately 1.045, which is a bit higher than the national sex ratio of 1.028 (General Statistic Office, Statistical Yearbook of Vietnam 2016). Only 140 out of 360 people were currently working, signifying a dependency ratio of around 1.57.

The mean age of survey respondents was around 56.32. On average, they attended school for around seven years, with most respondents (76.7%) having finished one to eight grades. Only 19 people (18.4%) had attended high school, and less than 2% had a high school or college degree. The sample was highly native: 97.1% of the respondents had lived in the area for more than 20 years. All of the respondents were Catholic.

### 5.2.2 *Exposure and Impacts of Flood and Other Hazards*

Through focus group discussion and household interviews, we were able to summarize several prominent flood events from the last 50 years and their impacts (Table 5.2). Major floods do not occur frequently in the study area—local people remembered only the events in 1968 and 1980. However, inundation caused by heavy rain occurs on a regular basis each year, having various impacts on the livelihoods of local communities.

According to the narratives of key informants and households, the water level usually increases by between 30 and 70 cm during floods. This triggers the blowout of sewage water from industrial zones to all areas in Phu Hao village. As a result, the water becomes heavily contaminated and causes death to cattle and fish. Floods like this occurred twice in 2016. In addition, surface water is heavily polluted during



the rainy season. In the dry season from December to May, Phu Hao villagers suffer from lack of water for agriculture activities in recent years.

In April 2004, the Binh Dien fertilizer plant left around 15,000 tons of nitrates outside, which was then washed by the rain into the industrial zone's drainage ditch. Combined with wastewater from Chai Chen Screw Plant, this led to mass mortality of fish and the rice did not produce any grain because of the high protein concentration. Rice yield was only fifteen quintals per hectare, while the normal yield in the area is 75 quintals per hectare. Fish that reached maturity and were ready to be harvested by 15 households in the village receiving water from the drainage ditch of IZ were all killed. Cattle were also killed after drinking water from the drainage ditch.

The compensation of several tens of millions VND was not satisfactory. Thousands of people here are suffering from air pollution and polluted water from earth wells as well as boreholes because of industrial wastewater leaking into the groundwater. Every day from 7:00 PM until the end of the night, the air is so stuffy, breathless, and smelly that we have to wear masks to sleep.

Local villager, key informant, 2017

### ***5.2.3 Socio-Ecological Systems and Infrastructures***

Khanh Phu Industrial Zone started operating in 2005. Currently, the zone includes shipbuilding industries as well as steel production, advanced material processing, fertilizer factories, garment factories, and logistic services. All the taxes and environmental fees from the factories are paid directly to the provincial level, with the local community getting benefits from only factory employment. Khanh Phu's economic growth rate has been increasing. In 2017 the economic growth of Khanh Phu was 6% compared to 5% in 2016. The three main economic sectors of Khanh Phu are agriculture, fisheries, construction, and services. Agriculture and fisheries account for 37.51% of Khanh Phu's production value, industry construction represents 49.46%, and services make up 13.03% of the economy.

The percentage of households that are poor (according to multidimensional poverty criteria) in the commune is 3.05% and near-poor households make up to 6.83%. In 2017, of 2,603 people who were of working age (males from 18 to 60 and females from 18 to 55), there were 1,912 people with permanent jobs while 691 people had part-time jobs. Over 1,000 people worked as builders, masons, or electricity- and water-related employees with salaries of about 5–7 million Vietnam dong per month (approximately 220–310 USD).

The expansion of industrial zones has coincided with the decline in agriculture production. Because of arable lands converting into industrial areas, the land available for growing rice has significantly diminished. Previously, people grew two crops of rice per year, but now they produce only one crop in spring. Other crops include maize, potato, sweet potato, winter melon, black, green, and soya beans, and some traditional herbs. The reductions in agricultural products are also attributed to the shortage of labour since most young people become workers in industrial zones rather than farmers.

