Flood Governance in the Mekong Delta of Vietnam: Implications of Social Learning for Household and Institutional Adaptation

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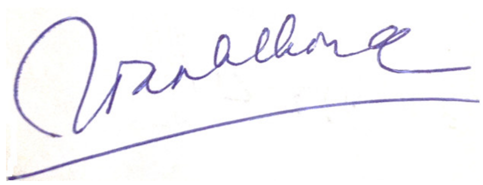
Declaration

I hereby declare that this thesis is entirely my own work. It contains no materials previously published by any other persons, except where due reference is made in the text of the thesis.

Signed:



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Abstract

This thesis is an empirical study into the complex flood governance system in the Mekong Delta of Vietnam, focusing on how social learning occurs across the interface of flood management and adaptation. It involves the multi-disciplinary theories of environmental governance, rural development, knowledge management, and political ecology. Drawing on Pahl-Wostl's conceptual framework of social learning in resources management, this thesis attempts to investigate how social learning influences household and institutional adaptation to the delta's forced adaptation complexities characterised by incremental impacts of climate change, local flood management policies, and hydropower dam development upstream. Based on this empirical understanding, it investigates how the adaptive co-management approach could inform the long-term adaptation strategies to address the social-ecological challenges of forced adaptation. A mixed methods approach was employed as the main strategy of inquiry.

This thesis makes an important contribution to the knowledge of social learning and the role it plays in facilitating household and institutional adaptation, and improving the implementation of flood management policies in the delta. The research findings suggest two main social learning patterns: external learning (communication and social interactions) and internal learning (reflective learning), which take place across household groups. According to the multiple linear regression results, these social learning patterns have significant positive effects on adaptive capacity.

This thesis reveals the emergence of strategic alliances and their interaction patterns across the formal and informal interaction boundaries. In the formal flood management boundary, there is little evidence of social learning. The top-down governance approach inhibits opportunities for innovative thinking and democratic processes in support of policy change. In contrast, the flexibility of the informal interaction boundary promotes collaborative learning in adaptive livelihood practices. This thesis highlights the significance of 'shadow systems' that are forged in the learning interactions between farming households and extension officials. While farming households are knowledge brokers, the extension officials play a role as policy brokers who facilitate the incorporation of local knowledge (farming initiatives) and specialised knowledge (scientific knowledge) into organisational knowledge (government policy). In the rural governance context of the Mekong Delta of Vietnam, policy change often arises from such bottom-up endeavours.

This thesis argues that the adaptive co-management approach is continuously linked to the flood management and adaptation processes in the delta. The research findings reveal that the flood management and adaptation practices, through the delta's 'opening-up and closing-off' processes, have evolved towards the adaptive and collaborative approach. Drawing on the empirical understanding of these evolutionary processes, this thesis suggests that the adaptive co-management approach should play an essential role in guiding the long-term adaptation strategies to address the ongoing complexities of forced adaptation in the region.

Key words: adaptation, adaptive co-management, flood governance, social learning, the Mekong Delta of Vietnam

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List of Acronyms

AAI	Activity-based Adaptation Index
AGDARD	An Giang Department of Agriculture and Rural Development
AIS	Agricultural Innovation Systems
ANOVA	Analysis of Variance
AusAID	Australian Agency for International Development
CMBs	Compartment Management Boards
CPC	Communal People's Committee
CTU	Can Tho University
DARD	Department of Agriculture and Rural Development
DPC	District People's Committee
ELP	External Learning Performance
FA	Farmer's Association
FGDs	Focus Group Discussions
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GSO	General Statistics Office
GWP	Global Water Partnership
HYVs	High Yielding Varieties
IDS	Institute of Development Studies
IDSUs	Irrigation and Drainage Service Units

ILP	Internal Learning Performance
IMC	Irrigation Management Company
IME	Irrigation Management Enterprise
IPCC	Inter-governmental Panel on Climate Change
IWRM	Integrated Water Resources Management
KMO	Kaiser-Meyer-Olkin
LXQ	Long Xuyen Quadrangle
LWR	Law on Water Resources
M	Mean
MARD	Ministry of Agriculture and Rural Development
MDV	Mekong Delta of Vietnam
MOA	Memorandum of Agreement
MONRE	Ministry of Natural Resources and Environment
MRC	Mekong River Commission
NEDECO	Netherlands Engineering Consultants
NGOs	Non-Governmental Organisations
NVN	North Vam Nao
OARD	Office of Agriculture and Rural Development
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares

PPC	Provincial People's Committee
RBOs	River Basin Organisations
SD	Standard Deviation
SE	Standard Errors
SIWRR	Southern Institute of Water Resources Research
SLIM	Social Learning for the Integrated Management
SMB	Scheme Management Board
UNDP	United Nations Development Program
VAC	*Vườn* (Orchard) – *Ao* (Fish Pond) – *Chuồng* (Poultry Pen)
WFD	Water Framework Directive

Chapter 1

Introduction

1.1 Research context

The floodplains of the Mekong Delta of Vietnam (MDV) are the lifeblood of the local inhabitants. This region makes a significant contribution to agricultural and aquacultural production, which is dependent on the productive functions of seasonal floodwaters. Annual floods in the delta are influenced by the overflows from the Mekong River, high tidal levels from the sea, and local heavy rainfalls, extending from July to December (Le Anh Tuan et al., 2007). On the one hand, floods bring substantial livelihood opportunities for the majority of local households, especially the poor. On the other hand, they cause negative impacts such as the loss of crops, assets, and family fatalities (Nguyen Huu Ninh, 2007). This has caused floods to be commonly viewed as a 'natural enemy', which remains the case today. Over the past few decades, the MDV has experienced a large number of major floods with varying levels of impact (Tran Nhu Hoi, 2009). Nearly 50 percent of the region is subject to major floods that occur every four to five years (Sneddon and Nguyen Thanh Binh, 2001). According to World Bank et al. (2003), the delta is currently faced with increased flood uncertainty, in terms of frequency, magnitude, and retention.

In addition to the adverse effects of floods concerned with climate change and upstream hydropower development, growing public concerns have been raised about the existing flood management policy in the MDV (Reis, 2007; Waibel et al., 2012). According to Pahl-Wostl et al. (2011), flood management refers to the objectives of reducing flood hazards and increasing the safety of human life and infrastructure on floodplains. In the context of the MDV, flood management aims to both mitigate negative flood impacts and capitalise on flood-based resources for local livelihood development. At present, very little account is given to how the flood management policies relate to the everyday life of rural societies. Experience shows that addressing these 'wicked' problems links closely to the way the rural societies have learned in order to adapt to the complexities.

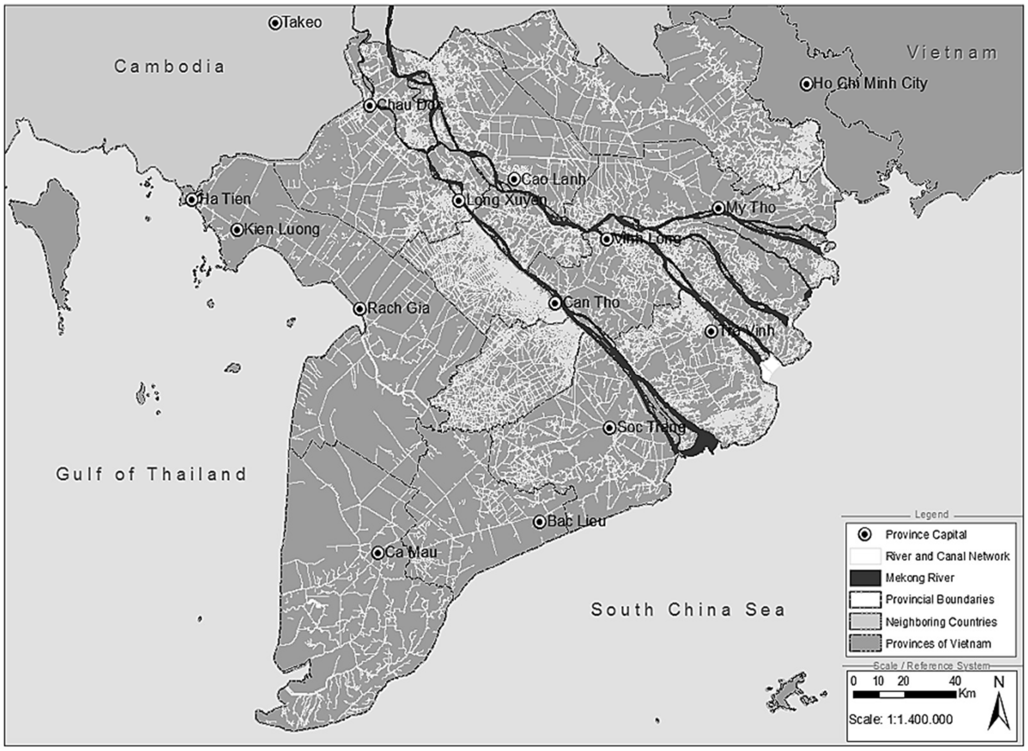


Figure 1.1 River and canal networks in the MDV

Source: Evers and Benedikter (2009: 417)

Flood governance in the MDV is embedded within the national-level water governance framework, which has encountered multiple constraints. According to the Global Water Partnership Framework for Action, "water crisis is mainly the crisis of governance" (GWP, 2000a: 17). It is commonly argued that failures of governance are products of decision makers' insufficient understanding of emergent attributes of governance concerned with inclusive decision-making processes, coordination and negotiated outcomes (Tropp, 2007; Pahl-Wostl and Kranz, 2010). In Vietnam, the policy constraints on water governance have been found to be related to the inconsistency of legal frameworks and the poor institutional collaboration (Nguyen Thi Phuong Loan, 2010; Waibel, 2010; CTU, 2011; Renaud and Kuenzer, 2012). According to Waibel et al. (2012), the national water resources management strategy has traditionally focused on flood control and the provision of freshwater for aquacultural and agricultural production. Considering the role of state management in water resources management, Waibel (2010) argues that governance constraints are associated with the limited capacity of the central state to enforce the national policy frameworks at the local level. While the institutional arrangements on the water sector are well documented at the national level, their implications for flood management at the sub-national (provincial, district, and communal) level have not been investigated. This research attempts to explore how these policy gaps affect the flood management and adaptation processes of the rural societies in the MDV.

Under the umbrella of the national-level water governance framework, the flood management strategies in the MDV are strongly influenced by the 'command and control' approach. This approach dictates the prioritised development of structural systems (dykes, irrigation schemes, sluices) across the delta. The early success of building low dykes[1] in the floodplains in the late 1970s, coupled with food deficits in the 1980s, placed increasing pressures for the extensive construction of large-scale structural systems to provide secure settlements for the growing population and enable multiple cropping systems (Fox, 2003; Biggs et al., 2009). However, the negligence of enforcing collaborative flood management arrangements has exposed unexpected distribution of floodwaters across flood-prone areas. It is evident that full protection dykes cause increased flows in the rivers and canals, leading to excessive flooding in non-protected areas, and placing dyke systems in protected areas at high risk (Pilarczyk and Nguyen Si Nuoi, 2005; Le Thi Viet Hoa et al., 2007a; Lebel and Bach Tan Sinh, 2009). These structural systems also relate to prevalent flood inundation in the downstream areas (Le Anh Tuan et al., 2007; Birkmann et al., 2012). As proposed by the Netherlands Engineering Consultants (NEDECO, 1993), there needs to be an institutionalised mechanism accountable for planning coordination, monitoring and

[1] Low dykes are also known as August dykes *(đê bao tháng Tám)*, initiated in An Giang province in 1978. This system attempts to delay the seasonal floodwater inflows into fields until the summer-autumn *(hè-thu)* crop is harvested. The protection of this enclosed embankment enables rice farmers to actively pump the remaining floodwaters out of the fields to start the winter-spring *(đông-xuân)* crop early.

evaluation of flood governance and structural development in the MDV. However, this has never been implemented.

The decentralisation process in the post-Renovation[2] period has offered unprecedented autonomy for the delta's governments to decide on the service provision and maintenance of structural systems (Fritzen, 2006; Biggs et al., 2009; Waibel, 2010). The argument for decentralisation is based on the premise that local authorities have better understanding of their local conditions, and thus are in a better position to formulate and implement their economic development (Bach Tan Sinh, 2003). Brockhaus and Kambire (2009) see this as providing a means for the increase of local adaptive capacity. According to Tran Phong and Bui Duc Tinh (2010: 202), decentralisation is an important mechanism since "local government is becoming more accountable to its constituencies than to a distant and weak national government." Under the broad policy frameworks from the central state, specific policies can be pursued at the provincial level by the Provincial People's Committee (PPC) to better address local concerns (Small, 1996). The autonomy from the central authorities provides greater institutional flexibility that allows the local governments to pursue their own interests (Molle and Dao The Tuan, 2006; Waibel, 2010). Inevitably, this has led to the formulation of divergent water planning and management policies across the delta (Molle, 2005). This thesis argues that, albeit subject to the top-down governance approach, the local governments tend to shift their focus on flood management policy away from the central policy framework. Stimulated by the decentralisation process, this 'self-governance' approach is one of the proximate causes for the fragmentation in institutional design for the construction, operation, and management of irrigation and flood control schemes in

[2] The Renovation *(Đổi Mới)* was promulgated at the Sixth Party Congress in 1986. This period witnessed significant reforms in all sectors, directing the centrally planned economy towards a market-oriented system. See Ljunggren, B. (1997) in Beckman, B., Hansson, E., and Roman, L. eds., Vietnam – Reform and transformation, Stockhom: Center for Pacific Asia Studies, 9-36.

the delta. This institutional fragmentation has caused constraints for collaborative flood management between adjacent flood-prone localities.

The development in the MDV is currently standing at the crossroads (Käkönen, 2008). Although non-structural measures are increasingly recognised in recent years, sustained efforts by the central government have been made in building large-scale flood protection systems across the floodplains (Le Anh Tuan et al., 2007). According to the Ministry of Agriculture and Rural Development (MARD) (2003) report, the MDV currently possesses an extensive network of canals, composed of 7,000 km of main canals, 4,000 km of secondary canals in on-farm systems, and more than 20,000km of dykes to protect against early floods. These development trajectories raise a significant question of whether control or adaptation-oriented policy should be prioritised (Käkönen, 2008; Biggs et al., 2009). A paradox can be seen in this regard. While the 'living-with-floods' *(sống chung với lũ)* practices are promoted as the formal adaptive strategies to sustain local households' livelihoods in the flood season (Dang Quang Tinh and Pham Thanh Hang, 2003; Lebel and Bach Tan Sinh, 2009), the rice intensification and agricultural diversification policies (Le Coq and Trebuil, 2005; Nguyen Duy Can et al., 2007; Biggs et al., 2009) come to employ engineering infrastructure as main supports. It has been argued that without dykes the protection of local infrastructural systems and rice cultivation would be impossible (Pilarczyk and Nguyen Si Nuoi, 2005) or even placed at risk. This development trajectory corresponds to Holling and Meffe's (1996) view that contemporary human-nature interactions often count on rapidly developed short-term incentives and control measures rather than a long-term development strategy. The inconsistent flood management policies for the socio-economic development in the delta, combined with escalating constraints of climate change and upstream hydropower development, have impelled rural households into the inevitable stance of what I term 'forced adaptation.' This concept sets the research context and analysis throughout the thesis.

This research argues that the complexities of forced adaptation give greater impetus for the rural societies to develop their adaptive livelihoods on the basis of shared learning and co-production and diffusion of knowledge among relevant stakeholders. This research conceives of farming households as key actors who contribute significantly to the production of innovative knowledge. The process of knowledge production, when facilitated by social interaction processes, leads to a change in households' understanding, behaviour, and actions in dealing with conventional farming practices. I conceptualise this as 'social learning'. In this research, the conceptualisation of this concept is fundamentally based on Reed et al.'s (2010) argument that the social learning process must involve a change in individual understanding which is situated in wider social units, and occurs through social interactions between social actors within a network. However, the passive social learning pattern which "rests on prior learning of others" as Glasser (2009: 49) suggested is also examined, as it stands out in households' adaptive responses. The cultural and social-ecological context of the MDV is the salient theatre of social learning that is qualitatively and quantitatively analysed in the thesis. The investigation of social learning complements the current state of knowledge of how these learning dynamics contribute to redressing the drawbacks of contemporary flood management and adaptation policies, and strengthening household and institutional capacity to adapt to the complexities of forced adaptation.

Tackling the 'wicked' problems requires learning and reflexivity in place of conventional management regimes (Ensor and Harvey, 2015). The role of social learning in natural resource management and water management are well-established in the European and Mekong Basin contexts (Maarleveld and Dangbégnon, 1999; Mostert et al., 2008; Pahl-Wostl et al., 2008b; Pelling et al., 2008; Lebel et al., 2010b). While social learning has gained widespread recognition as an important approach to facilitate adaptation to environmental challenges (Pelling and High, 2005b; Nilsson and Swartling, 2009; Srang-iam, 2013), this association remains largely unrecognised in the flood governance context of the MDV. To fill this knowledge gap, this research investigates how social learning influences the household and institutional capacity to improve the local flood management and adaptation practices.

There is a wide acknowledgement that experiential knowledge and willingness to take experimental initiatives are key ingredients in successful water resources management (Hansen and Do Hong Phan, 2005). The limited human knowledge of the uncertainties of ecological dynamics requires management to be adaptive. Management, in this sense, is seen as a series of experiments (Armitage et al., 2007). As Pahl-Wostl and Hare (2004: 193) noted, it is not the search for an optimal solution, but an ongoing learning and negotiation process. Learning from policy experiments necessitates individual diversity and experimentation as essential components of societies' adaptive processes (Olsson et al., 2004). Johnson (1972: 156) states that they are the "basic stuff of which adaptation and evolutionary change are made."

Experimentation is by no means a new approach to natural resources management in Vietnam; it is even encouraged at the local level (Kerkvliet, 1995). Autonomous efforts made by a small group of rice farmers in An Giang[3] in building low dykes to protect their rice fields against early floods in 1978 represent local households' experimental initiatives to deal with natural hardship. It is worth noting that these collective actions were taken without any consultation with the local government. However, the demonstrated success of this initiative was very much appreciated by the central and local governments, which made it popular as a pre-emptive solution to deal with floods until the late 1990s (Howie, 2011). At the delta-wide level, it has been acknowledged, due to limited understanding of the water resources system and the incapacity of state agencies to deal with it, the flood management in the delta relies on this experimental process, mostly directed by the 'learning-by-doing' approach. At the local level, the constraints of forced adaptation have impelled rural households to draw on their own innovative knowledge and seek out adaptive production technology to deal with newly created flood situations (Fox, 2003; Lebel et al., 2010a). In this sense, the production of such adaptive knowledge suggests collaboration in learning and taking actions among relevant actors (Bouwen and Taillieu, 2004).

[3] An Giang is one of the flood-prone provinces, which is located in the upper part of the MDV.

What makes farming households adaptable to environmental complexities depends on the proactive utilisation and dissemination of their experimental and experiential knowledge through social interaction. As Taylor (2001: 94) notes, farmers in the delta preserve 'a spirit of pioneering, even of adventure'. This distinct identity is characterised by the spontaneous nature of collectivistic group activities inherited from early predecessors and individualistic behaviour under the influence of capitalism. The households' knowledge is shared among peers within their learning networks, and exchanged with experts through local seminars, workshops, or in the fields. These relational spaces are useful to elicit households' innovative ideas and promote learning interactions. They can serve as a good means to overcome social barriers and bridge knowledge gaps between participants. Importantly, improved interactions between the participants can balance the conventional 'top-down' communication (IDS Workshop, 1993). Such learning interdependence can lead to the 'interdependence of knowledge' which is based on mutual negotiation and recognition of participants' contribution (Bouwen and Taillieu, 2004). According to Eckerberg and Joas (2004), the roles of knowledge and information sharing are conceived of as key ingredients in policy-making. In the MDV, the interdependence of knowledge leads to the formulation of informal and formal collaborative mechanisms among farming households, scientists and government agencies. Experimentation and collaboration are instrumental to institutional change in flood management to improve farming households' adaptive performance. This research attempts to unpack the concept of adaptive co-management in this respect.

While the policy constraints in flood governance in the MDV are recognisable, the collaborative learning between local households and government agencies is poorly understood at the intersection of flood management and adaptation. Employing comparative analysis of three empirical case studies of flood control schemes in three flood-prone provinces in the delta, the research argues that the exchange of households' initiatives and collaborative learning between local households and government agencies formulates effective communication channels for taking action. They are key ingredients to facilitate institutional change towards adopting appropriate flood management options to better support household adaptation on the ground. They form an empirical basis for formulating the long-term adaptation strategies in the delta for the future.

1.2 Research objectives

The main objective of this research is to explore the implications of social learning for household and institutional adaptation in the forced adaptation context of the MDV. It concurrently seeks to investigate how adaptive co-management has continuously linked to the flood management and adaptation processes in the delta, and informs an innovative governance approach to guide the long-term adaptation strategies in the future. The research has four objectives. It specifically aims to:

1. Examine how the forced adaptation context shapes rural farming household and institutional adaptation practices in the MDV.

2. Explain to what extent social learning influences rural farming households' adaptive capacity to floods in the MDV.

3. Examine how social learning facilitates institutional change in flood management and adaptation practices in the MDV.

4. Examine how adaptive co-management informs the long-term adaptation strategies in response to the forced adaptation complexities in the MDV.

1.3 Research questions

The development of the MDV is largely dependent on the abundant water resources from the Mekong River and the political, social-ecological conditions from upstream riparian countries. Although negative impacts caused by local floods are widely recognised, the abundance of floodwaters during the seasonal flood cycles provides environmental advantages for local farming households to develop a wide range of innovative livelihood patterns. However, these adaptation practices have not received adequate attention from local governments, who see rice production as a pre-emptive solution to achieve their political and socio-economic goals. Underpinned by this ideology, large-scale hydraulic systems for flood control have been built. This has placed tremendous pressure on the local households regarding how they can sustain their livelihoods in the flood season. This research particularly aims to gain better insights into how these structural systems have transformed households' farming patterns and livelihood strategies. To understand the empirical implications of this policy, the following question will be addressed:

1. How does the forced adaptation context shape rural farming household and institutional adaptation practices in the MDV?

Social learning has gained prominence as a key element in the domain of water resources management (Mostert et al., 2008; Pahl-Wostl et al., 2008b) and adaptation to climate change (Pelling and High, 2005b; Pelling et al., 2008; Albert et al., 2012). This research acknowledges social learning as a crucial approach to enhance local households' adaptive capacity in the MDV. Households are the main unit of analysis because they are directly exposed to negative flood impacts but are proactively engaged in shared learning and adaptation processes. Most studies have employed qualitative methodology to investigate the role of social learning in natural resource management (Rist et al., 2003; Pahl-Wostl and Hare, 2004; Measham, 2009; Johannessen and Hahn, 2013) and adaptation (Pelling and High, 2005b); this research quantifies the causal relationship between social learning and adaptive capacity at the household level. The second question that aims to explain this association is:

2. To what extent does social learning influence rural farming households' adaptive capacity to floods in the MDV?

In the view of state management agencies, flood control is simplistically a preferred solution to both tackle flood complexities and promote socio-economic development in the MDV. However, this strategy has been pre-occupied by the challenging question of whether flood control or adaptation-oriented policies should be adopted. At this crossroad is the policy contestation that emerges at the interface of flood management and adaptation. Multiple relational practices taking place between strategic alliances across the formal interaction boundary have emerged to tackle the issue. This research argues that the learning across informal and formal interaction boundaries between local households and government agencies plays an important part in influencing the local decision-making process to solve this conundrum. However, the existing literature on flood governance in the MDV reveals that the interactions of such learning systems have been poorly understood. To respond to this knowledge gap, the following research question is addressed:

3. How does social learning facilitate institutional change in flood management and adaptation practices in the MDV?

Contemporary environmental problems are far more complicated than in the past, which require novel governance approaches to deal with them (Pahl-Wostl, 2002). In recent years, adaptive co-management has been recognised as a key approach to promote collaborative environmental management in times of social-ecological change (Armitage et al., 2008). It particularly refers to a 'learning-by-doing' method in a collaborative manner (Armitage et al., 2007; Berkes, 2009; Cundill and Fabricius, 2009). Cardinal and Day (1998) argue that, by virtue of the technical and institutional biases, expert interference and professional judgment showed limitations in defining problems. An in-depth investigation of local experimental and experiential knowledge is needed to inform better solutions.

An efficient management approach on disaster risks needs to move beyond the sole reliance on conventional sources of expert knowledge in the bureaucratic system, and to integrate with the innovative knowledge found at the local level (Lebel et al., 2010a). Seeing social-ecological systems as co-evolving systems, Stagl (2007: 56) claims that decision-making in complex and co-evolving systems in the face of uncertainty "can only be an adaptive process where social actors involved are continuously learning." According to Rhoades (1993: 4), scientists provide nothing worthwhile for farmers. Farmers' knowledge, inventiveness and experimentation have been undervalued for a long time. Their roles should be elevated to that of an equal partnership with scientists. The evidence from the Renovation period in Vietnam suggests that the successful transition was most likely to be attributed to informal experimentation (fence-breaking) *(phá rào)*. It highlights pragmatic 'learning-by-doing' processes at the local level, with lessons learned by policymakers (Fforde, 1991). Armitage et al. (2007) noted that collaborative efforts provide fundamental conditions for local innovative knowledge to gain equal status with expert knowledge, which may be an effective lever for policy change.

Flood management in the MDV has been built on the 'learning-by-doing' approach, together with the 'administrative' typology of collaborative management. This research adopts Folke et al.'s (2002) definition of adaptive co-management to examine how local households and government agencies have involved in the adaptive learning process which stimulates policy change in flood management and adaptation. Understanding the 'state-society' relationship on the basis of these two domains provides a theoretical and empirical foundation to get to grips with how the adaptive co-management approach has emerged, and informs the long-term adaptation strategies in the MDV. Towards this end, the following question is investigated:

4. How can adaptive co-management inform the long-term adaptation strategies in response to the forced adaptation complexities in the MDV?

1.4 Knowledge gaps and significance of the study

Social learning has been increasingly recognised as a key approach in dealing with contemporary social-ecological complexities. A large body of literature investigates the role of social learning in the domains of resource management and adaptation to climate change in the global context, but lacks the theoretical and empirical understanding of the concept in the cultural, social-ecological context of the MDV. Even though there have been some doubts about how social learning takes place in such a complex context, the contemporary governance system characterised by the mixture of formal-informal, cooperative-competitive, top down-bottom up, and centralised-decentralised processes (Chu Thai Hoanh et al., 2014) provides space for shared learning and exchange of knowledge among the social actors. Analysis of the learning dynamics within and between the flood management and adaptation boundaries demonstrates much evidence of social learning. It reveals a wide range of communication and learning patterns that to some extent drives institutional change.

This research highlights the significance of formal and informal interaction boundaries where local farming households and government agencies take prominent roles in the learning process. The flexibility of local informal institutional systems (informal interaction boundary) creates an enabling environment for collective learning and experimentation from which innovative knowledge is generated. The interactions between formal and informal knowledge boundaries provide room for the emergence of shadow systems. Stacey (1996) defined the shadow systems as the space of informal interaction that lies outside of, but interacts with, formal institutions and relationships. In the MDV, shadow systems provide a safe space and stimulate the exchange of knowledge between farming households (farming initiatives) and extension officials (scientific knowledge). On the one hand, they identify local households as knowledge brokers who contribute to diffusing empirical knowledge and farming initiatives. Households function as the main nodes that facilitate knowledge sharing within their learning networks and with external partners. On the other hand, continual interactions between the formal and informal boundaries provide conducive conditions for the integration of innovative knowledge into local adaptation policies. This research identifies extension officials as policy brokers who play a key role in facilitating institutional change. In this context, it is important to recall Raymond's (2008: 43) claim that "any fundamental change to Vietnamese society would have to begin in the countryside."

This research employs a 'bottom-up' approach to reflect how the farming households' innovative knowledge, crystallised from the social learning process, is formally incorporated into local decision-making and planning processes. In other words, social learning involves the translation of unorganised knowledge into organised knowledge, which Vink et al. (2013) believe, is the building blocks of policy-making.

Creativity and innovation, according to Pahl-Wostl (2002), are critically important in the process of change, through which individual responsibility and informal networks, not formal hierarchies and control, are acknowledged. In the MDV, the innovative knowledge generated from farming households' self-organisation in adaptation comes to challenge normative scientific knowledge underpinning the conventional flood governance approach. Borrini-Feyerabend et al. (2007: 69) identified a schism between policy and practice, and in many cases, practice is ahead of policy. In this research, innovative livelihood initiatives implemented by local farming households help complement the current scientific knowledge and address the policy deficiencies. In this sense, the innovative knowledge held by local farming households constitutes a form of power that can mediate policy change. Chambers et al. (1993: 3) emphasised that "farmers are professional specialists in survival, but their skills and knowledge have yet to be fully recognised." This research highlights the important role played by farming households in contributing to the improved performance of the delta's flood management and adaptation.

This research critically analyses adaptive co-management as a governance approach that has been employed to deal with the 'wicked' problems in the delta. Substantial evidence of the delta's development history has illuminated the significance of 'learning-by-doing' and the 'administrative' paradigm of collaboration in flood management and adaptation. Drawing on this empirical evidence with reference to the incremental complexities of forced adaptation in the MDV, the thesis argues that this governance approach plays an essential role in informing the long-term adaptation strategies in the MDV.

1.5 Structure of the thesis

The thesis structure is organised into eight chapters as follows:

Chapter one presents the research background and rationale leading to the identification of lacunae in the flood governance context of the MDV. It provides a means for investigating the implications of social learning for household and institutional adaptation in the current context of forced adaptation in the region. Discussion about the research issues is followed by the research objectives, questions, significance and scope of the research.

Chapter two provides an extensive literature review on the domains of environmental and natural resources management. In particular, it presents key themes on governance, social learning, and adaptive capacity, adaptive co-management and how they are defined and operationalised in the forced adaptation context of the MDV. This chapter provides theoretical and empirical foundation for the concepts that support the scientific significance of the research.

Chapter three discusses the research methodology and the adoption of the mixed methods approach to guide the research questions and the relevant hypothesis to be tested. Various data collection approaches have been employed, with the sequential steps for formulating the techniques for qualitative and quantitative data collection. The desk research involves the synthesis and critical analysis of flood management and adaptation policies that have been implemented at the sub-national level. The qualitative data collection involves conducting focus group discussions with different household groups and in-depth interviews with key representatives of various professional and governmental institutions and relevant agencies involved in flood management and adaptation in the MDV. The empirical findings from the qualitative data analysis inform the design of the structured household survey that is subsequently administered in three selected research areas. This step validates the theoretical and empirical evidence for constructing appropriate dimensions and variables to measure the causal relationship between social learning and adaptive capacity. The chapter ends with the description of sampling strategies for the household survey and statistical analysis of the quantitative data.

Chapter four presents the empirical findings based upon on-the-ground observations. This chapter focuses on the evolution of flood management (dyke policies) in the MDV and the state ideologies that lie behind it. It examines the emergence of various irrigation and flood control approaches contextualised in the historical development of the region. The chapter provides a critical analysis of how the forced adaptation complexities characterised by the combined impacts of climate change, upstream development and dyke policies affect local households and institutional adaptation. It also provides the comparative analysis of the pre-dyke and post-dyke landscapes and the inevitable transformation of local households' farming systems and livelihood strategies in response to change. This chapter also sheds light on how households have developed multiple farming initiatives that contribute significantly to local adaptation policies.

Chapter five explains the causal relationship between social learning and adaptive capacity at the household level. It focuses on how social learning is characterised by households' everyday livelihood practices, and how it shapes the learning patterns across household groups and surveyed areas. The chapter also examines how households' learning interactions, which are nested in social relationships, catalyse farming innovations on which their adaptive capacity depends.

Chapter six provides insight into how social learning facilitates institutional change in flood management and adaptation in the MDV. This chapter concerns the relational practices that shape the learning interactions between strategic alliances across formal and informal interaction boundaries. The strategic alliances that encompass relations between local government agencies, academics, farming households, and external actors are respectively examined in light of boundary organisation, bridging organisation, and shadow systems. The chapter investigates how the interactions of knowledge systems involved in the social learning process contribute to reframing the local flood management policies to better accommodate the local adaptation context.

Chapter seven examines the evolution of adaptive co-management over the course of flood management and adaptation processes in the MDV. This chapter shows how social learning facilitates 'learning-by-doing' and collaboration in these two domains. Drawing on the empirical evidence of adaptive co-management, this chapter discusses how this governance approach informs the long-term adaptation strategies in the delta.

Chapter eight presents a summary of the research findings, and examines key insights gained from the empirical analyses in light of the research questions. The chapter discusses how these findings contribute to the advancement of knowledge in the field. It concludes by discussing research limitations, policy recommendations, and suggestions for potential research in the future.

Chapter 2

Literature Review

2.1 Introduction

The incremental impacts of current climate change and divergent development policies in river basins have raised critical issues concerning how to appropriately manage natural resources. The contemporary literature has shown an increasing recognition of social learning as a normative approach for adaptation to climate change (Collins and Ison, 2009; Nilsson and Swartling, 2009; Pelling, 2011), water resources management (Kranz et al., 2005; Wolters et al., 2006; Blackmore et al., 2007; Ison et al., 2007; Pahl-Wostl et al., 2007a; Mostert et al., 2008; Lebel et al., 2010b; Kruijf et al., 2014), and environmental management (Keen et al., 2005). To reflect on these domains with reference to social learning, this chapter is structured as follows.

The first section of the literature review shows how social learning is conceptualised and understood in different research domains. The next section discusses how social learning is associated respectively with adaptation, social capital, and social and institutional change, and how these associations are of significance for effective flood governance in the MDV. Drawing upon the conceptual framework of social learning adapted from Pahl-Wostl (2007), the analytical framework of social learning will be developed in this section. It illustrates how social learning, taking place in the forced adaptation context of the MDV, facilitates the evolution of innovations by local farming households and contributes to enhancing their adaptive capacity and institutional change towards effective flood management. In recognition of adaptive responses as experimental and experiential processes for the basis of collaborative learning, the concept of adaptive co-management will be discussed.

2.2 The concept of social learning

2.2.1 Social learning as a confusing concept

Although social learning has recently become fashionable in the domain of resources management, this concept has not achieved consensus in the scientific community by virtue of its vagueness in meaning and theoretical basis. Various typologies of social learning have been developed. Reed et al. (2010) identify three key problems with respect to how social learning is used in a variety of ways in the literature. Firstly, social learning can represent both a process (people learning from one another) and an outcome (the learning occurring as a result of social interactions). Secondly, the distinction between individual and wider social learning is not clearly made (Davidson-Hunt and Berkes, 2003). It means that the learning process can take place in an individual as a result of a change in his understanding of the outside world. This personal change can also result from social interactions with other individuals, or through information dissemination. Thirdly, social learning is often confusingly used with stakeholder participation through which individuals or groups take proactive actions (Tàbara and Pahl-Wostl, 2007). However, Tippett et al. (2005: 289) argued that the participatory process does not necessarily stimulate social learning to take place. Instead, the occurrence of social learning necessitates critical attention to "process, attitudes, and underlying cultural and institutional norms." In the same vein, Bouwen and Taillieu (2004) assume that social learning does not simply imply 'community participation', but rather has to do with the understanding of the limitations of existing institutions and mechanisms of governance.

