CHAPTER I. INTRODUCTION

In Vietnam, the Mekong Delta is an area significantly affected by climate change. In recent years, saline intrusion (SI) has increased in frequency due to climate factors and the effects of human development. Saline intrusion causes significant damage to livelihoods and the life of coastal inhabitants. Changing their farming system is a common strategy used by coastal farmers to respond to environmental change which can bring economic gain but can also create social challenges. From this context, collective risk adaptation (CRA) has emerged as an approach to mobilize the adaptive capacity of groups of actors.

A. Research background

The Vietnamese Mekong Delta (VMD) is the last part of the country where the Mekong River flows out into the East Sea. The Mekong River, which rises in Tibet, flows down through China for about 2.500 km and then for another 2.400 km between Lao PDR and Myanmar, Lao PDR and Thailand, into Cambodia, and down to the Delta in Vietnam ((ICEM) International Center for Environmental Management, 2013). The formation of the VMD links to changes in sea level and hydrology of the Mekong River. In the Holocene, the coastline was close to Phnom Penh, however, since 7,000 years ago, the Delta started expanding southeastwards due to the alluvial deposition from the Mekong River (CCAFS-SEA (Climate Change - Agriculture and Food Security - Southeast Asia), 2016). The Delta borders with Cambodia to the North, Pacific Ocean to the East, Gulf of Thailand to the West and Ho Chi Minh City to the North East. Administratively, there are twelve provinces and one central city including Long An, Tien Giang, Dong Thap, Vinh Long, Tra Vinh, Hau Giang, Soc Trang, Ben Tre, An Giang, Kien Giang, Bac Lieu, Ca Mau and Can Tho city (Figure 1).

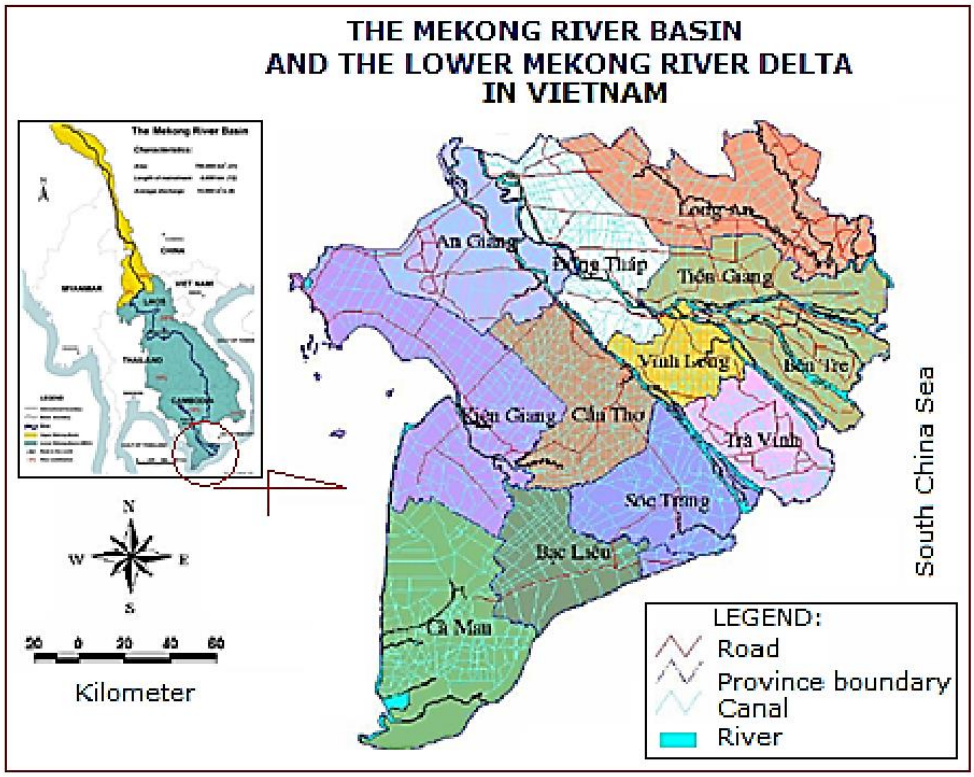

Figure 1. Administrative map of the Vietnamese Mekong Delta
Source: (Le and Wyseure, 2007)

The Delta climate is tropical with two distinct dry and wet seasons. The wet season begin in April through November and provides almost all of the annual rainfall of local regions[1]. The rest of the year is the dry season. The Delta temperature is high and stable, varying from 24,5 ^{0}C to 28,9 ^{0}C.

