Chapter 5

Vulnerability to Natural Disasters: The Case of Vietnam's Mekong Delta

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Abstract

In late 2015, the El Nĩno phenomenon induced Vietnam's worst drought in 60 years, which lasted until mid-2016 and intensified the most expansive saline intrusion in 90 years. The combination of the two hazards resulted in a large-scale disaster, which has led 18 provinces of Vietnam, most of them from the Mekong Delta, to water shortage, insanitation, human and animal diseases, food emergency need and a considerable disruption in local communities' livelihoods. These devastating effects raise the question of what makes local households vulnerable to drought and saline intrusion. The chapter argues that vulnerability to the natural disaster is not something resulted from external threats, but rather, is derived from the interplay between social structures residing deeply inside the socio-economic systems and agency's conditions presenting at the household level. Social structures are rules and procedures that constrain and/or enable human actions in agricultural production, risk taking and adaptation. Agency refers to the capacities of disaster-affected households in the Vietnamese Mekong Delta who cultivated third rice crop and suffered heavily from the 2015–2016 disaster. In addition to households' lack of planning and coping capacities, the constitution of vulnerability to drought and saline intrusion can be attributed to the interaction between farmers' choice of extra rice crops and the state's policies and directions in agricultural and irrigation development since 1990s to date.

Keywords: Vulnerability; natural disaster; Vietnamese Mekong Delta; social construction; social structure; human agency

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1. Introduction

On 8 April 2019, I received a text message via mobile phone from Mr Bong Da, a farmer from Soc Trang province in the Mekong Delta of Vietnam. He wrote: "This year's third rice crop is a bumper harvest, averaging 10 tons per hectare". Mr Bong Da's message expressed joy about the successful crop, which had the potential to counter the painful memory of being badly affected by the saline intrusion and drought four years ago. In late 2015 to early 2016, the combination of the drought and associated saline intrusion caused a damaging disaster to local farmers in Soc Trang province in particular, and those in the Vietnamese Mekong Delta in general. Bong Da and his fellow farmers suffered one of the worst losses of their rice production since 2000s when they started cultivating the third rice crop.

In late 2014, an El Niño phenomenon – understood as abnormally local warming in temperature of the surface seawater – started to take its effect (Rojas, Li, & Cumani, 2014). Beginning in a "very weak" form from late 2014 to 2015, the phenomenon transformed into a "very strong" form in late 2015 to mid-2016, which was ranked above the two worst El Nĩno events in the history (1982–1983 and 1997–1998) (Null, 2019). The phenomenon induced Vietnam's worst drought in 60 years, which lasted until mid-2016 and intensified the most expansive saline intrusion in 90 years (UNDP, 2016). The combination of the two hazards resulted in a large-scale disaster, which has led to water shortage, insanitation, human and animal diseases, food emergency need and a considerable disruption in local communities' livelihoods (FAO, 2016; United Nations, 2016a).

The Mekong River Delta was the most severely affected region with nine out of 13 provinces of the region that faced both drought and related salinisation (United Nations, 2016b, 2016c). Due to the loss of food sources from their agriculture, many local households experienced severe food insecurity. The lack of water for daily consumption also led to many skin and eye diseases. As a result, many local people migrated to big cities such as Ho Chi Minh City in search of employment (FAO, 2016; Nguyen & Ngo, 2016, 2017).

Those devastating effects raise a question of what makes local households so vulnerable to drought and saline intrusion. Answering this question is the primary goal of this chapter. The chapter argues that vulnerability to drought and saline intrusion is a social product. Vulnerability to the natural disaster is not something resulted from external threats, but rather, is derived from the interplay between social structures residing deeply inside the socio-economic systems and agency's conditions presenting at the household level. Social structures in the disaster risk management context refers to rules and procedures that constrain and/or enable human actions in agricultural production, risk taking and adaptation. Agency refers to the capacities of disaster-affected households in the Vietnamese Mekong Delta who cultivated third rice crop and suffered heavily from the 2015–2016 disaster.

The sections that follow start with an introduction of the context and data of the research, then the chapter moves on to discuss the occurrence and effects of the 2015–2016 disaster on local agricultural production. The final section will

begin by presenting the lack of planning and coping capacities at the household level and examine the root causes in a wider context of socio, economic and political systems where those affected households and communities living in.

2. Context and Data

This chapter draws on a dataset collected in two villages, Village A and Village B, of Tan Hung commune of Long Phu district of Soc Trang province, which is located in the downstream of the Vietnamese Mekong Delta. The dataset consists of semi-structured interviews with 30 households (15 from Village A, 14 from Village B, and 01 from other village in pilot). Also included were semi-structured interviews with 21 key stakeholders such as experts (who have knowledge of the Mekong Delta and irrigation systems in the region), local officials (who are in charge of relevant positions in authorities from the provincial to communal levels), village heads, socio-political organisations' representatives (including Women's Union, Farmers' Union, Fatherland Front Elderly People's Association) and agricultural input suppliers. In addition, six observations of dyke systems and sluice gates, rice fields, café and restaurants – where local farmers often gather and exchange information were also implemented. Furthermore, documents (including laws, policies, emergency plans, authorities' and donors' reports) and archival records (including census and statistical data relating to population, land use, migration, agricultural development, village and households' records, maps, for example) were also collected.[1]

Tan Hung is a rural commune with a current area of 3,226.8 hectares. Of the total area, 2,900 hectares (89.87%) is devoted to agricultural production, 48.03 hectares for housing area (0.14%) and 278.77 hectares (8.63%) for non-agricultural purposes. Since 2000, the share of agricultural land area has decreased 1.85 percentage points from 91.72% (2,903.28 hectares), which could be ascribed to the increase of the shares of non-agricultural areas and land for housing construction (see Table 1).