Social learning is associated with theoretical debates across various disciplines. Drawing on psychological and pedagogical perspectives, Miller and Dollard (1941) discussed how learning principles link to imitation. They identified four factors: drives, responses, cues, and rewards as basic to learning and performance behaviours. Rooted in behavioural psychology, Bandura (1977: 39) saw social learning as "casual or directed observation of behaviour performed by others in everyday situations." Put simply, individual learning is based on the process of observation and imitation of role models. Drawing on his social cognitive theory, Bandura (1986) pointed out that the individual learning occurs through iterative feedback between an individual learner and his environment, with the learner changing the environment and the environmental changes affecting the learner (Tàbara and Pahl-Wostl, 2007). This point sees individuals as both "products and producers of their own environments and of their social systems" (Muro and Jeffrey, 2008: 328). However, Bandura's theory encountered critical debates from contemporary scholars, who claim his view as being too narrow to cover the complexity of learning processes that take place in current social-ecological systems. Borowski et al. (2004) contend that social learning is not solely learning by an act of imitation, but rather conveying the key implications of 'learning together to manage together' (Kranz et al., 2005; Wolters et al., 2006). It is a way to facilitate the exchange of knowledge and gain a shared understanding of the problems at stake from different perspectives at different social levels through a framing and reframing process (Nilsson and Swartling, 2009). Recognising five strands (reflection, systems orientation, integration, negotiation and participation) of social learning as crucial to environmental management, Keen et al. (2005: 4) define social learning as the collective action and reflection, occurring among different individuals and groups, aiming to improve the management of human and environmental interactions. Social learning occurs in social contexts, which include not only institutions but also networking systems (Coleman, 1990; Wenger, 1998).

Given the lack of conceptual clarity and the prevailing theoretical contestation as previously discussed, Reed et al. (2010) argue that a social learning process must demonstrate a change in understanding, which is situated in wider social units or 'communities of practice'[4] through social interactions. That means "individuals learn through engaging in the practices of their communities" (Muro and Jeffrey, 2008: 328). This thesis adopts this conceptualisation of social learning to investigate how this

[4] The concept of 'community of practice' was coined by Wenger (1998), emphasizing learning as participation and the importance of shared practices among community members (Wenger, 2000; Berkes, 2008). Individual communities of practice can be defined as having a shared identity, and are held together by bonding ties of social capital (Pelling et al., 2008).

concept contributes to an enhancement of institutional and household adaptive capacity. Drawing upon Pahl-Wostl's (2007) conceptual framework of social learning, this thesis aims to examine how the relational practices taking place in these 'communities of practice' contribute to tackling the critical problems of flood management in the MDV. Within this framework, social learning is examined in terms of both process and outcome, but the former will be explored in detail in the thesis. The expected institutional change is attributed to the performance of this overall learning system where multi-level social interactions occur.

2.2.2 Multiple aspects of social learning

Theoretical debates on social learning arise from the multi-faceted characteristics of the concept. Social learning is associated with public participation and sustainability (Pahl-Wostl, 2002; Tippett et al., 2005; Muro and Jeffrey, 2008; Swartling et al., 2011). It is referred to as the multiple-loop learning processes: single loop, double loop, and triple loop learning (Argyris, 2003; Keen et al., 2005; Tàbara and Pahl-Wostl, 2007; Pahl-Wostl et al., 2011). These learning cycles resonate with the framing and reframing processes (Mostert et al., 2008). According to Argyris and Schon (1978: 2), learning is the process of detecting and correcting errors. At the lowest level, single-loop learning refers to a refinement of actions to leverage performance. This level of learning is seen as the incremental improvement of established routines and experiment-based practices (Tàbara and Pahl-Wostl, 2007; Pahl-Wostl, 2009). Double-loop learning is concerned with the learning of underlying assumptions that drive actions taken. Social learning associated with double-loop learning involves the transformation, innovation, and creation of various new forms of institutional norms of interactions (Rist et al., 2006; Sol et al., 2013). At the highest level, triple-loop learning involves enquiry into values, beliefs, or norms that underpin operating assumptions and actions (Keen et al., 2005: 16). Social learning in the domain of sustainability requires new ways of thinking and a radical change in values (Tàbara and Pahl-Wostl, 2007). The operation of multiple loop learning is crucial to stimulate innovations, improve adaptive capacity, and change governance regimes (Tàbara and Pahl-Wostl, 2007).

According to Glasser (2009: 49), any learning that “involves some forms of input drawn from others, regardless of individuals or collectives, is characterised as social learning.” Social learning exhibits passive and active learning patterns. While the passive learning is based on information captured from media, the active learning involves “conscious interactions and communication among living beings.” The latter has three categories: (1) hierarchical (pre-determined, inflexible relationships); (2) non-hierarchical (two-way learning with knowledge and experience sharing among participants); and (3) co-learning (non-hierarchical relationships with collaboration, trust, full participation and shared exploration). Social learning can be facilitated in the form of fora or activities where different stakeholders can get involved (Bouwen and Taillieu, 2004: 144). However, the facilitation process does not mean trying to bring all stakeholders together in one place at one time, but occurs throughout an extended period of time.

In terms of mechanisms of social learning, Nilsson and Swartling (2009) present three analytical themes regarding how the concept is associated with climate change adaptation at different levels. The first theme, ‘bridging and boundary organisations’, indicates forms of governance structure with reference to communities of practice. The term ‘bridging organisations’, which stems from adaptive co-management in social-ecological systems, is considered essential in “trust-building, knowledge generation, collaborative learning, preference formation and resolutions of conflicts in environmental issues” (Hahn et al., 2006: 573). ‘Boundary organisations’ refers to “arenas for scientists and decision makers to reach common understanding of the issues at hand” (Nilsson and Swartling, 2009: 4). ‘Shadow systems’ is the second theme, representing the informal interactions existing outside of, but interacting with, formal institutions (Stacey, 1996). In an organisational context, shadow systems, when fully recognised, might contribute most to learning and innovation (Pelling et al., 2008: 869). The third theme refers to ‘conflicting goals’ among the actors involved, where social learning provides a means for disputing actors to reframe the issues of conflict so that mutual understanding could be achieved.

Moving beyond organisational boundaries, these themes of social learning can be usefully explored in the 'living-with-floods' context of the MDV. In light of boundary organisations, the collective efforts of flood management in the delta have recently strengthened reciprocal interactions between local government agencies across administrative levels and professional scientists. Various informal forms of communication are also forged and nurtured outside of formal spheres. In this context, shadow systems represent interactions between farming households and government agencies. Examining the institutional relationship between rural villages and the state, the implication of the proverb "The writ of the king yields to the village" *(Phép vua thua lệ làng)*, although rooted in the historical and political traditions in northern Vietnam, remains visible in the delta's rural societies (Luttrell, 2005: 122). Values and norms compliant with local informal institutions are still preserved and practised. Fforde (1990: 112) observed that Vietnamese culture is "simultaneously highly collective and highly individualistic". In the MDV, the integration of the collectivistic culture of the north into the individualistic values of the rural societies is the legacy of the early settlements throughout the 'March to the South' *(Nam Tiến)* process by the middle of the 18th century in the Vietnamese history (Evers and Benedikter, 2009). These mixed values profoundly shape the way the local inhabitants socially interact with each other and the way they respond to local social-ecological complexities. The formation of spontaneous groups is the most conspicuous in this regard (Taylor, 2001). It is such dual personhood of the local inhabitants that makes them highly-adaptive and innovative learners in times of change.

Pahl-Wostl (2007) provides a holistic conceptual framework, showing how social learning operates in the integrated water resources management context (Figure 2.1). This framework begins with an original context including social and natural elements. The social element implies institutions, culture and networking systems in which individuals and groups are embedded, while the natural element refers to hydrological and geographical conditions. The learning process illuminates the relational practices between social involvement and content management. This interaction process involves knowledge exchange among social actors who hold different perspectives to gain a shared understanding of the water problems at stake. In these learning dynamics, it is expected that social actors should take responsibility and be empowered for desired behavioural change and transformation of views, attitudes and values. The outcome of this learning process attempts to find out how the concerns over water resources can be managed, and new skills, knowledge and trust developed. These achievements subsequently feed back into the original social and natural context in efforts to change it.

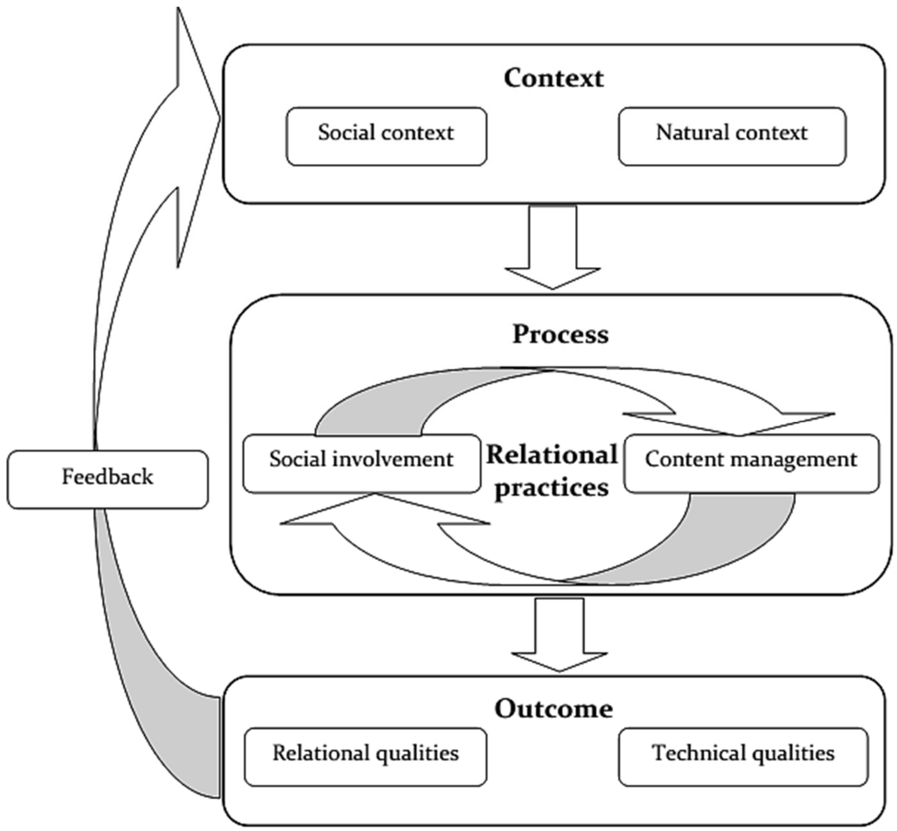


Figure 2.1 Conceptual framework for social learning

Source: Pahl-Wostl (2007)

This social learning framework provides a theoretical foundation to explore the learning processes of rural households, social groups, and formal institutions in the flood governance context in the MDV. The floodplains contextualise the evolution of the rural households' 'living-with-floods' practices, which are triggered by the adverse effects of forced adaptation. The learning process demonstrates the self-reflection and shared understanding of practical concerns over contested flood management and livelihood practices engaged in by rural households, scientists, and government agencies across the administrative levels. This joint exchange of knowledge creates dynamic relational practices on both a formal and informal basis. The feedback loops of the learning outcomes respond to the original context, providing a need to reframe flood management policies, and to incorporate households' innovations into local livelihood strategies. These collaborative learning efforts eventually contribute to building the capacity of the rural societies to challenge the status quo of the forced adaptation complexities.

2.3 Social learning as a key approach for water resources management

Recent decades have seen increasing global attention to social learning as a key approach to address contemporary social-ecological complexities. Failures to address these complexities are attributed to over-dependence on the conventional 'top-down' governance approach supported by technocratic ideology (Pahl-Wostl et al., 2008a; Light et al., 2013). It has been shown that dominant technical solutions pursued by states narrowly define environmental problems, which are becoming increasingly uncertain and complicated. Alternatively, efforts to tackle these environmental uncertainties and complexities require an innovative approach that takes into account the social dimensions of shared values and meanings among social actors. These joint actions reflect the nature of the social learning concept.

Although the literature shows that social learning is conceptualised in different ways, and used in a range of contexts, it increasingly appears in the contemporary domain of water resources management. Under the pressure of the Water Framework Directive (WFD) that establishes participatory water management practices to achieve 'good water status' in European countries (Mostert, 2003), a number of research projects on participatory river basin management have been implemented. These projects consider social learning as 'learning together to manage together', which fits the WFD's framework for water management (Kranz et al., 2005). It has been argued that the democratic legitimacy of the European governance regimes sets the ground rules for those who are affected by management decisions. They should be given equal opportunities to be actively engaged in the decision-making processes (Pahl-Wostl et al., 2007a). Social learning in the HarmoniCOP project[5] is particularly grounded in recognition of multi-party collaborative processes and the application of information and communication tools (internet, newsletters, presentations) (Borowski et al., 2004; Tippett et al., 2005; Wolters et al., 2006; Maurel et al., 2007; Mostert et al., 2007; Pahl-Wostl et al., 2007a). Embedded in the umbrella of the European WFD, the SLIM[6] (Social Learning for the Integrated Management) project sees social learning as a complementary policy instrument for systemic change in integrated management and sustainable use at the catchment level (Blackmore et al., 2007; Ison et al., 2007). In this project, social learning implies concerted action based on the process of knowing (Ison et al., 2007).

These WFD projects in political, environmental and socio-economic European contexts provide a clear window to refer to how social learning operates to enhance household and institutional capacity to deal with the flood complexities of the MDV. In light of social learning, it is important to examine whether the WFD's water management framework could be adopted to resolve the delta's flood management problems. Substantial evidence suggests that the current flood management approach in the MDV, which is based on technical measures, has caused obvious drawbacks and social tensions (Le Anh Tuan et al., 2007; Le Thi Viet Hoa et al., 2007a; Reis, 2007; Le Thi Viet Hoa, 2008; Vormoor, 2010; Pahl-Wostl et al., 2011; Waibel et al., 2012). Therefore, the region should adopt a novel flood governance approach, which is based on shared understandings and joint decision-making by social actors involved, to

[5] Social learning in the European HamoniCOP (Harmonising Collaborative Planning) project promotes participatory processes in water resources management. It was co-funded by the European Commission, which started in November 2002 and ended in December 2005. Participating countries included Belgium, France, Germany, Hungary, Italy, the Netherlands, Spain, Switzerland and the United Kingdom (Wolters et al., 2006).

[6] SLIM (Social Learning for the Integrated Management) is a multi-country research project involving four country teams from Italy, France, the United Kingdom, and the Netherlands. Funded by the European Commission (1998–2002), this project investigates the socio-economic aspects of the sustainable use of water. Further details can be retrieved at http://slim.open.ac.uk.

inform better policy decisions. Apparently, much of the literature on climate change and natural resources management has shown that social learning is closely associated with the adaptation and adaptive capacity of vulnerable societies.

2.4 Implications of social learning for adaptation and adaptive capacity

The increasing threat of climate change brings to the fore critical debates on whether adaptation or mitigation should be adopted (Klein et al., 2005; Stehr and Storch, 2005; Ingham et al., 2007). The limitations of mitigation responses in dealing with current climate complexities provide greater recognition of adaptation as a requisite complement to climate change policy (Pielke, 1998; Smit et al., 2000; Nilsson and Swartling, 2009). In Vietnam, climate change impacts have been incorporated into the national development agenda which gives preference to adaptation (ADPC, 2003; Chaudhry and Ruysschaert, 2007). In the MDV, prevailing flood complexities triggered by the combined impacts of climate change, hydropower dam construction, and internal structural development (dykes, canals) demand that adaptation options should attempt to generate flood-based livelihood opportunities and diversify sources of income for rural households during the flood season (Nguyen Duy Can et al., 2007; Bosma et al., 2012).

The climate change literature shows that adaptation can be interpreted in different ways. Pielke (1998: 159) refers to adaptation as "adjustments in individual, group, and institutional behaviour in order to reduce society's vulnerabilities to climate." The IPCC defines it as "adjustments in natural and human systems in response to actual or expected climatic stimuli or their effects, which moderates harm and exploits beneficial opportunities" (IPCC, 2007: 869). According to Smit et al. (2000: 225), adaptation "refers to adjustments in ecological-social-economic systems in response to actual or expected climatic stimuli, their effects or impacts." Pelling (2011: 5) sees adaptation as the process of change from resilience to transition and transformation" (Table 2.1). His perspective of adaptation as resilience highlights social learning and self-organisation as the pivotal factors that enable technological innovations, new information exchange or decision-making procedures (Pelling, 2011: 56). Holistically, seeing adaptation as a process of change offers opportunities for social reform and reshaping power relations in society.

Adaptation has a close relationship to social learning. According to Adger (2001: 929), adaptation is socially mediated, taking place through mechanisms which can be characterised as social learning and policy learning. In return, social learning can be used as a policy paradigm for adaptation (Collins and Ison, 2009). It facilitates the process of reframing solutions for climate problems that shift the perspectives from mitigation towards adaptation (Nilsson and Swartling, 2009). It is 'a composite of individual adaptation' that takes place through collective activities (Adger, 2003a). In the case study of Grasshoppers (a group of dairy farmers), Pelling (2011) shows that social learning, as characterised by openness and the sharing of information, assists individual farmers in proactively adapting to climate change.

Table 2.1 Attributes of adaptation for resilience, transition and transformation

	Resilience	**Transition**	**Transformation**
Goal	Functional persistence in a changing environment	Realise full potential through the exercise of rights within the established regime	Reconfigure the structures of development
Scope	Change in technology, management practice and organisation	Change in practices of governance to secure procedural justice; this can in turn lead to incremental change in the governance system	Change overarching political-economy regime
Policy focus	Resilience building practice Use of new seed varieties	Implementation of legal responsibilities by private and public sector actors and exercise of legal rights by citizens	New political discourses redefine the basis for distributing security and opportunity in society and social-ecological relationships
Dominant analytical perspectives	Social-ecological systems and adaptive management	Governance and regime analysis	Discourse, ethics and political-economy

Source: Adapted from Pelling (2011: 51)

Adaptive capacity can be conceptualised in different ways. One way is that it links to adaptation (Smit et al., 2001; Adger et al., 2005; Smit and Wandel, 2006; Pelling, 2011; Plummer, 2013). According to the IPCC (2007: 869), adaptive capacity is "the ability of a system to adjust to climate change to moderate potential damages, to take advantage of opportunities, or to cope with the consequences." It represents the capacity of a system to use the resources (natural, financial, institutional or human) and access ecosystems, information, expertise and social networks (Brooks and Adger, 2004). From Adger and Vincent's (2005: 400) perspective, adaptive capacity involves the capacity to modify the exposure to risks, to absorb and recover from impact losses, and to exploit new opportunities arising from adaptation processes. Meanwhile, Folke et al. (2003) relate adaptive capacity to resilience building based on four factors: (1) learning to live with change and uncertainty; (2) nurturing diversity for resilience; (3) combining different types of knowledge for learning; and (4) creating opportunity for self-organisation to foster socio-ecological sustainability. Colombi and Smith (2012) see adaptive capacity as a transformative cultural practice to escape from the poverty trap. In the context of climate change in developing countries, McCarthy et al. (2001) attribute the high level of vulnerability to their low adaptive capacity. In this sense, the enhancement of adaptive capacity equates with reducing vulnerability and promoting sustainable development (Smit et al., 2001). Adaptive capacity depends on a society's ability to act collectively and resolve conflicts among social actors (Brooks and Adger, 2004; Adger et al., 2005). According to Lebel et al. (2010a: 135), building adaptive capacity needs critical attention to "existing institutions, knowledge, and capacity within and outside government." Armitage (2005: 703) sees adaptive capacity as the critical aspect of resource management, reflecting "learning as ability to experiment and foster innovative solutions in complex social-ecological circumstances." Drawing on Armitage's conceptualisation of adaptive capacity, this thesis centres on investigating how the flood governance system in the MDV provides an enabling environment for learning to stimulate local experimentation and innovations essential to increase household and institutional capacity to adapt to the flood constraints facing the region.

Different dimensions have been explored to measure adaptive capacity in the climate change literature (Table 2.2). There is evidence to suggest that the adaptive capacity of traditional societies depends on experience, knowledge, and weather-sensitive resources (Adger and Vincent, 2005). Recent studies see psychological factors as contributing substantially to the adaptive capacity of individuals and the community (Grothmann and Patt, 2005; Kuruppu and Liverman, 2010). Bussey et al. (2012) draw on both historical and future connections to map the adaptive capacity of societies in response to environmental and social stresses. When comparing the capacity between developing and developed countries in the face of climate change, IPCC assumes adaptive capacity as a significant indicator determined by five key attributes: wealth, access to technology, institution effectiveness, information dissemination and equitable power distribution (Smith et al., 2003). According to Yohe and Tol (2002), resources, institutions, social capital, human capital, risk spreading, information management, and awareness determine adaptive capacity. Gupta et al. (2010) develop the Adaptive Capacity Wheel paradigm on the basis of six key dimensions: variety, learning capacity, room for autonomous change, leadership, availability of resources and fair governance, to examine how institutions stimulate adaptive capacity of a society to respond to climate change. Other empirical studies show that adaptive capacity is a function of social capital (Adger, 2003a, b; Pelling and High, 2005a); governance, civil and political rights and literacy (Brooks et al., 2005); and the social costs of the adaptation process (Kates, 2000). Selecting appropriate dimensions to measure the adaptive capacity of farming households in the MDV is grounded on the relevant literature and the empirical understanding of its cultural, political, social, and environmental contexts. Three main dimensions are captured to measure adaptive capacity in this thesis: (1) access to resources; (2) institutional effectiveness; and (3) information dissemination.

Table 2.2 Dimensions of adaptive capacity in different adaptation contexts

Dimensions to measure adaptive capacity	Application in adaptation contexts	Reference
Social capital	Adaptive capacity of societies relies on the ability to act collectively in the face of climate change	Adger (2003a, b)
Institutions (integration of vulnerability and resilience approaches)	Institutions play a key role in transforming coping capacity to adaptive capacity Households' and communities' adaptive capacity depends on how institutions regulate and structure their interactions	Berman et al. (2012) Agrawal et al. (2009)
Governance Civil and political rights Literacy	Adaptive capacity as an element of vulnerability to climate change at the national level	Brooks et al. (2005)
Complexity Technology Leadership Institutions Imaginative resources inherent in social systems	Adaptive capacity is framed in the interface of history and future lens to identify how societies respond to stress	Bussey et al. (2012)
Governance Institutions Management	Adaptive capacity is positioned to improve linkages between vulnerability and resilience	Engle (2011)
Variety Learning capacity Room for autonomous change Leadership Availability of resources Fair governance	Developing the Adaptive Capacity Wheel to examine characteristics of institutions to stimulate adaptive capacity of society to adapt to climate change	Gupta et al. (2010)
Social costs (direct costs of adaptation, the costs of adapting to adaptations and the costs of failing to adapt)	Adaptive capacity is determined by economic conditions of poor people in developing countries	Kates (2000)
Human cognition	Psychological factors contributing to adaptive capacity	Kuruppu and Liverman (2010) Grothmann and Patt (2005)

Economic wealth Access to technology Strengthening of social networks Institution effectiveness Information dissemination and skills Infrastructure Equitable power distribution	Comparing the levels of capacity between developing and developed countries to adapt to climate change	Smith et al. (2003) Smit and Pilifosova (2003)

Source: Summarised by Tran Anh Thong (2014)

From the organisational perspective, social learning is seen as central to adaptive capacity (Pelling, 2011: 113). As a fundamental component of social learning, shadow systems provide key sources for adaptive capacity. They cultivate open space for "individuals and subgroups within organisations to freely experiment, copy, communicate, learn, and reflect on their actions" (Pelling et al., 2008: 868). The learning process can result in adaptive responses to uncertainty (Bagheri and Hjorth, 2007; Lebel et al., 2010b). In the 'living-with-floods' context of the MDV, the shadow systems identify the informal interactions between local households and government agencies as key contributing factors to promote the adaptive responses. The relative flexibility in the shadow systems in the region provides a secured space for local households' voluntary experimentation, communication, learning and reflection on their farming practices during the flood season. These learning practices serve as the catalyst for the evolution of households' initiatives, which make a significant contribution to their adaptive capacity. This thesis adopts Pelling's (2011) interpretation of adaptation as a transitional process to investigate how social learning facilitates the incremental reform of flood management policies to better support local households' adaptive livelihood activities.

2.5 Social capital as lubricants for social learning

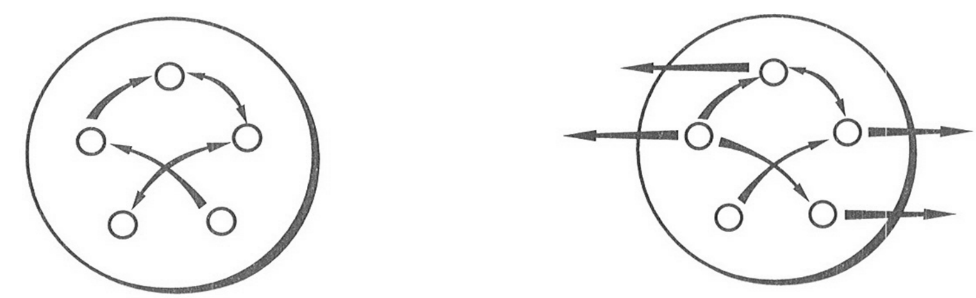
Three different approaches to social capital are found in the literature. It is seen as an indication of social stratification (Bourdieu, 1984). In an educational context, Coleman (1990) defines it as an outcome of social processes and interactions. According to

Putnam (1995: 664-665), social capital is formed by "features of social life – networks, norms and trust – that enable participants to act together more effectively to pursue shared objectives." Moving beyond formal organisational structures, social networks are key to learning and bringing about policy change (Lebel et al., 2010a). Access to new information entails communication with network members (Newig et al., 2010).

Contemporary scholars have developed a range of perspectives on social capital, contextualising this concept in efforts to adapt to climate change. Woolcock and Narayan (2000: 226) regard social capital as "the norms and networks that enable people to act collectively". Adger (2003a, b) points out that social capital is made up of the networks and relationships between individuals and social groups that function as an important substitute in the absence of governmental intervention during disaster crises. Nested in the forms of social ties (bonding, bridging and linking), social capital constitutes key assets, connecting social actors at various levels of relationships to deal with risks (Adger, 2003a; Pretty, 2003). In discussing the relationship between social capital and adaptive capacity to climate change, Pelling and High (2005a: 312) claim that social capital offers resources necessary to generate material interventions and institutional modifications in response to background stress. All levels of decision-making in society are embedded in such social processes; they are lubricated by the networks and flows of information. In this light, social capital lays a fundamental foundation for social learning to take place.

There are reciprocal interactions between social capital and social learning. On the one hand, social capital constitutes a connecting bridge for the operation of social learning. It acts as a moderator for knowledge transfer (Wei et al., 2011). In the context of climate change, social capital shapes how information and knowledge among social actors could be exchanged to foster adaptation in times of crisis. Adger (2003b: 392) presents a detailed analysis of two forms of social capital (bonding and networking) that shape learning pathways, communication patterns, and flows of information (Figure 2.2). The learning interactions where actors get involved can be determined by the spatial boundary of their relationships and the extent to which the interactions are to be maintained. On the other hand, social learning "describes the pathways and social relationships that shape information exchange and can lead to new ways of thinking and acting" (Pelling, 2011: 67). In line with Falk and Harrison (1998) who see learning as a mechanism for building social capital, Adger (2003b) points out that collective action requires networks and flows of information between individuals and groups to oil the wheels of decision making. In linking social capital to social learning, Pelling and High (2005b) explain that the emergence of adaptive behaviour at one level is the result of learning among a range of actors networked across a range of scales. In the case of co-management of protected marine areas in Tobago, Adger (2003a) claims that the building of networking social capital leverages learning relationships between the government and local stakeholders. The evidence suggests that social learning, when operating across various social relationships, is conducive to change.

Bonding social capital	Networking social capital



Flow of information and resources – learning pathways

Social actors engaged in the learning process

- Based on kinship and locality - State substitutes for external linkages - Operating at the household levels - Important assets for coping with impacts of extreme weather	- Based on weaker bonds of trust and reciprocity - Social and policy learning - Operating at the household and institutional levels - Important for coping and for evolutionary adaptation

Figure 2.2 Forms of social capital represented by learning pathways

Source: Modified from Adger (2003b)

In a nutshell, it can be seen that social capital, social learning and adaptive capacity are closely linked. In the context of climate change, Adger (2003b: 388) articulated that societies have inherent adaptive capacities, and these capacities are bound up in the ability to act collectively. Social capital is "a necessary 'glue' for adaptive capacity" (Adger, 2003b: 392). Such linking characteristics provide opportunities for social learning to take place. While paradigms of social capital form various pathways for learning interactions among social actors nested across levels of relationships (Pelling and High, 2005a, b), these social learning processes can subsequently contribute to enhancing the actors' adaptive capacity and facilitating institutional change.

2.6 Social learning as leverage for change

2.6.1 Social learning for the emergence of innovations

There are different interpretations of what innovation means. Hinrichs et al. (2004), simply define innovation as 'newness'. Menon (2004) saw it as a "process of change and of novelty," which leads to successful exploitation of new ideas. According to the World Bank (2007), the notion of creating local change is fundamental to innovation. Biggs et al. (2010) grouped innovation into two categories: (1) incremental innovation and (2) radical innovation. They implied that innovation means not only the creation of new ideas or products but also the process of diffusion or adoption. The Organisation for Economic Co-operation and Development (OECD, 2014: 50) termed innovation as "grounded in the actions of individuals looking for ways to solve specific problems." It contributes to creating new products or finding new ways to modify existing products to reduce costs or improve quality. Benefits of rural innovations not only serve a rural territory, but also extend globally (OECD, 2014). In the context of climate change, innovation is analogous to 'human adaptations' to socio-economic conditions (Rodima-Taylor et al., 2012: 107).

Social learning involves the generation and dissemination of knowledge that stimulates innovations (Kilpatrick and Johns, 2003; Newig et al., 2010). Social learning in support of innovations is indicative of double-loop learning (Sol et al., 2013). The empirical evidence supporting this claim is dominant in the agricultural sector (World Bank, 2007; Spielman et al., 2011; Dessie et al., 2013). Innovation is not only generated by the farmers themselves, but also involves diverse forms of interactions. The Agricultural Innovation Systems (AIS) is the framework designed to analyse technological, economical and institutional change in agriculture. Drawing upon this approach, innovation is perceived as “the process of networking and interactive learning among a heterogeneous set of actors such as farmers, input industries, processors, traders, researchers, extensionists, government officials, and civil society organisations” (Klerkx et al., 2010: 390). Their interactions are pivotal to mobilise knowledge and innovate to deal with technological, social and environmental complexities (Hall, 2007). Pahl-Wostl et al., (2011) see social learning as an exploratory process through which social actors experiment with innovations and try to overcome constraints. In the case of agricultural adaptation to climate change in Nepal, Chhetri et al. (2012) present how social learning is constituted by the learning alliance of institutions, scientists, and farmers. Such combination of conventional technological process and farmers’ tacit knowledge contributes significantly to co-producing technological innovations to adapt to climate change. IDS Workshop (1993) indicated that the interactions between farmers, researchers and extension workers through exchanges of ideas and information and their social linkages offer substantial opportunities for fostering local innovations.

How social learning stimulates the emergence of innovations is also found in the economic literature. The era of technological change sees capacity to learn as an essential condition for the innovation process to maintain a sustainable competitive advantage. Social learning therefore plays an important role in the shared intelligence of economic entities whereby the role of the innovation process is highlighted (Wolfe and Gertler, 2002). Drawing on the entrepreneurship theory, Hinrichs et al., (2004) examine how social learning through vendors’ engagement with customers and fellow vendors contributes to their innovation in marketing at farmers’ markets in California, Iowa, and New York. They argue that the social context of the farmers’ markets functions as the mediating social institution from which innovation emerges. In particular, the informal networks are established from face-to-face interactions between vendors and customers, providing the former with valuable information and customers' feedback on used products and services. The social learning that arises out of vendors' monitoring and observations at the farmers' markets contributes to their changed strategies and the guidance of their enterprises. The study findings reveal that the vendors who have "more social learning through engagement with farmers' market customers and farmers' market vendors are more likely to report innovation in the form of increased sales" (Hinrichs et al., 2004: 52).

The rural adaptation endeavours in the flooding context of the MDV have witnessed a multitude of innovations. The every-day livelihood practices offer a rich innovation system through the iterative learning interaction processes. In this thesis, households' innovation is defined as a form of novel practice generated from their experimental and experiential learning processes in engagement with their everyday livelihood activities. The constant learning interactions among local households and with scientists and government agencies through these activities provide an arena for social learning to take place. This provides a means for constructing formal and informal networks conducive to the diffusion of new ideas across geographical scales. It shows that the spatial evolution of farming households' empirical innovation practices provides greater support to enhance their adaptive capacity to annual flood events. Besides its effects on the evolution of the innovation system, social learning is seen as a driving factor for social and institutional change.

2.6.2 Social learning for social and institutional change

Scholars see institutions from different perspectives. According to Thynne (2008), institutions are understood as clusters of people, sets of rules, norms, performance and decision-making procedures. While O'Riordan and Jordan (1999: 81) define institutions as "the multitude of means for holding society together", North (1990: 3) conceives of them as "the rules of the game in a society" or "the humanly devised constraints that shape human interaction." This definition includes formal and informal institutions. Expanding North's (1990) view, Pelling and High (2005b: 3), claim that formal institutions entail legislation and rules that constrain agency while simultaneously being subject to change by the action of individuals or groups in society. Meanwhile, informal institutions are found in cultural norms and values, while being reproduced by customary behaviour. Similarly, Young (2002) makes a distinction between thin and thick institutions. Institutions in the thin sense refer to systems of rules, decision-making procedures or 'rules on paper', articulated in constitutive agreements. In the thick sense, institution is defined as social practices or 'rules in use', including informal understandings and routine activities in compliance with stated rules. The continuous interactions between these two conceptions contribute to the advancement of the social system. However, the evolution of social practices over time makes it difficult to comply with constitutive foundations (Young, 2002). Therefore, the successful management of social-ecological sustainability demands institutional capacity "to respond to the environmental feedback, to learn and store understanding, and be prepared and adaptive to allow for change" (Folke et al., 2002: 354).