### 5.3 Infrastructure

Housing is classified into three main types: permanent, semi-permanent, and temporary. In Phu Hao, the majority of the households owned permanent houses. Only 13 households (less than 18%) (three upper middle class, seven middle class, and three poor) owned semi-permanent houses and three middle-class households (less than 3%) in the sample had temporary homes.

Public infrastructure for water management and flood prevention in Phu Hao is poorly planned and managed. The controlling canal of Khanh Phu Industrial Zone is over 4 km long, snaking around Phu Hao village and the cultivated area of 17 ha of agricultural land belonging to 300 households. However, the canal is located just 100 metres from Phu Hao village, provoking strong smells that disrupt the activities of about 375 households with 1,450 people affected (Fig. 5.2).

Khanh Phu Industrial Zone is built on ground that is one metre higher than the village foundation. Because Phu Hao village is trapped between the industrial zone and the Day River dyke (which is about seven metres higher than the field and the industrial zone), Phu Hao is regularly flooded during summer. According to key informants, the villagers of Phu Hao have experienced multiple flooding for more than 10 years since the industrial zone started operation. In the rainy season, with the rainfall of about 50 mm, rice fields are also flooded. If the sun is out, the hot water



**Fig. 5.2** Canal surrounding Phu Hao village and the agricultural area. In 2014 and 2015, it was polluted during the heavy rain, causing death to fish and other aquatic organisms (*Source: Field research, 2017*)

causes the rice to die. The village is often flooded four times per year and each time lasts about one or two weeks. Phu Hao presently has only 35 ha<sup>2</sup> and only the spring crop is grown. This has adversely affected more than 200 households in the village.

### 5.3.1 Agent Capacities

#### 5.3.1.1 Income

The Vietnam economic reforms that started in 1986 have brought about the following changes: (1) they eliminated the cooperative's monopoly on agriculture and forestry, (2) they introduced short-term land-use rights (up to 20 years for agriculture and 50 years for forestry), and (3) they encouraged privatization and market liberalization. As in other places in the Red River Delta, the market liberalization period saw significant diversification of household income strategies in Khanh Phu commune. The most significant one allowed individuals to work as waged labourers in the industrial zone.

There is high inequality of income across households. Diversification from agricultural income into sources of non-agricultural income was considered one cause of the increase in inequality. This has been exacerbated by the booming industrial zones in the region. Full-time employment in the private sector and full-time employment in nearby factories have contributed to inequality in household income. Table 5.3 shows annual cash income per capita for each group and the overall distribution of incomes per capita for each household group in the village.

Table 5.3 shows the sources of cash income for the four income groups in 2017. The upper middle- and middle-class households in the sample had the most diverse sources of income, while the rich had the least diverse. Khanh Phu in general and Phu Hao is traditionally a farming community. While the data show that the four groups earned income from farming, this source accounts for a very small percentage of the total household income. The rich earned 0.15 million VND per member, accounting for less than 1% of the total household income. The upper middle class earned 0.9 million VND per member which made up 1% of their total income. Middle-class households made 0.1 million VND per member constituting 1% of the total income and the poor made 0.27 million VND per member accounting for less than 2% of their total income.

In contrast, the income sources of full-time employment in nearby factory and full-time employment in the private sector contribute a very significant percentage to total household income and are considered one cause of the rise in inequality. The rich, upper middle-, and middle-class households earned from full-time employment in the private sector. The poor were the only group that did not earn any income from this source. Our data analysis shows that the upper-middle-class households earned the most per member—4.5 million VND or 34% of the total income. The rich earned 3.2 million VND per member making up 15% of the total household income and