By 2015, the average population of Tan Hung commune was 12,084 people with 3,078 households. Of the total households, there were 1,597 reported to base their livelihood entirely on agriculture (accounting for 51.88%). Central to the agricultural system is irrigated rice production, with most households cultivating yearly double or triple crops (Summer-Autumn crop – the first crop and Autumn-Winter crop – the second crop; or one of these crops with Winter-Spring crop – the third crop; or all these three crops). As of 2017, the average natural land area per capita and the average agricultural land area per capita are 0.27 and 0.24 hectares, respectively. These figures decreased a little compared to those of 2005, 0.2725 and 0.2468 hectares respectively, which was due to the increase of population from 11,841.25 people in 2005. For only agricultural households, the average agricultural land area per household is at around 1.82 hectares

[1]All of the participants in this chapter were given pseudonyms, for privacy and protection.

Table 1. Land Use in Tan Hung Commune in 2000, 2005 and 2017.

Indicators	2000	% in Total	2005	% in Total	2017	% in Total
Total area (hectare)	3,164.78		3,226.74		3,226.80	
Agricultural land area	2,903.28	91.74	2,911.2	90.22	2,900	89.87
Housing area land	37.64	1.27	46.56	1.44	48.03	1.49
Non-agricultural land area	221.83	7.01	268.98	8.34	278.77	8.64

Source: Compiled from information obtained from Soc Trang Provincial People's Committee (2005) and Tan Hung commune's People Committee (2017).

(Soc Trang Steering Committee of Land Statistics, 2005; Tan Hung Commune People's Committee, 2017, 2018).

Tan Hung commune has ethnicity diversity, with the Khmer group – the ethnic minority of Vietnam – making up the largest share of the commune population (63.9%), followed up by the Kinh population – the ethnic majority in Vietnam (35.2%), and Vietnamese-Chinese (the Hoa) and others (0.2%) (Soc Trang Division of Statistics Office, 2017). In terms of settlement, each of the first two major ethnicities often occupy different villages, except some persons/households of each group living within each other's territories due to migration and marriage. Chinese people often live in the villages of the Kinh group. Some Vietnamese-Chinese tend to declare/register themselves as Kinh ethnicity (for instance, Chin Ro, male, 35+, Vietnamese Chinese, non-poor household, Village A). The Khmer population is currently living mostly in Village B (accounting for 95% of the total village population), followed by Village E (88.02%), Village D (87.05%), Village C (64.37%) and Village A (just 10.32%) (Tan Hung Commune People's Committee, 2018). Although living more or less in separate villages, farmers of different ethnic groups could cultivate rice fields across villages due to the dynamics of land exchange and rental. Farmers of one village owning, renting and cultivating rice fields across other villages is a common practice.

According to the Tan Hung commune's household poverty database in 2017 (see Table 2), by 2017 the percentage of poor households stood at 15.82 (487 households) and that of near-poor households at 7.21 (222 households) (see Table 2).[2] Khmer households occupied the largest share of poor households

[2]The classification of household poverty was changed in 2015 – the year Vietnam started to use a multidimensional poverty assessment method to rank poor households. The Vietnamese official poverty line is calculated by the Ministry of Labour, Invalids and Social Affairs (MOLISA) based on the National Census on Poverty undertaken

Table 2. Poor and Near-poor Households of Tan Hung Commune in 2017.

#	Village	Total Households	Poor Households	% in Total	Near-poor Households	% in Total
1	Village A[a]	804	73	9.08	29	3.61
2	Village C	567	100	17.64	58	10.23
3	Village D	718	89	12.40	33	4.60
4	Village B[a]	480	116	24.17	38	7.92
5	Village E	509	109	21.41	64	12.57
Total		3,078	487	15.82	222	7.21

Source: Compiled from information obtained from Tan Hung Commune People's Committee (2018).
[a]Two villages chosen for data collection.

(79.01% of total poor households of the commune) with 325 poor households out of 424 total poor households. In Village B, this rate was absolute (100%).

In sum, Tan Hung is a typical commune of the Mekong Delta with rural settings featuring a diversity of ethnicities. Both the two most-dominant groups, the Khmer population and the Kinh population, produce rice crops as their main livelihood. This crop is, however, highly susceptible to natural hazards, as shown in the next section.