Institutions interact with social learning that consequently facilitates institutional change. Institutional contexts may present problems, but simultaneously provide conditions and incentives for individuals to make collective efforts (Ostrom, 2007) that enable institutional change. This dynamic evolution provides opportunities for social learning to take place. Woodhill (2002: 327) sees institutions as both the means to, and the outcome of, social learning. Drawing on a case study of the Australian Landcare initiative, he claims that the incentive framework to enable sustainability in rural Australia is contingent upon the social learning process, but this process in turn depends on a set of supportive institutional arrangements. With regard to the role of social learning in the controversies over plantation forestry, Leys and Vanclay (2011a) state that social learning can increase opportunities for participation and facilitate the process to explore more options for the plantation industry development on the basis of prevailing policy guidelines. In the same vein, Collins and Ison (2009) claim that social learning is instrumental to formulating a new policy and practice paradigm to enable concerted action for adaptation. In practical terms in the SLIM project, social learning is utilised as a complementary policy instrument that regulates the implementation of the European Water Framework Directive (Blackmore et al., 2007). In the agricultural sector, Maurya (1993: 10) discusses how Indian farmers were involved in the learning process of testing a new rice variety, Mahsuri, in Eastern India. This experimental success was then disseminated across neighbouring states, which made Mahsuri the third most popular variety among Indian farmers. In this case, the social learning process taking place in the form of 'farmer-to-farmer' extension facilitates the constitution of a sort of knowledge power, demanding that the government of India provide formal certification of the Mahsuri variety under the Seeds Act. From North's (1990) perspective, it is explicitly posited that the differences between the rules and the players (social actors) in society and learning interactions between them can drive institutional change.

In the case of the rural transformation in northern Vietnam, Tran Thi Thu Trang (2004) discusses how social learning promotes the innovation process for institutional change in Hoa Binh province in the 1980s. Diversification of sugarcane production was initiated by individual veterans who used to serve in the military during the war. Their intensive engagement in military service and practical experiences through extensive travelling afforded them excellent opportunities to acquire new knowledge of various farming systems in different localities. Upon their return after the war, these veterans took a leading role in introducing agricultural techniques they had observed on sugarcane cultivation to their villages. Their informal networks and the local Association of Veterans supported them to update information and cultivation techniques to maintain their crops. Their willingness to experiment and intensive investment in sugarcane cultivation successfully paved the way for other community members to follow. This case study exemplifies how social learning provides a means for disseminating innovative knowledge in sugarcane diversification through which veterans were the key actors. Their successful attempts broke up the local conventional agricultural production, providing open opportunities for initiating a novel agricultural system across the village.

Evidence of how social learning facilitates institutional change in flood management was also found in southern Vietnam in the late 1970s. Howie (2011) reports on an empirical study of how the August dyke systems were introduced into the structural design for the protection of the summer-autumn rice crop from early flood threats in An Giang province. The shared understanding among rice farmers of flood risks facing their livelihoods enabled them to take this initiative. The early success of these endeavours soon convinced the central and local governments to formalise this initiative as an adaptive measure to manage the local flood circumstances. The dissemination of this locally-based knowledge had a substantial influence on the flood management policies in surrounding localities, leading to the proliferation of the August dyke systems across the flood-prone areas of the delta in the following years.

Overall, the two case studies in Vietnam confirm that social learning which occurs at the local level can bring about institutional change. Through this transformational process, innovations play an intermediary role in validating the local knowledge power that challenges contemporary formal policy. This thesis investigates how social learning facilitates the innovation process with reference to farming activities implemented by rural households in the flood season. It emphasises the collaborative learning mechanisms among local households, scientists, and government agencies as essential to promote the institutional change in the delta's flood management policies and its rural livelihood strategies. These 'learning-for-change' dynamics are contextualised in the water governance system that is currently in place in the MDV.

2.7 Governance paradigms and pathways towards effective water governance

Governance has received significant attention in the discourse and operation of natural resources management. It moves beyond the scope of government towards public-private-civil society partnerships, filling up the deficiencies left by single agency and top-down management (Berkes, 2009). Governance involves "the ways in which society shares power, through structures and processes that shape individual and collective action" (Lebel et al., 2010a: 116). UNDP (United Nations Development Program) defines governance as "mechanisms and processes through which citizens and their groups can articulate their interests, exercise their rights and obligations" (UNDP, 2004: 4). In the same vein, Tropp (2007: 21) states that governance refers to linkages and processes between and within organisations and social groups involved in decision-making at both horizontal and vertical levels. He discusses the new forms of governance that move beyond the conventional concept (Table 2.3). Its new dimensions emphasise multi-scaled interactions and the relationships of the public and private sectors on the basis of negotiation, dialogue and networking. Kooiman (2000: 1694) sees good governance as characteristic of "the direct engagement of people in resource management decisions that affect their livelihoods." It depends on the institutional capacity to address problems and to "achieve social consensus through agreements and compromise" (Borrini-Feyerabend et al., 2000: 7). Meanwhile, Pahl-Wostl (2009: 354) emphasises formal and informal institutions as key aspects of governance. Their inter-dependence forms an emergent feature of more collaborative governance styles. Understanding institutional dimensions is therefore an essential step to move towards more adaptive water management regimes.

Table 2.3 New and old forms of governance

Old governance emphasises	New governance emphasises
Government and bureaucracy	Civil society and markets. The government and bureaucracy are still important entities but with reduced authority
Political power monopoly	Co-steering
Steering	Diversity of actors and power diffusion
Hierarchical control	Horizontally shared control
Enforcement of rules and regulations	Inter-organisational relations and coordination
	Decentralisation/bottom-up management
Control	Formal and informal institutions
Top-down management	Co-governing (distributed governance)
Formal institutions	Network governance
Inter-governmental relations	Process orientation
	Expansion of voluntary exchange, self-governance and market mechanisms
	Dialogue and partnership
	Participation and negotiation

Source: Adapted from Tropp (2007: 25)

Various modes of governance are found in the literature, indicating a range of connotations. Adaptive governance refers to "the devolution of management rights and power sharing that promotes participation" (Folke et al., 2005: 449). It is operationalised through adaptive co-management systems, identifying the roles of social capital, relationships, learning and trust building as essential (Folke et al., 2005; Armitage, 2006). Kooiman (2000) sees this mode as co-governance that represents the cooperation, coordination, and communication of multiple actors. This collaborative form is undertaken by complex networks of various actors, including governmental agencies, non-governmental organisations and private groups. Network governance is an emergent concept that originated from economic and social networks literature. Seeing individual and collective learning as an essential element, this governance mode aims to bring together different state and non-state actors in attempts to integrate and make available different sources of knowledge to address environmental management problems (Newig et al., 2010). Derived from institutional theory, polycentric governance is defined as relationships among the multitude of authorities of overlapping jurisdictions. In this sort of governance system, actors are offered opportunities for "institutional innovation and adaptation through experimentation and learning" (Andersson and Ostrom, 2008: 77). According to Neef (2009), this mode is configured as the number and density of nodes (actors) and links (interactions) that operate in a resource governance system. The patterns of such interactions and outcomes rely on relationships among these governance actors at different levels (Andersson and Ostrom, 2008). Despite having conceptual variations, these concepts share the factors of iterative learning orientation in adaptive management and the linkage orientation of collaborative forms of management (Armitage, 2006). The shared understanding of these various governance typologies raises two critical questions that need to be addressed in this thesis: (1) how the complexities of forced adaptation in the MDV should be addressed, and (2) on what basis an innovative governance framework should be formulated to inform the long-term adaptation strategies in the region.

Water governance is a crucial domain in contemporary public policy relating to water. According to the Global Water Partnership (GWP), water governance refers to:

> The range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society (Rogers and Hall, 2003: 18).

However, the historical context of water governance reveals multiple constraints in the implementation of policies. The prevailing impacts of human-induced activities and climate change have hindered efforts for flood risk management and governance systems (Opperman et al., 2009). Pahl-Wostl and Kranz (2010: 576) attribute these problems to governance failures. They argue that "water governance is not fully understood". In the domain of environmental management, Keen et al. (2005: 7) claim that old institutional and social arrangements are the prime causal factors. According to Nilsson and Swartling (2009: 2), the implications of these policy constraints are because "the dynamic nature of linkages between levels of governance is not well understood". Therefore, effective water governance requires some degree of decentralisation alongside vertical integration and cross-level interactions and decision-making, recognising the interplay between informal and formal institutions as key in the process (Pahl-Wostl and Kranz, 2010). In this respect, Leussen and Lulofs (2009) suggest that collaboration mechanisms should be taken into account.

Evident failures of the 'command-and-control' management of water resources demand a shift towards a modern governance paradigm (Pahl-Wostl and Kranz, 2010). This shift requires the radical change in water governance arrangements, processes and institutions (Ward et al., 2013). Unlike the traditional governance approach that tends to become alienated from the social context (Ison et al., 2007), the new paradigm sees formal authority as increasingly supplemented by informal authority (Rogers and Hall, 2003) by means of collaboration, negotiation, and deliberation among policy-makers, scientists, and local stakeholders (Neef, 2009). These participatory mechanisms contribute to increasing the actors' capacity for continuous learning and adaptation (Folke et al., 2005; Tropp, 2007; Pahl-Wostl et al., 2008b).

However, public participation seems elusive in many developing countries, where the patron-client structure and power imbalances persist. It is partly due to policy makers' distrust of local meaningful contributions to governance performance (Neef, 2009). In the case of Vietnam, public participation in government decision-making and planning processes are viewed as unnecessary and time-consuming (Bach Tan Sinh, 2003). Kujinga and Jonker (2006) attribute the failures of water governance in Zimbabwe to stakeholders' lack of knowledge of the 1998 Water Act. They argue that water resources could be successfully managed if there were active participation of relevant stakeholders in the process. This case study indicates that the top-down governance approach constrains the information flow to the majority of black farmers, who should have been equipped with sufficient knowledge to be able to fully engage in the decision-making process.

A governance perspective conceives of social learning as an essential element in the process of policy development and implementation (Pahl-Wostl et al., 2008b). Therefore, a mode of governance that "accommodates diverse views, shared learning, and the social sources of adaptability" (Armitage et al., 2008: 96) is required to deal with problems on water resources management. It particularly demands the establishment of a networking system that promotes co-ordinating activities and shared knowledge and learning among relevant stakeholders and institutions for collective action. Water governance in times of climate change has posed critical questions of what level should be addressed. While Pahl-Wostl et al. (2008a) emphasised the importance of understanding water governance at the global level, this research particularly attempts to understand how flood governance operates at the sub-national level, especially in the forced adaptation context of the MDV.

The existing flood governance system in the MDV has shown institutional inconsistency and divergence in flood management policies (Waibel et al., 2012). This administrative fragmentation is attributed to the legacy of the partial decentralisation process, the weak collaboration in the regional development trajectories, and provincial authorities' divergent priorities in socio-economic development.

Subsequently, various flood control schemes have been designed and implemented in the floodplains to achieve their respective socio-economic development goals. Admitting that the top-down approach still prevails, the flood governance performance in the MDV is taking transitional steps into a relatively flexible governance system. This transition is clearly elucidated at the local level. Drawing on Tropp's (2007) classification, some key dimensions of the new governance paradigm have been initially introduced into the system.

The paradigm of 'living-with-floods' is needed when the flood protection system fails (Kundzewicz, 2002). Substantial evidence on 'living-with-floods' practices in the MDV demonstrates that the rural societies have been familiar with adopting shared learning and innovative knowledge as a key strategy to sustain their livelihood activities during the flood season. These aspects are well represented in flood management efforts exercised at the household and institutional levels. Some locally-designed flood governance systems in the MDV are informed by 'learning-by-doing' through some form of collaboration. This evidence provides a robust foundation for institutionalising adaptive co-management as a pragmatic governance approach to deal with the complexities of forced adaptation. Given the soaring impacts of climate change and upstream development, this thesis argues for the necessity of this mode to provide guidance for the long-term adaptation strategies of the delta in the future.

2.8 Adaptive co-management to fill policy gaps in natural resource management

Adaptive co-management is recognised as a key approach in the domain of natural resource management. This concept has different definitions with multiple overlapping features. Adaptive co-management is defined as a learning-by-doing process, integration of different knowledge systems, collaboration and power sharing among community, regional, and national levels (Olsson et al., 2004; Plummer and FitzGibbon, 2007). This approach sees actions and policies as experiments (Plummer and Baird, 2013). In other words, adaptive co-management connects learning from past experiences (experiential learning) and explores new alternatives (experimental learning) with vertical and horizontal collaboration with the aim of improving our understanding of, and ability to respond to, complex social-ecological systems (Armitage et al., 2009; Leys and Vanclay, 2011a). According to Folke et al. (2002: 20), adaptive co-management is "a process by which institutional arrangements and ecological knowledge are tested and revised in a dynamic, ongoing, self-organised process of learning-by-doing." Self-organisation in light of adaptive co-management refers to "the emergence of formal and informal networks, working in a collaborative and creative process, often drawing on the range of knowledge sources and ideas, to resolve issues and move forward in response to disturbance" (Armitage et al., 2009). The self-organising process, when facilitated by rules and incentives from higher levels, has the potential to make social-ecological systems more robust and adaptive to change. It requires "actors and institutions to learn to live with change and uncertainties" (Armitage, 2008: 16). The adaptive co-management approach views change as an inherent property of systems (Doubleday, 2008).

Table 2.4 Differences and similarities between co-management, adaptive management, and adaptive co-management

Characteristic	Co-management	Adaptive management	Adaptive co-management
Focus on establishing linkages	Establishing vertical institutional linkages	Learning-by-doing in a scientific and deliberate way	Establishing horizontal and vertical linkages to carry out joint learning-by-doing
Temporal scope	Short-to-medium term: tends to produce snapshots	Medium-to-long term: multiple cycles of learning and adaptation	Medium-to-long term: multiple cycles of learning and adaptation
Spatial scope	Bridging between local level and government level(s)	Focus on managers' needs and relationships	Multi-scale, across all levels, with attention to needs and relationships of all partners
Focus on capacity building	Focus on resource users and communities	Focus on resource managers and decision-makers	Focus on all actors: 'two (or more) to tango'

Source: Adapted from Berkes et al. (2007: 309)

Adaptive co-management is the integrated approach of co-management and adaptive management (Armitage et al., 2009; Bown et al., 2013). Although based on distinctive theoretical foundations, the evolution of these two approaches has shown substantial complementarity (Table 2.4). Berkes (2009: 1698) comments that adaptive management without co-management lacks legitimacy while co-management in the absence of the 'learning-by-doing' mechanism fails to develop the ability to adapt to emerging problems. In the same vein, Bown et al. (2013: 130) offers a synthesis, suggesting that adaptive management plays a dominant role that supplies the driver (adaptation) whereas co-management supplies the means (legitimacy). According to Plummer and FitzGibbon (2007), adaptive management further highlights the social nature of co-management as an effective governance regime for social-ecological systems. With the adaptive co-management approach, knowledge generation and learning are essential elements (Olsson et al., 2004; Berkes, 2009).

As an approach instrumental to policy improvements, adaptive management involves utilising learning-by-doing to deal with uncertainty (Armitage et al., 2007). It involves "experimentation with different measures to see what works and adapt policy in the light of lessons learned" (Bown et al., 2013: 128). According to Atkinson and Canter (2010), adaptive management is not an end in itself, but rather a means to more effective decision-making. Adaptive management provides a theoretical framework for bridging the gap between adaptation research and policy (Arvai et al., 2006). Management of actions and policies are treated as experiments undertaken during the learning process (Holling, 1978; Lee, 1993). The experiments involve identifying hypotheses that are assessed to attain a desirable option for policy formulation. In this regard, social learning is central to effective adaptive management, which involves not only citizens but also scientists, environmental managers and institutions (Smith and Lazarow, 2006). According to Fazey et al. (2005), adaptive management is based on the premise that knowledge of the system is always incomplete. Therefore, integrating adaptive management and social learning is essential to enhance the flexibility and the responsiveness of socio-ecological systems, which enable better adaptation to stress, crisis, and change (Fernandez-Gimenez et al., 2008).

Co-management is found in the wealth of research literature that presents the interplay between local resources users and the government in terms of shared management of power and responsibility (Castro and Nielsen, 2001; Olsson et al., 2004; Plummer and FitzGibbon, 2004; Carlsson and Berkes, 2005). Emerging in the early 1990s, this arrangement is formed by the shift in the governance mechanism from centralised control towards the practice of co-management (Plummer and FitzGibbon, 2004). Practically, co-management has been largely adopted as an approach to manage fisheries (Sen and Nielsen, 1996; Pomeroy et al., 2001; van Hoof, 2010; Evans et al., 2011) and natural resources (Borrini-Feyerabend et al., 2000; Plummer and Fitzgibbon, 2004). It is portrayed as "the mixture of top-down and bottom-up elements" (Bown et al., 2013: 129). Carlsson and Berkes (2005: 65) see it as a continuous problem-solving process, rather than a fixed state. From Berkes' (2009) perspective, it refers to a knowledge partnership facilitated by bridging organisations and knowledge co-production. In the co-management context, as noted by Cardinal and Day (1998), local knowledge and expert knowledge are treated equally.

Co-management plays an important role in enabling learning and adapting (Armitage et al., 2011). According to Borrini-Feyerabend et al. (2000: 12), these processes are reflected through the enhancement of "common knowledge, awareness and skills by thinking, discussing and acting together". Co-management ensures greater participation of stakeholders and communities in the decision-making process. Its potential benefits involve more appropriate, more efficient, and more equitable governance, and improvement of the processes and functions of management (Armitage et al., 2007: 3). From Berkes' (2009) perspective, successful co-management is synonymous with knowledge partnership. It necessitates systematic learning and innovation under conditions of uncertainty.

Social learning is key to adaptive co-management (Schusler et al, 2003; Plummer and FitzGibbon, 2007; Armitage et al., 2008; Leys and Vanclay, 2011a). The collaborative efforts and learning-by-doing approach are underpinned by shared understanding and knowledge facilitated by communication and social interactions. From the adaptive co-management perspective, social learning provides a complementary process for empowering local participants to contribute innovative management practices to make the existing governance system better (Leys and Vanclay, 2011a). Taking this into consideration, the integration of scientific and local knowledge for adaptation and change needs to be promoted.

A number of case studies have shown how the adaptive co-management approach is vital to natural resource management. Armitage (2007a) presents a case study of narwhal management in northern Canada, seeing adaptive co-management as a form of governance innovation. The results from the case in Nunavut suggest the typical collaborative mechanism of actors from different levels in support of resilience of their community livelihood. Plummer and Hashimoto (2011) present a successful shell fishery conservation on Kyushu Island in Japan. In this case, adaptive co-management successfully facilitates the movement of the problem-solving process from an authoritarian to a participatory manner. This approach adopts the integrated values of power sharing, shared decision-making processes and communication among different actors across levels. In particular, it engages governmental agencies, prefectural and municipal authorities, and local fishing communities into common efforts for fishery conservation. In the Cambodian context of natural resource management, adaptive co-management is portrayed as a form of community-based management (Marschke and Nong, 2003). It reflects experimentation and learning-by-doing practices in managing local coastal resources, and the collaboration among government agencies, community members, NGOs, and donor agencies in dealing with it. In the absence of set structures and frameworks, these interactions offer a flexible space for learning to occur, with the acknowledgement of changed understanding and attitudes of the stakeholders involved.

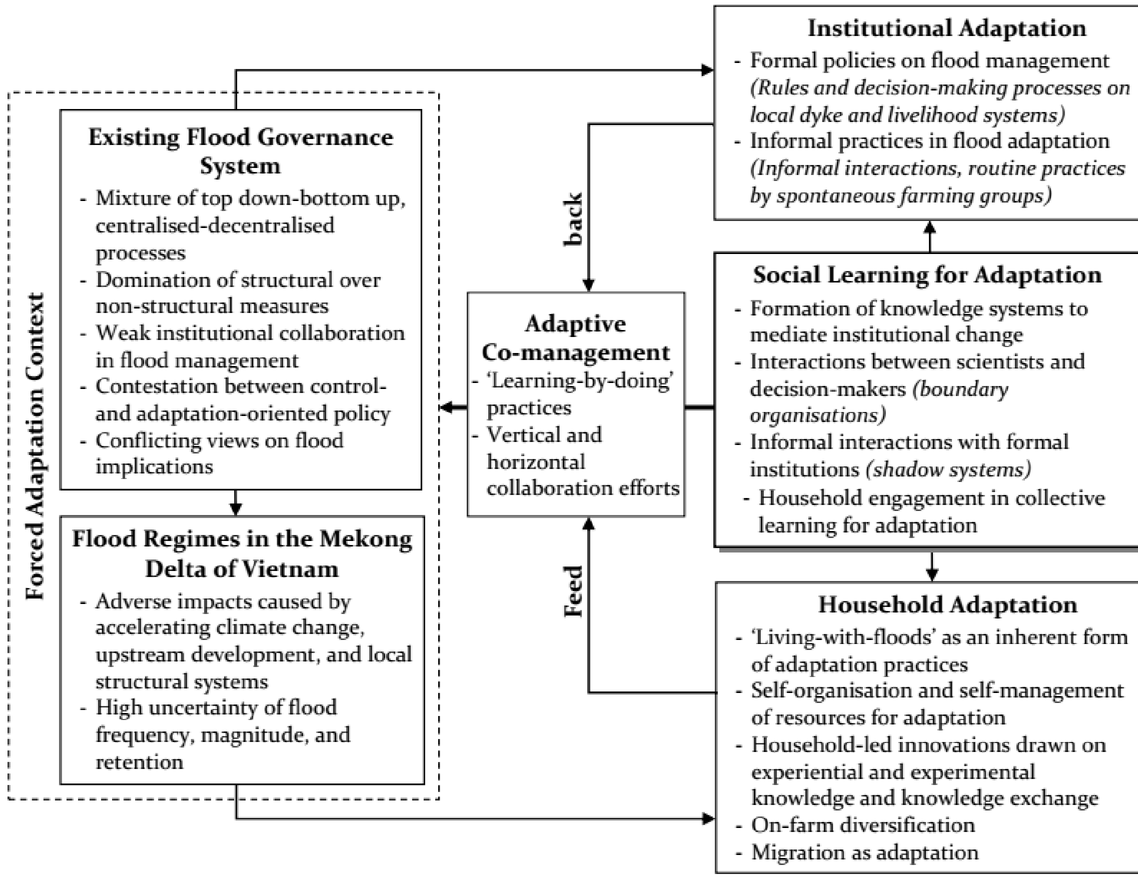


Figure 2.3 The analytical framework of social learning for household and institutional adaptation in the MDV

Source: Figure by Tran Anh Thong (2014)

Adaptive co-management treats social-ecological uncertainty as inherent in governance. Dealing with it requires collaborative processes and a pool of different sources and types of knowledge (Armitage et al., 2009). This consideration acknowledges adaptive co-management as an essential approach to address forced adaptation constraints in the MDV (Figure 2.3). The extant governance approach still hinges on the conventional centralised bureaucracy. While the formal engagement of local actors into the local decision-making process has not occurred, various forms of collaborative learning and informal interactions among farming households, scientists, and associated government agencies have become increasingly prominent. These 'shadow systems' have stimulated changes in local institutions. The flexibility of the local informal interaction boundary provides a secure space for these social learning processes to happen. At the household level, farming innovations have immensely evolved. This phenomenon acknowledges the pivotal role of local households through their experiential and experimental learning practices. Successes in their everyday livelihood activities offer the main incentives that drive them into further quests for innovative knowledge. These factors are of great significance and enable local households to increase their adaptive capacity.

The social learning process contributes to designing an innovative governance approach, which is essential to deal with the forced adaptation context in the MDV. This thesis sees the adaptive co-management approach as emerging from the social learning process that involves informal and formal interactions among farming households, scientists and government agencies. Their learning interactions both formulate some forms of collaboration and facilitate the propagation of innovative knowledge across geographical levels. These learning effects promote institutional change in flood management policies that better support households' livelihood practices in the flood season. From the adaptive co-management perspective, making effective use of different sources of innovative knowledge suggests a key strategy for the long-term adaptation of the rural societies in the delta.

2.9 Conclusion

Social learning is a multi-faceted concept. Given its conceptual plurality, there have been theoretical debates about the meaning of social learning across multiple disciplines. However, empirical evidence shows that social learning is increasingly recognised as a key approach to deal with natural resource management and climate change. In the domain of water resources management, the social learning process helps to address the deficiencies of the conventional bureaucratic governance system, and facilitates participatory decision-making processes based on shared learning and co-production of knowledge among associated social actors. The WFD's participatory water management framework across European member countries confirms the role of social learning in achieving its water management goals.

Social learning is closely associated with adaptation in the context of climate change. It plays an important role in facilitating the process of shared understanding among stakeholders and reframing solutions towards adaptation. There is a connection between social learning and social capital. Social learning acts as a mechanism for building social capital, which in return functions as a bridge for the operation of social learning. Operating across various social relationships, social learning stimulates the generation of innovative knowledge and the dissemination of this knowledge across the geographical levels. The learning interactions between social actors facilitated by social learning also lead to social and institutional change.

The significant role of social learning suggests the need to investigate how this concept operates in the forced adaptation context of the MDV. The multi-faceted learning interactions among local farming households, scientists, and government agencies demonstrate how shared understanding contributes meaningfully to tackling flood management and adaptation problems. Social learning provides conducive conditions for the emergence and the diffusion of innovative knowledge among the social actors. These learning effects enable institutional change and enhance the rural societies' adaptive capacity to deal with the local social-ecological complexities.

Adaptive co-management is the integrated approach of co-management and adaptive management. It connects learning from past experiences (experiential learning) and explores new alternatives (experimental learning) with vertical and horizontal collaboration to respond to complex social-ecological systems. From the historical perspective, this integrated approach has been closely intertwined with the flood management and adaptation processes in the MDV. On the one hand, it concerns the application of 'learning-by-doing' in flood management and the development of local adaptation-oriented innovative knowledge based on iterative learning processes. On the other hand, it illustrates how households and government agencies can arrive at collaborative decision-making with regard to irrigation and flood control. The complexities of forced adaptation make it urgent to promote the application of adaptive co-management to inform the long-term adaptation strategies in the delta.

Chapter 3

Research Design and Methodology

3.1 Introduction

A diverse range of research approaches has been employed to examine the implications of social learning and how it relates to adaptive capacity, governance, and adaptive co-management in the context of water resources management in the MDV. Social learning involves social interactions among multiple stakeholders. Therefore, understanding the theoretical aspects of this concept demands the application of a multi-faceted methodological repertoire.

Social learning has been applied in the discipline of sociology where it was quantitatively measured (Akers and Lee, 1996; Lee et al., 2004). However, literature shows that the qualitative approach has been extensively adopted to examine how this concept plays a role in a range of domains associated with water resources management (Blackmore et al., 2007; Ison and Watson, 2007; Jiggins et al., 2007; Lebel et al., 2010b; McCarthy et al., 2011; Johannessen and Hahn, 2013; Benson et al., 2015), climate change adaptation and vulnerability assessment (Pelling et al., 2008; Falaleeva and Albert, 2009; Albert et al., 2012; Yuen et al., 2013), and natural resource management (Schusler et al., 2003; Dessie et al., 2013; Kruijf et al., 2014). These studies were mostly undertaken in the Western contexts.

Recently, the mixed methods strategy of inquiry, which combines qualitative and quantitative approaches has been widely used. Garmendia and Stagl (2010) employ this combined approach to examine how social learning takes place at workshops. They firstly conducted in-depth interviews to collect qualitative information from representative participants and subsequently quantified subsequent changes in behaviour and attitudes using Likert scales. The same approach has been used to examine the role of social learning in plantation forestry (Leys and Vanclay, 2011b) and collaborative natural resource management (Schusler et al., 2003). In the study of governance experimentation where social learning is situated, Bos et al. (2012) began with qualitative data collection and then administered structured quantitative surveys to selected respondents. Integrated in the social learning process, the mixed methods approach was used by Pahl-Wostl and Hare (2004) to collect participants' reflections on the water issues in the Swiss case study on urban water management.

In this research, I used the mixed methods approach to investigate the implications of social learning for household and institutional capacity to respond to the complexities of forced adaptation in the MDV. This approach involves two phases of data collection, starting with the qualitative inquiry. Creswell and Clark (2011: 122) suggest that the initial qualitative findings can help to inform a second phase where quantitative data are collected and analysed. Accordingly, FGDs, in-depth interviews, and field observations were initially conducted to inform the findings that assisted in developing the quantitative instruments for the administration of the household survey. This research gives greater priority to the qualitative than the subsequent quantitative inquiry. The quantitative data are used to assist in interpreting the qualitative findings (Sieber, 1973; Creswell et al., 2003).

This chapter describes how the mixed methods strategy of inquiry is used in this research. Section 3.1 is the chapter introduction. Section 3.2 presents the rationale for favouring the mixed methods approach. Section 3.3 discusses how the research areas were selected. The overarching strategy for primary and secondary data collection and analysis is provided in sections 3.5 and 3.6 respectively. Section 3.7 discusses the research questions and corresponding methods for data collection. Ethical considerations for the research are discussed in section 3.8. The final section presents the conclusion of the chapter.

3.2 Mixed methods research and application of exploratory sequential design

Mixed methods research has multiple definitions with various levels of specificity (Johnson et al., 2007). Tashakkori and Creswell (2007: 4) broadly define mixed methods research as "research in which the investigator collects and analyses data, integrates the findings and draws inferences using both qualitative and quantitative approaches." According to Johnson and Onwuegbuzie (2004: 17), mixed methods research is referred to as the class of research from which the researcher can integrate quantitative and qualitative research techniques, methods, approaches, concepts or language into a single study. Creswell and Clark (2011: 5) claim that the mixed methods research emphasises "collecting, analysing, and mixing both quantitative and qualitative data in a single study or series of studies."

The mixed methods approach has been adopted in multiple disciplines across a range of substantive areas. In particular, it is used in educational research (Rocco et al., 2003; Johnson and Onwuegbuzie, 2004), healthcare research (Foss and Ellefsen, 2002; Forthofer, 2003), and sociology (Hunter and Brewer, 2003; Pearce, 2012). Mixed methods research provides a great advantage to evaluation (Greene et al., 2001; Rallis and Rossman, 2003). Jacobs (2003) states that policy evaluations traditionally apply the quantitative approach, but increasingly use the qualitative approach to add value. This approach is invaluable for policymakers seeking to develop effective policy.

Six different typologies of mixed methods designs have been defined (Parylo, 2012; Terrell, 2012) (Table 3.1). They include (1) sequential explanatory; (2) sequential exploratory; (3) sequential transformative; (4) concurrent triangulation; (5) concurrent nested; and (6) concurrent transformative. According to Teddlie and Tashakkori (2006: 12), the classification of these typologies is useful to help researchers design mixed methods research, to establish a common language, to provide an organisational structure, and to help legitimise the field.

The mixed methods research offers beneficial ways to collect a variety of data. According to Creswell and Clark, (2011: 5), the combination of qualitative and quantitative approaches provides a more robust understanding of research problems than either approach alone. This approach compensates for limitations and disadvantages of a single method (Creswell et al., 2003; Johnson and Onwuegbuzie, 2004; Robins et al., 2008) and enhances the validity of inquiry (Green and Caracelli, 1997). Greene et al. (1989: 259) suggest five main purposes for conducting mixed methods research: (1) triangulation to seek the convergence of the findings; (2)

complementarity to gain elaborated understanding of the study results; (3) development to inform a method based on the results from the other; (4) initiation to discover paradox and how new perspectives emerge; and (5) expansion to extend the breadth and range of inquiry by including multiple inquiry components.

Table 3.1 Typologies of the mixed methods designs

Design	Description
Sequential explanatory	Typically starts with dominant quantitative data collection and analysis followed by qualitative data and analysis and then the interpretation of entire analysis is conducted. Integration occurs at the interpretation phase.
Sequential exploratory	Starts with dominant qualitative data and analysis, followed by quantitative data and analysis, and ends with the research interpretation of all data collected. Integration occurs at the interpretation phase.
Sequential transformative	Data could be collected in any order, and either qualitative or quantitative methods are chosen as dominant. Integration occurs at the interpretation phase.
Concurrent triangulation	Qualitative and quantitative data are collected at the same time followed by the data interpretation stage where the data from both methods are compared. Integration occurs at the interpretation phase or analysis phase.
Concurrent nested	Simultaneous collection of qualitative and quantitative data, but one method is dominant. Integration occurs at the analysis phase.
Concurrent transformative	Simultaneously collected data may be either equal in priority, or one of the methods is given priority while the other is less dominant. Integration occurs at the analysis phase (but can occur at the interpretation phase also).

Source: Parylo (2012: 301)

Validity has been acknowledged as one of the key issues in the mixed methods research. Although mixed methods research involves the combination of complementary strengths, assessment of the validity of research findings is rather complex (Winter, 2000). Onwuegbuzie and Johnson (2006) critically used the term 'legitimation' to address the validity issue. They specified a typology of nine mixed methods legitimation forms which may have validity effects on the research findings, consisting of sample integration legitimation, inside-outside legitimation, weakness minimisation legitimation, sequential legitimation, conversion legitimation, paradigmatic mixing legitimation, commensurability legitimation, multiple validities legitimation, and political legitimation (Onwuegbuzie and Johnson, 2006: 57). Validity considerations were also clearly articulated by Creswell and Clark (2011) employing the strategies that address the issues in data collection, data analysis and interpretations during data merging and connecting processes. This research draws particularly on Creswell and Clark's (2011) strategies to design the procedures for data collection, data analysis and interpretations so that validity threats can be minimised.

Drawing on the philosophical underpinnings of the mixed methods research typologies as discussed, this research employs the exploratory sequential design as the key inquiry strategy to investigate how social learning facilitates farming household and institutional adaptation in the MDV. Conceptualising social learning and examining its causal relationship with adaptive capacity in the social-ecological and cultural context of the delta requires the ethnographic approach and long-term interactions with local communities. It also involved the deliberate adoption of a sampling method to recruit participants for the research, because it is critical that the population needs to be properly defined before the sample is selected (de Vaus, 2002). This aimed to ensure that the data collected from qualitative and quantitative methods could reflect true empirical understanding which either approach alone (qualitative or quantitative) is insufficient to do (Creswell and Clark, 2011). This was also to address the validity of the research findings.