**Table 5.3** Net cash income sources/year/group of household/capita in 2017 in Phu Hao village

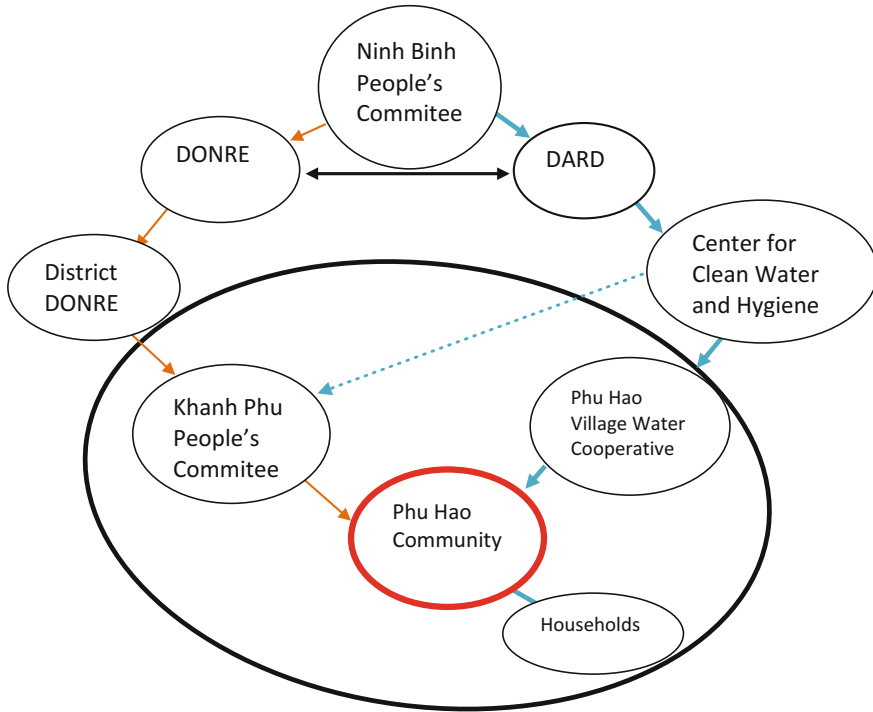
	Type of households				Total
	Rich	Upper middle class	Middle class	Poor	
Farming	147,368 VND	91,167	101,075	266,666	38,090,002
Animal husbandry	–	671,532	383,010	–	163,240,000
Aquaculture	–	–	139,784	100,000	27,500,000
Wage income for farm jobs	–	160,583	322,580	–	82,000,000
Full-time employment in government sector	–	188,321	258,064	4,000,000	133,800,000
Full-time employment in private sector	3,157,894	4,466,861	1,868,279	–	1,019,460,000
Part-time employment in government sector	2,526,315	182,481	268,817	3,200,000	171,000,000
Part-time employment in private sector	–	1,723,357	2,044,623	–	616,400,000
Full-time Employment in nearby factory	11,684,210	1,919,709	787,096	6,666,666	731,400,000
Part-time employment in nearby factory	–	671,532	688,172	–	220,000,000
Own small local enterprise	–	306,569	978,494	–	224,000,000
Contribution by relatives working outside the community/country	–	–	139,784	–	26,000,000
Other	3,779,578	2,923,436	1,775,698	1,600,000	826,602,800
Total	21,295,368	13,305,554	9,755,483	15,833,333	4,279,492,802

Source: Field research, 2017

the middle class earned 1.9 million VND per member constituting about 19% of their total income. Furthermore, the rich and the poor earned the most per member from full-time employment in the Khanh Phu Industrial Zone, followed by the upper middle and the middle class. The rich earned 11.7 million VND per member from this source of income, accounting for 55% of their total income. The poor earned 6.7 million VND per member from this source of income, also accounting for 55% of their total income. The upper middle class earned 0.8 million VND per member making up about 8% of total income.