3. The 2015–2016 Drought and Saline Intrusion

Under the effect of the El Nīno-induced drought, saltwater intruded inland from January to March 2016 when local farmers were about to harvest their third rice crop (late Winter-Spring crop or Spring-Summer crop). Saline intrusion travelled inland as far as 90–93 kilometres at the Vam Co river area, and around

every five years. According to the Decision No. 09/2011/QD-TTg, between 2011 and 2015, a rural poor household is a household with each member earning an average income of up to VND 400,000 per month (or VND 4,800,000 per year), and a rural household in danger of falling into poverty (that is to say, near-poor household) is a household with each member earning an average income of between VND 401,000 and VND 520,000 per month.

According to the Decision No. 59/2015/QD-TTg, from 2016 to 2020, Vietnam applies multidimensional poverty levels to the poverty classification by addition of 10 indicators of the lack of access to basic social services. A rural poor household is a household meeting one of two criteria: (i) having an average monthly income per capita of up to VND 700,000, or (ii) having an average monthly income per capita of between VND 700,000 and VND 1,000,000 and lacking three or more indicators of accessing basic social services. A rural near-poor household is a household having an average monthly income per capita of between VND 700,000 and VND 1,000,000 and lacking less than three indicators of accessing basic social services.

55–60 kilometres at the Hau River area and Soc Trang province – where this study was conducted (Southern Institute of Water Resources Research, 2016). According to the 2016 report by Soc Trang's Steering Committee for Preventing Floods and Storms and Rescue (2016), in the dry season 2015–2016, the degree of salinity in river water increased by 2.4–8.6 gram per litre and penetrated deeper into river and canal networks. Salinity degree recorded in the Long Phu station located in my research site reached 9.4 gram/litre in January, increased dramatically to 12.82 gram/litre in March, only dropped to below 6 gram/litre from May onwards (Soc Trang's Steering Committee for Preventing Floods and Storms and Rescue, 2017a, 2017b). As of 2016, the maximum degree of salinisation was measured at 23.1 gram per litre at the same station, increasing from 14.5 gram per litre in 2015. An increase of 8.6 gram per litre in Long Phu district was highest among eight city, towns and districts of Soc Trang province.

The combination of drought and associated saline intrusion triggered significant damage to 31,560.15 hectares of rice crops, vegetables, sugarcane, fruit trees and fishing areas across the province. These circumstances resulted in an estimated economic loss of VND 908,121 billion – the highest losses of Soc Trang province in the past seven years. In 2016, the agricultural production areas with a crop loss of over 70% of productivity were 12,314.65 hectares, and those from 30% to 70% were 19,245.50 hectares.[3]

According to the report by Division of Agriculture and Rural Development of Long Phu district (2016), the 2014–2016 disaster initiated "serious damage" to the Spring-Summer crop (namely, the third rice crop or crop 3). In Long Phu district, the occurrence of drought and saltwater intrusion caused a dramatic decline of 81.9% of total crop 3 output from 109,148 tons in 2015 to just 19,661 tons in 2016. The planted area also dropped significantly from 13,273.48 hectares in 2015 to 6,449.56 hectares in 2016 and 3,297.70 hectares in 2017.

The loss was also evident in Tan Hung commune's agricultural production, which saw total output and planted area of three crops in 2016 falling from 31.49% and 15.66%, respectively, compared to those of 2015. Of the total of 4,401 affected agricultural households in Long Phu district, Tan Hung commune had 582 households (13.2%), who were reported to have lost from 30% to 100% of their crop 3. The commune received a relief fund of VND 1,587,460,000, which was the highest amount of support among the 11 towns and communes of Long Phu district.[4]

In Tan Hung, Village A (143 affected households) and Village B (130 households) were among the most severely influenced villages, only behind Village C

[3]It is important to note that although the 2015 crop 3 is the third crop of the 2015 season, the figures including planted areas and total outputs of this crop is counted for the year 2016 by local government. Thus, the total output of 2016 will be the combination of outputs from the 2015 crop 3 (from December 2015 to April 2016), crop 1 (from May/June to September 2016) and crop 2 (from September/October to December 2016).

[4] Unfortunately, Tan Hung commune People's Committee does not have statistics for crop 3.

with 241 households. According to fieldwork interviews, each household invested around VND 1.5 to 2 million per cong or 0.1 hectares. This amount includes the cost for agricultural inputs such as fertiliser, pesticide, seeds and labour cost (e.g. employing people to do specific jobs such as seed sowing, ploughing, pumping or harvesting). With one hectare completely affected, they would lose roughly between VND 15 and 20 million.[5]

4. The Social Construction of Vulnerability

The section seeks to answer what causes vulnerability to disaster inside studied communities. The chapter starts with a description of the lack of planning and coping capacities at a household level, then moves on to a discussion of the agricultural intensification and irrigation development policies in relation with changes in farmers' crop production routines and finally discusses the changes in cropping production systems to the point that puts farmers at risk.

4.1. Vulnerability at Households' Level: Planning and Coping Strategies

The El Nĩno-induced drought began in late 2014 and peaked in late 2015 and early 2016. The saltwater intrusion was intensified during January and March of 2016. Before the 2015 Spring-Summer crop began (in late December 2015 or early January 2016), the central and local governments and mass media had warned local farmers about water scarcity and the risks of saltwater intrusion in advance. Interview data show that most farmers in the studied sample received such a warning before the 2015 crop 3. However, most households did not take the warning seriously. In all households interviewed, only one household omitted the crop, two reduced the land area under cultivation, while all of the remaining households kept growing or even expanded the crop's cultivated area.