In this research, the overall inquiry process begins with the qualitative data collection and analysis followed by quantitative data collection and analysis (Figure 3.1). It involves two primary stages: pre-fieldwork and data collection. In the pre-fieldwork stage, I spent one month visiting the delta's flood-prone areas to better understand the social-ecological context. This duration allowed me to engage extensively in formal and informal conversations with local government officials and inhabitants, whereby I gained better insights into how flood management policies and practices have been implemented in their respective areas, and how rural communities have learned to adapt to the transformation of the social-ecological landscapes. Narratives captured from these exploratory interviews provided me with preliminary understanding of how the social learning concept was defined and how it linked in practical terms to rural household capacity in adapting to change. This exploratory approach assisted me in refining the research issues, and identifying the research areas. Three flood prone areas in the MDV where three distinct flood control schemes are currently operated were then selected. When the pre-fieldwork stage was completed, I proceeded with relevant procedures for data collection.

The data collection stage included two main phases. The first phase involved conducting nine FGDs with household farming groups, thirty-three in-depth interviews with key informants, and field observations. These exploratory techniques are of paramount importance, because they provided me with in-depth information about the research issue under investigation, and empirical evidence to design structured questionnaires for survey administration. After completing the qualitative data collection and analysis in the first phase, I conducted the household survey in the second phase.

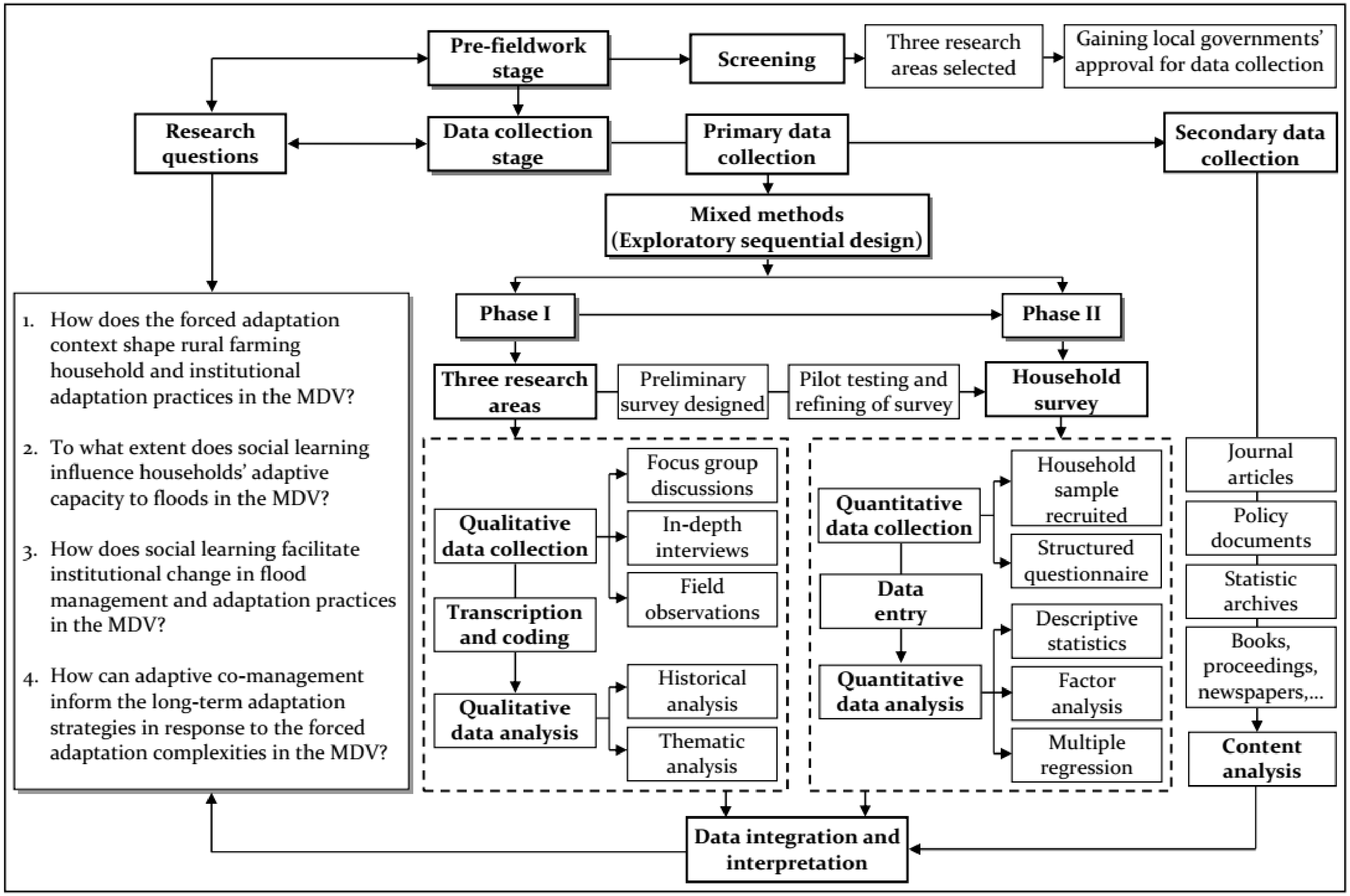


Figure 3.1 The procedures for the exploratory sequential design for the research

Source: Figure by Tran Anh Thong (2014)

3.3 Selection of research areas

The flooding context of the MDV provides the primary background for this research. It illustrates the historical evolution of flood management systems over the course of the delta development. The proliferation of dyke systems prompted by the central and local policies for rice intensification and on-farm diversification over the last few decades has had significant impacts on its social-ecological landscapes. These development strategies have led to the substantial transformation of farming households' livelihood patterns, especially in the flood season. At the local level, the traditional farming systems, which are unsuitable for the dyke-based farming methods, have gradually changed. This suggests that rural households have proactively managed to learn, from which they can increase their capacity to adapt to the changing conditions. It also demonstrates greater demands of farming households for integrating local knowledge and advanced technology into their farming activities, from which new initiatives emerge. At the institutional level, the flood management practices suggest the adoption of the adaptive co-management approach is based on lessons learned in combination with the informal contribution of households' adaptive knowledge in dealing with everyday flood complexities.

In this research, three adjoining flood-prone areas (An Giang, Dong Thap, and Can Tho) were selected because they represent the most important sectors in terms of rice production and aquaculture in the MDV (GSO, 2014). Geographically, they are located in three distinct landform units of the delta, consisting of the Plain of Reeds, the upper floodplain, and the tide-affected floodplain (Tanaka, 1995). The hydrological characteristics of these localities prompt the establishment of three flood control schemes which have had significant implications for the livelihood practices of the majority of local households over the past few years. Investigation of these schemes and their respective significance provides an empirical understanding of how the flood governance arrangements in the delta are implemented, and how social learning facilitates the decision-making process on flood management, and stimulates the generation and dissemination of farming initiatives across geographical levels.

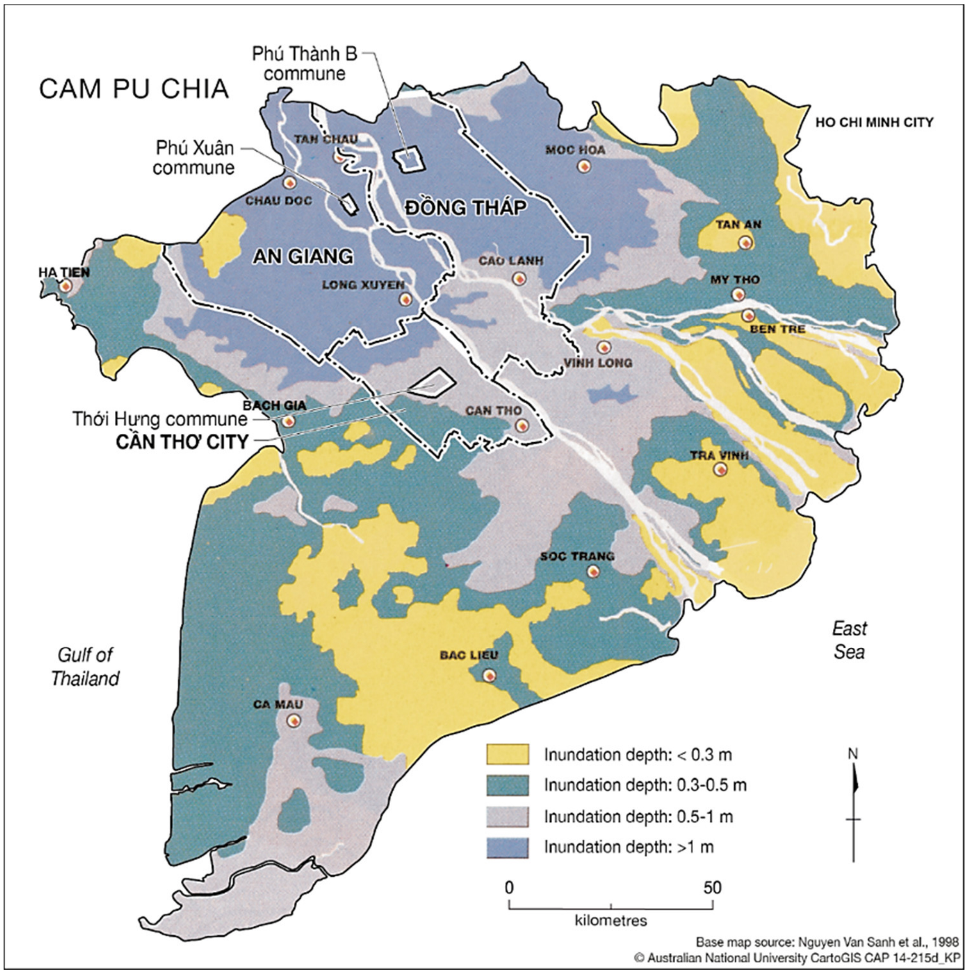


Figure 3.2 The flood levels of the MDV and research areas

As mentioned, three flood control schemes located across three flood-prone localities of the delta were selected for the research (Figure 3.2). Hydrologically, both research areas (Phu Thanh B and Phu Xuan communes) are located in the upper part of the delta, which experiences a high level of annual flood inundation (>1m). In administrative terms, the former belongs to Dong Thap province, a part of the Plain of Reeds[7]. The latter is located in An Giang province, which is covered by the upper floodplain of the Long Xuyen Quadrangle[8]. This commune is bounded by the Tien and

[7] The Plain of Reeds covers an area of 500,000ha in the MDV, consisting of Dong Thap and Long An provinces. It is a vast wetland depression located between the Mekong River and Vam Co Tay River (Nguyen Xuan Vinh and Wyatt, 2006). This low-lying region is annually subject to deep flood inundation from July to December.

[8] The Long Xuyen Quadrangle, which includes An Giang and Kien Giang provinces, is situated in the North West of the MDV. It covers an area of 400,000ha, most of which is subject to high inundation.

the Hau Rivers, the two main branches of the Mekong River. The last research area (Thoi Hung commune) belongs to Can Tho City, which belongs to the tide-affected floodplain sharing the border with the Long Xuyen Quadrangle in the south. It has a lower flood depth level (<1m). The implementation of flood management and adaptation policies in these research areas provides illustrative examples of how the local governments and farming households have learned to adapt to the forced adaptation constraints over the last few years (Table 3.2).

Table 3.2 General information on three research areas

Description	Selected research areas		
	Phu Thanh B	Phu Xuan	Thoi Hung
Total land area (ha)	5,161	1,837	6,925
Agriculture land area (ha)	4,636	1,629	5,200
Population (persons)	5,425	5,349	15,091
Number of households	1,337	1,396	3,432
Flood inundation depth and duration	>1m (4-5 months)	>1m (2-3 months)	<1m (1.5-2 months)
Geographical location	In the Plain of Reeds	In the Long Xuyen Quadrangle (the upper floodplain)	Bordering with the Long Xuyen Quadrangle in the south (the tide-affected floodplain)
Physical characteristics of the flood control schemes	Supported by low dyke systems	Supported by perimeter ring-dyke and compartment dyke systems (the North Vam Nao scheme)	Supported by high dyke systems (the Song Hau State Farm)
Main sources of household income in the flood season	Fishing, collecting aquatic resources, prawn farming	Growing sticky rice, field crops, collecting aquatic resources	Rice-fish culture, field crops and fruit orchards

Sources: Tanaka (1995); Phu Xuan People's Committee (2013); Party Committee of Thoi Hung (2013); In-depth interviews (2013-2014)

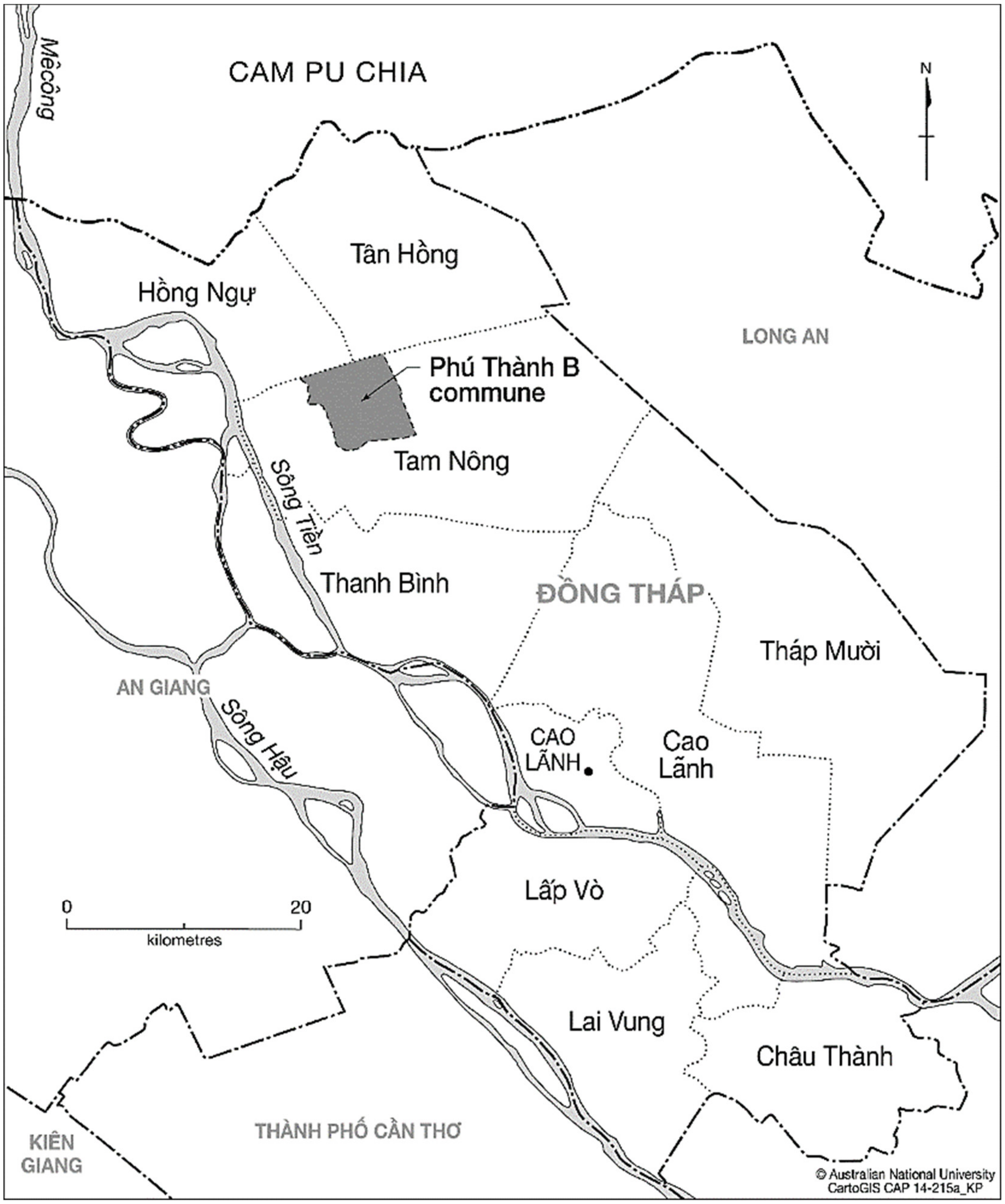


Figure 3.3 The research area in Tam Nong district, Dong Thap province

Phu Thanh B belongs to Tam Nong district, Dong Thap province (Figure 3.3). Situated in the low topography of the Plain of Reeds, this area frequently experiences high flood inundation in the flood season caused by flow discharge from the Mekong River, heavy rainfalls, and overflows from Cambodia. Given such complex hydrological conditions, the local government constructed the low dyke systems across the commune in the mid-1990s. The aim of this strategy is three-fold. First, this structural system aims to protect the summer-autumn crops from early flood entry, until they are completely harvested. Second, floods are flushed into the rice fields to replenish soil fertility as soon as the crops are harvested. Third, floods provide great opportunities for local households to practise various flood-based livelihood activities for daily subsistence. Wild fish and aquatic resources (fresh-water crabs, golden snails, moina, *sesbania sesban* flowers, and waterlily) constitute a large proportion of income for the majority of local households, especially the poor. It is worth mentioning that the deep flooding in this commune has created a favourable natural environment for the culture of giant fresh-water prawn which brings lucrative earnings for most better-off and medium households during the flood season (Figure 3.4). Initiated in 2004, this production model has been widely adopted across neighbouring communities.

Figure 3.4 Raising giant fresh-water prawn in the flood season in Phu Thanh B

Source: Photo by Tran Anh Thong (2013)

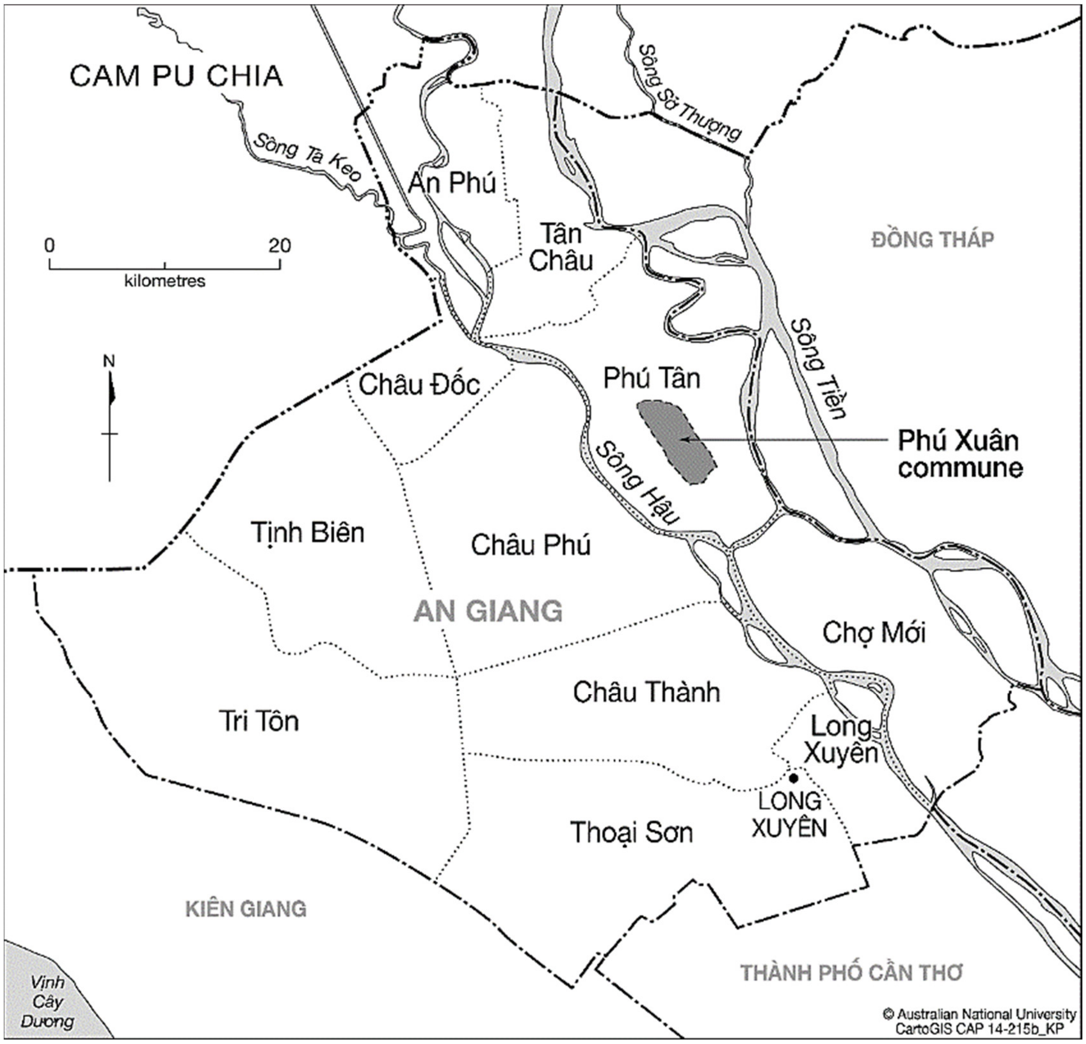


Figure 3.5 The research area in Phu Tan district, An Giang province

Phu Xuan commune belongs to Phu Tan district, located between the two main branches of the Mekong River: the Tien and Hau Rivers (Figure 3.5). The district has the highest flooding depth in the MDV (Tran Nhu Hoi, 2005). The irrigation and flood control system of Phu Xuan commune is regulated by the overall management of the North Vam Nao flood control scheme. This project originated from the Delta Master Plan undertaken by the Netherlands Engineering Company (NEDECO, 1993) with Australian assistance. It includes an external high embankment of 100 km and internal dyke systems of 300 km with 24 original compartments, embracing Phu Tan and a part of its upstream neighbouring district (Tan Chau). The key objectives of this flood control system include (1) to protect local inhabitants and infrastructure from the negative impacts of high floods; (2) to sustain soil fertility within compartments; (3) to maintain natural aquatic resources in the flood season; and (4) to increase rice crop production. With this integrated flood management system, floods are proactively managed to allow the production of eight rice crops within three consecutive years. The last crop (autumn-winter crop) of the third year is suspended for flood retention until the end of the flood season. Phu Xuan commune has four compartments surrounded by high compartment dyke systems (5+ meters). These systems provide protection for local land transport and inhabitants during the flood season.

Figure 3.6 Collecting moina in a flooded compartment in Phu Xuan

Source: Photo by Tran Anh Thong (2013)

The North Vam Nao flood control system has significant implications for local livelihoods. Assisted by this system, farming households in Phu Xuan can engage in a variety of farming activities during the flood season. Sticky rice is predominantly cultivated in the area as it is well-suited to local soil conditions and brings higher profits than other crops. The domination of this crop therefore makes local households give less attention to investing in field crops or fruit orchards. In the meantime, the short-term availability of floodwaters within flooded compartments and surrounding canal systems provides an essential means for poor households to earn a living in the flood season (Figure 3.6). Catching wild fish and collecting aquatic resources are the main sources of income for this household group.

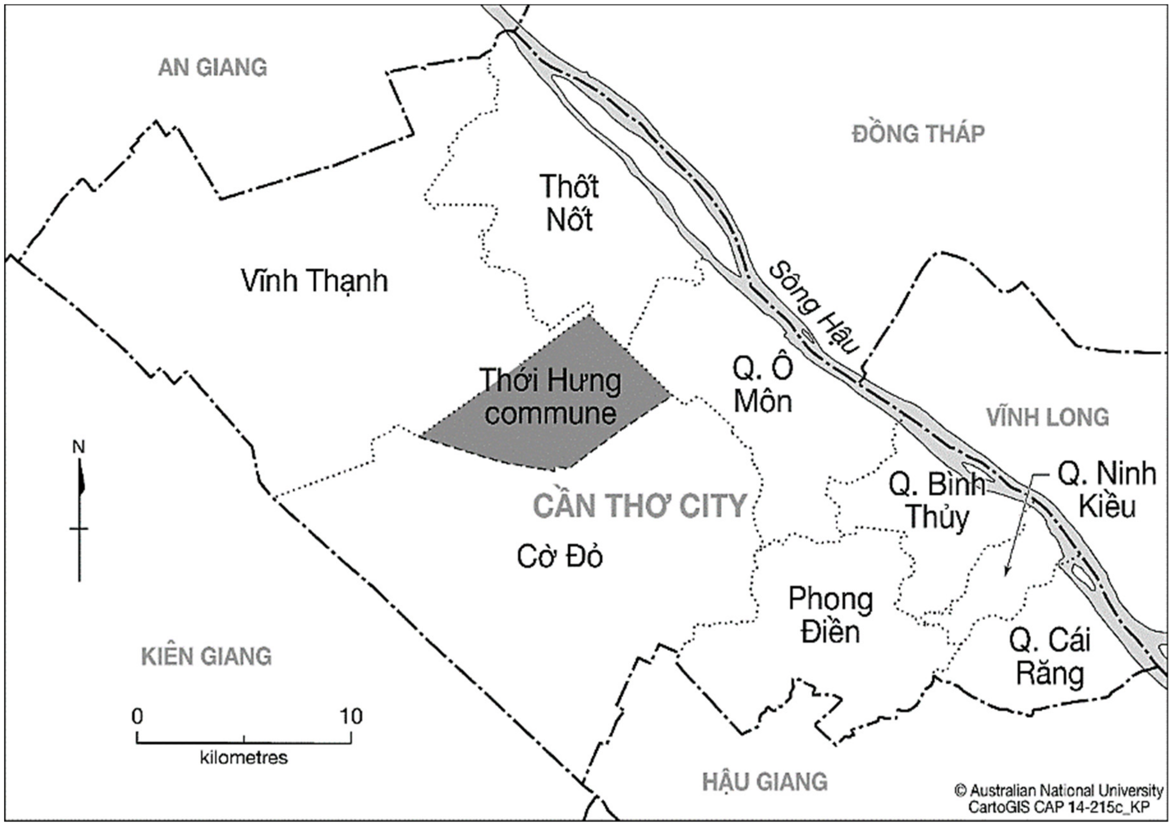


Figure 3.7 The research area in Co Do district, Can Tho City

Thoi Hung commune in Co Do district is located within the low depression of the Trans-Bassac Depression Zone of the floodplain (Figure 3.7). This commune was transferred from the administration of the Song Hau State Farm in 2004. Therefore, the management and operation of its flood control scheme are still characterised by the former State Farm's approach. In the flood season, upstream flood flows enter the commune through its primary and secondary canal systems.

Thoi Hung is protected by a highly-controlled dyke system. For every kilometre, a secondary canal was built to connect primary canals. Installed at each end of the secondary canals, sluice gates aim to actively control flood inflows into the internal system and to secure water supply for agricultural production. The volumes of earth dredged from these canals help fortify the dykes which serve as roads for local traffic.

Inside the high dyke system is a lower embankment that encircles each household's land area. It aims to secure the production of various cash crops during the flood season. Each of this household-level dyke system has a sluice gate that controls the inlets of floods into rice fields. From the onset, the Song Hau State Farm actively implemented a wide range of integrated farming systems to support the cultivation of field crops, fruit trees, and the rice-fish culture (Figure 3.8). The model 'one bund, two ditches' *(bờ giữa, mương cặp)*, for instance, is seen as one of the most successful initiatives in the commune. A bund that serves as a cadastral line is built between two adjacent household units. It also provides space for planting mangoes and short-term cash crops. An additional advantage of this integrated model is that the parallel linear ditches built both sides of the bund provide irrigation for field crops and refuges for fingerlings. Qualitative evidence suggests that the majority of local farming households, when taking advantage of this irrigation and flood control system, have successfully diversified into cash crops to increase their income.

Figure 3.8 Rice-fish culture in the flood season in Thoi Hung

Source: Photo by Tran Anh Thong (2013)

3.4 Strategy for qualitative data collection and analysis

Qualitative research is multi-method in focus, which involves an interpretive, naturalistic approach to its subject matter (Denzin and Ryan, 2007). It is recognised as "a legitimate and appropriate tool for studying people's subjective experiences and understanding the meanings and interpretations individuals have within the context of their lives" (Liamputtong, 2013: 23). For qualitative research, a variety of empirical materials such as "case study, personal experience, introspection, life story, interview, and observational, historical, interactional and visual texts which describe routine and problematic moments and meaning in individuals' lives" are used (Denzin and Ryan, 2007: 580). According to Taylor and Bogdan (1984: 17), good qualitative research combines an in-depth understanding of the particular research context and theoretical insights that transcend that type of context.

Qualitative research draws upon three main theoretical frameworks (Denzin and Lincoln, 2003; Flick, 2006; Liamputtong, 2013). Termed the 'fieldwork concept', qualitative ethnographic research entails a long-term period of social immersion in a particular setting (Mitchell, 2007). This approach is useful to "explore a wide variety of social settings, subcultures, and aspects of social life" (Neuman, 2011: 421). From the phenomenological perspective, qualitative research attempts to describe the lived experience of participants in their everyday world (Liamputtong, 2013). Symbolic interactionism represents the way individuals subjectively construct meanings based on their interactions with the environment (Flick, 2006: 66). It focuses on "the essence of meaning and interpretation as crucial human processes" (Liamputtong, 2013: 9). These theoretical frameworks provide a foundation to adopt the qualitative approach as the key strategy of inquiry in this research.

Qualitative inquiry into how social learning operates in the 'living-with-floods' context of the MDV is situated within the above theoretical frameworks. In this research, social learning processes are contextualised in the rural societies' adaptation under the impacts of the forced adaptation. From the phenomenological perspective, social learning reflects the lived experience of rural households in living with floods.

It demonstrates their efforts and capacity in shared learning and adopting innovative knowledge to manage farming practices during the flood period. At the institutional level, qualitative inquiry examines how institutional arrangements for local flood management have been formulated and implemented on the ground. Three main qualitative methods including FGDs, in-depth interviews with key informants, and field observations are employed to collect the data. As this research adopts the exploratory sequential approach, the qualitative inquiry was undertaken in the first phase of data collection.

3.4.1 Methods for qualitative data collection

3.4.1.1 Focus group discussions

Among other qualitative techniques, FGD is a comparatively new research method (Denzin and Ryan, 2007). King and Horrocks (2010) state that focus groups are used to facilitate interactive discussions which help stimulate the elaboration of opinions. It is to share "what people think, how they think, why they think in specific ways and their understandings and priorities in a given subject area" (Paula et al., 2001: 46). This method is useful where the researcher seeks to explore people's knowledge and experience (Kitzinger, 1995; Liamputtong, 2013).

The application of FGDs in this research is firstly to identify local farming households' perceptions of the implications of the local government's flood management policies for their farming practices. It is also to explore how the households construct their experience and knowledge and use them to build up their capacity, and innovate their 'living-with-floods' initiatives. Using the social learning term achieves in-depth understanding of how households' adaptive initiatives have evolved and disseminated across the community and their effects on their everyday livelihood practices during the flood season. When facilitating the FGDs, I adopt Narayanasamy's (2009) participatory rural appraisal approach, which includes timeline analysis, trend analysis, impact analysis, seasonal calendar, and Venn diagram to collect information (Appendix 1). Preliminary information acquired from these FGDs supports the identification of the dimensions and construction of corresponding indices for social learning and adaptive capacity in the household survey. This first phase is crucial to establish the content validity of the instruments.

Careful selection of participants for FGDs helps shape their outcomes (Neuman, 2011). In this research, the recruitment of household participants for the FGDs was based on the participatory approach. Firstly, I worked with representative government officials, who were in charge of household administration, to determine a set of criteria on which household samples for FGDs were based. Primary criteria to select FGD participants consisted of their occupation, gender, age, and socio-economic characteristics. Knowledge of the demographic and residential information on households held by the government officials provided substantial support to the selection process of participants. From the registered household documentation, I recruited suitable participants for FGDs. In each research area, the overall participant lists were discussed with the commune leader before FGDs were conducted.

Nine FGDs were conducted in this research. King and Horrocks (2010) suggest that focus group participants should share similar experiences and demographic characteristics. As such, the balance of homogeneity and heterogeneity of the groups was factored into the recruitment process. The participants were recruited on the basis of socio-economic characteristics. Three groups (poor, medium, and better-off) were identified respectively, with six to ten participants in each FGD. According to King and Horrocks (2010), this group size is optimum. The groups comprised members of varying ages and on-farm and off-farm employment. However, senior participants were favoured because they have more empirical experience in farming and responding to local flood conditions. As posited by Cameron (2005), mixed gender groups should be considered because different knowledge, experience, and perspectives held by women and men constituted a diversity of how research issues are understood. This research deliberately involved female participants with at least three in each FGD. As the success of FGDs depends on the composition of members in each group, and the interactions among participants to produce data and insights

(Punch, 2012), managing the issues of power dynamics and biases in groups is very important. As a facilitator in all of the FGDs, I attempted to ensure that all participants had equal chance to engage in group discussions. Data collected from FGDs require the inclusion of observer descriptions of group dynamics (DiCicco-Bloom and Crabtree, 2006). Following Hennink and Diamond's (2000) advice on having a 'focus group team', I recruited an experienced research assistant who acted as a scribe, and helped me with note-taking during the qualitative data collection process. All the FGDs were undertaken across the research areas from October 2013 to January 2014.

The FGDs were conducted at a selected member's house with which participants were familiar. The careful selection of venues for FGDs is essential as they create a feeling of safety and ease for all participants (King and Horrocks, 2010). The FGDs took place between the researcher, a research assistant, and the participants without any outsiders being present. This focused arrangement created a natural setting that enabled open conversations and discussions among participants. Participants were served free refreshments that made them feel comfortable and relaxed while the FGDs were taking place. Following Cameron's (2005) suggestion, each FGD session lasted for between one and two hours. The FGDs were recorded and transcribed afterwards. The data gathered from the FGDs informed findings for the design of the structured household survey.

At the beginning of every FGD, several procedural steps were completed. Firstly, I briefly introduced myself and my research assistant, presented the research objectives, and set the ground rules for the FGDs. The ground rules concerned how participants should contribute to the group discussion. The establishment of the ground rules was based on the viewpoints of participants and their reaching a consensus. These initial tasks helped the participants understand the research focus and get a sense of how the FGDs should be undertaken. Secondly, I read the oral consent form to confirm the participants' willingness to participate in the FGDs, making sure that they could engage deeply in the discussions with no hesitation. This formality is preferably applied when conducting research in the rural context of the MDV. It is one of the key strategies to build an initial rapport with participants and to gain trust from them (King and Horrocks, 2010). Thirdly, I asked for their permission to use the recorder and explained how the recorded information would be protected and used confidentially for my research. Finally, I declared the financial compensation for members' time awarded to each participant before having them start the FGDs.

3.4.1.2 In-depth interviews

In-depth interview is one of the primary data collection techniques in qualitative research. It is a discovery-oriented method, which enables the interviewer to explore deeply the respondents' feelings, thoughts, and perspectives on a certain subject (Guion et al., 2011; Liamputtong, 2013). The main advantage of the in-depth interview is that it helps obtain much more detailed information from respondents (Boyce and Neale, 2006). According to Kumar (2005), repeated interactions between the researcher and the respondents enable the latter to gain confidence, which leads to in-depth and accurate sharing of information. It is advisable that respondents to be selected for in-depth interviews should represent diverse stakeholders (Boyce and Neale, 2006). Besides following formal procedures to contact key informants, I employed the snowball sampling approach to identify key informants.