The rich households were the only group in the sample that did not earn income from full-time employment in the government sector. The poor earned the most per member at 4 million VND accounting for more than 20%, while the middle class made 0.3 million VND and upper middle class made 0.19 million VND per member accordingly. The figures also reveal that the rich and the poor were not engaged in animal husbandry at all. Only the upper middle and middle class engaged in this activity and earned 0.7 million per member accounting for 5% of the total income and 0.4 million VND making up less than 4% accordingly. Similarly, the upper middle and the middle class were the only two groups that earned wage income for farm jobs, but that accounted for only a small percentage of their total household income. Only the middle-class and poor households were engaged in aquaculture and this source of income constitutes a relatively small percentage of their total household income. The upper middle and the middle class were the two groups who owned small local enterprises such as construction, house repair, or painting. The upper middle class earned 0.3 million VND per member from this source of income accounting for 2% of total income and the middle class made less than 1 million VND which constituted 10% of their total income. The figures also show that the poor were the only group with income from remittances from relatives working outside the community.

In summary, traditional income sources such as farming, animal husbandry, aquaculture, and state wage accounted for small percentages of the total household incomes and contributed less to inequality than their overall share of income. In contrast, nonfarming activities, such as full-time employment in nearby factories and full-time employment in the private sector contributed more to inequality than their overall income share. These were the income sources driving inequality. The rich were more often the households that could take up off-farm opportunities created by the Khanh Phu Industrial Zone which has emerged as a major source of income since 2005. In total, the middle class earned the least per member compared with the other three groups followed by the upper middle class. The poor earned even more than the upper middle and middle class. The reason these wealthier classes are in the poor group is that they had household members suffering from health problems. Three out of five poor households had members who were suffering from cancer and so medical expenses absorbed a disproportionately large part of their income.



**Fig. 5.3** Mapping institutions responsible for supplying clean water in Phu Hao village (Source: Field research, 2017)

### 5.3.2 Institutions

A village cooperative (*Hop tac xa*) provides services such as clean water, sanitation services, the commune’s market management, and other kinds of basic services. In 2017, this cooperative invested in expanding the water system and upgrading kiosks in the Ve Market to meet the local community’s demand (Fig. 5.3).

## 5.4 Drivers of Vulnerability, Water Stresses, and Impacts

When Khanh Phu commune lost 300 ha of its best land upon the establishment of Khanh Phu Industrial Zone (IZ), the villagers were promised that they would be provided jobs in the industrial zone and that they would have a much better life. Interviews with key informants during the field research revealed that almost all houses and remaining rice paddies in Phu Hao village are trapped between the IZ and the Day River dyke. The whole village and its surrounding area flood for about one week every year when 50 mm of rainfall occurs. Cultivated land in Phu Hao is

abandoned for six months from June to November every year because of flooding. Consequently, the income of the poor and old households is adversely affected. Many people have lost one crop per year while others have lost two crops per year.

In Khanh Phu commune, 800 out of 6,000 people of working age are hired by the IZ (Khanh Phu Commune People's committee 2016). According to the Phu Hao village head, 200 out of 850 people of working age are hired to work in the IZ in Phu Hao. In group discussions, people told us how Phu Hao villagers were promised jobs before their land was taken away by the IZ, but in fact people from other villages/communes that did not lose land were also offered jobs. Many interviewees expressed their worries that social evils would occur in the context with loss of land and no jobs available.

Phu Hao villagers depend on the so-called 'clean water' source from the Day River, which receives sewage from upstream, including Hanoi and Ha Nam province, before emptying out into the East Sea. A clean water project was funded and supported by the Ministry of Agriculture and Rural Development in 2003. At present, the Phu Hao Clean Water Cooperative is managing the clean water. Because of the terrain in Phu Hao, groundwater is not available and so surface water is used. A big hole was dug, and surface water is pumped from the Day River into the hole. Sometimes oil, grease, black scum, and even leeches are seen in the water. The water price is 6,600 VND (approximately 0.30 USD) per cubic metre. Interviewees reported that the clean water system is far below the demand of local people and the workers at the water station are poorly trained. Water storage and treatment processes are also inadequate. Therefore, most people have to buy a water filter and often spend a whole night to purify enough water for their home use. The rich can buy high-quality water purifiers for 10 million VND and the poor buy them for 5 million VND. In group discussions villagers said they want the waterhole to be dug deeper and with walls to keep out water buffalo and cattle. They also want water to be treated and filtered better to ensure quality. Authorities need to ensure water quality and health for the villagers. They reported that a staff member from the commune's People's Committee was sent to the village to take water samples for water quality assessment. However, villagers never received the inspection results. Results from group discussions and field observation confirmed that there was no sewage plan designed for the whole community during the time the research was being carried out. Polluted water has caused water-borne diseases for locals such as red eyes, itchy rashes, and dermatitis.