Fieldwork data show that there were two main patterns of coping with the 2015–2016 drought and associated saltwater intrusion. The first pattern was to omit or reduce the planted areas of the 2015–2016 crop 3 in order to prevent the risk of such natural hazards. The second pattern was to maintain or even expand the planted area of the 2015–2016 crop 3.

There were three households following the first pattern. Of which, Mr Quan Vot's household was the only one that did not cultivate the 2015 final rice crop, although he possessed the largest area recorded in the interviewed sample (15 hectares). As a result, he did not suffer any losses during the hazard incident. Quan Vot was very cautious about the news of drought and water shortage. He did not only rely on information from television but also found other ways to assess the risk of drought and saltwater intrusion. One of the ways was to rely on information about the flood from his relatives living in An Giang province, which

[5] In the Mekong Delta, farmers use the land area unit of cong, with each cong equivalent to 0.1 hectares (in Village B) and to 0.1296 hectares (in Village A).

was located in the high-lying region where the Mekong River flows into Vietnam. According to his experience, if the flood in the upstream An Giang province happens to be small, there is a likelihood that there is a lack of water flowing to the downstream Soc Trang. He also considered the fact that the canal system around his rice fields was clogged, which prevented this system from holding enough water for crop production. All of these reasons led him to skip the 2015 crop 3. When asked during the interview, "Why did many farmers cultivate the 2015 third crop but you did not?", Quan Vot replied: "Because I heard the information [of saltwater intrusion]. I had a relative [in An Giang province] helping me assess the situation, so I did not go ahead." Quan Vot did not appear to have regrets about not doing crop 3. He commented: "The chance of success was just 25 per cent, everyone else lost (Quan Vot, male, 45+, Kinh, non-poor household, high school degree, Village A)".

The other two households, Cau Long and Bong Ban, in the first pattern were those who reduced the cultivated area of the 2015 final crop. These two farmer households had the same assessment of the water shortage as that of Quan Vot and ultimately reduced their planted area. Cau Long said:

> In the 2016 season, I only did 1.7 hectares of crop 3 because this area was on a lower lying region and near the canal, so that water could flow to the fields without the need of using pumping machine. Other areas were higher, and the canal networks around them were not dredged so I omitted planting the crop on those area. (Cau Long, male, 60+, Kinh, non-poor household, secondary school degree, Village A)

With this strategy, Cau Long and Bong Ban could harvest one ton per 0.1 hectares – a reduction of about 100–200 kilograms compared to normal conditions. Thus, the 2015–2016 incident was not enough to drag them into crisis.

The second pattern accounted for the remaining households interviewed who did not take any serious measures to cope with drought and saltwater intrusion. In this group, there were five households who needed to borrow more land to grow the 2015–2016 crop 3. Interviews with these households indicated that although they received the warning on the risk of saltwater intrusion from the local government, they still lacked any preparation or prevention methods to cope with the disaster.

It was found that the attempt to plant the third crop was in part due to the following reasons: First, they lacked past experience with saline intrusion (i.e. the third rice crop usually produced a bumper harvest). Some farmers did not experience any loss from drought and saltwater intrusion in their agricultural cultivation history, which made them belittle the risk of the hazard intensified by the historical drought. Second, they did not have other livelihood options to generate income between the end of the second crop (late November or December) to the end of the first rice crop (August or September). Third, they chose to gamble on crop 3 with expectation of getting better income compared to the other two rice crops. According to interviewed farmers, it was expected to gain from VND 4 to 6 million

per 0.1 hectares of crop 3, while this figure is only around VND 1.5–2 million per the same unit under crop 1 and crop 2. Regardless of the reasons, continuing to grow or expand the 2015 crop 3 and neglecting the warning of saline intrusion and water scarcity from the government showed the lack of planning and coping skills of those households in dealing with the 2015–2016 drought and saline intrusion.

4.2. Vulnerability Rooted in Socio-economic Systems

The previous section has shown that the reasons local farmers choose to do the risky crop 3 derive from downplaying the risk of natural hazards, households' motivation for profits and/or the lack of livelihood options. These factors contributed to the vulnerability at the household level. However, this section argues that these factors are connected further to social, economic, political and legal systems that constitute the circumstances in which local farmers make their decisions regarding livelihoods and risk reduction strategies.

4.2.1. Past Policies of Agricultural and Irrigation Development. The implementation of the third rice crop did not yet become a widespread practice among local farmers until 2010s (Cau Long, male, 60+, Kinh, non-poor household, Village A). The new crop only became popular with the support from the policies of the government and the Communist Party of Vietnam (CPV). This process can be traced back to the time of national unification in 1975, when the country was reunified under the leadership of the Socialist Republic of Vietnam and since 1986, when it executed economic reform (renowned as Đổi mới).

4.2.1.1. Agricultural Development Policies. The top-down policy from the CPV and the state could be seen as the catalyst for encouraging farmers to change from single cropping system (especially in downstream areas such as Soc Trang) to a double or triple cropping system in order to meet the target of rice output.