In total, thirty-three in-depth interviews were conducted with key informants for this research. Key informants consisted of two main groups. The first group involved the representatives of local mass organisations, academic and research institutions, and government agencies at provincial, district, and communal levels. They have diverse professional profiles with profound knowledge of the overall process of formulating and implementing local flood management policies. Qualitative interview techniques using open-ended questions attempted to explore key informants' perceptions of (1) local flood situations and flood management policies; (2) adaptive learning for flood management; and (3) collaborative approaches for flood governance (Appendix 2). For the second group, those who participated in collective learning for the sake of better adaptation were recruited for interviews. These informants represented three household groups (poor, medium, and better-off) engaging in typical adaptive livelihood activities in the research areas. Key questions used for in-depth interviews included (1) informants' perceptions of flood situations in association with local flood management policies; (2) informants' 'living-with-floods' strategies and the development of innovative farming models (evolution of farming innovations through on-farm experimentation and knowledge exchange); (3) informants' shared learning and adaptation practices to floods; and (4) informants' perspectives on the collaborative approaches for flood management (Appendix 3). All in-depth interviews were conducted from September 2013 to March 2014.

The venues for conducting in-depth interviews varied. The interviews with government officials took place at their offices, while household informants preferred to have interviews at their homes. Each in-depth interview was conducted face-to-face and lasted for approximately one hour. Combined with the FGDs, the results collected from in-depth interviews were applied to design the household survey, which was administered in the second phase.

Conducting in-depth interviews with key informants encountered some challenges on the ground. This is not unusual. Firstly, interviews were difficult because key informants were often busy. Therefore, arranging suitable sessions for interviews is rather time-consuming. Secondly, paperwork had to be submitted to gain their approval for the interview appointment. Accordingly, I had to send them an introductory letter from my home organisation (Research Centre for Rural Development of An Giang University) which served as a credential. This procedure is required to prove my identity as the primary research investigator and present my proposed plan for the research fieldwork. Finally, the spatial distance between the research areas, and the unfavourable weather conditions at the end of the rainy season in the MDV caused some inconvenience for traveling during my pre-fieldwork visits and the data collection process.

3.4.1.3 Field observations

Field observation is a "fundamental and highly important method in all qualitative inquiry" (Marshall and Rossman, 2006: 99). The results from the field observations are recorded as field notes, which comprise the systematic noting and recording of events and behaviours taking place in the social setting under study. A comprehensive picture of the study subject sketching the everyday experiences of individuals is obtained through observations (Fraenkel and Wallen, 1990). They include listening and looking skills, and verbal and visual behaviour through everyday face-to-face interaction (Punch, 2012). According to Marshall and Rossman (2006), field observations should be used in the early stage of qualitative inquiry.

This method was applied during the pre-fieldwork stage of the research in order to explore social practices, traditions, and cultural values held by household groups living with floods in the MDV. The recorded field-notes aimed to describe and interpret how rural households have learned to adapt in the forced adaptation context. According to Marshall and Rossman (2006), field observations are complementary to the other qualitative methods. Audio-visual tools are used to document the empirical evidence and subjects' activities on the ground. In this research, households' livelihood activities performed in the flood season are visually captured to enrich and complement the qualitative analysis.

3.4.2 Sampling strategies for collecting qualitative data

This research employed two main sampling strategies to recruit key informants for interviews. They included purposive sampling and snowball sampling approaches. According to Liamputtong (2013: 14), the use of the purposive sampling is associated with the deliberate selection of specific individuals, events, or settings because of the crucial information they can provide that cannot be obtained through other channels. In this research, the key informants from local government agencies, academic and research institutions, and farmers were identified on the basis of their administrative responsibilities and empirical and scientific knowledge relevant to the research topic.

For instance, I targeted the heads of local government agencies to collect flood policy documentation, and the scientists and researchers to access research-based evidence and perceptions of floods and rural livelihoods in the delta. Meanwhile, farmers offered me evidence from their extensive experience in dealing with floods and the impacts of dyke policies they have accumulated during their everyday activities.

Snowball sampling is a useful way to build a pool of informants for interviews (Taylor and Bogdan, 1984). This technique requires researchers to first select a few participants and ask them if they know others who meet the criteria of the research and who might be interested in becoming involved (Liamputtong, 2013). At the household level, key household informants who were identified from FGDs were subsequently contacted to explore in-depth information. After the completion of the interviews, they introduced me to potential informants whom they were familiar with for further interviews. These new informants again suggested others for further interviews. I continued the same procedures until I obtained adequate data for the inquiry. I found this sampling approach very useful and convenient in ways it assisted me in identifying appropriate informants for interviews and saved a great deal of time compared to the formal procedures (paperwork arrangements). However, critiques have been raised about bias issues when utilising the snowball sampling approach. Most snowball samples depend on the subjective choices of the respondents first accessed. In this case, the snowball samples are mostly targeted towards individuals with inter-relationships, therefore leaving out 'isolates' not connected to any network (Atkinson and Flint, 2001). To address this issue, I often cross-checked other key respondents about whether the newly-introduced respondent truly held the additional information that I needed to explore for my research. When following this procedure, I was able to access the 'good-quality' respondents who were independent from the preceding respondent's network.

3.4.3 Qualitative data analysis

Qualitative data are analysed using thematic analysis, which is defined as the method for "identifying, analysing and reporting patterns (themes) within data" (Braun and

Clarke, 2006: 79). King and Horrocks (2010: 150) define themes as "recurrent and distinctive features of participants' accounts", which characterise their particular perceptions or experiences. Braun and Clarke (2006) suggest thematic analysis as a foundational method for qualitative analysis.

Various techniques have been applied to capture themes from qualitative data for thematic analysis. Attride-Stirling (2001) uses thematic networks to depict themes at different textual levels. King and Horrocks (2010: 153) use a different approach which involves three stages: descriptive coding, interpretive coding, and overarching themes for thematic analysis. Similarly, Neuman (2011) introduces the technique involving three coding stages: open coding (assigning labels for emerging themes), axial coding (making connections among themes), and selective coding (selecting data that support previously-coded categories). He points out that in qualitative research the coding process allows the researcher to organise raw data into conceptual categories from which themes arise. In this research, I adopt Neuman's coding technique using NVivo software (version 10) to analyse the qualitative data.

Thematic analysis was mainly employed to analyse the qualitative data in this research. Primary qualitative findings on informants' everyday narratives, perception, and learning experiences in 'living-with-floods' from in-depth interviews and FGDs were captured and placed into themes and analysed respectively. According to Tuckett (2005), the analysis of researcher's field entries recorded throughout the fieldwork is an advantage. These early findings provide flexible clues that support the 'active pursuit of themes.' Field notes contribute to the emergence of themes that need to be further explored. As previously mentioned, this analysis provides the key evidence that complements the qualitative data.

Historical analysis was also used to analyse the key events in the process of learning to adapt to change by the rural societies. In this research, I examine the local flood management process through the pre-dyke and post-dyke stages and analyse the corresponding transformation of households' livelihood strategies. In particular, the way households have changed their farming practices and livelihood patterns in order to accommodate the pre-dyke and post-dyke contexts in each research area are discussed and comparatively analysed. A robust understanding of the transformation of these social-ecological landscapes is essential to evaluate the contemporary flood management policies, and to examine households' capacity to adapt to change.

3.5 Strategy for quantitative data collection and analysis

3.5.1 Procedures for household survey administration

The quantitative data collection formed the second phase of the fieldwork. It was carried out in a one-month period (April of 2014). As previously indicated, a structured household survey was designed on the basis of the qualitative findings and administered to selected households in each research area. When conducting the household survey, the interviewer worked directly with a representative of the household, usually the household head. The interviews took place at the household head's house and lasted for about one hour.

Conducting the household survey involved some important tasks that had to be performed beforehand. It is true that careful recruitment of a survey team contributes significantly to the acquisition of reliable field data. Therefore, key criteria for the survey team recruitment are determined to ensure that team members have adequate experience in conducting the survey and have genuine interest in the research. In particular, I recruited eight undergraduate students in the discipline of rural development at An Giang University, who were in the final year of their academic program. The recruitment was undertaken in consultation with one of my university colleagues who were teaching them in a course relevant to survey data collection and analysis. Before undertaking the fieldwork, the survey team was required to attend an intensive training session over which I presided. This plenary session aimed to ensure that the survey team thoroughly grasped the research objectives, the survey structure, the phrasing and meaning of each item in the questionnaires, the instructions to follow in the survey and procedures throughout the interviews. In particular, they were required to keep track of every single item in the survey questionnaires. This work was essential to check spelling errors, avoid meaning ambiguity, and make necessary refinements. It aimed to make sure that the respondents could understand the questions well enough and thus could provide accurate representations of their opinions (Rea and Parker, 2005). Additionally, the survey team was equipped with hands-on skills related to humour, time-keeping, confidence, and behavioural management when conducting interviews. These 'toolkits' are pivotal to assist the survey team in successfully conducting interviews and effectively managing the interview process.

A pre-test survey was conducted before it was officially used in the subsequent household administration. In each research area, six respondents were randomly selected to participate in the test. During this initial stage, the interviewers were required to take note of all possible errors associated with the structuring of the survey, phrasing, and meanings of items on inquiry. The work aimed to assess the relevance and clarity of designed questions and ensure the reliability of collected information. The results from the pre-test survey suggested that some questions had to be restructured to ensure the complete understanding of the respondents, especially of those who have a low education level. After the pre-tests, the questionnaires were revised to make them ready for the actual household survey.

Conducting the household survey required some assistance from local government. As noted, I made formal contacts with the local governments to gain official approval for my fieldwork. In supporting the field survey, local subordinate staff were assigned to work as field guides. They were responsible for arranging appointments with target households and setting up drop-off and pick-up points for the survey team. Since most local household heads worked away from home, the field guides had to make prior contact with them, making sure that they were available and ready for the interviews. At the interviews, the field guide often made a short introductory statement to the respondents. This ice-breaking approach is needed to create a friendly environment, build trust between the respondents and the interviewer, and provide a safe space for the conversation. In principle, households should not be compelled to participate in the survey (de Vaus, 2002: 59). Therefore, I had to obtain the informed consent of participants about whether they were willing to participate in the survey. In the social-cultural context of the MDV, informed consent is often obtained orally.

Frequent interactions between the research investigator and the survey team supported the success of the household survey. During the field survey, I accompanied the research team, providing them with feedback and technical support when needed. At the end of each workday, I convened a short meeting with the survey team and reviewed what they had experienced in their interviews. Any possible contingencies or faults were identified and treated with caution. This informal gathering is important to enhance the survey team's responsibility and nurture their collaborative working relationships during the survey administration process.

3.5.2 Sampling strategies for collecting quantitative data

Three research areas that included Phu Thanh B, Phu Xuan, and Thoi Hung communes were selected for the household survey. The stratified sampling approach was used to recruit respondents for the household survey (Figure 3.9). According to Neuman (2011: 256), the stratified sampling approach "produces samples that are more representative of the population than those of simple random sampling."

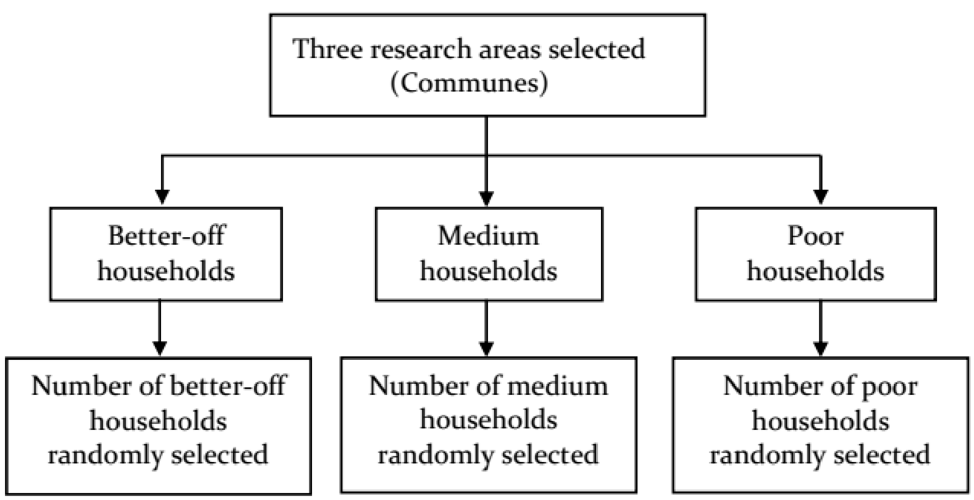


Figure 3.9 Stratified sampling method for the household survey

The recruitment of respondents for the household survey involved the classification of household groups, which was known as wealth or well-being ranking. Developed by Grandin (1988), this method aims to identify different socio-economic groups in a particular community and to learn about the local criteria of well-being (Narayanasamy, 2009: 208). In this research, households were classified on the basis of their socio-economic characteristics (poor, medium, and better-off). Those who practised on-farm and off-farm livelihood activities were categorised into these three sub-populations (strata). From each of these strata, a random sample was drawn. In each commune, 100 households were recruited. The total sample size recruited for the household survey in this research was 300 (Table 3.3).

Table 3.3 Household sample size by research areas

Research areas	Household groups			Total
	Poor	Medium	Better-off	
Phu Thanh B commune	35	35	30	100
Phu Xuan commune	35	30	35	100
Thoi Hung commune	30	35	35	100
N	100	100	100	300

Source: Household survey (2014)

The classification of household groups involved a participatory group discussion. It was jointly undertaken by a representative government official together with local key informants who are knowledgeable about the households in the commune. The classification criteria were suggested and discussed by the group members who finally approved of land ownership, level of income, and housing conditions as the key indicators. These criteria are often used in rural development studies in developing countries (Ellis and Freeman, 2004; Tefera et al., 2005; Nguyen Van Kien, 2012), although they can vary in each country.

3.5.3 Demographic characteristics of sampled households

In this research, households' socio-demographic information was obtained through FGDs and in-depth interviews. Income is determined by households' occupation and employment. For example, seasonal employment and aquatic resources constitute a large share in poor households' income. Poor households often live in a house with cheap and simple materials (mostly made of thatch and bamboos). Meanwhile, the medium household group often engages in on-farm activities, e.g. cultivating cash crops or breeding fish. Evidence suggests that they also engage in off-farm work to get additional income. The medium households' houses are built as semi-permanent structures, mostly covered with tile roofs and enameled floors. Compared to their counterparts, the better-off household group has better living conditions. They often depend on crop production in their farmlands and rural self-employment services. They can invest in farming practices that require high capital such as prawn or fish raising during the flood season. Better-off households barely engage in off-farm work. Most of them own large concrete houses with fully-equipped facilities.

Table 3.4 Distribution of households' land holdings by research areas

Research areas	Land holdings (ha)		
	Poor	Medium	Better-off
Phu Thanh B commune	<0.5	0.5-2,0	>2,0
Phu Xuan commune	<0.2	0.2-0.5	>0.5
Thoi Hung commune	<0.5	0.5-2.5	>2.5

Source: In-depth interviews (2013-2014)

Table 3.4 presents the substantial variations in households' land holdings across the research areas. In general, households in Phu Xuan own the smallest land size compared to those in Phu Thanh B and Thoi Hung. The findings from the in-depth interview with the local government leader revealed that a large agricultural land area in Phu Xuan is owned by the farming households from its neighboring communes. Under the agricultural land distribution policy from the former Song Hau State Farm, most household groups in Thoi Hung possess an equal land size (2.5 ha). That is the minimum land size that the better-off household group owns in this commune.

Table 3.5 presents the demographic characteristics of the households sampled in the three research areas. Descriptive statistics was used to present the comparative distribution of household size, age, gender, marital status, educational attainment, primary occupations, religion, and length of residency. The household size in the sample was over 4 on average, with a minimal variation among the households. There was a slight difference in the mean age of respondents, varying from 48 in Phu Xuan and Thoi Hung to 50 in Phu Thanh B. In general, the proportion of respondents who were married across the research areas was quite high. The number of male respondents in the sample is predominantly high, suggesting that males still play a key role in the rural households.

The respondents' educational attainment level in the sample was relatively low. A majority of respondents in the three communes reported completing elementary school (58 percent in Phu Thanh B, 48 percent in Phu Xuan, and 47 percent in Thoi Hung). Those completing secondary school were a much lower proportion. Of all the communes, Thoi Hung had the highest number of respondents who completed high school and above (20 percent). It had the lowest illiteracy rate (only 1 percent) compared to Phu Thanh B, which had the highest level (22 percent).

Agricultural production constitutes the main livelihood of the farming households across the research areas. This corresponds to the relatively high proportion of seasonal agricultural employment (30 percent in Phu Thanh B, 33 percent in Phu Xuan, and 14 percent in Thoi Hung) available for rural labourers. Concerning religions, those who practised Hoahaoism and Buddhism dominated the sample. In Phu Xuan, 81 percent identified themselves as the followers of Hoahaoism. Meanwhile, 71 percent in Phu Thanh B practised Buddhism. A large number of respondents have been settled in the communes for more than 10 years. It could be inferred that they may have extensive experiences of living with floods.

Table 3.5 Households' socio-demographic characteristics by research areas

Variables	Research areas		
	Phu Thanh B	Phu Xuan	Thoi Hung
Household size			
Mean	4.46	4.24	4.59
Standard deviation	1.42	1.27	1.58
Respondents' age (Years)			
Mean	50.24	48.31	48.19
Minimum	22	26	17
Maximum	87	84	78
Standard deviation	14.07	12.54	12.41
Respondents' gender (%)			
Male	68	63	91
Female	32	37	9
Respondents' marital status (%)			
Single	2	3	1
Married	94	90	98
Widower/Widowed	4	7	1
Respondents' educational attainment (%)			
Illiterate	22	14	1
Elementary school	58	48	47
Secondary school	13	31	32
High school and above	7	7	20
Respondents' primary occupations (%)			
Agricultural production	44	51	73
Aquacultural production	4	1	2
Animal husbandry	1	0	1
Gardening	0	0	4
Seasonal employment	30	33	14
Petty trader	3	2	1
Fishing	2	3	0
Public servant	1	0	0
Hired labourer	1	0	0
Housemaid	11	10	4
Other	3	0	1
Respondents' religion (%)			
Buddhism	71	15	45
Catholics	7	1	3
Hoahaoism	14	81	34
Caodaism	2	3	4
Other	6	0	14
Length of residency (%)			
Less than 5 years	3	1	0
From 5 to 10 years	11	4	2
More than 10 years	86	95	98

Source: Household survey (2014)

3.5.4 Administration of household survey

3.5.4.1 Design of survey questionnaires

The design of the household survey (Appendix 4) is based upon the qualitative findings which have been collected in the first phase. The survey is organised in seven main sections. In particular, they include: (1) households' identification; (2) overview of households' demographic information; (3) households' perceptions of flood processes in the post-dyke context; (4) households' participation in local flood management; (5) households' flood-based practices, shared learning and knowledge exchange during the adaptation process; (6) households' property ownership and income; and (7) households' attitudinal measurements on social learning and adaptive capacity dimensions (Table 3.6). The household survey includes closed questions with a response checklist provided to target respondents.

Table 3.6 Households' information in the household survey

Section	Household information
I	*Households' identification* Demographic information of households' name, gender, socio-economic status, age, religion, and size
II	*Overview of household members' demographics* Demographic information of household members including their names, age, gender, educational attainments, religion, and occupations
III	*Households' perceptions of social-ecological changes observed in the post-dyke context* Households' length of residency; history of local dyke systems; process of dyke construction and operation Households' perceptions of the altered flood regimes in terms of frequency, intensity and timing; alterations of households' farming systems and livelihood patterns; status of employment opportunities; household income and migration in the flood season; change of local infrastructure and transport systems
IV	*Households' participation in local flood management* Frequency and level of households' engagement in local consultations Households' perspectives on the involvement of local institutions and relevant stakeholders in flood management

V	*Flood-based practices and evolution of households' adaptive knowledge and learning interactions* Households' sources of knowledge, occasions and means for shared learning (informal and formal learning interactions), and implications of exchange of adaptive knowledge Identification of social actors involved in knowledge exchange, space of interactions, and frequency for knowledge exchange Interaction patterns among households in implementing flood-based production models Origin of households' initiatives in their daily livelihood practices and how knowledge is disseminated
VI	*Households' property ownership and flood-based income* Households' properties, households' livelihood activities and income during the flooding months
VII	*Attitudinal measurements on households' social learning and adaptive capacity (Using a 5-point Likert scale)* Use of attitudinal scales on the three dimensions of social learning (communication, interaction, reflection) and the three dimensions of adaptive capacity (access to resources, institutional effectiveness, information dissemination)

3.5.4.2 Unit of analysis

Households are the core units in societies. They play a key roles in socio-economic development in many ways. Kaufman-Scarborough (2011) claims that in periods of economic downturn, households create innovative ways to maintain their well-being. In developing countries, livelihood diversification is conceived as one of the proactive strategies that contribute to improving rural households' livelihood security and increasing their living standards (Ellis, 1998; Ellis, 2000; Martin et al., 2013). This research focuses on investigating how farming households have learned to adapt their livelihoods to the significant impacts of the forced adaptation in the MDV. Households involved in this research are those who directly experience the annual floods and perform on-farm and off-farm practices in the flood season. According to Below et al. (2012: 225), "the household operates as the ultimate decision-making unit in farming and livelihood processes." From the perspective of social learning, farming households have made substantial efforts to develop location-specific innovations, using their experimental and experiential knowledge together with formal knowledge (scientific knowledge) to support their livelihoods. The integration of these knowledge systems contributes a great deal to enhancing households' adaptive capacity and mediating the improvement of local flood management policies.

Households are the units of analysis in this research. In the rural socio-cultural context of the MDV, males often assume the role of household heads in the family. They are the legitimate representatives of a family to conduct social transactions in the community. They are commonly seen as the main breadwinners who are mainly responsible for earning a living. These responsibilities make them important; therefore, they often have the highest authority in decision-making in the family.

Given the dominant role in the family, household heads are the main respondents in the survey. This provides a number of advantages. By contacting household heads, the researcher is likely to gain better access to the information than if he contacted other household members. Clark and Steel (2007: 64) claim that selecting one person per household for surveys is more statistically efficient than selecting all household members. As to whether a household head can speak for the entire household, his responses are strongly tied to the housing and safety factors shared by the household (Bookwalter et al., 2006). In the household survey, the information shared by the household head can act as a valid proxy for the entire household.

3.5.5 Quantitative data analysis

All variables were employed to undertake the comparative analysis of household groups in the three research areas. Univariate analysis was used as the main method to describe households' perceptions of the respective changes in the pre-dyke and post-dyke contexts. Accordingly, mean, standard deviation, minimum and maximum were used to describe the variables. Bivariate analysis was also used to examine the association between the latent factors of social learning and adaptive capacity and demographic variables (gender, marital status, age groups, education level, length of residency, surveyed areas, and household groups). Measuring the association between social learning and adaptive capacity involved the application of multivariate statistical techniques such as factor analysis and multiple linear regression. Nominal variables were transformed into dummy variables for analysis in the regression models. In this research, Stata software (version 13) was used to perform all the statistical techniques.

3.6 Secondary data collection and analysis

Secondary data were largely collected at the beginning of the research. This step is essential in providing preliminary understanding of flood regimes, households' livelihood activities in the flood season, and the flood management approach in place in the MDV. These secondary data sources provide great support for scoping the research context and refining the research focus.

Content analysis was used for the secondary data analysis. It is a method of analysing the information in written documents, verbal or visual communication messages (Neuman, 2011; Elo and Kyngäs, 2008). For this research, content analysis involved the extensive reviews and analysis of diverse sources of data including policy documents, journal publications, statistical archives, books, newspapers, and scientific reports from the government agencies across the administrative levels. The analysis results were integrated into the primary data to respond to the research questions.

3.7 Research questions and methods for data collection and analysis

3.7.1 Forced adaptation context, household and institutional re-adaptation

The forced adaptation context has posed multiple challenges in the MDV. The flood management policies in support of the local agricultural and aquacultural development characterised by the 'top-down' approach have resulted in significant drawbacks at the local level. While flood control-oriented measures have received far more attention by local governments, there is an absence of a collaborative governance approach across the region. Massive campaigns of dyke construction imposed by the central government for the intensification of rice production have transformed local social-ecological landscapes in the delta. They have disrupted the regular function of the local flood regimes, and have caused significant change in the rural livelihoods in the flood season. The MDV has reportedly experienced high unpredictability of flood flows over the past few years. This phenomenon has put even greater pressure on farming households regarding how to effectively adapt to such unexpected change. While medium and better-off groups are more likely to sustain their livelihoods over the flooding periods thanks to their successful mobilisation of multiple sources of support through learning networks, poor households are still entrenched by multiple difficulties as they fail to gain equal access to sources, and other alternative opportunities to deal with change. This suggests an urgent need to investigate the nature of the forced adaptation context and how it impacts on the rural societies. Understanding this relationship provides empirical insights into how the rural societies have developed their adaptive capacity to overcome hardship. The research question that aims to address this issue is presented below:

- How does the forced adaptation context shape rural farming household and institutional adaptation practices in the MDV?

Responding to this research question involves critical analysis of households' responses to the structural development processes. Their perceptions of alterations of flood regimes and the transformation of farming practices and livelihood strategies in the post-dyke context are analysed. Both qualitative and quantitative analyses were performed using the results from FGDs, in-depth interviews with key informants, and the household survey. Historical analysis was used to examine the schemes' development process and how they were constructed and operated on the ground.

Three sub-questions that support this first research question are provided below:

1) How does the evolution of flood control schemes reflect the local government's ideologies in development?
2) How do the social-ecological landscapes change in the wake of dyke construction?

3) How have the household groups implemented their adaptation strategies to respond to the social-ecological change?

3.7.2 Social learning for household adaptation

Social learning and adaptive capacity are the key terms that have received increasing attention to address concerns related to climate change (Collins and Ison, 2009; Pelling, 2011; Albert et al., 2012). However, examining the association between these two concepts often involves the application of the qualitative approach (Pelling and High, 2005b; Pelling et al., 2008; Lebel et al., 2010b). This research attempts to explain this relationship in quantitative terms. The hypothesis that guides the quantitative approach to address this causal relationship is as follows:

Hypothesis: Social learning is associated with the level of capacity available to farming households to adapt to the forced adaptation context in the MDV.

Defining appropriate dimensions for each concept to validate the measurement is essential. It depends on the researcher's understanding of the social-cultural context of the areas under study. In the context of forced adaptation in the MDV, the social learning and adaptive capacity concepts have not been defined. Therefore, validating the dimensions of these two concepts in this social-cultural context is challenging. Additionally, there is no quantitative instrument available to measure either their association or them individually. In this research, I adopted Myers and Oetzel's (2003) approach to determine and validate the appropriate dimensions to be measured.

This approach proceeded in two steps. The first step involved the exploration of the dimensions of social learning and adaptive capacity. An extensive review of the relevant literature was conducted to identify established dimensions that have been operationalised (Onwuegbuzie et al., 2010). My literature review produced an exhaustive list of dimensions. The thematic analysis of qualitative results from FGDs and interviews with key informants assisted me in identifying a number of dimensions derived from themes. Apart from those from the literature, I propose six dimensions for operationalisation (Table 3.7). As previously noted, the capture of the dimensions involves the critical considerations of how they fit into the socio-cultural and political context of the MDV. Those which fail to apply to these contextual conditions were excluded from the list. Subsequently, three dimensions of social learning included communication, interaction, and reflection. Three dimensions of adaptive capacity were access to resources, institutional effectiveness, and information dissemination.

The dimensions of social learning and adaptive capacity underpinned the development of the itemised instrument in the second step. The items were intended to reflect a particular content of each dimension. Firstly, I discussed with the survey team how to ensure that they could understand the item meanings and knew how to elicit households' responses. Secondly, the items were pre-tested to check how well they were understood by respondents. Based on the survey team's feedback on the pre-test results, the items were finally revised before the official household survey was administered. A 15-item social learning scale and 18-item adaptive capacity scale out of six dimensions were constructed to be operationalised. In the household survey, the instruction to measure the items was provided: "There are some statements about social learning and adaptive capacity that need to be completed. To what extent do you agree or disagree with each of the statements provided below." A five-point Likert scale (1="strongly disagree", 2="disagree", 3="undecided", 4="agree", 5="strongly agree") was used to rate the respondents' responses.

Table 3.7 Key dimensions identified from literature and qualitative data for measurement

Concepts	Dimensions	Implications	Supporting literature	Key points from FGDs and in-depth interviews
Social learning	Communication	A key element for transmitting knowledge and fostering social learning Conditions for shared understanding and behavioural change for successful adaptation	Newig et al. (2008) Dlouhá et al. (2012) Harvey et al. (2012)	Local farming households often have informal communication, such as chats or discussions with friends, neighbours to exchange experience and knowledge related to their production activities Communication takes place between local households and technical experts when needed
	Interaction	Learning through deliberate interactions	Tippett et al. (2005)	Interactions taking place among local farmers, technical officials, and other participants at local seminars or workshops where they can discuss and learn from one another Visiting successful production models stimulates farmers' knowledge exchange and promotes innovations Households are willing to share what they have learned
	Reflection	A reflective learning process when sharing knowledge, experiences, or ideas with others leading to a change in behaviours and actions	Dlouhá et al. (2012) Keen et al. (2005)	Self-reflection through experimental and experiential learning processes Conducting experiments to learn from them Learning from mistakes from oneself and others Learned lessons are put into practice

Adaptive capacity	Access to resources	Ability to gain access to available resources	Gupta et al. (2010) Nelson et al. (2010)	Being accessible to loans from local banks for production investment Having assistance from relatives, neighbours, or friends when needed Being confident in having sufficient skills and knowledge for crop production Receiving support from local government and local institutions in the flood season Land granted to households for cash crop production in the flood season
	Institutional effectiveness	Institutional support and responsiveness, decision making authority	Bussey et al. (2012) Engle (2011) Berman et al. (2012) Smit and Pilifosova (2003) Yohe and Tol (2002) Adger et al. (2001)	Local farmers are allowed to participate in local dyke construction Local governments provide necessary conditions for households to have employment in the flood season and access bank loans Organising seminar and workshops regularly to promote shared learning among local farmers and others
	Information dissemination	Spatial sharing of information and knowledge	Bussey et al. (2012) Smit and Pilifosova (2003)	Farmers' knowledge and learning experience are disseminated across communities Shared learning is an effective approach to increase households' farming knowledge and experience Farming households' initiatives are well recognised by local governments Information shared contributes to expanding initiatives across communities

Six dimensions of social learning (communication, interaction, reflection) and adaptive capacity (access to resources, institutional effectiveness, information dissemination) from which the items were respectively developed are shown below:

(1) Communication

The current literature recognises communication as an important element in influencing behavioural change. Effective communication underpins successful adaptation to climate change (Harvey et al., 2012) and assists in climate-related decision-making (Pidgeon and Fischhoff, 2011). Johnson (2012) refers to communication as strategies to persuade people to accept adaptation, to foster collective action to change individuals' and institutions' behaviour and collective efforts to identify problems and solutions. According to Tippett et al. (2005), communication makes information accessible to a wide range of stakeholders. It involves the process of interactions among actors involved in social networks. It is conceived of as a crucial platform for shared knowledge and information and effective collective action (Roling and Maarleveld, 1999; Dlouhá et al., 2012).

Social learning stimulates the change in individuals and systems through the process of learning and negotiation (Reed et al., 2006), recognising communication as an indispensable attribute. In the rural context of the MDV, communication is the means for local people to develop their adaptive strategies in response to complex flood conditions. At the household level, communication is illustrated in an informal way. Chats on the occasions of casual gatherings, family celebrations, or field visits are the daily activities whereby the households' knowledge and information can be shared. Four items measuring the dimension of communication were developed. One of the examples, which used the Likert scale to measure the level of households' agreement on the items, is provided below:

Statement: *"I like communicating with those who have farming experience to advance my knowledge."*

Response: *(1) strongly disagree; (2) disagree; (3) undecided; (4) agree; (5) strongly agree*

(2) Interaction

Interaction is a key element of social learning. According to Reed et al. (2010), social learning takes place through the process of social interactions that leads to change of understanding of involved actors. New information or knowledge can be obtained through deliberative interactions among actors within a social network. According to Muro and Jeffrey (2008), social learning involves the continuous process of feedback between the learner and environment. This social interaction approach stimulates collective actions and learning. The interactions may occur in different forms of social relationships (Adger, 2003b), which help to strengthen rural communities' capacity to adapt to environmental challenges. In the MDV, households' interactions are specifically represented by their collective engagement in learning processes between their peers, or with local technical officials, researchers, media, and private sectors. It is indicated that seminars or training workshops create useful learning platforms that assist the joint learning to take place. For the dimension of interaction, six items were developed. Using the Likert scale as indicated, one of the items that aimed to measure respondents' response to this dimension was as follows:

Statement: *"When attending seminars, I usually take part in discussions with other participants."*

Response: *(1) strongly disagree; (2) disagree; (3) undecided; (4) agree; (5) strongly agree*

(3) Reflection

Social learning is a process of iterative reflection through which the members of the 'communities of practice' are engaged. The reflective process is characterised by multiple-loop learning (Dlouhá et al., 2012), which illustrates a series of learning cycles that bring about change in actions, ideas and behaviours (Keen et al., 2005). In the MDV, reflection is demonstrated in the way local households attempt to learn through their intensive engagement in a self-learning process. It represents their iterative interactions between what they do and what they learn to subsequently achieve the desired outcomes in farming activities. The self-learning process often occurs implicitly, involving the households' individual observations and testing in combination with lessons learned from their own mistakes and others'. This internalised knowledge has a strong influence on households' livelihoods. Reflection had five items, of which a typical item is presented as follows:

Statement: *"I do not easily believe things until I experience it myself."*

Response: *(1) strongly disagree; (2) disagree; (3) undecided; (4) agree; (5) strongly agree*

(4) Access to resources

Capacity to gain access to available resources and entitlements is one of the key strategies that contributes significantly to households' capacity to adapt to social and environmental stress (Yohe and Tol, 2002; Nelson et al., 2010). Gupta et al. (2010) considered authority (legitimate power), human resources (expertise, knowledge, and labour), and financial resources as the key criteria that have major influence on adaptive capacity. They posited that institutions should demonstrate their capacity to provide sufficient resources for their social actors to make a change.