The VMD is located in an important area for the socio-economic development of Vietnam. It is a vast wetland of 40.604,7 km^2, accounting for 12% of the country's total area and 27% of the agricultural land of Vietnam. It is home to 18 million people, 20% of the country's population (IUCN Vietnam (International Union for the Conservation of Nature in Vietnam), 2010). The Delta has enormous potential for agriculture and aquaculture production. In 2016 it produced 25 million tons of rice; an agricultural output that accounted for 50% of the whole national production. Regarding exports, the Delta produced about 90%

[1] About 90% of total rainwater falls from May to October (Le *et al.*, 2004).

of rice, 60% of fruit trees and 70% of aquaculture products (IPSARD (Institution of Policy and Strategy for Agriculture and Rural Development), 2016).

The VMD consists of flat terrain, with an average height of 0,7 to 1,2 m above mean sea level, except for some high hills in the Northern Delta (Deltares & Alliance, 2011). The river network of the Mekong River as it reaches the Delta is complicated with nine estuaries and dense canal systems. The Delta is recognized by diverse hydrological characteristics varying greatly between two different parts of the Delta. The upper part is vulnerable to flooding while the lower one has coastal characteristics and is vulnerable to SI (Figure 2) (IMHE (Institute of Meteorology - Hydrology and Environment in Vietnam), 2010, Nguyen, 2008).

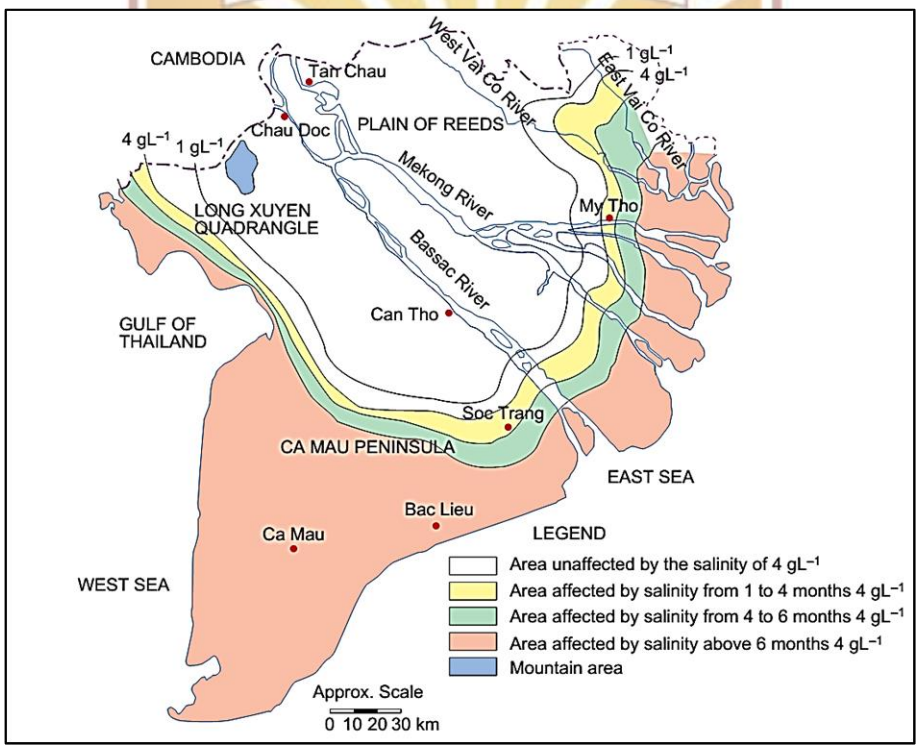

Figure 2. The incidence and severity of saline intrusion in the Vietnamese Mekong Delta

Source: (Clayton, 2003)

SI is indicated by the distance of saltwater intruding mainland and concentration of salt level in the water (SIWRR (Southern Institute of Water Resources Research), 2015). Approximately 2,1 million hectares of the Delta coastal areas (50% of the Delta land) are affected by salinity during the dry season (WB (World Bank), 2015). Saltwater intrudes inland from the Hau and Tien river

mouths' and Ca Mau peninsula's estuaries, strongly from February to April (Le *et al.*, 2004). Salinization has severe consequences, affecting agriculture, aquaculture production, and livelihoods of the farmers living in coastal areas (Nguyen, 2016a, IPSARD, 2016).