The government policy since 1986 was to intensify agriculture by motivating farmers to produce higher agricultural outputs with the aim of increasing rice exports. This policy was part of Vietnam's economic reform initiated in 1986, which transformed Vietnam from "a net rice importer to a net rice exporter" (Niimi, Vasudeva-Dutta, & Winters, 2004, p. 178). From the net import of minus 0.3 million metric tons of rice in 1975 and minus 0.4 tons in 1986 (Minot & Goletti, 2000, p. 44), Vietnam recorded the net rice export of 1.37 million tons in 1989 and 5.72 million tons in 2017, after peaking at 7.72 million tons in 2012 (Vietnam Food Association, 2018).

To ensure rice export and food security, the government issues a fixed quota for rice products and export. Although the rice export quota was dismissed in 2001 with the Decision No. 46/2001/QD-TTg on Vietnam's Export-Import Management Mechanism for 2001–2005 (Nielsen, 2002, p. 7), the setting of quotas for rice production seems to continue in effect, especially to the Mekong Delta that includes provinces with a big rice production system. For instance, in the Decree 12/2006/NĐ-CP released by the Government in 2006 on Making detailed provisions for implementation of the Commercial Law with respect to international purchases and sales of goods; and agency for sale and purchase, processing and

transit of goods involving foreign parties, the people's committees of provinces with large local output of rice goods such as the Mekong Delta's provinces must manage to meet the "annual export of rice" and ensure "the food security" (The Government of Vietnam, 2006, Article 10).

This focus has been continuously demonstrated in the following policies. For instance, in the Decision number 1581/QĐ-TTg released in 2009 by the Prime Minister on approving the planning for the Mekong Delta until 2020 with a vision until 2050 (The Prime Minister of Vietnam, 2009), the Mekong Delta was aimed to become "a big agricultural production region in the global market" by 2050. This aim was repeated in the Decision number 2270/QĐ-TTg issued in 2013 by the Prime Minister on implementing the Conclusion of 28-KL/TW of the Vietnamese Communist Party's Politburo on socio-economic planning for the Mekong Delta until 2020 (The Prime Minister of Vietnam, 2013), the Mekong Delta was set to be a central agricultural production area utilising modern approaches. In 2014, another planning on the development of the Mekong Delta until 2030 with a vision to 2050 was included in the Decision number 1005/QĐ-TTg (The Prime Minister of Vietnam, 2014). While repeating the goal of the previous decisions, the Prime Minister also stressed that the Mekong Delta must be responsible for "national food security and agricultural and fishing output exportation to global markets". When these policies passed down to the Mekong Delta, local governments in this region were required to set the cultivated area and total output targets for agricultural production in general and rice production in particular for each year (Smajgl et al., 2015, p. 168). Attempting to meet those targets made it difficult for local governments and eventually local farmers to break the rice production cycle. As a result, although the Mekong Delta was set to change its economic structure in the direction of reducing the share of agriculture and fishery while increasing the shares of the industry, construction and service sectors, the pace of this transformation was slow. According to the results of the Rural, Agricultural and Fishery Censuses in 2016 (Vietnamese General Statistics Office, 2018), the share of agricultural households (those doing agriculture, forestry and fishery livelihoods) of the Mekong Delta in 2016 still occupied over half of total households in the region (57.88%). This figure was higher than those of the whole country (53.66%), the North Central and Central coastal areas (56.88%), the Red River Delta (35.5%) and the South East (31.42%). The decrease of the share of agricultural households in total households of 2016 over 2011 of the Mekong Delta was –7.7 percentage points, which was less than that of the whole country (–8.49), the Red River Delta (–11.89), the North Central and Central coastal areas (–9.64).

According to a district staff member, from 2000 to 2013 the year when a saltwater intrusion struck the district, the district authority maintained a requirement of rice outputs for each commune in their administrative management. Consequently, each commune within Long Phu district needed to meet a fixed quota of agricultural outputs proposed each year by the district's government, who followed the directives from higher levels of government. Due to the success of crop 3, the amount of rice outputs increased. The government started to take this crop into account and set the yearly target of rice outputs for three crops,

instead of two crops, as before. For instance, the Long Phu district agricultural department did not feature the data for crop 3 output in their yearly reports from 2008 to 2011, but started to include this data from 2012 onwards (Long Phu Division of Agriculture and Rural Development, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017).

4.2.1.2. Irrigation Development Policies. To meet the target of rice export and food security since the 1990s, the government initiated the agricultural intensification policy which served two purposes: maximising land area for rice cultivation and increasing rice production per unit (Nguyen & Pittock, 2016, p. 6). The first purpose can be fulfilled by hard policy options which mean building large-scale sea-dykes and sluice gates; while the second can be done through soft policy options such as the use adjustment of agricultural production strategies and land use (Smajgl et al., 2015, p. 167)

The soft policies can be dated back to 1968 when higher yield rice varieties (HYV) was first introduced under the impact of Green Revolution (Cummings, 1978; Nguyen, 2016). Although HYV requires the high concentration of labour and capital (Cummings, 1978, p. 237), they allow farmers to plant and harvest in a shorter duration, enabling them to cultivate more than one crop a year. In addition, the increasing use of chemicals (e.g. fertiliser and pesticide) has also allowed farmers to enhance their crop productivity.