Given the political, cultural, and socio-economic context in the MDV, it is important to know how rural farming households are able to get access to these resources to adapt effectively to the complexities of forced adaptation. Five main sources of capitals including social, human, physical, financial and natural sources are examined respectively. For example, having assistance from relatives, neighbours, or friends is a form of social bonding that contributes significantly to local households' adaptive capacity. In this regard, it is critically important to explore how the three household groups (poor, medium, better-off) could have equal opportunities to access these resources. Five items were developed for the dimension of access to resources. A representative item that addressed households' access to resources is presented below:

Statement: *"I don't think it is difficult to get a loan from the local bank for flood production investment."*

Response: *(1) strongly disagree; (2) disagree; (3) undecided; (4) agree; (5) strongly agree*

(5) Institutional effectiveness

It is widely recognised in the literature that institutions play an important role in promoting adaptive capacity (Adger and Vincent, 2005; Agrawal et al. 2009; Gupta et al., 2010; Bussey et al., 2012). In particular, institutional processes and decision-making structures are instrumental in creating adaptation options (Yohe and Tol, 2002). Adger et al., (2001: 4) argue that "the key to understanding the process of adaptation is to focus on institutions." According to Bussey et al. (2012), institutions are one of the main determinants of adaptive capacity. They provide meaningful structure for action and are instrumental in implementing responses to change. In the same vein, Agrawal et al. (2009: 4) claim that effective local adaptation demands local institutions to be responsive, flexible, and able to adapt to uncertainties. The institutional effectiveness in the MDV refers to responsibility, incentives and supportive policies taken by local government agencies in facilitating households' adaptive responses to annual flood events. For example, creating employment for poor household groups during the flood season is one of the government's important policies that have been implemented. The institutional effectiveness is also reflected by the local government's recognition of households' views and participation in local flood management. For the dimension of institutional effectiveness, seven items were constructed. One typical item is presented below:

Statement: *"I think everyone has a say in the decision-making process on local dyke matters."*

Response: *(1) strongly disagree; (2) disagree; (3) undecided; (4) agree; (5) strongly agree*

(6) Information dissemination

Information is concerned with the application of technology and imagination that influences adaptive capacity of the social actors involved (Bussey et al., 2012). In the context of climate change, information should be made available and understood to enable discussion and implement adaptation measures (Smit and Pilifosova, 2003). According to Gupta and Hisschemöller (1997), the enhancement of adaptive capacity in a system can be attributed to how successfully climate change and adaptation information are disseminated. In the flood context of the MDV, the shared learning in relation to farming production by rural households constitutes an important component in their adaptive responses to annual flood events. It is conceivable that the learning platforms such as seminars or workshops that are locally organised contribute considerably to enriching and disseminating local farming households' knowledge. This place-based learning approach is seen as one of the most effective mechanisms to stimulate the knowledge exchange between farming households, technical experts, and other relevant social actors. It is how households' initiatives come to be pervasive across communities. Six items were developed for information dissemination. To measure this dimension in the household survey, one of the items was used as follows:

Statement: *"I share my farming experiences with those who not only reside locally but elsewhere."*

Response: *(1) strongly disagree; (2) disagree; (3) undecided; (4) agree; (5) strongly agree*

Factor analysis is a statistical technique that is used to deconstruct abstract concepts. It informs preliminary statistical results for the regression modeling to examine causal relationships of these concepts. This analytical procedure has been adopted by a number of social researchers. To operationalise social capital and the attitude to conservation of the local community in Cat Tien national park of Vietnam, Nguyen Ngoc Thuy (2007) used exploratory factor analysis to identify the latent factors from which he performed linear regression modeling to examine their relationship. Brown and Raymond (2007) followed a similar approach to examine the relationship between place attachment and the landscape values of residents and visitors to the Otways region, Victoria, Australia. The exploratory factor analysis identified two dimensions from the place attachment index. On the basis of these results, they used regression analysis to examine the relationship between place attachment and landscape values. In a case study of the Morogoro region of Tanzania, Below et al. (2012) explored the latent variables of farmers' adaptation behaviour from the activity-based adaptation index (AAI) and calculated the multiple regression analysis to examine the relationship between socio-economic variables and these latent variables.

I followed the statistical procedure in the previous studies to examine the relationship between social learning and adaptive capacity at the household level (see Chapter 5). I first conducted exploratory factor analysis to explore the latent factors arising from the social learning and adaptive capacity dimensions. These results were subsequently included in the multiple regression models to examine their relationships in combination with other explanatory socio-demographic variables (gender, educational level, age groups, household groups, communes, and length of residency). Detailed discussion of how these combined techniques were applied to respond to the second research question is presented in the following section.

3.7.2.1 Use of exploratory factor analysis

Exploratory factor analysis is a statistical technique that is widely used in the social sciences (Costello and Osborne, 2005). According to Reio and Shuck (2015), the most common application of exploratory factor analysis involved "reducing relatively large sets of variables into more manageable ones, developing and refining a new instrument's scale, and exploring relations among variables to build theory." In this research, I used exploratory factor analysis since social learning and adaptive capacity were designed as exploratory measures. In addition, I have no pre-existing knowledge about the factors that may explain the relationships between variables. Therefore, applying this technique is suitable to explore how the latent constructs of social learning and adaptive capacity could be identifed to serve further statistical analysis.

Sample size in factor analysis has encountered critical debates among scholars. Some 'rules of thumb' have been arrived at. According to Tabachnick and Fidell (2007), at least 300 cases are adequate for factor analysis. Others argued that the number of cases needed for factor analysis should be 100 or greater (Hair et al., 2014). Sapnas and Zeller (2002) suggested that the sample size may even be 50 cases. However, according to Winter et al. (2009), exploratory factor analysis can achieve good quality results even when the cases are below 50. For this research, the sample size was 300, which corresponds to most scholars' suggestions in conducting factor analysis.

The KMO (Kaiser-Meyer-Olkin) test was used to measure the sampling adequacy. It assists in determining whether the items are adequately predicted by each factor. The KMO index ranges from 0 to 1. It is recommended that this technique should yield high values above 0.7 (de Vaus, 2002: 188). Others agreed that the KMO values could be 0.5 (Gray and Kinnear, 2012; Tabachnick and Fidell, 2012). In this research, the KMO test yielded the values of 0.839 for social learning and 0.910 for adaptive capacity, compared to the recommended threshhold of 0.7. In addition, the significant value ($p<0.001$) of Bartlett's test of spherity suggested that the data were sufficiently high for exploratory factor analysis.

The first step in exploratory factor analysis involved checking correlations of the variables. It aimed to identify the suitable items on the basis of their coefficients (ranging from 0 to 1). According to de Vaus (2002), any items of which coefficients are less than 0.3 were dropped out of the scale. He suggested using interval-level variables for exploratory factor analysis. In this research, all items measuring social learning and adaptive capacity dimensions were designed in the five point Likert-scale format. I used principal axis factoring analysis to determine the unobserved (latent) factors of the two concepts. According to Lorenzo-Seva (2013), it is a straightforward extraction method and its conclusion can be generalised to most factor analysis methods. With the principal axis factoring technique, latent factors are the focus of the analysis (Henson and Roberts, 2006). They are the key variables to be used for further statistical analysis.

The number of factors to retain for rotation depends on the eigenvalues. The eigenvalue of a factor is the amount of variance in all variables that is explained by that factor. The higher this value is, the more variance the factor explains (de Vaus, 2002). According to most scholars, eigenvalues greater than 1.0 should be retained for further analysis (de Vaus, 2002; Costello and Osborne, 2005; Hammitt et al., 2006). Others suggested using the Scree test (Williams et al., 2012). The data points that are located above the break suggest the number of factors to be retained. Ledesma and Valero-Mora (2007) found this to be important since negligent extraction of factors would lead to erroneous conclusions in the analysis. In this research, both approaches were examined. The results from factor extraction suggested that two factors in social learning and one factor in adaptive capacity had eigenvalues greater than 1.

Rotation is to simplify and clarify the data structure (Costello and Osborne, 2005), which makes it easy to interpret. Three rotation methods that use the orthogonal technique include varimax, quartimax, and equamax. However, varimax is the most commonly used as it effectively distinguishes between factors after rotation. However, considerations on rotated factor structure should be taken. Costello and Osborne (2005) suggested a 'cleanest' factor structure should guarantee three criteria: (1) item loadings above 0.3; (2) no or few item crossloadings (an item loading at 0.3 or higher on two or more factors); (3) and no factors with fewer than three items. According to de Vaus (2002), for an item to be retained, its loading coefficients should be at least 0.3. However, Hair et al. (2014) and Hammitt et al. (2006) agreed that the item loadings should be 0.4 or higher in order to be significant for interpretative purposes. I developed the factor structure in light of these theoretical perspectives in this research. In particular, items below 0.4 were dropped out of the factor-loading matrix. Three items with high cross-loadings on the two factors of social learning were deleted. In total, four items in social learning and five items in adaptive capacity were excluded from the analysis.

A test for reliability is needed to examine the consistency of a respondent's response on a scale item compared to others. The measurement of the scale reliability is presented by Cronbach's alpha coefficient, which ranges from 0 to 1. The higher this figure is, the more reliable the scale becomes. According to de Vaus (2002: 184), Cronbach's alpha should be at least 0.7 for the scale to be reliable. In this research, the factor analysis produced the overall reliability of social learning and adaptive capacity indexes which met this conventional benchmark. Their Cronbach's alpha values were greater than 0.7.

Eventually, the exploratory factor analysis obtained 11 items loading on two factors of social learning and 13 items on one factor of adaptive capacity. These factors need to be labelled, which makes them available for further analysis. Labelling was based on the shared content of the items in each factor (Williams et al., 2012). The first factor of social learning was labelled external learning performance (ELP) because all the items were concerned with households' preference over external interactions and communication. In this sense, Glasser (2009: 51) calls it active social learning. The second factor of social learning was labelled internal learning performance (ILP), as the items involved the sense of internalisation in knowledge acquisition. Adaptive capacity was labelled by itself due to only one factor being identified.

Three ways of forming scales are recommended to calculate the latent factors, including unweighted factor-based scales, weighted factor-based scales, and factor scales (de Vaus, 2002: 191). In this research, I used the weighted factor-based scale to generate the summated scores for each factor. Using this approach, I weighted the item scores by their loadings (all selected variables were multiplied by their corresponding loadings and then added all together). This calculation produced the final scores for the three factors. These factors were used as continuous variables in the multiple regression analysis.

3.7.2.2 Use of multiple linear regression models

Multiple regression is a statistical method that is commonly used for data analysis when there are multiple explanatory variables (Leech et al., 2003). As previously noted, because the factor of adaptive capacity was a continuous response variable, multiple OLS (Ordinary Least Squares) regression models were used to explain the relationship between social learning and adaptive capacity. In these regression models, social learning was the explanatory variable which was represented by the two latent factors. Meanwhile, adaptive capacity was the response variable represented by its single factor. Other explanatory socio-demographic variables were represented by their respective dummy variables. According to Aiken and West (1991), this is the most commonly used procedure to represent categorical variables in regression equations. The equation for the multiple linear regression models is shown below:

$$Y = b_0 + b_1X_1 + b_2X_2 + \ldots + b_nX_n + \varepsilon$$

In this equation, Y is a response variable that represents adaptive capacity. b_0 is the intercept term. b_1, b_2, … b_n are the regression coefficients which correspond to their explanatory variables X_1, X_2, … X_n. As previously noted, ELP, ILP (continuous) and the socio-demographic variables are the explanatory variables (dummy). Finally, ε is an error term.

Three multiple regression models were constructed for households' adaptive capacity. In each model, the interaction terms were included. They were formed by the multiplication of a continuous variable (ELP and ILP) by each of the dummy variables (socio-demographic variables). This research attempted to examine how the effects of each explanatory variable of social learning (ELP and ILP) on adaptive capacity varied across the communes (Thoi Hung, Phu Thanh B, and Phu Xuan) and household groups (poor, medium, and better-off).

3.7.3 Social learning for institutional change

Adaptation to climate change requires policy considerations whereby institutions play a crucial role (Tol et al., 2003; Adger, 2000). Institutions involve socialised ways of interacting and underlying worldviews as well as structures and organisations that influence resource allocation (Adger, 2000). So far, policy processes and institutions have rarely been discussed at the jurisdictional scale of sub-national policy and planning (Dovers and Hezri, 2010). While formal institutions are seen as the determinants to manage local-level climate change vulnerabilities in the western society (Glaas et al., 2010), the role of informal institutions in natural resource and risk management in the Vietnamese context is more prominent. Concerning the institutional change for adaptation associated with the control and use of natural resources in coastal Vietnam, Luttrell (2001b) found that local community members created *de facto* common property situations as the result of subverting the existing institutions and developing new informal structures. When examining the institutional adaptation under the risks of flooding and typhoons in coastal northern Vietnam, Adger (2000) pointed out that the spontaneous emergence of local civil institutions for collective actions in managing environmental risks offset the state's inertia driven by the de-collectivisation process.

Social learning operates across institutional structures. It becomes an alternative policy instrument in the context of water governance (Blackmore et al., 2007). Social learning provides valuable opportunities for sharing initiatives, ideas, values and formulating new policies and practices (Collins and Ison, 2009; Pelling, 2011). These collective learning processes are believed to detect the intangible flaws in the existing institutional systems. Multiple stakeholders that are engaged in the context of flood governance in the MDV are identified. This 'community of practice' presents the informal and formal interaction boundaries between the stakeholders such as local government agencies, academics, farming households, and external social groups. These relationships are formed in light of boundary organisation, bridging organisation, and shadow systems[9]. This research elucidates how the learning interactions taking place within and across these boundaries facilitate the integration of existing knowledge systems to address the institutional gaps in flood management and adaptation. So far, the learning interactions of these knowledge systems in the flood governance context in the MDV are poorly understood. The research question that aims to advance this understanding is provided below:

- How does social learning facilitate institutional change in flood management and adaptation practices in the MDV?

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[9] Refer to Chapter Two for further references. Also see Nilsson, A. E. and Swartling, A. G. (2009) *Social learning about climate adaptation: Global and local perspectives*, Stockholm: Stockholm Environment Institute.

To respond to the above question, the following sub-questions need to be addressed:

1) How is social learning characterised in formal and informal interaction boundaries?

2) How are the learning patterns shaped by strategic groups in the formal and informal learning boundaries?

3) How do the integrated knowledge systems constructed from these learning interactions mediate the institutional change in local flood management and adaptation?

Qualitative data analysis was the primary approach to respond to these research questions. The intention was to explore how the social learning process was portrayed in the light of flood management and adaptive performance of the rural societies. Through qualitative analysis, the stakeholders' roles and power relationships that shaped the learning patterns and decision-making processes and the policy influence across administrative levels were respectively investigated. This research aims to provide a better insight into how the shared knowledge systems which were facilitated by the social learning process contributes to enhancing the performance of flood management and adaptation on the ground.

3.7.4 Adaptive co-management to inform the long-term adaptation strategies in response to the forced adaptation complexities

The social-ecological complexities provide opportunities for governments to select which governance approach is best suited to natural resource management. According to Huntjens et al. (2012: 67), current institutional arrangements are not sufficient to manage the new challenges. Critical debates have been raised in the domain of water governance. Tropp (2007) presented the contemporary understanding that water decision-makers and managers are not fully aware of the new form of governance that involves inclusive decision-making processes, coordination and negotiated outcomes. Therefore, the strengthening of the horizontal and vertical linkages of formal institutional settings and informal institutions and adaptive management is the key to future governance approaches (Pahl-Wostl, 2006). Effective governance links closely with the management of people and processes, diversity of organisation, and knowledge sharing (Armitage et al., 2011). In response to Huntjens et al.'s (2012) position, the application of the adaptive co-management approach, when facilitated by social learning processes, can better address the current institutional gaps.

A number of studies on adaptive co-management in natural resources management have been conducted in developing countries (Marschke and Nong, 2003; Evans et al., 2011; Bown et al., 2013). The challenges encountered in the forced adaptation context in the MDV necessitate an appropriate governance approach to remedy the policy deficiency in the prevailing flood governance system. This research suggests that adaptive co-management has been clearly manifested at the household and institutional level. At the household level, it refers to local households' enterprise in experimenting with various farming initiatives employing the knowledge acquired from their self-learning and learning interactions with others. At the institutional level, it demonstrates institutional endeavours in trying out various measures to support local flood management and adaptation. The policy change has been largely drawn from lessons learned by themselves or iterative interactions with local stakeholders. Understanding how adaptive co-management can effectively tackle the delta's forced adaptation complexities in the long term requires an in-depth investigation of the following question:

- How can adaptive co-management inform the long-term adaptation strategies in response to the forced adaptation complexities in the MDV?

To address this question, three sub-questions need to be investigated:

1) How do flood management and adaptation processes over the course of the delta development evolve towards the adaptive co-management approach?

2) How is adaptive co-management demonstrated at the interface of flood management and adaptation practices?

3) How can these adaptive co-management practices inform the long-term adaptation strategies in the MDV?

Qualitative analysis is employed as the primary approach to respond to this research question. In particular, historical and content analyses are used to illustrate the three key milestones of the 'opening-up and closing-off' processes in the delta. Through qualitative analysis, the research aims to elaborate the reflective interactions between the state's flood management policies and the rural societies' adaptive responses that shape the social-ecological landscapes of the delta at present.

3.8 Ethical considerations for the research

I conducted my fieldwork under the authority of the local governments. Before it was undertaken, I informed them about the research content and how the data collection process would be implemented. In this research, the ethics procedures for the fieldwork complied strictly with the guidelines stipulated by the Human Research Ethics Committee of the Australian National University.

Some ethical issues may arise from the presence of the government staff during the process of data collection. This is clearly realised in the social-political context of Vietnam. In this research, it was critically acknowledged that the accompanying staff, despite working as 'field guides', did not show up in any FGDs or household interviews. Being aware that their presence could have potential effects on the respondents' confidence and the quality of information shared, the researcher often consulted with the staff to ensure that respondents felt truly comfortable when participating in the FGDs and interviews. For this reason, all of the data collection activities were undertaken at a respondent's house.

The researcher gained oral consent from respondents involved in the research. The oral consent script provided information about the research and the ethical principles it followed. Compared to written informed consent, oral consent is more appropriate to the social-cultural context in the MDV. Rural respondents prefer this informal procedure because it is much simpler. It is apparent that some of them were illiterate, thus feeling unfamiliar with formal procedures involving paperwork. Oral consent procedures instead made them feel at ease before they were ready to participate in the interviews. There was no serious problem associated with obtaining oral consent during the data collection.

As stated in the oral consent, the information collected from the respondents will be kept confidential. All research data were protected in a safe place and exclusively employed for my academic purposes and thesis write-up only. In the household survey, each case was labelled with an identification number which makes it easy to check the case information and sort out the data when needed. For those who were involved in FGDs and in-depth interviews, I used pseudonyms when citing their personal statements in the thesis report. This aimed to protect their identification and avoid potential harm associated with their disclosure of information.

3.9 Conclusion

Investigating the implications of social learning for household and institutional adaptation in the flood governance context of the MDV necessitates the application of the mixed methods approach. This research employs the exploratory sequential design as the primary inquiry strategy that integrates the qualitative and quantitative approaches into data collection and analysis. The qualitative approach assisted by the FGDs, in-depth interviews, and field observations helps explore the ways farming households have learned to adapt to flood complexities and institutional performance in flood management. The qualitative analysis provides empirical evidence for the design of household questionnaires. Following the qualitative approach, the quantitative data collection was conducted. The stratified sampling approach was employed to recruit appropriate respondents for the household survey. The quantitative analysis complements the qualitative data in order to respond to the research questions. By adopting the exploratory sequential design in this research, the incorporation of the qualitative and quantitative data aims to ensure that the true pictures of social learning and adaptation practices at the household and institutional level can be best illustrated and explained. Using the complementary strengths of the qualitative and quantitative approaches also helps guarantee the validity and trustworthiness of the research findings. Given the complexity in defining and measuring the constructs in the social, cultural and political context of the MDV, the application of the mixed methods approach in this research is critically important.

Drawing on the relevant literature and the qualitative data gathered in the first phase of the data collection, the dimensions of social learning and adaptive capacity were selected and operationalised. The indexes of social learning dimensions (communication, interaction, and reflection) and those of adaptive capacity dimensions (access to resources, institutional effectiveness, and information dissemination) were constructed and validated respectively. The overall reliability of social learning and adaptive capacity indexes using Cronbach's alpha met the conventional criteria for further statistical analysis. The latent factors produced by the factor analysis will be used in the multiple linear regression analysis in order to explain the causal relationship between social learning and adaptive capacity. In this regard, this research contributes a new methodological approach.

It is interesting to investigate how the forced adaptation complexities have stimulated the rural societies to shift from natural (free) adaptation to re-adaptation (forced adaptation) strategies in response to change. The next chapter discusses the relevance of the state flood management processes in the MDV to the ongoing transformation of social-ecological landscapes and the rural societies' adaptation practices. In particular, it presents a comparative analysis illustrating the change in the rural livelihood portfolios under the effects of dyke building policies. Adaptive efforts made by the household groups (better-off, medium and poor) in the pre-dyke and post-dyke conditions will be discussed.

Chapter 4

From Free to Forced Adaptation: Implications for Household and Institutional Re-adaptation

> "Man never stops affecting his natural environment. He constantly transforms it; and he actualises new forces whenever his efforts carry him to a new level of operation."[10]

(Karl-August Wittfogel, 1957)

4.1 Introduction

Most riverine societies have developed ways to live with floods (Cuny, 1991). These adaptation strategies have constituted the unique life characteristics of local inhabitants in the MDV for hundreds of years. The delta's history has undergone continuous 'opening-up and closing-off' processes (Miller, 2007). This evolution has transformed the delta from a riverine civilisation to a modern hydraulic society (Benedikter, 2014). Empirical evidence of the exploitative stage in the delta concerning the management of natural resources for early human demands is well represented in a large body of scientific research and policy documents. However, little is known about how local adaptation practices interact socially and institutionally with the contemporary flood management policies. While the development planning in the delta has raised suspicion about its sustainability (Käkönen, 2008), the landscape engineering has practically revealed considerable challenges to local livelihoods.

Irrigation and flood control are at the heart of the state's policies on water resources management in the MDV. They are key measures to regulate floodwaters and provide freshwater sources for local agricultural production (Chu Thai Hoanh et al., 2012; Waibel et al., 2012). The flood management in the delta is associated with the detrimental impacts of forced adaptation characterised by local engineering

[10] This extract is adopted from S. Benedikter (2014).

structures, upstream development, and climate change (Le Thi Viet Hoa et al., 2007a). Meanwhile, the rural societies have to self-organise and empower themselves to deal with these complexities. This interaction forms the basis for the formulation of my argument in this chapter. I argue that the forced adaptation complexities have brought about the continual reframing of adaptive performance at the local level. The argument addresses the relationship between the local dyke development policies and the transformation of local social-ecological landscapes, prompting rural households to adjust their livelihood strategies to fit the emerging conditions.

This chapter is structured as follows. Section 4.1 is the introduction. Section 4.2 concerns the evolution of flood management in the MDV and the ideologies of the contemporary state underpinning it. In this section, three main stages of flood management are discussed. Section 4.3 provides an overview of flood regimes in the delta and their alterations over the last few decades. Section 4.4 discusses how the dyke systems shape the adaptive performance of farming households on the ground. In this section, the evidence and implications of the pre-dyke versus post-dyke landscapes associated with the corresponding transformation of households' farming patterns and livelihood strategies are comparatively analysed. Section 4.5 is the chapter conclusion.

4.2 Processes of flood management in the MDV

Flood management is embedded in the overarching legal framework and the history of water resources management in the MDV. According to the water governance assessment (CTU, 2011), the process of water management in the delta is categorised into three primary periods, which include: (1) natural (free) adaptation (before 1975); (2) intensive irrigation (from 1976 to 2010); and (3) re-adaptation (forced adaptation) characterised by the combined impacts of dyke systems, upstream development and climate change (after 2010 to date). The water resources management in the delta's history is associated with various flood management approaches undertaken by contemporary states to achieve their respective development goals. This chapter focuses particularly on the social-ecological complexities of the last period, and examines how they impact on local household and institutional adaptation.

4.2.1 Free (natural) adaptation of the early rural societies

All human societies are fundamentally adaptive, as evidenced in history (Adger et al., 2003a). In the MDV, the transition from the ancient culture (Oc Eo) confirms that the livelihoods of early inhabitants (including Khmer Krom groups) were closely attached to local natural conditions (Taylor, 2014: 105-106). Long-term interactions with the natural environment helped strengthen their capacity to adapt to emerging situations (Tran Hoang Kim et al., 1991, cited in Taylor, 2001; Taylor, 2014). Their adaptation involved a tenacious compromise with nature to serve their needs. The interviews with a social scientist at Can Tho University revealed that the local inhabitants' livelihoods in the pre-1975 period depended heavily on exploiting available natural resources, expanding human settlements, and excavating hydraulic systems for cultivating subsistence crops (Figure 4.1). Even though several large-scale canal projects were initially built, the social landscapes of the delta in the mid-18th century were largely characterised by "loosely connected enclaves along waterways" (Biggs, 2004: 30). Yet, these early development efforts set an important milestone for the accelerated 'opening-up' of the delta in the era of colonial administration.

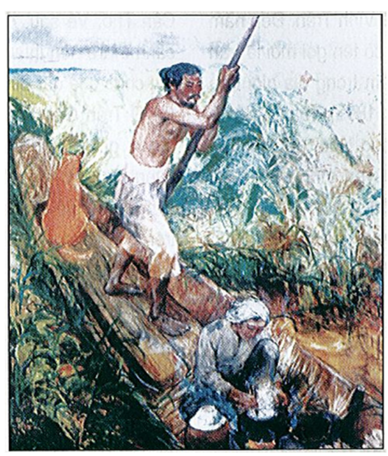

Figure 4.1 Early inhabitants in the MDV

Source: Chu Viet Luan (2006)

During the early period of French rule, canal excavation was one of the policy priorities of the colonial regime, aimed at accelerating local rice production and aquatic transportation (Phan Khanh, 2005). From 420,000 ha of land in 1880, the expansion of canal systems and rice production reached 1.2 million ha in 1905, accounting for nearly one-third of the delta (Cosslett and Cosslett, 2014). This process was positively correlated with the growth of the local population (Figure 4.2). By 1930, approximately 2.1 million ha had been brought under cultivation, mostly in the lower part of the MDV. However, large areas of the delta (about 1 million ha) remained untouched due to acid sulphate soils which make rice cultivation impossible.

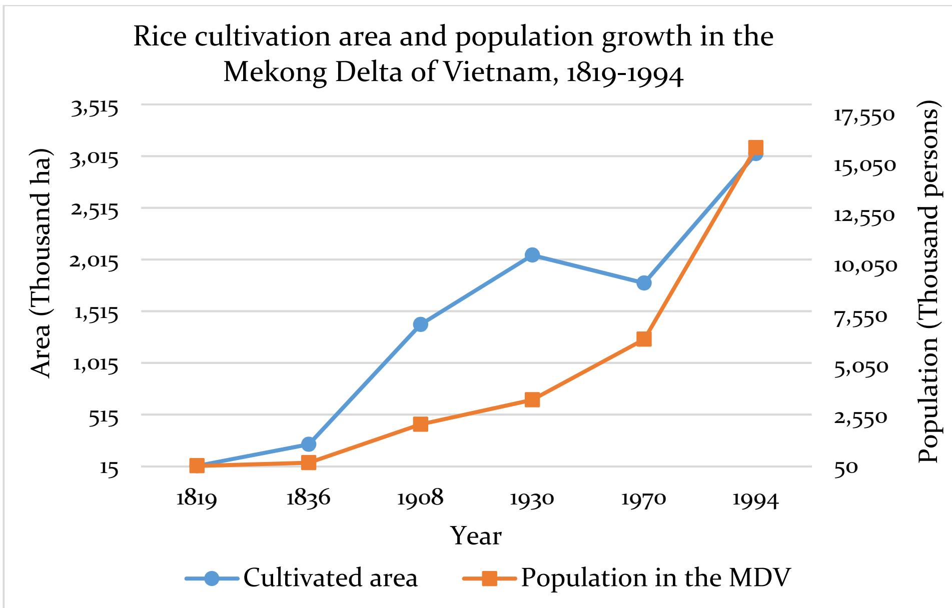

Figure 4.2 Rice cultivation areas and population growth in the MDV

Source: Figure by Tran Anh Thong; Nguyen Dinh Dau (2001)

The practice of traditional cropping systems illuminates how the local inhabitants adapted to the natural environment in the early stage. Free-flowing flood regimes and existing soil conditions are the key elements that enable these farming practices. To adapt to such natural conditions, the inhabitants have to select cultivation methods and farming patterns suitable for local environments (Nguyen Huu Chiem, 1994). Floating rice is the predominant crop, and covers a large part of the Long Xuyen

Quadrangle and the Plain of Reeds (Vo Tong Xuan, 1975; Brocheux, 1995; Nguyen Van Sanh et al., 1998). These depressed areas are commonly exposed to high inundation during the flood season. The floating rice varieties have a long growing period and are harvested at the end of the flood season (Nguyen Huu Chiem, 1994). Local inhabitants can also collect another variety of rice known as 'Heaven's rice' *(lúa Trời)* for domestic consumption (Figure 4.3). This unique variety grows wild and abounds in high flood areas. Until the end of the Vietnam War in 1975, floating rice cultivation remained the popular farming system, especially in the upstream areas of the delta.

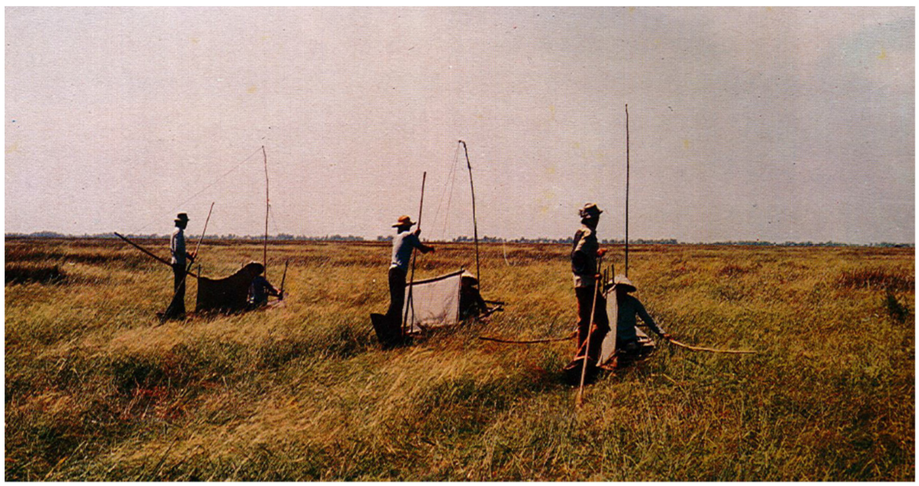

Figure 4.3 Harvesting the Heaven rice *(lúa Trời)* in the Plain of Reeds

Source: Thach Phuong et al. (1992)

First introduced in the MDV in 1968, high yielding rice varieties (HYVs) soon became popular (Vo Tong Xuan, 1975). The rapid growth of the HYVs leads to the spread of double-cropping systems, accelerating the 'closing-off' process in the delta. This renders two paradoxical implications. On the one hand, this policy has been accompanied by an extensive campaign launched by the central government for the expansion of cultivated areas, rice intensification, and agricultural diversification to ensure the national food security and increase household income. Dyke construction and canal excavation are taken as the pre-emptive measures to promote these agriculture-oriented policies. On the other hand, this structure-oriented approach has seriously constrained local inhabitants' free adaptation to the natural environment.

4.2.2 From flood risk mitigation to rice intensification and agricultural diversification: The role of flood control approach in the MDV

The state's vision of expanding the delta to achieve national security and inhabitant resettlements since the Nguyen Dynasty sheds initial light on the employment of the control approach in the colonial and post-war periods. During the colonial era, the French government accelerated land exploitation by mechanising the canal excavation process, turning it from a state of 'wildernesses' into 'civilisation'. Apparently, this 'opening-up' process took flood control as an essential approach to the state's water governance in the delta. Frequent occurrences of large floods causing human casualties, as well as substantial loss of properties and crops, led the contemporary state to use flood control structures as the key solution to mitigate the flood impacts. Since 1937, the MDV has experienced 14 major flood events (Figure 4.4). The ideology of 'human mastery over nature' inherited from the colonial period, together with food shortages in the post-war period has strengthened the state's mandate over agricultural development in the floodplains. This policy implies that the structural systems play a pivotal role in flood control to enable rice production and farming diversification in the short and long term (Imamura and Dang Van To, 1997).

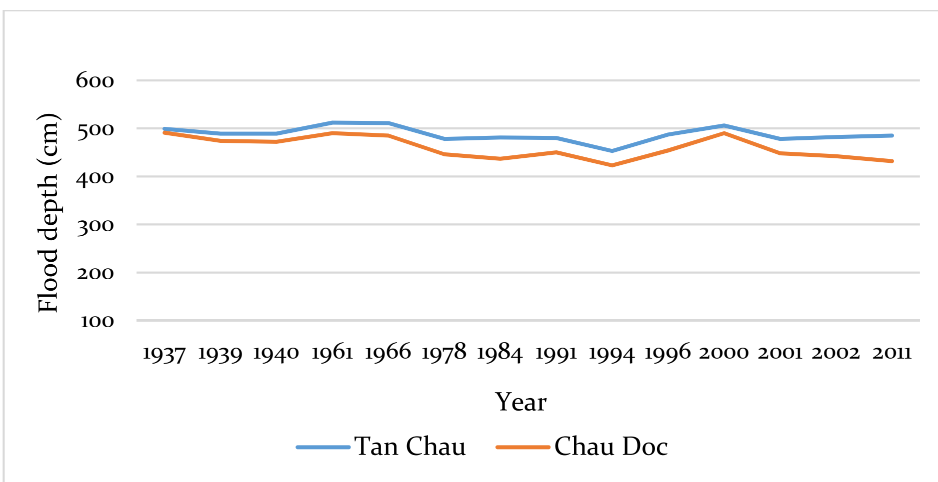

Figure 4.4 Large flood events in the MDV from 1937 to 2011

Source: Figure by Tran Anh Thong; Tran Nhu Hoi (2009); MRC (2014)

The structure-oriented approach dominates the state policy of flood management. Since 1975, the hydraulic landscape of the delta has been transformed dramatically, driven by the central government's flood control policies for the expansion of rice cultivation areas (1976-1990), rice intensification (1991-1999) and farming diversification (2000 to date) (Bosma et al., 2005; Garschagen et al., 2012; Chu Thai Hoanh et al., 2014). The disastrous flood events in 1978 and the subsequent widespread food shortages in the 1980s provided the key rationale for the state to increase the investment of large-scale hydraulic schemes to mitigate flood impacts and ensure food security (Le Anh Tuan et al., 2007; Biggs et al., 2009; Waibel, 2010). Miller (2007) noted that about 62 percent of the state's total capital investment in agriculture was allocated for water resource development between 1976 and 1989. These efforts reflect the legitimacy of the state control policy, which highlights the significant role of hydraulic systems in agricultural development (Luttrell, 2001a).