In addition to water-related hazards, air pollution is also a massive problem for the local community. The air is polluted all year round by emissions from factories in the IZ and coal dust from the uncovered coal on the dock in the village. Polluted air has affected the life and health of the locals and caused respiratory diseases. In December 2017, all villagers protested the Ninh Binh Coal Company that had been heavily polluting the area around the kindergarten. All the children's hands and faces were black with coal dust. The villagers were furious, and the local government had to call for a meeting between the company and the villagers. Agreements were finally reached, according to which the company had to follow the Vietnam Law on Environmental Protection of Vietnam. If the company violates the law, it will be penalized or even requested to stop its operation in Phu Hao village.

**Table 5.4** Household members who are chronically sick or disabled

		Type of households				Total
		Rich	Upper middle	Middle	Poor	
Is there anyone in your household who is chronically sick or disabled?	No	1	30	37		68
	Yes	4	3	19	5	31
Total		5	33	56	5	99

*Source:* Field research, 2017

Table 5.4 shows that the majority of the rich and the poor and more than half of the middle class were sick. The upper middle class had the smallest number of household members who were sick. Most of the heads of the upper middle and the middle households are between 50 and 70 years of age and they do not work in the IZ. Most of the sick people have been suffering from cancer, stomach problems, kidney stones, and chronic bronchitis among other ailments.

## 5.5 Gender and Resilience

Le Masson (2016) argues that adopting a gender approach requires projects to recognize social differences, roles, expectations, and the needs accorded to women and men and between people within these gender categories. This means going beyond the women/men binary to look at the intersection between and interaction of different social identities (e.g., gender, status, ethnicity, class, age, religion, and disability). With this bigger view in mind we hoped to gain a better understanding of the underlying causes of people's vulnerability to climate extremes and longer-term climate change as well as their resilience capacities (Gaillard et al. 2017; Morchain et al. 2015).

In Vietnam in general and in Ninh Binh in particular, the persistence of patriarchal values in society situates women in the private sphere, constrains women's freedom of movement, and respects men while disregarding women. Phu Hao is no exception. Interviews with the head of the village revealed how persistent patriarchal norms at the village level have led to women being virtually excluded from lucrative jobs. According to the head of the village's Women's Union, female-headed households account for 15% of the total number of households in the village. Almost all of those household heads lost their husbands and are middle aged. But they are not hired by factories in the Khanh Phu Industrial zone or in any other factories in the region. Only women who are between the ages of twenty and 35 are employed in the industrial zone. Focus group discussions revealed that most older women household heads stay



at home taking care of their grandchildren so that their children could work away from home and send remittances home to support the family.

Based on household data and focus group discussions, we found that women are largely expected to respond to water crises and the health effects of flooding, and manage water conservation at home in anticipation of water shortages. Women are also responsible for linking up with support systems. According to key informants, if household members—men and women as well as children—are sick from water-borne diseases, women care for the sick. When heads of the households were asked ‘who usually solicits help from others during water stress periods?’ the majority of them said ‘mostly wife and daughter’. Men are supposed to do ‘big things’ and fetching the water is considered a ‘small thing’. Results from focus group discussions show that women seem to be busier than men in Phu Hao village. In addition to taking care of all the housework and their children and grandchildren, they also seek help from others to cope with any problems such as financial problems or flood.