Saline intrusion is a natural phenomenon occurring annually in the dry season when not enough river discharge flows to the low-lying estuaries and instead salt water take the place flowing into the mainland (Le *et al.*, 2007, Estellès *et al.*, 2012). In the Delta, SI happened regularly during the period from 1977 – 1997. The year 1998 was the first time SI had been recognized as a climate risk (Dang *et al.*, 2007) since the distance saltwater intruded inland was farther than it had in previous years. Since this time, the effects of SI have become more serious and uncertain. It has occurred with higher density and a bigger magnitude (IPSARD, 2016, SIWRR, 2015). For example, in 2016, SI occurred more seriously than has been expected (Figure 3).

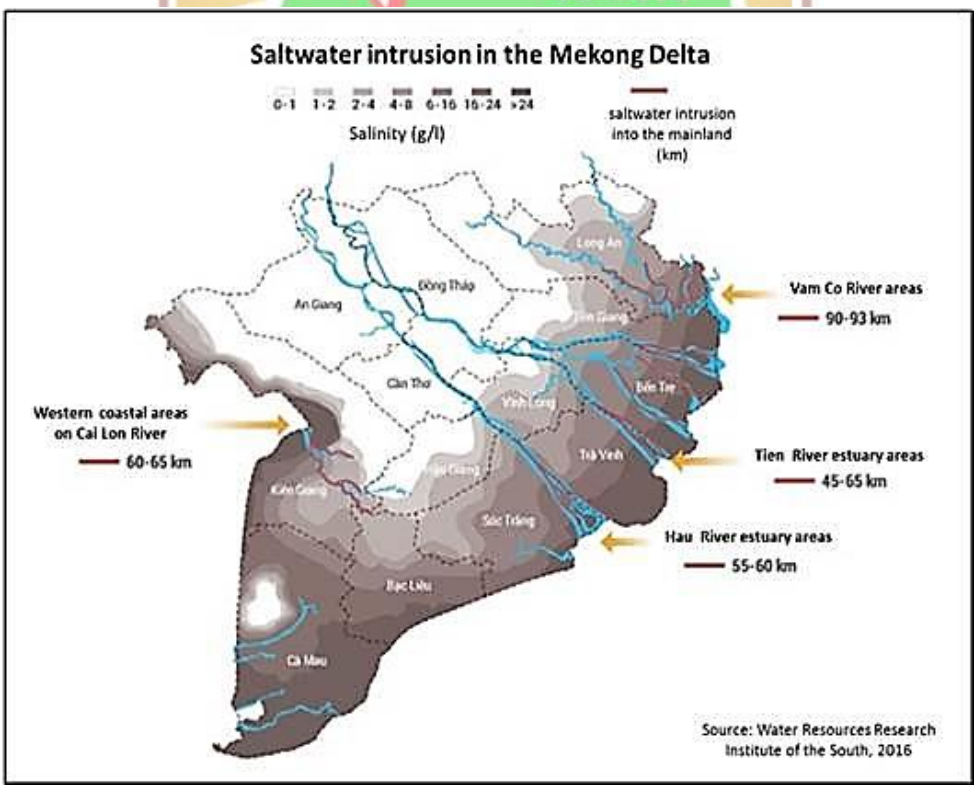

Figure 3. Saline intrusion occurred seriously in the Mekong Delta in 2016
Source: (Water Resources Research Institute of the South, 2016)

The main factors determining SI are the Mekong river discharges, local rainfall and runoff, the amplitude of tides in the East Sea and the Gulf of Thailand,

the slope of the river bed, the wind velocity and direction and the depth of the estuary (IUCN Vietnam, 2010, Nguyen, 2016a, Tran *et al*., 2012, CCAFS-SEA, 2016, WB, 2015, Nguyen, 2016b, Nguyen, 2008). The VMD is relatively flat and low and the interlaced canal systems (with an average density of 4 km in length 1 km^2) that create the favorable conditions for the tidal sea (MARD (Ministry of Agricultural and Development), 2017, Nguyen, 2016a). Besides, building dams on the upstream areas of the Mekong river has become an important reason influencing seriously on the SI's status because of reducing of water flow in the main river (WWF (World Wide Fund for Nature), 2012, CCAFS-SEA, 2016).