Nonetheless, after seizing their power in 1975, the Socialist Republic of Vietnam seemed to concentrate more on hard policy options with large-scale irrigation projects (Beresford, 1989; Miller, 2007; Smajgl et al., 2015). According to Miller (2007), from 1976 to 1989, the state devoted an average of approximately 62% of total investment in agriculture to water resource management, with the Mekong Delta was the main target of those investments. The irrigation development strategy included the building of flood control infrastructures such as secondary dyke systems and pumping stations in the upper part of the delta, and the construction of salinity control works such as dyke systems, canals and sluice gates in the lower part (including Soc Trang province). As a result, the irrigated rice area in the Mekong Delta tripled from just around 1 million hectares in 1980 to 3 million hectares in 1994 (in total 4 million cultivable areas of the delta) (Miller, 2007, pp. 197–198).

Since the mid-1990s, irrigation development in the Mekong Delta was expanded to a more considerable extent in order to achieve three goals including rice production intensification, protecting the delta from flooding as well as from salinity intrusion (Miller, 2007, p. 201). On 9 February 1996, the Prime Minister issued the Decision 99-TTg (The Prime Minister of Vietnam, 1996) concerning two parts of the irrigation development: one, building infrastructure to prevent flooding in the upper part of the Mekong Delta including the Plain of Reed (Dong Thap Muoi), Long Xuyen Quadrangle and the West of Hau River; and two, implementing a "sweetening project" which aimed to prevent salinity intrusion and store fresh water for the coastal part including Ca Mau, Go Cong and South Mang Thit (see also Can, Duong, Sanh & Miller, 2007, p. 75). The second project brought about the benefits to farmers in the research sites of Soc Trang, who started to get rid of their concern about salinity intrusion. Since then, the

emphasis on constructing the dyke systems and sluice gates to prevent salinity intrusion and store fresh water for agricultural development has been consistently incorporated in the Mekong Delta's irrigation development policies, such as the Decision Number 84/2006-QD-TTg dated 19 April 2006 by the Prime Minister on the adjusted and supplemented planning on irrigation in the Mekong Delta in the 2006–2010 period with the orientation towards 2020 (The Prime Minister of Vietnam, 2006); the Decision 1397/QD-TTg dated September 2012 by the Prime Minister on approving irrigation planning in the Mekong Delta in the period 2012–2020 (The Prime Minister of Vietnam, 2012). As a result of these "closing off" policies, the Mekong Delta has gone from "naturally regulated water regime to a closed system, where human regulation of water has taken on greater importance with the construction of complex regulatory structures" (Miller, 2007, p. 204).

4.3. Interaction between State's Policies and Farmers' Actions

As a consequence of agricultural and irrigation development, since 1980s farmers in Soc Trang province has changed from single and double cropping system to triple cropping system (see Table 3).

Prior to 1980s, local farmers in Soc Trang province in general and Tan Hung commune in particular, cultivated a single crop a year. This traditional crop was called vụ Mùa (some labelled this the traditional Mua crop (Liew et al., 1998), some regarded as winter crop (Nguyen, Dumaresq, & Pittock, 2018), which started around July to August and ended in between December and February after approximately 145 days (long-duration crop). This crop relied entirely on rainwater and yielded very low outputs of approximately 3 tons per 1.3 hectares (called 'big' hectare, or 'mẫu lớn').

With the construction of dyke systems and sluice gates, from early 1980s to early 1990s, local farmers invented an overlapping double cropping system by cultivating a short-duration rice (the early crop or "lúa sớm", about 100 days) together with the winter crop (Mua crop), with most farmers seeding the two on the same fields, and some on different fields (Ka Co, 50+, male, official). On the same fields, when the winter crop (long-duration crop) was still growing, the early crop (short-duration crop) was harvested. This is why local people called them

Table 3. Timeline of Rice Cropping Transformation in Soc Trang Province.

Timeline	Rice Cropping Events
1980s backward	Farmers cultivated a single rice crop (the winter crop)
Late 1980s to early 1990s	Farmers planted overlapping double rice crops, combining the early rice crop with the winter crop
Mid-1990s to 2000s	Farmers cultivated separated double rice crops, forming the Summer-Autumn crop (crop 1) and the Winter-Spring crop (crop 2)
Early 2000s	Farmers experimented the third rice crop in the dry season
2010 to present	The third crop was expanded to be a common crop

Source: Compiled from information obtained from fieldwork data.

overlapping double crops. With this irrigational development since mid-1990s and the use of short-duration HYV and agrochemicals, local farmers began to do a separate double cropping system including Summer-Autumn crop (crop 1) and Winter-Spring crop (crop 2).

Although the goal of building infrastructural embankments was to serve the production of a double cropping system, its side-effect was to motivate farmers to experiment third rice crop.