Younger women are expected to give birth to boys. As a result of great economic progress in recent years, women in Khanh Phu, in general, and in Phu Hao, in particular, are supposed to have more children and especially boys than they did in the past. Having a large family is also considered a symbol of wealth. This has placed a burden on women’s shoulders and the population has dramatically increased.

## 5.6 Conclusion and Recommendations

The case of Khanh Phu illustrates how the commune is subject to heavy pressure from development of the Khanh Phu Industrial Zone and associated environmental problems. The villagers notice water stress, water pollution, and air pollution and are concerned. Cattle and fish were killed, and the villagers’ health has been adversely affected, although no technical research has been carried out yet to directly establish the causal relationship between degraded water quality in the commune and the health status of the local population. Water pollution has also resulted in the scarcity of clean drinking water.

Since 2003, clean water has been supplied to households in Phu Hao village. However, many people complain about the quality of the clean water supplied to households and a number of households use rainwater and rely on deep boreholes when the clean water becomes scarce in February. Most people have bought water filters. The rich buy high-quality water filters that cost twice as much as the filters bought by upper-middle- and middle-class households. The poor depend entirely on the water supplied by the cooperative for drinking.

Local institutions have responded to water stress and air pollution by facilitating face-to-face discussion between the Khanh Phu Industrial Zone entrepreneurs and Phu Hao villagers. This has helped ease villagers’ anger to some extent. However, because of a lack of local participation in the design and building of the water supply station, local people are not satisfied with the water’s quality. Villagers have become more vulnerable than ever because the local institutions are weak in man-

aging complex peri-urban systems that are nested, interlinked, and operating across administrative boundaries. The lack of regulations, an unplanned built environment, and an underdeveloped water infrastructure for supply, sanitation, storm drainage, and pollution pose more severe challenges to an already-strained and ill-developed existing adaptive capacity in the area.

Our findings also show that women and female-headed households have become more adversely affected than men as a result of persistent patriarchal norms at the village level. Accessing equal opportunities and enjoying equal rights is part of developing women and/or marginalized people's absorptive, anticipatory, and adaptive capacities to build their resilience to climate change and disasters.

To resolve the situation that villagers in Khanh Phu face, the local institutions must be strengthened. They urgently need a clear delineation of responsibilities and strong coordination among the Ninh Binh Industrial Zone Management Board, the Ninh Binh Provincial Department of Natural Resources and Environment, the Ninh Binh Provincial People's Committee, and the Ministry of Natural Resources and Environment so that appropriate policies for managing industrial zones will be designed to make use of the local comparative advantages in the development process and, at the same time, ensure green growth, efficiency, and security for all residents.

## References

- Adger WN (2006) Vulnerability. *Glob Environ Change* 16(3):268–281
- Allen A (2010) Neither rural nor urban: service delivery options that work for the peri-urban poor. In: Kurian M, McCarney P (eds) *Peri-urban water and sanitation services: policy, planning and method*. Springer, London and New York, pp 27–61
- Dávila J (2006) Falling between stools? Policies, strategies and the peri-urban interface. In: Simon D, McGregor D (eds) *The peri-urban interface: approaches to sustainable natural and human resource Use*. Earthscan, London, pp 44–56
- General Statistic Office (2015) *Statistical year book of Vietnam*. Statistical Publishing House, Hanoi
- General Statistic Office (2016) *Statistical yearbook of Vietnam*. Statistical Publishing House, Hanoi
- Gaillard JC, Sanz K, Balgos BC, Dalisay SNM, Gorman-Murray A, Smith F, Toelupe V (2017) Beyond men and women: a critical perspective on gender and disaster. *Disasters* 41(3):429–447
- Hudalah D, Winarso H, Woltjer J (2007) Peri-urbanisation in East Asia: a new challenge for planning? *Int Dev Plann Rev* 29(4):503–519
- Huynh TA, Resurreccion BP (2014) Women's differentiated vulnerability and adaptations to climate-related agricultural water scarcity in rural Central Vietnam. *Clim Change Dev* 6(3):226–237
- Khanh Phu CC, KP (2016) *Socio-economic report of Khanh Phu Commune—Year 2016*. Khanh Phu People's Committee, Yen Khanh District, Ninh Binh Province