In the future, the VMD would experience significant negative impacts from sea level rise[2]. Research from the SIWRP (Southern Institution for Water Resource Planning) showed that by the year 2050 VMD salinity soil at the level >4g/L will increase up to 2.018.822 ha (52,9% of total Delta land), up to 5,4% more in comparison with the current status (47,5%; about 1.813.826 ha) (Le, 2016).

The Vietnamese government has intervened by building salinity control projects to prevent SI since 1990s of the last century. The Government has invested heavily in salinity control structures[3] to control a region of about 926.000 ha with 650.000 ha for agricultural land (Tran, 2009, Nguyen, 2016a). In addition, 450 km of sea dikes, 1.290 km of main river/canal dikes and 7.000 km of tertiary and quaternary canal dikes with sluices were constructed (Nguyen, 2016a). By implementing these projects, the Government expected that farmers in the saline zones could intensify rice farming and other freshwater upland crops to improve their livelihoods (WB, 2015, Dang *et al*., 2012). However, SI still occurs and forces coastal farmers to adapt to overcome the impacts. In addition, there is clear evidence that SI occurs and affects the whole coastal communities in the Delta in which farmers earn less income than freshwater farmers due to water and land constraints (Dang *et al*., 2007 and Clayton, 2003). In the future, SI will increase (MARD (Minister of Agriculture and Rural Development) & MORE (Minister of Environment and Natural resources, 2013).

[2] The sea level rise had increased by 20 cm since 1901 (CCAFS-SEA, 2016).

[3] They are Go Cong, South Mang Thit, Quan Lo Phung Hiep, and Ba Lai salinity control projects

Some of the research has studied collective action in cases of salinity management (Marshall, 2004, Panda, 2006). However, the issue of collective adaptation has been mentioned rarely in previous studies in Vietnam (Joffre and Sheriff, 2011) and none has been done in studying collective action in managing water resources to face SI. The lesson learned from current adaptation to climate change in Vietnam indicates that strength of community capacity has not been discovered which is very important to build adaptive capacity (IPSARD, 2016), while the result of preliminary research done in 2016 in An Bien district, Kien Giang province illustrated that the potentials of collective action helping farmers to create group adaptive capacity to adapt to SI. Therefore, this study was conducted to gain insights into the status of collective action and its ability to build group capacity to adapt to SI. With the assumption that ecological factors contribute to the adaptation process, the research was done in both sides of the Delta (the West and the East) to answer the overarching research question: What are type of CRA and factors affecting the formation process?

To respond to the general question, the four specific questions are answered as follows:

1. What are the physical characteristics of SI in the VMD?
2. What are the social and economic impacts of SI on the household's livelihoods?
3. How have CRA been formed and what are the outcomes?
4. How do social and ecological factors influence CRA?

B. Objectives of research

Saline intrusion impacts agriculture and livelihoods of the Mekong coastal inhabitants. Collective action contributes to managing natural resources, especially in the case of adapting to environmental change. This research was carried out to examine appropriate CRA and its potential to strengthen group adaptive capacities in the case of SI in the VMD.

The research was carried out to achieve the four objectives:

1. To analyze the physical characteristics of SI's change in the VMD;
2. To analyze the social and economic impact of SI on households' livelihood;
3. To identify patterns of CRA and the outcomes;
4. To explore factors influencing CRA in the VMD.

C. Significance of the research

This dissertation contributes innovative original research findings on how collective adaptation has been formed and the factors taking part in the formation process to face SI. Collective action plays an important role in managing natural resources, especially dealing with the impacts of climate risk. SI happens in the Delta and its impacts affect whole coastal communities so adaptation is not only an individual concern, but also a community consideration. There are few lessons learned from studies of collective action in Vietnam and no research has been conducted in the field of collective action with SI.

In the context of Vietnam, centralized government management has been considered an important source of climate risk adaptation. This research will give opportunities for both farmers and governmental agencies to know to what extent CRA exists in local communities and its ability to overcome the challenge of SI. This research also proposed that by understating the relations between social and ecological context give more spaces for institutions to discuss to share their understanding and decision-making for the collaborative saline management and formulating the CRA policies in the region.