According to interviewed farmers, the introduction of the third crop in Tan Hung commune was first conducted spontaneously in the early 2000s by a few farmers who, in their leisure time, experimented with planting an additional crop in between the end of crop 2 (from October to January) and the beginning of crop 1 (around late May or June to September). This was called the Spring-Summer crop or crop 3. The experiment turned out to be a good model which motivated other farmers to follow. It is clear that the fragmented water control policies opened up chances for cultivating the third rice crop in the dry season as the dyke systems and sluice gates prevent saline intrusion and kept fresh water for crop production. Recalling the situation at that time, Mr Cau Long, a former government official of Tan Hung Commune's People's Committee in 1990, said:

> Farmers had not yet planned to do crop 3 until the [Vietnamese] state led them by the policies and built the dyke systems to prevent saltwater intrusion. Farmers did not feel strongly that they would do the new crop yet. Only when the state encouraged them to look at how effective the third crop was, they started to follow. (Cau Long, male, 60+, Kinh, non-poor household, Village A).

With the establishment of the dyke systems and sluice gates, farmers did not need to worry about saltwater intrusion and felt safe to join cultivating crop 3.

> The extra crop started in the 2000s. Only when they [the state] built sluice gates preventing saltwater intrusion, farmers [began] cultivating the [third] crop. Otherwise, they were scared of saltwater intrusion (Bong Ban, male, 40+, Kinh, non-poor household, Village A).

Khmer farmers recalled the same experience. Mr Tao, a farmer from Village B recalled that he already started planting the new crop in around the 2000s. However, his first attempt failed and he lost around two hectares of the crop (his total land holding at that time) due to saltwater intrusion. Mr Tao then skipped the crop for several years until the dyke system was completed and he did not plant it again until 2010. He explained:

> I decided to do the third crop again because the state has built the dykes and there was enough fresh water. From that time, I have done consecutively seven crop 3's …. Before 2010, no farmers around my field dared to do the third crop because there was no dyke protecting saline intrusion. And after seeing that my crop did well, they followed. (Tao, male, 60+, Khmer, non-poor household, Village B).

Reflecting on this matter, Quy Ro, a staff member in Long Phu district, agreed that the installation of the dyke and canal systems was the key to the expansion of the new Spring-Summer crop from a few households to a widespread practice in Long Phu district (Male, 40, agricultural staff, Long Phu district).

The transformation from double cropping to triple cropping in Tan Hung can be seen in the changes of crop structure in Long Phu district. Data show that the practice of triple crops a year has been popular in Long Phu district since 2012, at least as shown in official records. In Long Phu district's yearly agricultural development report, the statistics of the third rice crop was only calculated since 2012. From 2012 to 2017, except two years 2016 and 2017 due to the effect of the 2015–2016 disaster, the yearly planted area of the third crop was maintained above 12,000 hectares (see Table 4). Although this figure was lower than those of the other two crops, whose annual planted areas were always above 15,000 hectares during the same period, the total outputs of the third crop in normal years (without saltwater intrusion and drought) were often higher than those two crops. For instance, in 2012, the total output of the third crop was 104,544 tons, while that of the first and second crops were 96,541 and 100,598 tons, respectively. In 2015 – the year before the disaster came, the total output of the third crop recorded as much as the first crop (109,148 tons), and higher than that of the second crop (99,297 tons). In the recent two years, 2016 and 2017, when the third crop production was heavily affected by the 2015–2016 disaster and its following crises, the total rice outputs of three crops also dramatically dropped from 317,593 tons in 2015 to just 211,628 tons in 2016 and 209,922 tons in 2017. These statistics indicate that the practice of third crop has been crucial to Long Phu district's rice production in particular and agriculture in general.

Table 4. Total Planted Areas of Three Crops in Long Phu District.

Rice Crops	**Years**					
	2017	**2016**	**2015**	**2014**	**2013**	**2012**
Spring-Summer (third crop)	3,297.70	6,449.56	13,273.48	12,707.45	15,058.68	14,985.00
Summer-Autumn (first crop)	16,375.22	16,552.98	15,530.30	15,561.81	15,529.95	15,791.00
Winter-Spring (second crop)	16,545.28	16,545.28	16,522.00	15,516.82	15,529.62	15,790.00
Total	36,218.20	39,547.82	45,325.78	43,786.08	46,118.25	46,566.00

Source: Compiled from information obtained from Long Phu Division of Agriculture and Rural Development (2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017).

On the regional level, the change from single cropping to double cropping and triple cropping seemed to occur as early as 1990s, with some places such as An Giang did double cropping after 1975 (Demont & Rutsaert, 2017; Nguyen et al., 2018). According to a report by Vietnam National Mekong Committee and UNDP (1999, p. 56), from 1990 to 2000, while land use for single rice crop dropped significantly from 718,000 hectares to just 485,000 hectares, the figures for double rice crop and triple rice crop increased dramatically from 943,000 hectares to 1,209,000 hectares and from 97,000 hectares to 248,000 hectares, respectively. Although this data indicated that triple rice crop was not popular in 2000, the rise of its area of 165% from 1990 to 2000 somehow showcased the changing direction in crop production in the Mekong Delta.

The consequence of implementing the third rice crop is complicated. On the one hand, it helps generate more profits for farmer households than the other two rice crops as previously discussed. On the other hand, the third crop has brought about their vulnerability to drought and saltwater intrusion.