- Le Masson (2016) Gender and resilience: from theory to practice. Working Paper. The BRACED Knowledge Manager, UK
- Le NT (2007) Climate change adaptation with stakeholder participation. Presented at the workshop on climate change and human development. Hanoi
- Luer A (2005) The surface of vulnerability: an analytical framework for examining environmental change. *Glob Environ Change* 15(3):214–223
- McElwee P, with contributions from CRES and DRAGON institutes, Vietnam (2010) Economics of adaptation to climate change—social component: national synthesis report for Vietnam. University of Arizona, Tucson, Arizona, United States
- McEvoy D, Ahmed I, Trundle A, Sang LT, Diem NN, Suu LT et al (2014) In support of urban adaptation: a participatory assessment process for secondary cities in Vietnam and Bangladesh. *Clim Dev* 6(3):205–215
- McGranahan G, Balk D, Anderson B (2007) The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones. *Environ Urbanization* 19(1):17–37
- Morchain D, Prati G, Kelsey F, Ravon L (2015) What if gender became an essential, standard element of vulnerability assessments? *Gend Dev* 23(3):481–496
- Nghiem PT, Le TV, Vu TD, McElwee P (2009) Project report—learning from past adaptation: assessing adaptive capacity to climate changes in the Red River Delta of Northern Vietnam. Center for Natural Resources and Environmental Studies, Vietnam National University, Hanoi
- Nguyen PV (2007) Community response and adaptation to floods in Binh Dinh Province. Paper presented at the national consultation workshop on climate change adaptation organized on Nov 28. Hanoi
- Ninh Binh BIZD, NB (2018) Khanh Phu Industrial Zone. Retrieved from Ninh Binh People's Committee, Ninh Binh Board of Industrial Economic Development: <http://www.banptkcn-ninhbinh.vn/industrial-zones/khanh-phu-industrial-zone>
- Ninh Binh PC, NB (2018) Ninh Binh Portal. Retrieved from natural condition of Ninh Binh Province: <http://ninhbinh.gov.vn/ubnd-ninhbinh/4/467/39049/Dieu-kien-tu-nhien/>
- OXFAM (2008) Vietnam: climate change, adaptation and poor people. A report for OXFAM. OXFAM and OXFAM, Hanoi and Oxford
- Simon D, McGregor D, Thompson D (2006) Contemporary perspectives on the peri-urban zones of cities in developing areas. In: McGregor D, Simon D, Thompson D (ed) *The peri-urban interface: approaches to sustainable natural and human resource use*. Earthscan, London, pp 1–17
- Tran T (2007) Climate change: concerns and views of human development. Presented at the workshop on climate Change and human development. Ho Chi Minh City
- Tran N, Ngoc K (2017). The urbanization process in Vietnam: Fast but not synchronized. Retrieved from The Voice of Vietnam VOV: <https://vov.vn/kinh-te/qua-trinh-do-thi-hoa-tai-viet-nam-nhanh-nhung-chua-dong-bo-624122.vov>
- Truc Q (2016) Ninh Binh radio and Television Broadcasting Station. Retrieved from Workshop on Urban Residential Plannings of Ninh Binh. <http://nbtv.vn/tin-tuc-su-kien/ninh-binh-24h/thoi-su-chinh-tri/201606/hoi-nghi-nghe-bao-cao-quy-hoach-mot-so-khu-do-thi-tai-ninh-binh-681991/>
- Tyler S, Moench M (2012) A framework for urban climate resilience. *Clim Dev* 4(4):311–326

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