Theoretically, this research can make a contribution by giving an example of autonomous adaptation as a function of the social and ecological system, environmental change guides community adaptive capacity. It supports the adaptation theory with the fact that adaptation base on local adaptive capacity. It provides empirical evidence to see how local communities have overcome collective action problems to achieve common goals. Regarding SES, it is clear to see how the social-ecological system (SES) concept works in the political system to respond to climate risk's impacts. Also, it gives readers a space to see how the Institutional Analysis Development Framework (IADF) acts in the political system

that is important to sustain social capital's functions. In conclusion, findings from those four objectives can be developed for further policy implication to improve collective risk management in the study sites.

D. Structure of dissertation

The thesis contains eight chapters.

Chapter I: *Introduction*- This chapter gives an overview of research areas mentioning about natural conditions of the VMD and the SI's status. It also explains about the gaps and objectives of research and the reasons to do research in regards to fill the gaps, looking for current situation of SI, forms and factors affecting the forming process.

Chapter II. *Literature review*- The first part of the dissertation reviews those issues related to the concept of climate change, vulnerability and adaptation together with the status of SI in the Delta which has been considered as climate risk. Collective action in terms of theory and practice is also considered in regarding to concept of social capital, its forms and functions. At the last part, IADF is learnt for better understanding how collective action is formed in reality and the contribution of social and ecological factors into the shaped process.

Chapter III. *Research methodology* - Research size, research methods and stages of conducting the research are described in this chapter. Initially, the reasons to choose research size are discussed relating to the issue that change of natural conditions guides human actions that have been made to cope with the changes. In the second part, research methods are written to show clearly how the four research objectives can be achieved through the two research stages.

Chapter IV. *Physical characteristic of saline intrusion in the Delta*- It is apparent that the Delta is affected by climate change and SI is one of the impacts occurring seriously in the coastal areas. In addition, causes of SI are described to show the complicated causes of SI affected by both regional and local factors. Farmers' perception of SI is also mentioned in regarding the difference between the West and the East. The trend of SI places at the

last part of this chapter displacing that SI will change upwards in the upcoming years.

Chapter V. *Economic and social impacts of saline intrusion on coastal livelihoods*- Shifting of the farming system as the main adaptation is placed in the first part showing the different adaptive actions of coastal farmers in the West and the East. Economic impacts are included in the second part regarding its gain in both areas, more sources of income from shrimp rice system in the West and big profit from intensive farming in the East, while the social problem is followed. The chapter is ended by the issue of social changes taking place differently on both sides of the Delta to overcome the challenges.

Chapter VI. *Adaptive capacity and collective adaptation forms*- The first part expresses information at the household's level related to the roles of the families' members in making collective decision. Adaptive capacity at the community level is described at the second emphasized on the fact that it is more in the West. The last part mentions forms of CRA which are classified following social structure and function criteria. Characteristics of formal organization and social groups last at the end to explain clearly the various characteristics between two organizations.

Chapter VII. *Factors shaping collective adaptation*- This chapter describes ecological and social factors affecting CRA classified into the four categories: resource system, resource user, governance system and resource unit. The next part mentions about linkages between social and ecological factors in causal loops and also in levels of links among three categories (physical characteristics of the environment, social-economic factors and institutional system) at different levels of interaction within social-ecological system starting from interpersonal, organization, community and policy.

Chapter VIII. *Discussion*- This chapter discusses those issues that have been discovered throughout the research. The first issue related to adaptation theory explained that human action as a response to environmental change. Natural conditions have been changed in the Delta and the result is that

changing the farming system as a main adaptation strategy to cope with changes. The second issue discusses the roles of social capital in building collective adaptation in regards to the social capital forms (trust, network, and institution) which act differently on social groups and formal organizations. To achieve better sustainable development, the issue of social entrepreneurship should be brought into this context to better manage and make the income of natural resources. The potential of social entrepreneurship and partnership to achieve sustainable development is the third point to be discussed in this chapter.

Chapter IX. *Conclusion and recommendation*- This chapter concludes the issues which have been mentioned in the previous chapters. In the second part, it also proposes recommendations for farmers, local authorities and theoretical aspects in order to build more effective collective adaptation in future time.