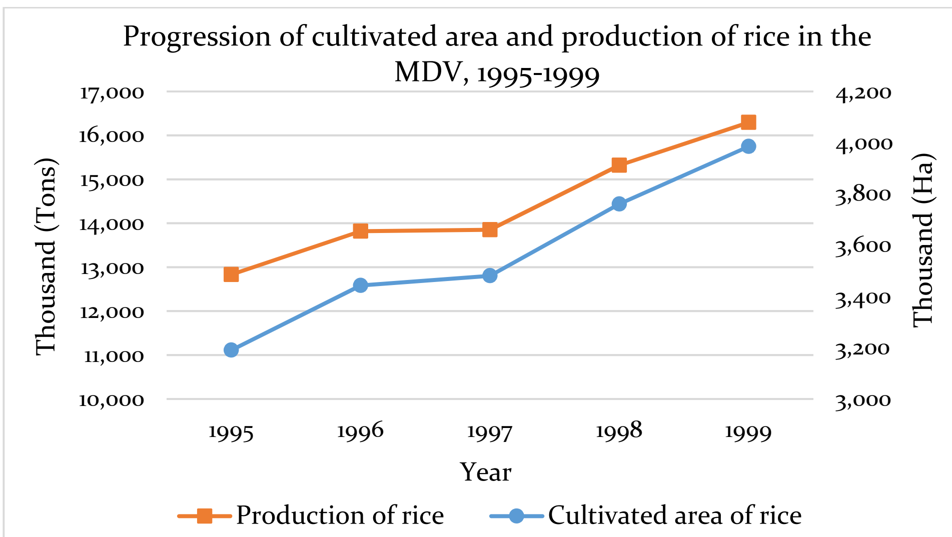

Figure 4.5 Cultivated area and production of rice in the MDV from 1995 to 1999

Source: Figure by Tran Anh Thong; GSO (2014)

The policy reforms after *Đổi Mới* in 1986 paved the way for the intensification of rice production and agricultural diversification in the MDV. According to Prime Minister's Decision No. 99/TTg issued on February 9th, 1996, dykes and irrigation systems are preconditions for rice production and local transportation. The third article of this

Decision stated that the construction of irrigation systems in the MDV, until the year 2000, aimed to expand by 500,000 ha of rice cultivation, contributing to the total cultivated area of over 3 million ha. There was a proportional increase in rice outputs to the cultivated areas during the 1995-1999 period (Figure 4.5). In 1999, Vietnam exported 4.6 million tons of rice (Le Anh Tuan et al., 2007), over 90 percent of which was produced in the delta.

The introduction of the HYVs cultivation had substantial impacts on the intensification of rice production in the MDV. Stimulated by this innovative technique, single-cropping patterns have been rapidly converted to double-cropping systems (Tanaka, 1995; Yasuyuki, 2001; Yamazaki, 2004). In particular, about 400,000 ha of floating rice cultivation in the Long Xuyen Quadrangle and the Plain of Reeds moved to the double cropping rice system (Nguyen Van Sanh et al., 1998). New irrigation works were built to serve the expansion of this farming pattern in the delta.

Figure 4.6 An embankment dyke of North Vam Nao project in Phu Xuan with the flood season (left) and the winter-spring crop after flood recession (right)

Source: Photos by Tran Anh Thong (2013)

Enforcement of the decentralisation policy since 1986 offers provincial governments legitimacy to implement further investment in structural measures. They have been motivated to find new models of cooperation to sustain and improve their systems (Biggs et al., 2009). As stipulated in the Prime Minister's Decision (2006), the irrigation planning in the MDV should be adjusted and supplemented to promote agricultural, aquacultural, and rural development. To mitigate the flood effects in

Omon-Xano, irrigation works supported by the World Bank built 234 km of dykes and reinforced existing dyke systems to protect the agricultural area from annual flood inundation (World Bank, 2011). Further upstream, between the Tien and Hau Rivers, is the North Vam Nao flood control scheme, which covers an area of 30,836 ha of Phu Tan and Tan Chau districts of An Giang province (Figure 4.6). This scheme includes canal systems, sluices, irrigation pump stations, 100 km of closed ring dykes and 300 km of internal dykes (Kellogg Brown and Root Pty Ltd., 2005). These structural systems aim to control high floods, enable intensive rice production, and diversify agricultural production. In the flooded areas of the delta, dyke systems have been constructed to increase the cultivation from two to three rice crops per year. Since 2006, the cultivated areas for the third crop (autumn-winter crop) have increased steadily (Figure 4.7). In 2012, An Giang, for instance, had the largest cultivated area devoted to the autumn-winter crop (> 145,000 ha) compared to the surrounding areas. In addition to intensive rice production in the wake of structural development, various farming patterns have emerged at the local level.

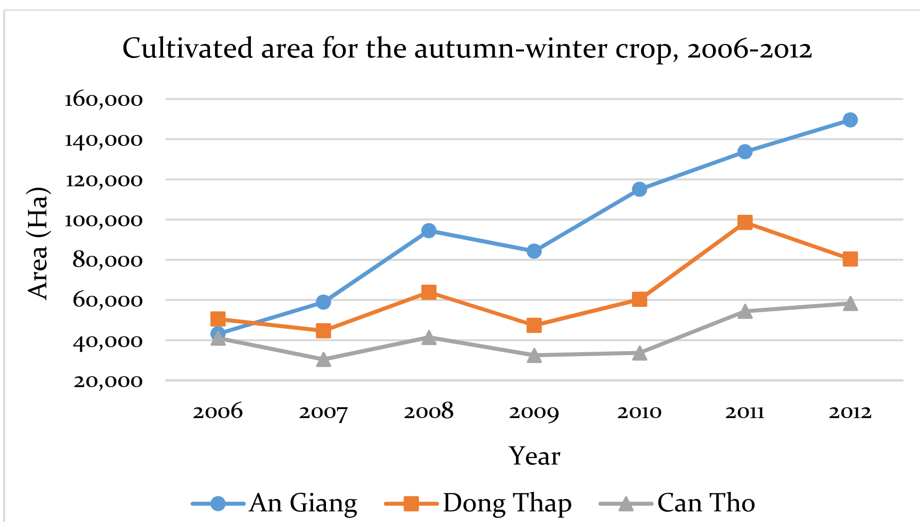

Figure 4.7 Expansion of cultivated areas for the autumn-winter crop in An Giang, Dong Thap, and Can Tho from 2006 to 2012

Source: Figure by Tran Anh Thong; An Giang Statistical Office (2013); Dong Thap Statistical Office (2013); Can Tho Statistical Office (2013)

There is an evolution of innovative production models at the local level (Table 4.1). Since its establishment in 1979, the Song Hau State Farm has built high dyke systems with well-connected irrigation networks. It aims to promote a double-cropping system and an integrated farming system known as VAC (*Vườn* as Orchard, *Ao* as Fish pond, and *Chuồng* as Poultry pen) (Figure 4.8). It is a highly intensive small-scale farming practice that makes optimal use of land and water to increase households' economic benefits (Dang Kieu Nhan et al., 2005). Also, the integrated farming system 'one bund, two ditches', which has been practised since 1985, adds to the sources of household income.

> Owing to the flood control system constructed in the early 1980s, the Song Hau State Farm converted a swampy area into today's thriving land. The high dykes and well-connected irrigation systems enable local households to implement various production systems. Typically, the model 'one bund, two ditches' allows the planting of fruit trees on bunds. The ditches provide irrigation for cash crops and freshwater sources for fish culture *(Interview with the Chairman of Thoi Hung, October 22nd, 2013)*.

> The integrated rice-fish model is very effective in Thoi Hung commune. The ditch provides room for fish nurseries and acts as a refuge for fish when the field water level becomes shallower. As the summer-autumn rice is at the second month growth stage, young fish are released into the rice field. At this time, the water depth in the field should be about 0.2-0.3m. Before rice harvesting, water is drained to drive the fish back to the ditch. The fish return when floodwaters are released back into the rice fields. Reproductive rice[11], organic matter, and nutrients available in the fields are the main food sources for the fish *(Interview with the Vice Head of Co Do OARD, October 22nd, 2013)*.

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[11] After the summer-autumn rice crop is harvested, the remaining stems continue to grow and reproduce rice grains, which are called reproductive rice *(lúa chét)*. In the flooded fields, the rice grains fall into the floodwaters and provide food for the fish being raised.

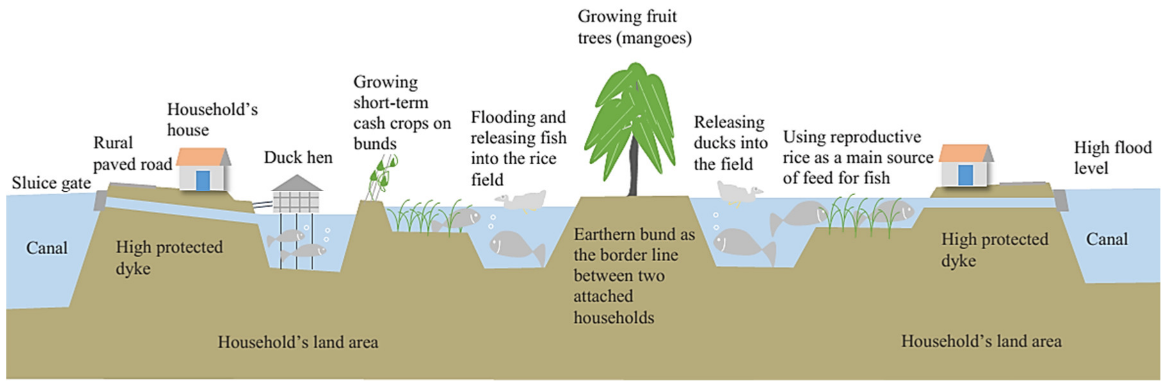

Figure 4.8 The flood control scheme and the integrated farming system in Thoi Hung

Source: Figure by Tran Anh Thong; Focus group discussions (2013)

In the upper part of the delta, early flood protection measures (August dykes) have been undertaken since the 1990s to support the summer-autumn rice crop. A total length of 13,000 km of embankments and dykes, which includes 7,000 km of embankments for early flood protection, is constructed in the Long Xuyen Quadrangle and the Plain of Reeds (Vo Khac Tri, 2012). In Phu Thanh B, high dykes are not encouraged due to the high flood depth. Local households commonly practise the double-cropping system and exploit natural flood resources for their livelihoods. Freshwater giant prawn culture is one of the successful flood-based models that has been practised in the commune over the past decade (Figure 4.9).

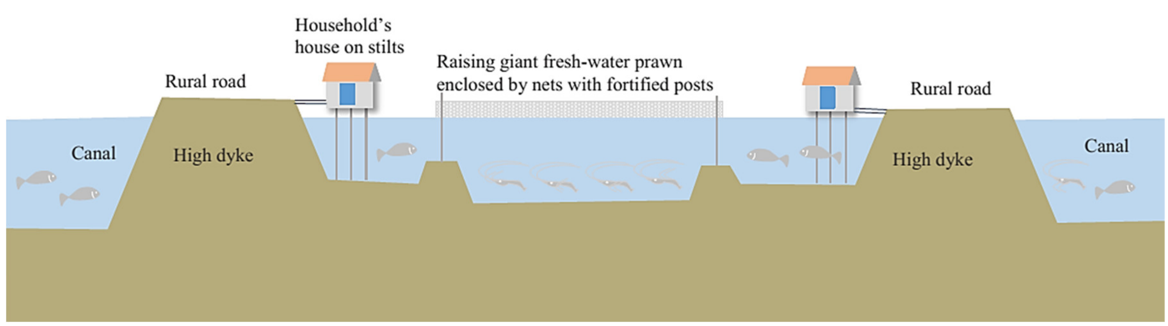

Figure 4.9 The flood control scheme and the freshwater giant prawn culture in the flood season in Phu Thanh B

Source: Figure by Tran Anh Thong; Focus group discussions (2014)

The full protection of the North Vam Nao flood control scheme allows the farming households in Phu Xuan to pursue the triple-cropping system (Figure 4.10). In this commune, sticky rice is the predominant crop as it is suitable for the local soil conditions. There are minimal field crops. The scheme allows the practice of '3 years, 8 crops' *(ba năm, tám vụ)*. This model allows the cultivation of eight consecutive crops, leaving the third crop (autumn-winter crop) in the third year unplanted. Conventionally, the cultivation of the third crop falls in the flood season. Any compartments scheduled for flooding should be left open for flood retention for about 2-3 months. According to Phu Xuan People's Committee (2013), two out of four compartments of the commune (637 ha) were opened to receive floodwaters in 2013.

> The North Vam Nao flood control scheme protects the safety of local inhabitants, properties and agricultural production activities in Phu Xuan. With this scheme, bringing floodwaters into the rice fields is a must after the completion of the eighth crop. After the summer-autumn crop is harvested, the local government publicly announces the schedule of flood entry to ensure the properties and production activities in the compartments can be safely protected. Floodwaters are impounded in the compartment within the depth of about 0.8-1.2 m from the field surface. The main objectives of flood entry are to replenish alluvium for the rice fields and to adjust the cropping calendar after 8 consecutive crops *(Interview with the Vice Chairman of Phu Xuan, November 5th, 2013)*.

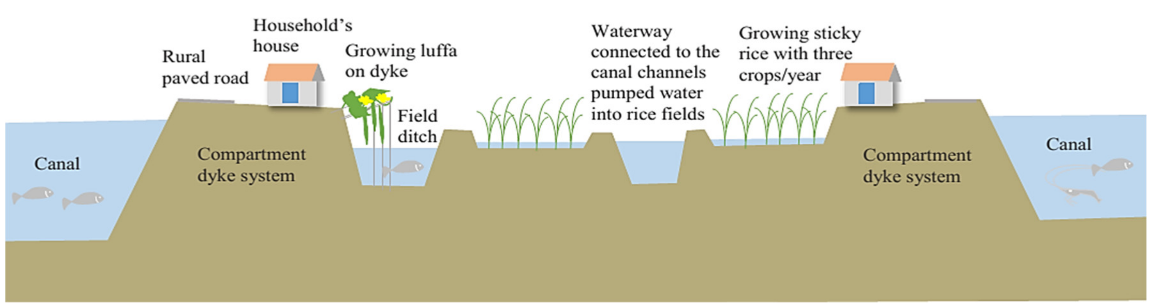

Figure 4.10 The flood control scheme and the farming system in Phu Xuan

Source: Figure by Tran Anh Thong; Focus group discussions (2013)

Table 4.1 Historical events for dyke construction process across the communes

	Phu Thanh B commune		Phu Xuan commune		Thoi Hung commune
		2013	The second round of floodwater inlets into rice fields in enclosed compartments in Phu Xuan		
		2012	Completion of the scheme testing		
2008	Main residential areas are protected by high dyke systems				
		2007	Cultivation of triple rice crop introduced in the North Vam Nao scheme areas		
2006	Introduction of single rice crop production followed by giant fresh-water prawn farming				Removal of sluice systems at main headworks, making more room for free floodwater flows
2005	Completion of constructed low dyke systems in the commune to safeguard the production of two rice crops	2005	The compartments of the North Vam Nao flood control scheme in Phu Xuan constructed	2005	Expansion of cultivated areas for field crop production
2004	The flood-based model of giant fresh-water prawn farming was introduced in the commune	2004	Structuring the institutional arrangements for management and operation of the scheme	2004	Establishment of Thoi Hung commune from the Song Hau State Farm Emergence of growing field crops
		2003	Implementation of the second North Vam Nao scheme		
		2000	Termination of the first North Vam Nao scheme and preparation for the second scheme		
		1999	Testing of high dyke systems in neighbouring compartments in Tan Hoa and Phu An communes		

1996	Expansion of low dyke systems				
1995	Beginning of building low dykes to allow the production of two rice crops			1995	Completion of intensive excavation to enable the large-scale production of summer-autumn crops
		1994	Low compartment dyke systems established to protect local summer-autumn crops		
1992	Establishment of Phu Thanh B				
				1985	Investment in building high dykes and internal schemes to enable the cultivation of high-yielding rice crops The integrated model of ‘one bund, two ditches’ first introduced
		1984	Establishment of Phu Xuan		
		1982	Survey of North Vam Nao flood control project firstly conducted		
				1980	Initial excavation of canals and dykes to protect some cultivated areas
				1979	Establishment of the Song Hau State Farm from Quyet Thang State Farm
				1976	Establishment of Quyet Thang State Farm under administration of provincial military of Hau Giang

Source: AusAID (2007); Focus group discussions (2013-2014); In-depth interviews (2013-2014)

4.2.3 Adjusted 'living with flood' measures in response to the complexities of forced adaptation

An adaptation-oriented policy (Decision No. 2730/QD-BNN-KHCN dated September 5th, 2008) was approved by MARD. It identified the agricultural and rural development in the MDV as essential in the adaptation process. According to this legal document, the adaptation-oriented policy aims to promote rural households' 'living-with-floods' practices. However, under the complex context of forced adaptation, the original paradigm 'living-with-floods' that alludes to the inhabitants' traditional adaptive practices appears misleading (Miller, 2006). In this respect, I argue that while the local governments maintain their structure-oriented solutions for flood control, there is evidence that local households have increasingly adopted non-structural measures to 're-adapt' to the hydrological change. A critical question arises as to how they undertake successful re-adaptation to the unprecedented flood conditions characterised by the combined impacts of internal flood control systems, upstream hydropower development, and climate change.

The implications of forced adaptation provide the lens for the contemporary state to reframe its structural development policies through the course of the delta development. As stated by Biggs et al. (2009: 203-204), what the delta's societies are currently confronting is the legacy of past actions:

> Many present-day challenges facing society in the delta are partly the result of past actions that have tended towards more mechanistic approaches to the water environment premised on ideologies of centralised state control rather than support for local adaptation to change and variability.

Changes in behaviour and adjustments to adaptive strategies occur at the institutional and household levels (Table 4.2). Local households present more proactive behaviours and flexibility in their livelihood practices, including implementation of crop diversification as key strategies to overcome the forced adaptation constraints. My observation shows that local farming households in Thoi Hung are more amenable to apply advanced technology, shift cropping patterns, and diversify agricultural activities based on shared learning and knowledge exchange among themselves and with local technical experts. It can be assumed that their residence in the vicinity of Can Tho City and academic and research institutions offers them greater opportunities to access various sources of scientific knowledge. In addition, farming households are more aware of the uncertainty of external factors. Plagued by rice market fluctuations in recent years, the majority of local rice farming households have sensibly switched to non-rice crops from which they can gain higher returns.

In Phu Thanh B, farming households' livelihoods which depend on the exploitation of natural resources in the flood season represent the major source of income. Over the last decade, the commune has seen the emergence of multiple innovative flood-based production models, one of which is the freshwater giant prawn cultivation. According to Tam Nong People's Committee's (2014) report, since 2004 the prawn breeding areas in the district have increased steadily (Figure 4.11). However, the prawn yields have recently become unstable. At present, the number of prawn breeders has dropped due to flood delays, increasing costs of breeding, and fluctuations of market price.

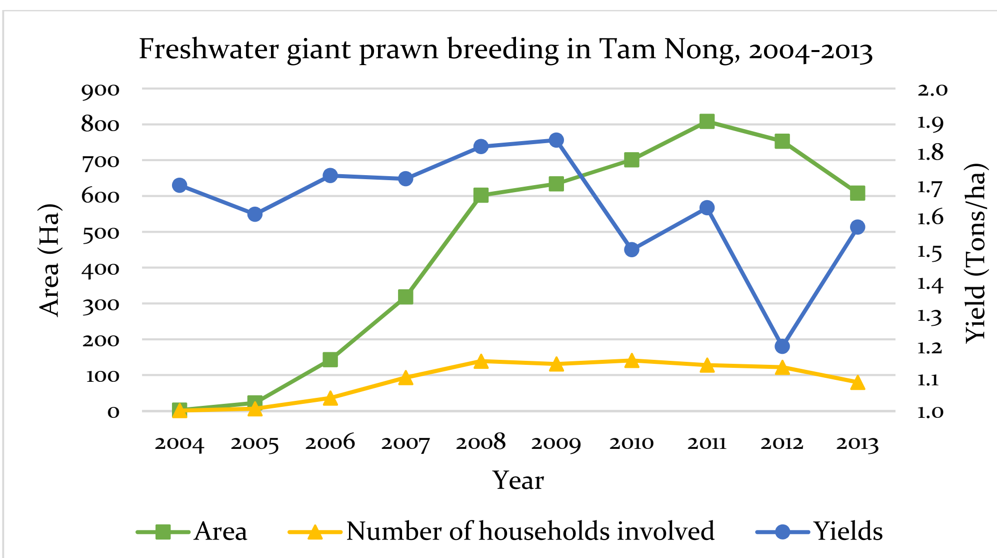

Figure 4.11 Freshwater giant prawn culture in Tam Nong from 2004 to 2013

Source: Figure by Tran Anh Thong; Tam Nong People's Committee (2014)

Institutional support provides local households with more alternatives to pursue their 'living-with-floods' strategies. In An Giang province, farming households are encouraged to employ their existing knowledge and wisdom on living with floods (Bach Tan Sinh et al., 2009). Most Vietnamese people are fully aware of the proverb *'Cái khó ló cái khôn'* (Adversity is the mother of wisdom), which appreciates their attempts to wisely seek out advantages when facing hardship. The project 31[12] aims to diversify local inhabitants' production, create jobs and improve material and spiritual life conditions in the rising water season *(mùa nước nổi)*[13] (An Giang People's Committee, 2002). This government's initiative has promoted the joint engagement of local institutions with self-organising groups and households and developed their capacities to explore conditions created by floods (Bach Tan Sinh et al., 2009). According to Phu Tan People's Committee (2010), 3,169 households are engaged in various flood livelihood activities with production areas of over 592 ha. Fish and prawn culture in net/cage enclosures and ponds are viable options for the majority of medium and better-off households. They also grow field crops and aquatic plants for additional income (Figure 4.12). In Phu Xuan commune, the full protection of the North Vam Nao flood control scheme enables the triple cropping of rice, which is important to the local agricultural sector. According to Phu Xuan People's Committee (2013), the total cultivated area for three crops accounted for 3,689 ha. Some 58 households engaged in aquaculture (13 ha). Open compartments for flood entry allow poor households to engage in fishing or collecting wild aquatic products as a mode of survival *(Interview with the Vice Chairman of Phu Xuan, November 5th, 2013)*. For example, a number of households form small groups to collect moina[14]. In Phu Thanh

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[12] Launched by the Chairman of An Giang People's Committee in 2002, project 31 is intended to assist local inhabitants in making use of floods as a resource to develop their flood-based production models, create employment, and enhance material and spiritual living conditions in the flood season.

[13] This term is intended to promote positive views on the natural behaviour of floods in the MDV. Traditionally, the term literally describes the gradual rise of floodwaters over time in the flood season. However, this natural phenomenon has changed a great deal as a result of the combined impacts of structural development and external climate-related factors over the past few decades.

[14] Moina *(trứng nước)* is a kind of freshwater crustacean, which grows naturally in the flood season. It is an important source of food for fingerlings. Collecting moina constitutes the major income for most of the poor households during the flood season.

B, the freshwater giant prawn cooperative plays an intermediary role in providing information to prawn breeders about techniques and sources of prawn fry, feed, and outlets for consumption. It facilitates close connection between breeders and technical experts, and aims to offer the former adequate techniques to improve the efficiency of prawn production *(Interview with the Chairman of the freshwater giant prawn cooperative in Phu Thanh B, November 7th, 2013)*.

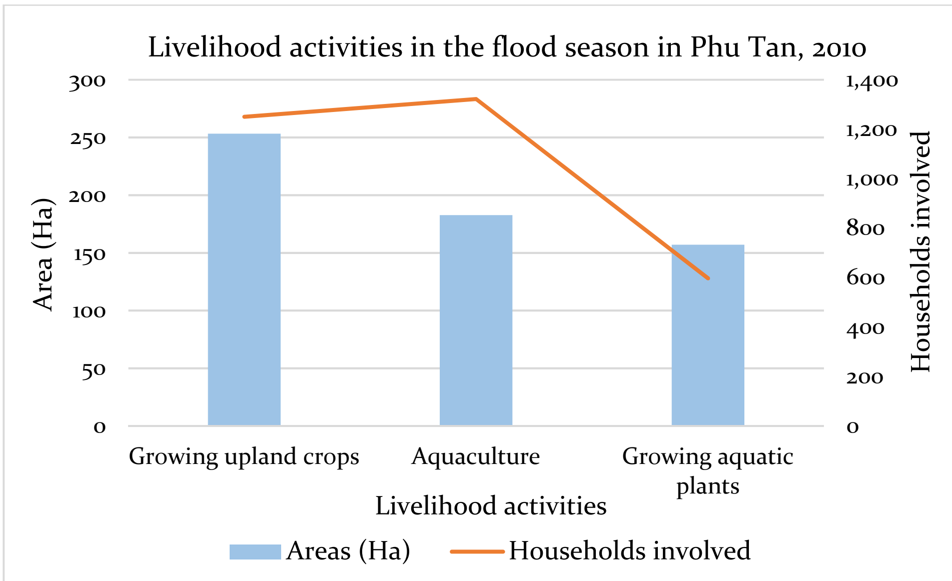


Figure 4.12 Livelihood activities in the flood season in Phu Tan in 2010

Source: Figure by Tran Anh Thong; Phu Tan People's Committee (2010)

Adverse impacts caused by structural measures over the past few decades have led local governments to switch their policy orientation towards non-structural measures. This policy change represents the reframing of their views on the 'living-with-floods' practices. Emphasising the vital role of non-structural measures as integral in the 'living-with-floods' paradigm, Kundzewicz (2002: 11) argues:

> Since a flood protection system guaranteeing absolute safety is an illusion, a change of paradigm is needed. It is necessary to live with the awareness of the possibility of floods and to accommodate them, rather than to try, in vain, to eradicate them.

Non-structural measures have gained a great deal of attention as an alternative approach to adapt to the local flood situations. They recall the nostalgia of traditional 'living-with-floods' practices, and promote aquaculture-oriented production and shifts in crop patterns and animal husbandry (Nguyen Hieu Trung et al., 2013). In An Giang province, the non-structural measures are incorporated into project 31, focusing on the exploitation of aquatic resources and aquaculture-oriented production to diversify the household income in the flood season (AGDARD, 2005; AGDARD, 2011). In this regard, floods are perceived as a source of generating economic benefits rather than disasters. In Phu Thanh B, low dyke systems are maintained to make prawn culture possible. Taking further advantage of high floods, the local government plans to expand the area cultivated (Tam Nong People's Committee, 2014). In Thoi Hung, apart from two rice crops, the high flood protection scheme allows local households to promote the integrated farming system to increase their income in the flood season.

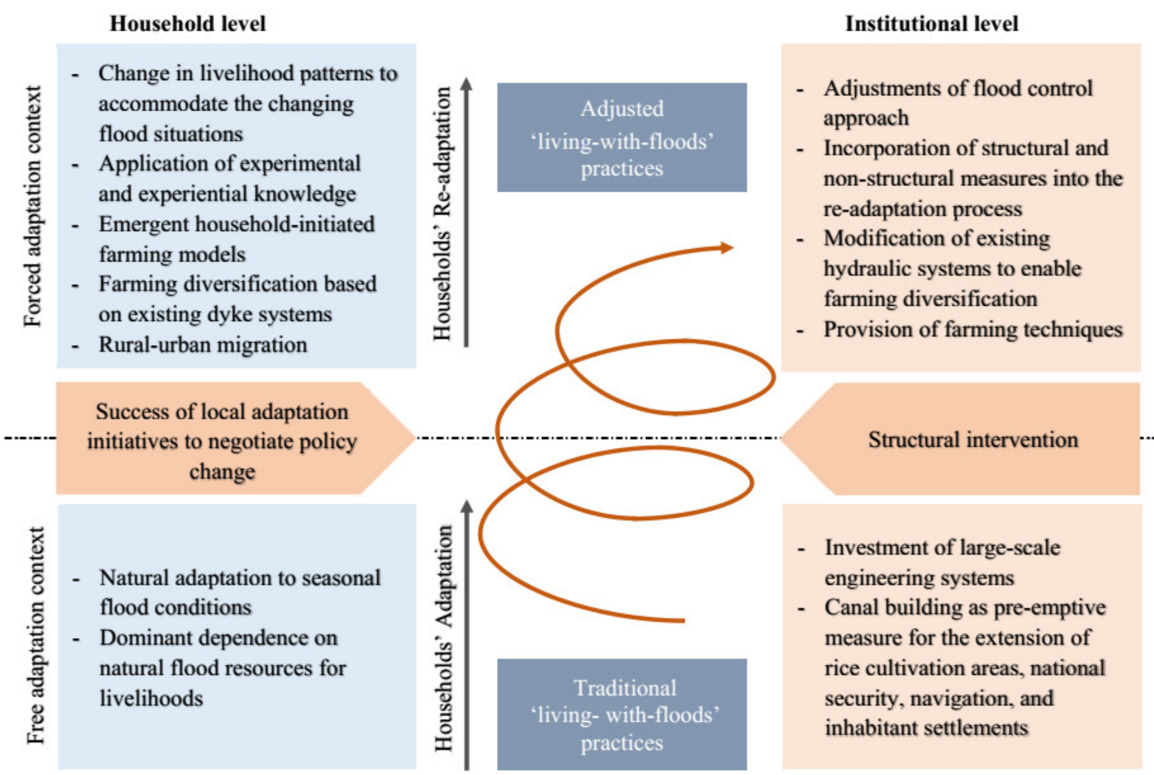


Figure 4.13 Adaptation evolution at the household and institutional level

Source: Figure by Tran Anh Thong; In-depth interviews (2013-2014)

The adaptation evolution in the MDV from the natural (free) adaptation (before 1975) to the re-adaptation (forced adaptation) (after 2010 to date) represents contested processes through which the state and the rural societies iteratively interact with each other to adapt to change (Figure 4.13). Literally, these interactions reflect a significant move from the traditional to adjusted practices in adaptation. Some policy adjustments can be observed at the institutional level. The local governments have provided farming households, especially poor households, with technical skills and formal credits so that they can self-manage their livelihoods to deal with new conditions *(A FGD with the poor households in Phu Xuan, December 6th, 2013)*. Additionally, non-structural measures have been mainstreamed to further support local adaptive performance. At the household level, myriad farming initiatives have been generated and disseminated across rural communities (see Chapter 5). This represents the high flexibility and proactive response of the rural societies to adapt to social-ecological change. Empirical evidence suggests that farming households across the communes make beneficial use of local dyke and flood conditions to develop innovative agricultural and aquacultural production models, from which they can earn more income during the flood season *(Interviews with Mr. Tam, a Chairman of the Farmer's Association of Thoi Hung, April 4th, 2014; the Vice Chairman of Phu Thanh B, December 27th, 2013)*. It is worth noting that they have increasingly integrated such locally-developed knowledge and advanced technology into their farming production systems so that they can gain higher profits.