The introduction of the third rice crop led to higher intensity between crop production and water resources and natural hazards such as saltwater intrusion. To facilitate triple cropping system, farmers were forced to start their crop 2 earlier to save time for the final crop of the year. As a result, the rice production system is now divided as follows:

- Crop 1 (Summer-Autumn) from April or May to August. This is a bit earlier than before the 2000s as farmers could start from late May depending on the start of the rainy season.
- Crop 2 (Autumn-Winter or early Winter-Spring) from September to December. This crop has to start in September instead of October.
- Crop 3 starts right after crop 2, from late December or early January to between mid-March or mid-April. Although officials refer to this crop as Spring-Summer or sometimes early Summer-Autumn crop, farmers from Village A call it late Winter-Spring as the crop is harvested in Spring rather than Summer.

The practice of triple cropping increases considerably water demand for crop production in the dry season (Miller, 2007, p. 199). It can be seen that the cultivation of the third crop falls at the time of the dry season running from December to late April, with this crop entering the vegetative and reproductive phases varying from January to March, depending on the time it starts. If water scarcity occurs at this stage, the crop likely suffers yield losses. The period from January to April is when saline intrusion often reaches its peak. According to the database by the Soc Trang Provincial Steering Committee for Preventing Floods and Storms and Rescue (2017a, 2017b), the average salinity degree in six months from January to June in 2016 measured at the Long Phu station – the one used as a reference point for water control management in Long Phu district, stood at 8.53 gram per litre, having reached its climax at 12.82 gram/litre in March. The similar pattern was also found in the previous years, with the high spots often witnessed in March or April. Came close to the 2016's figure was that of 2010, 2013 and 2015, with the average salinity degree recorded at 5.6, 5.26 and 4.83 gram/litre, respectively. These three years were

reported to have saline intrusion intensified by associated droughts and experienced heaviest losses compared to other years. According to Soc Trang Provincial People's Committee's reports (2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017), the years 2010, 2013 and 2016, the total affected agricultural production areas lost due to natural disasters were 5,690, 12,274 and 31,560 hectares, respectively. These figures were much higher than those of the other "normal" years during the period from 2010 to 2017 (except for 2012 – the year suffered from a big flood), which remained under 3,000 hectares of losses. What means by this situation is that attempting the third rice crop is usually a very risky choice that probably put farmers under the attack of annual saline intrusion and possible drought.

5. Conclusion

In the Pressure and Release (PAR) model, Blaikie, Cannon, Davis and Wisner (1994; see also Wisner, Blaikie, Cannon, & Davis, 2004) developed a framework to understand vulnerability. They proposed that vulnerability progresses through three stages and forms. The first and the most obvious form is unsafe conditions presenting in the form of living in hazardous locations and lack of quintessential skills to cope with and recover from natural disasters. These conditions were facilitated by "dynamic pressures" that present in the form of macro forces such as rapid urbanisation or arms expenditure. However, these dynamic processes are not the root causes of vulnerability. The root causes indeed reside deep inside the social, economic and political systems, which can be from ideologies, cultural assumptions, beliefs, law and social relation (see more in Chapter 2). The root causes could be the heritage of the past ideologies or policies while the dynamic processes are in present time.

What is problematic with the PAR model is that it assumes that social structures presenting in social, economic and political systems are always the root causes of the vulnerability to natural disasters that human actors face when encountering natural hazards or threats. This may neglect the fact that social actors can be creative in forming their course of actions and changing social structures.

In this chapter, the state of susceptibility to drought and saline intrusion of local farmers in Soc Trang province is a social construction. The "social" here should be viewed as a consequence of the dialectical interaction between social structure (state's policies and strategies) and human agency (farmers' decision and actions). Vulnerability to the 2015–2016 disaster first seems due to farmers' lack of planning and coping capacities that disabled their decision making in crop production planning and disaster risk management. However, as the chapter has shown, to arrive at a triple cropping system is not just derived from farmers' decisions at the time. This is indeed linked strongly with the interaction between farmers' crop production and the state's policies and directions in agricultural and irrigation development in the past. It can be seen that the evolution of rice crop production from single cropping system to double and triple cropping system was first due to the execution of the agricultural intensification and "closing-off" irrigation development policies since mid-1990s. Farmers were allowed to expand their planted areas and increase number of crops per year with the advantage

of the "sweetening project". However, farmers were not passive actors in this project. They actively sought to plant and increase in scope the third crop, which turned the single cropping system to double cropping or triple cropping system.

This chapter has the potential to provide evidence for future discussion on the dynamic relationship between social structure and human agency in the shape of vulnerability to natural disasters. In this respect, the use of Giddens's theory of structuration could be relevant. Giddens (1984) attempted to close the gaps between structure and agency by proposing that we should go beyond the traditional dichotomy between structure and agency to accept a "duality of structure". This feature indicates that while social structures can provide rules and procedures that enables or constrains the development of human actions, human agency can in turn reproduce social structures through their regular practices. This means that the shaping and changing of social structures within social, economic and political systems are also dependent on human actions. Thus, the construction of vulnerability is a result of the interaction between social structure and human agency.

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