Table 4.2 Household and institutional re-adaptation strategies across the communes

Re-adaptation strategies	Phu Thanh B	Phu Xuan	Thoi Hung
Institutional responses	Promoting the role of local prawn breeding cooperative in assisting breeders to gain better access to technical knowledge; providing sources of high-quality prawn fry, feeds, and outlets for prawn consumption *"The main objective of the cooperative is to build the connection between prawn breeders and technical experts and regulate the input and output to bring prawn breeders' high profits." (Interview with the Chairman of prawn cooperative in Phu Thanh B, November 7th, 2013)* Maintaining low dyke systems for wild fish capture and collecting aquatic resources; expanding areas for prawn culture in the commune *"Phu Thanh B is a focal commune for breeding prawns, so no high dyke systems are needed. After the harvest of summer-autumn crop, high floodwaters overrun the low dykes into fields, creating favourable flood environments for prawn culture." (Interview with the Vice Chairman of Phu Thanh B, December 27th, 2013)*	Managing the North Vam Nao scheme and enabling the rotational rice cultivation model '3 years, 8 crops' and field crops in compartments *"This flood control scheme protects the cultivation of three rice crops per year without any fears of flooding as before." (Interview with the Vice Chairman of Phu Xuan, November 5th, 2013)* Complying with the seasonal opening of compartments for flood retention in the ninth crop for about 2-3 months. Maintaining the functions of the compartment management board (CMB) to undertake the monitoring in consultation with the local government and the pumping service groups in providing irrigation and technical advice for rice farmers. *"I think that the role of the CMB is very essential. It represents the rice farmers to raise issues to local government for solutions." (Interview with the Head of Phu Tan OARD, October 30th, 2013)*	Maintaining existing dyke systems with modified sluices to allow the entry of alluvium *"The dyke system in Thoi Hung functions as a shield, protecting the entire commune from high floods. It enables the crop production all year round." (Interview with the Vice Head of Co Do OARD, October 22nd, 2013)* Promoting the knowledge sharing among technical agencies, research institutions and local farmers through seminars and workshops *"Together with Can Tho university, extension centers and Co Do OARD, the local government provides training to improve farmers' skills." (Interview with the Chairman of the Farmer's Association of Thoi Hung, April 4th, 2014)* Promoting integrated farming system *"Rice cultivation alone does not bring high profits. We build ditches to breed fish, bunds to plant fruit trees, and pens to raise poultry or pigs." (Interview with the Chairman of Thoi Hung, October 22nd, 2013)*

Farming households' responses	Appropriate use of low dyke systems *"I agree with the low dyke systems as they enable the cultivation of summer-autumn crop and flooding conditions for prawn culture." (Interview with a prawn breeder, November 7th, 2013)* Maintaining shared learning and knowledge exchange among prawn breeders *"We usually sit back to share what we have experienced to the novice." (Interview with a prawn breeder, November 7th, 2013)* Poor households depend on seasonal work *"The main livelihood alternative for all poor households in this commune is seasonal employment. In the flood season, we engage in masonry or wild fish capture." (A male participant in a FGD in Phu Thanh B, January 22nd, 2014)*	Local aquacultural and agricultural production remains reliant on dykes Sticky rice production remains the dominant agricultural sector in the commune. Innovative farming models, such as raising eels, provides additional earning for many households in the flood season. *"In the flood season, I catch young wild eels to raise and catch wild fish as main sources for eel feed." (Interview with an eel farmer, December 17th, 2013)* Poor households live on fishing and other aquatic species captured in local canals and flooded compartments in the flood season Migration is the means of survival for most of the poor and landless households *"Due to dykes and increased use of pesticides, the fish stock is declining considerably. My life is unstable. My daughter works in Binh Duong and sends remittances back home monthly." (A female participant in a FGD in Phu Xuan, December 6th, 2013)*	Practising a double-cropping pattern in rotation with a cash crop *"After the winter-spring crop is harvested, we plant sesame which brings high profits. It is a good way to fertilise the soil." (Interview with a sesame farmer, February 21st, 2014)* Adopting advanced techniques in crop cultivation *"I think farmers now can improve their cropping techniques due to better access to multiple sources of knowledge." (Interview with a farmer practising crop diversification, April 4th, 2014)* Increasing number of farmers pursue crop diversification *"Due to declining price of rice, many farmers have transferred cropping structures. They have shifted to grow field crops rather than depending only on rice." (A male participant in a FGD in Thoi Hung, November 27th, 2013)* Landless households migrate to urban areas in search of work *"Due to the mechanisation process in rice cultivation, most landless households in Thoi Hung migrated to Binh Duong province to stabilise their life." (Interview with a senior farmer, April 4th, 2014)*

Source: Focus group discussions (2013-2014), In-depth interviews (2013-2014)

4.3 Alterations of flood regimes in the MDV

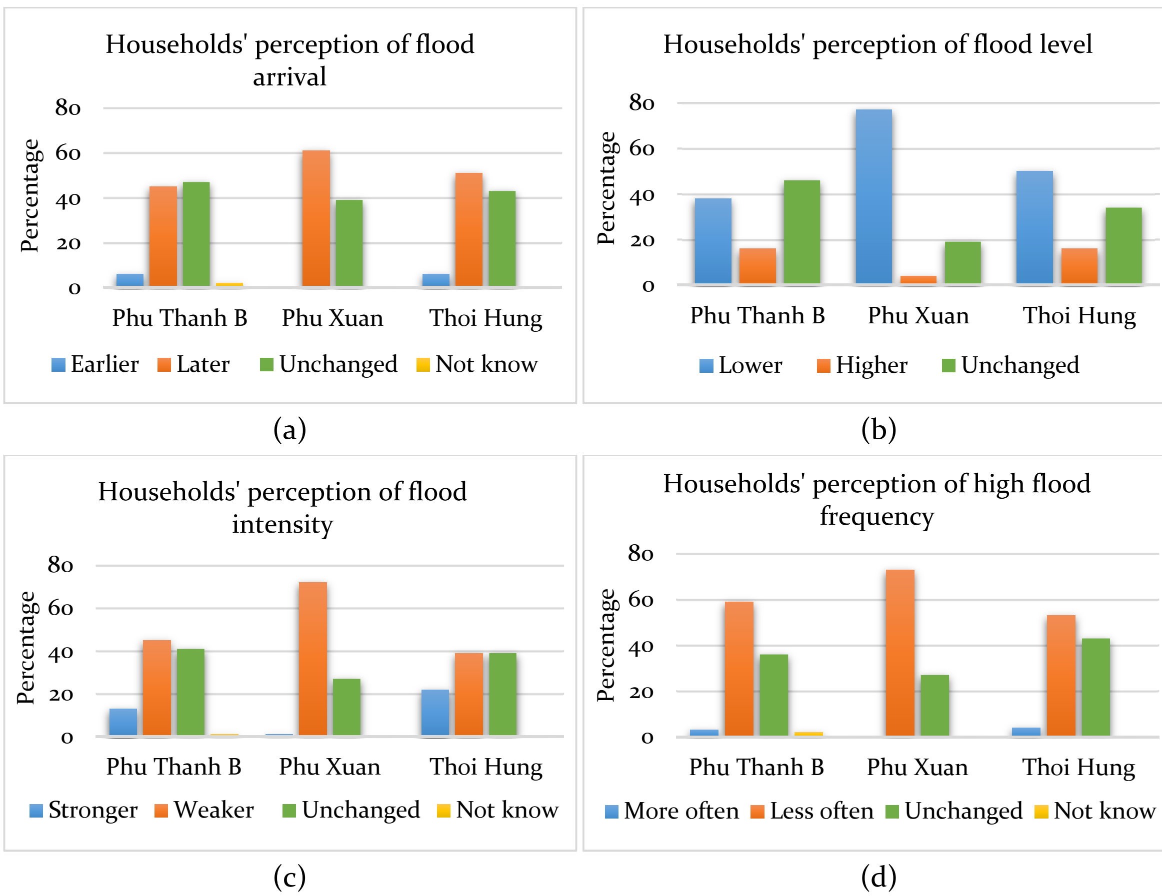
The MDV has a low-level topography (0.5-1.2 m above sea level) and is characterised by extensive networks of canals and rivers. Two main tributaries of the Mekong River, the Mekong (Tien River) and the Bassac (Hau River), run through the delta. The regional climate is influenced by the tropical south-west monsoon, and has two distinct seasons: the dry season from December to April and the rainy season from May to November. In the flood season, approximately half of the delta area (about 1.9 million hectares) is subject to inundation. The height of flood levels could reach over 5 meters and last for about 5 months, occurring mainly in the Long Xuyen Quadrangle and the Plain of Reeds. As observed by Kuenzer et al. (2013: 701), about half of the areas of such flood-prone provinces as An Giang, Dong Thap, and Can Tho are inundated during the high flood stage.

Floods in the MDV are driven by simultaneous occurrences of four main factors. According to Kuenzer et al., (2013), floods are influenced by (1) flood pulse of the Mekong and overland flows; (2) excessive volumes of floodwaters controlled by dykes and sluices; (3) extreme rainfall events; and (4) tidal effects of the East and West seas. There are two main flood peaks in the flood season. The first peak occurs from the end of July to mid-August while the second peak from the end of September to early October. In contrast to the observations that high floods in the delta occur every five years (Sneddon and Nguyen Thanh Binh, 2001), the hydrological records show that recent flood trends are becoming increasingly unpredictable. According to the Southern Institute of Water Resources Research (SIWRR) (2013), occurrences of high floods are now less common, while medium and low floods are more prevalent. Since 2010, the northern part of the delta has not experienced severe flooding as in previous years (Kuenzer et al., 2013: 698). However, it has been observed in recent years that high floods tend to occur late in the wet season (Gupta, 2007), but more abruptly than before *(A FGD with the farming households in Phu Thanh B, January 22nd, 2014).*

Increasing evidence suggests that altered flood patterns in the MDV are attributed to structural systems. An action plan on the national strategy for preparation, prevention and mitigation of natural disaster, pursuant to Decision No. 2278/QD-UBND approved by An Giang People's Committee, notes that the embankment systems (canals, dykes, land transport infrastructure, and residential clusters) are relevant to the change of local flood regimes and inundation levels. Technical observations reveal that the altered flood patterns and uneven distribution of floodwaters in the delta in recent years are largely driven by these structural systems (Le Thi Viet Hoa et al., 2008; Chu Thai Hoanh et al., 2012; Delgado et al., 2012; Kuenzer et al., 2013). Coupled with other external factors, these structural systems increase flow velocities causing bank erosion, and deepen the water levels in the rivers and canals (Le Thi Viet Hoa et al., 2007a). Nguyen Minh Quang (2000) suggests an explanation for these adverse impacts. He believes that the canal systems constructed between 1705 and 1975 did not alter flood patterns because they are oriented perpendicular to the direction of the flood flows. However, the extensive construction of the networks of roads, dykes, and sluices for irrigation in subsequent decades strongly affects the natural floodways, leading to the frequent occurrences of internal floods in the delta.

The results from the household survey present the alterations of flood patterns in recent years (Figure 4.14). Most local households perceive the high frequency of flood delays. Analysis of a FGD with better-off households in Phu Thanh B *(FGD on January 22nd, 2014)* revealed that high flood flows have been retarded, causing prolonged delays in releasing prawn fry. These empirical observations are in line with a case study conducted by Nguyen Viet Khoa et al. (2012) in Thap Muoi district of Dong Thap province, as well as Gupta's (2007) research on the alterations of the hydrological regimes in the MDV. Consistent with technical observations by SIWRR (2013), a large proportion of the households across the communes perceive fewer occurrences of high floods. They have also experienced lower and weaker flood trends. According to the Vice Head of Co Do Office of Agriculture and Rural Development (OARD), floods have decreased in terms of levels and intensity since 2008. He is concerned that the alterations of these flood patterns over the last few years have posed critical challenges to local aquacultural practices. *(Interview on October 22nd, 2013)*

> "We practise prawn breeding in the flood season and grow rice when floodwaters recede. However, the frequent flood retardation in recent years has prolonged our prawn catching period, thus causing delays for sowing the Autumn-Spring crop." *(A male participant in a FGD with giant freshwater prawns in Phu Thanh B, January 22nd, 2014)*



Note: Households' perceptions of (a) flood arrival; (b) flood level; (c) flood intensity; and (d) high flood frequency

Figure 4.14 Households' perceptions of the recent alterations of flood patterns across the communes

Source: Figure by Tran Anh Thong; Household survey (2014)

4.4 The pre-dyke versus post-dyke analysis and household transformation of livelihood patterns for re-adaptation

Under the local governments' structural intervention, rural farming households have transformed their farming systems and livelihood patterns to adapt to change. In this sense, I argue that transformation takes place as the process of re-adaptation. Aquacultural and agricultural sectors which constitute the primary livelihoods of the majority of the rural inhabitants in the MDV are pronounced in the transformational process. This section provides a comparative analysis of how the household groups across the communes have adjusted their livelihood strategies with greater emphasis on the post-dyke context.

The great majority of households in the communes agree that the natural resources have been declining in the post-dyke period (Figure 4.15). In this respect, the main reasons are attributed to the overuse of pesticides for rice production in dyked areas, the illegal use of electrical devices for wild fish capture and the dyke obstruction to fish routes. In the broader context, the reduced distribution of floods in the flood season caused by structural development for local transports, rice production, and population growth in the delta explain the decrease in these natural resources.

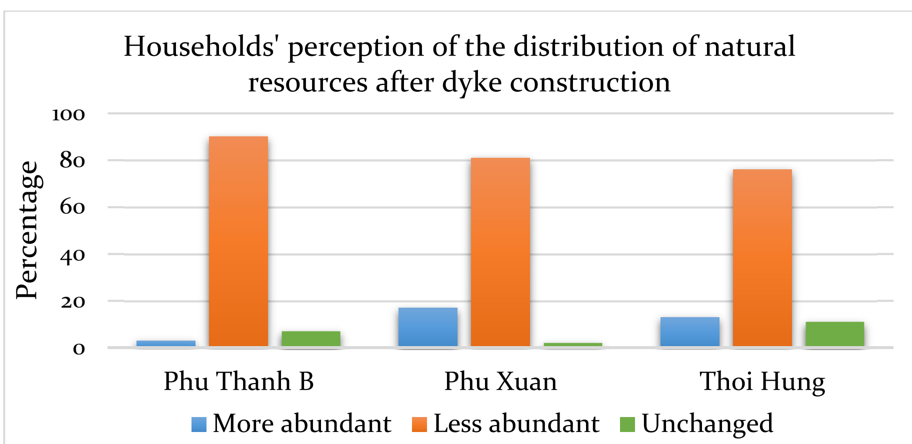


Figure 4.15 Households' perceptions of the distribution of natural resources in the post-dyke period across the communes

Source: Figure by Tran Anh Thong; Household survey (2014)

Figure 4.16 illustrates the transformational process undertaken by local farming households in Phu Thanh B commune. In the pre-dyke period, the medium and better-off household groups mainly engaged in floating rice cultivation and fish culture. The medium group trapped wild fish for additional income in the flood season. Meanwhile, the poor group derived most of their income from wild fish capture and collection of aquatic vegetables, which are abundant in the flood season. The findings suggest that the household groups adopted various adaptive approaches after low dykes were built. The better-off groups shifted to freshwater giant prawn culture in the flooding months and cultivated the winter-spring rice crop after the flood recession. The dyke systems allowed the medium group to practise the double rice system (winter-spring and summer-autumn). These farming production activities provided the poor group with seasonal agricultural work such as weeding, rice transplanting or field bund building from which they could earn additional income.

Poor households are faced with critical challenges in the wake of the dyke construction. Evidence from a FGD with poor households in Phu Thanh B suggests that they have hardly adapted to the post-dyke transformation. The fish population and aquatic plants are no longer abundant as before. According to Mertz et al. (2009), dyke building might increase cultivated areas but adversely affect local ecosystems that support livelihoods. These findings are consistent with Birkmann et al.'s (2012) study on the impacts of dyke construction in Tra Cu district, Tra Vinh province, a coastal area of the delta. They showed that local households experienced a sharp decline in natural fish stocks after dyke systems were built. It was reported that the natural fish resources contributed about 15 percent of total household income in 1990 but dropped to only 1 percent in 2009 (Birkmann et al., 2012). The findings from FGDs with poor household groups in Phu Thanh B reveal that this commune has witnessed the rapid agricultural mechanisation after the dyke building. The increasing application of combined harvesters in rice harvesting has deprived them of most possible means of survival. As stated by Akram-Lodhi (2005), mechanised agricultural production coupled with the land accumulation by rich peasants in rural Vietnam has aggravated unemployment rates, causing more hardship for landless households.

These findings support François and Tran Thi Thu Trang's (2013) argument that technological dependence in agriculture leads to the greater fragmentation of social networks in rural areas. Facing the growing insecurity of rural wages, many poor households have migrated to cities in hope of getting more stable employment.

> Before the dyke construction in the commune, I caught lots of fish. Since the dykes are built, the fish is decreasing terribly. The dyke walls block fish from entering into the fields. Because of strong flows in canals, fish get flushed away to downstream areas. *(A male participant in a FGD with the poor households in Phu Thanh B, January 22nd, 2014)*

> Supported by dykes, the increased application of combined harvesters in rice harvesting in recent years has worsened our livelihoods. We are not hired for work any more. We even cannot glean rice or shake off straw for rice collection as before. Our lives are getting much harder. *(Participants in a FGD with the poor households in Phu Thanh B, January 22nd, 2014)*

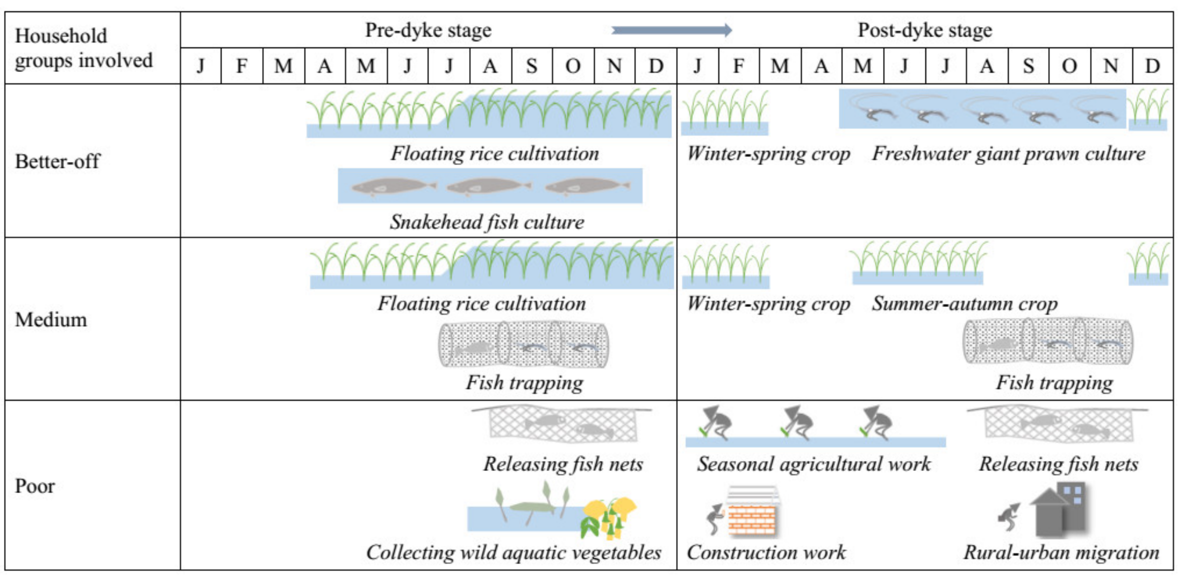


Figure 4.16 Households' transformation of livelihood patterns in Phu Thanh B

Source: Figure by Tran Anh Thong; Focus group discussions (2014)

There is a significant change in local households' livelihoods since the construction of the North Vam Nao flood control scheme in Phu Xuan commune (Figure 4.17). Formerly, the low dykes enabled the practice of double-cropping systems for the medium and better-off households. Poor households engaged in seasonal agricultural work and collect aquatic species in the flood season. Triple-cropping systems have been widespread since the scheme was established. Some better-off households took advantage of the natural resources in the flood season for fish culture. Although government officials stated that the triple cropping systems would provide more seasonal job opportunities for local poor households, the reality is different. Most of the poor households in Phu Xuan lacked livelihood options to diversify their income in the flood season, apart from engaging in wild fish capture and some trivial agricultural work. An interview with the Head of the CMB of V16 in Phu Xuan suggested that part of the household hardship could be attributed to the depletion of natural fish stocks. The evidence from the FGD in the commune also revealed that the poor households' livelihoods are increasingly dependent on local landowners who hire them to work. These findings are consistent with the study conducted in Central Vietnam (Phong Tran et al., 2008) that the poor households conceived of agricultural production activities, hired labour, or fishing as their main means of survival.

> I found it easier for me to live before the scheme was built. During this period, the prolonged flood retention allowed me to catch fish and maintain my daily income. I could earn about 70,000 Dong[15] per day. I caught fish until the floodwaters receded. However, my life has become much harder as the local dyke has been put into operation. The fish stocks are not abundant any more. At present, I live merely on low wages earned from seasonal work and fishing in the flood season. *(A male participant in a FGD with the poor households in Phu Xuan, December 6th, 2013)*

[15] This amount (Vietnamese Dong) is more than 3 US dollars at the exchange rate in December, 2013.

Most poor households in Phu Xuan agreed that they had to go far from the commune to trap fish. The main reason is attributed to the negative side effects of the compartments in the commune. As stipulated, about 8 out of 23 compartments are open for flood retention each year. This regulation makes it impossible for households to fish in the compartments that are not yet on their roster. The findings from an FGD in Phu Xuan stated that wild fish hardly got into the fields due to highly-protected culverts. They also revealed that the duration of flood retention in compartments is rather short, which is not adequate for fish to grow.

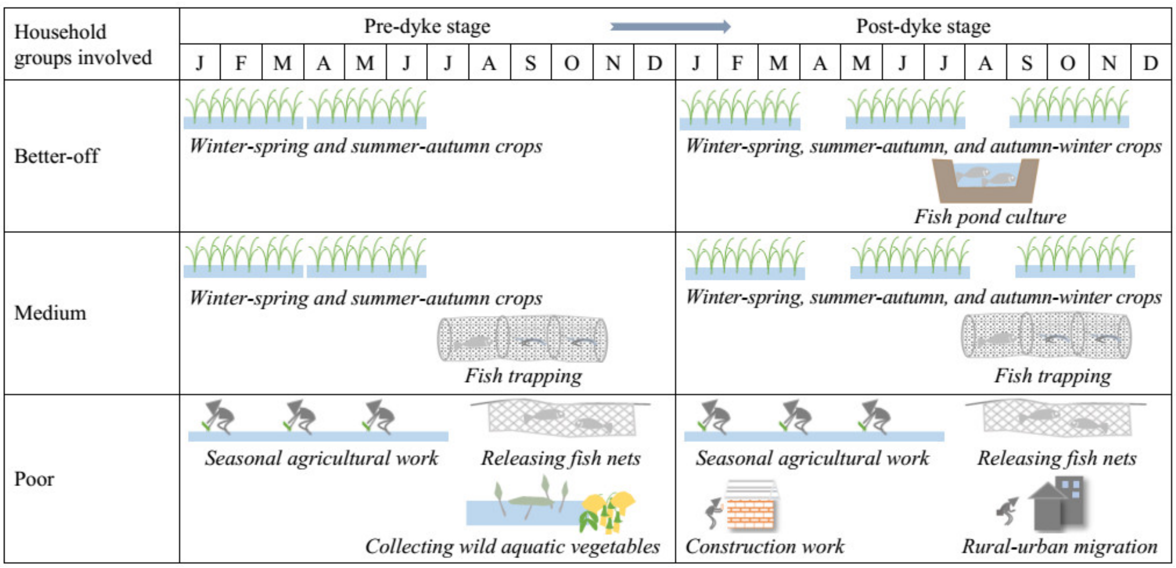


Figure 4.17 Households' transformation of livelihood patterns in Phu Xuan

Source: Figure by Tran Anh Thong; Focus group discussions (2013)

Dykes provide safety for the implementation of agricultural livelihoods by farming communities (Pham Cong Huu, 2012). In Thoi Hung, the dyke construction since the early 1980s has induced a remarkable transformation in farming systems (Figure 4.18). The introduction of innovative farming models has produced high profits for medium and better-off groups. These provide more occasional employment for the poor group. It is worth noting that the integrated farming systems supported by the local irrigation systems allow flexibility for practising gardening (planting mangoes), growing cash crops and poultry husbandry during the flood season. Taking advantage of space availability on rice bunds, local households put up trellises and grew a variety of climbing plants. Similar to the other two communes in this research, the livelihoods of the majority of the poor group in Thoi Hung are dependent on seasonal agricultural employment and migration during the flood season.

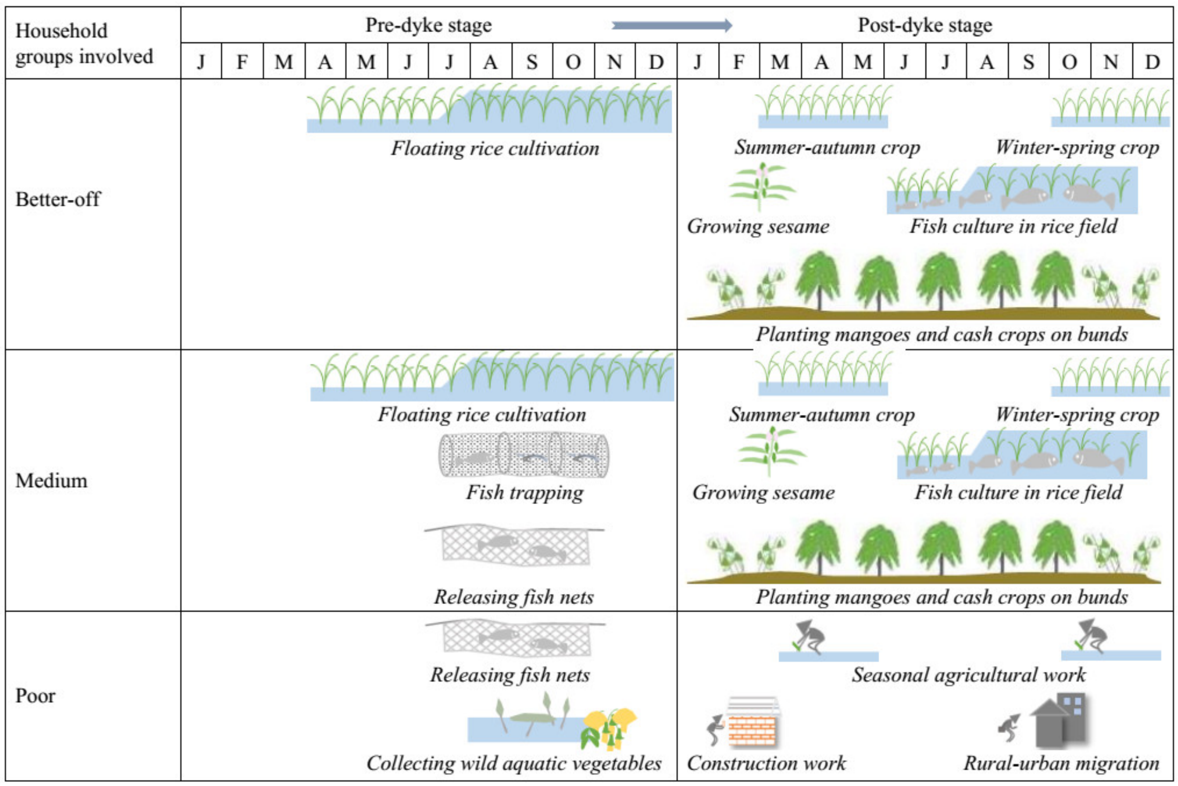


Figure 4.18 Households' transformation of livelihood patterns in Thoi Hung

Source: Figure by Tran Anh Thong; Focus group discussions (2013)

Migration is a vital strategy for adaptation (Black et al., 2011; UNDP, 2009; McLeman and Smit, 2006). In this research, it is one of the key adaptive strategies for poor households. Recent literature shows that environmental factors are one of the main drivers causing migration (Black et al., 2011; Renaud et al., 2011). While Dun (2011) perceives floods as the main trigger for migration in the MDV, this research suggested that the instability of rural employment, driven by the structure-based flood management policies and the rapid agricultural mechanisation, is the key driver for the increased outmigration of local households, especially the poor (Figure 4.19). These findings are congruent with the studies undertaken by Dang Nguyen Anh et al. (2003) and Huynh Truong Huy and Le Nguyen Doan Khoi (2011). These authors arrived at the similar conclusion that the transformation in agricultural production systems, which create surplus labour in rural areas, contributes significantly to the increased movement of labour from rural to urban areas. These push factors, in turn, have considerable effects on structural change in the delta's agriculture. According to Dapice and Vo Tong Xuan (2012), the labour force engaged in the agricultural sector in this region fell from 62-52 percent in the late 2000s.

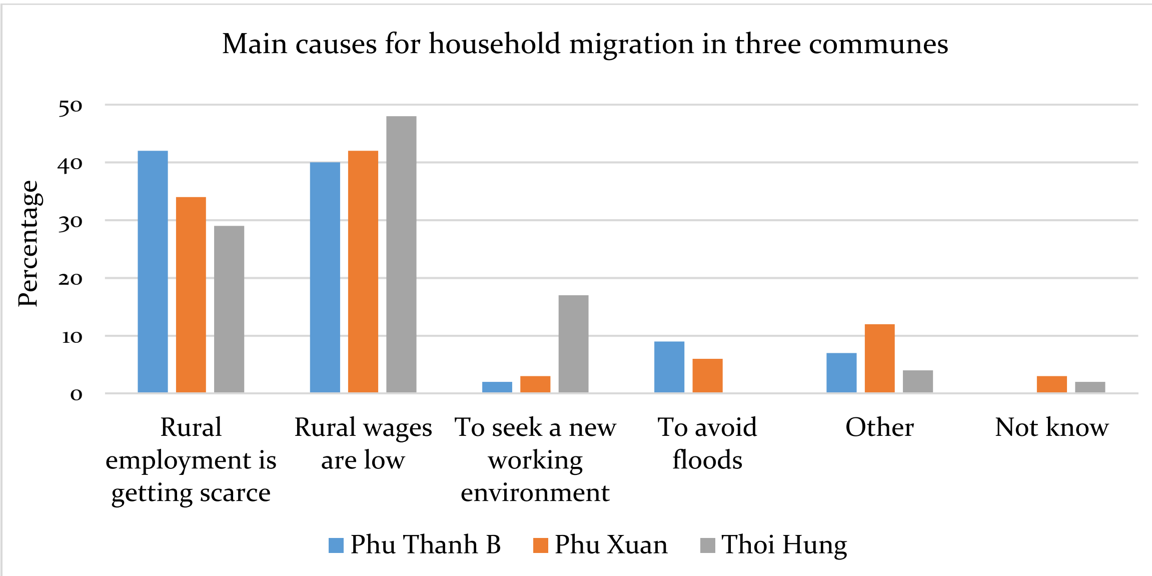


Figure 4.19 Main causes for household migration across the communes

Source: Figure by Tran Anh Thong; Household survey (2014)

4.5 Conclusion

The process of water management in the MDV has undergone three main stages with incremental structural intervention. They highlight the state's 'political mission' on accelerating agricultural production in the delta, from the expansion of cultivated areas for rice intensification to the diversification of farming systems. These processes have led to the rapid development of irrigation and flood control schemes across the delta, which eventually makes the delta one of the most human-regulated water regimes in the basin.

In the wake of structural development, the past decades have seen household transformation of their livelihood patterns to better respond to the constraints of forced adaptation. It demonstrated the prominent transformation from free adaptation to re-adaptation. Technical evidence shows that these structural systems are one of the key drivers for the unpredictable alterations in flood regimes in the delta, in addition to climate change and upstream development. Later flood onset, weaker flood intensity, lower flood level and less frequency of large floods were the prevalent phenomena as observed by the research institutions and the households across the research areas. Although non-structural measures have been promoted by local governments to support households' 'living-with-floods' practices in recent years, the role of the structural measures for farming production remains dominant.

The comparative analysis of three flood control schemes in this research illustrates the significant transformation of the local households' farming portfolios and livelihood strategies. The high dyke protection in Thoi Hung allows the local households favourable conditions to practise farming diversification in the flood season. They have increasingly shifted toward non-rice products to deal with the unexpected fluctuation of the rice market in recent years. Farming households have made strategic decisions in planting the kinds of vegetables which are rare during the flood season in order to gain higher income. In the case of Phu Thanh B, when experiencing deep flooding, farming households have often failed to cultivate field crops. Alternatively, they tend to capitalise on the local flood environment to make a living. Freshwater giant prawn farming is the profitable seasonal activity that has been widely practised by local households during the flood season. Given its demonstrated success in the early period, this production model has been formally recognised as the one of the key strategies to support the socio-economic development of the commune. In Phu Xuan commune, the flood protection from the North Vam Nao scheme has stimulated the proliferation of sticky rice cultivation over the last decades. This has contributed largely to the income of the majority of local farming households.

The dyke construction policies encapsulate the polarity that can be observed among the household groups. There are winners and losers in the post-dyke adaptation context. Better-off and medium groups are likely to enjoy more benefits from the dyke policy than the poor group. While the former can gain better access to capital sources to diversify their farming systems that could bring them higher income, the latter is trapped in seeking alternatives to sustain their livelihoods. While facing constraints in accessing local support (e.g. formal credit systems), the poor households are placed at high risk of being deprived of income-generating opportunities due to the increasing mechanisation process in farming production. The precariousness of rural employment and declining aquatic resources in the flood season add more hardship to their livelihoods. Because of having limited options, resources, and ability to switch to other alternative livelihoods, most of the poor households still adhere to seasonal employment and exploiting natural flood-based resources as means of survival during the flood season. Qualitative evidence shows that migration is the preferred adaptation option that helps them get out of such difficulties.

Successful management of households' livelihoods in the MDV depends on how well capital resources are to be mobilised and technological innovation to be applied. Experience at the local level suggests that these efforts are short-term and spontaneous in nature when referring to adaptation. Social learning is often seen as a vital strategy that enables the social actors to successfully adapt to social-ecological constraints. While social learning has received increasing recognition as an important approach in relation to adaptation in a number of case studies across the geographical levels, this relationship has not been investigated in the turbulent context of forced adaptation in the delta. The next chapter will examine to what extent social learning influences farming households' capacity to adapt to these complexities.

Chapter 5

Social Learning for Household Adaptation[16]

> During my fieldwork, I heard local government rhetoric intermingled with experts' enduring concerns about the delta's flood management policies. Amidst such ongoing discourses, I was especially intrigued by the tenacity of rural households in 'shaking hands with the floods'[17] to sustain their livelihoods. They have deep aspirations and strong determination to pursue learning, generate, and share innovative knowledge across farming communities. These images embody a typified personhood of the native inhabitants in adapting to the local environmental complexities.
>
> (Personal field notes, November 2013)

5.1 Introduction

The importance of social learning has been increasingly recognised in the domains of natural resources management (Schusler et al., 2003; Keen and Mahanty, 2006) and climate change (Pelling and High, 2005b; Collins and Ison, 2009; Shaw and Kristjanson, 2013). Emerging from these complex contexts, social learning is seen to be closely associated with adaptation (Pelling and High, 2005b; Berkhout et al., 2006; Lebel et al., 2010b; Johannessen and Hahn, 2013; Srang-iam, 2013). It is a key element that facilitates human actors to successfully adapt to change.

There is evidence of social learning associated with adaptation at the household level in the context of forced adaptation in the MDV. It suggests how farming households are engaged in shared learning and knowledge exchange to effectively deal with the negative impacts of the local dyke system and altered flood regimes. This chapter aims to quantify to what extent social learning influences their capacity to adapt to these

[16] An earlier version of this chapter was presented at the 10th Singapore Graduate Forum on Southeast Asian Studies at the National University of Singapore (NUS), Singapore (24-26 June, 2015).

[17] This term was adopted from Miller, F. (2007)

'wicked' problems. It argues that this relationship has existed and varied across the levels of household groups and research areas. The chapter attempts to demonstrate this argument by elaborating on this association. This understanding is critically important, as it can inform the better formulation of flood-based livelihood policies to effectively support household adaptation in the delta.

This chapter falls into five main sections. Section 5.1 is the introduction. Section 5.2 explores how social learning is characterised in households' everyday livelihood practices and how it catalyses their innovative capacity and collective learning. Section 5.3 presents households' socio-demographic characteristics. Drawing on the household survey analysis, the findings from the exploratory factor analysis for social learning and adaptive capacity are detailed in section 5.4. Section 5.5 elaborates the multiple regression analysis on the causal relationships between the two concepts. The conclusion is presented in the last section.

5.2 Characteristics of households' social learning in the MDV

5.2.1 Household participation in learning cohorts

Household responses to forced adaptation in the MDV are socially constructed. They are forged in the learning process, representing household endeavours to adapt to the change in flood regimes. They also indicate the households' willingness to explore new knowledge. The research findings reveal that social learning in the MDV takes two main forms: (1) collective learning through communication and interactions, and (2) individual learning through self-reflection. They are found to be complementary to each other in household efforts to adapt to changing conditions. Household learning behaviour in adapting livelihood practices to local hydrological regimes represents the integration of their communicative performance and the combination of experience, intuition, and practical expertise. These learning activities take place in communities of practice. The communities of practice in this context are defined as spontaneous groupings of household individuals utilising homogeneous farming practices. The qualitative results show that individuals in the learning cohorts are connected through the interwoven fabric of their social connections. Their relationships extend across the bonding, bridging or linking[18] systems of social capital. Brown and Schafft (2011: 36) claim that social interaction does not necessarily take place within a bounded geographic location but can be developed outside of this space. From Wah et al.'s (2007) perspective, these forms of social capital are essential to the sharing of knowledge.

There is a difference in the number of households participating in learning cohorts across the areas surveyed (Figure 5.1). The survey results suggest that 76 percent of households in Thoi Hung engage in collective learning, significantly higher than those of Phu Xuan or Phu Thanh B. There are several reasons behind this. Firstly, the former land use planning undertaken by the State Farm of Song Hau since the 1980s has created uniformity in its physical landscape. Each household is allocated 2.5 ha of land. The socio-economic development policies prescribed by the Song Hau State Farm drive the formation of identical farming patterns. It leads to high demands for knowledge exchange among fellow farmers. The second reason relates to the assumption that households attaining a higher level of education would be more likely to have greater demands to access new knowledge. It is true that Thoi Hung had the highest proportion of households completing high school compared to their counterparts in Phu Thanh B and Phu Xuan (see Chapter 3). Most residents in Thoi Hung migrated from various provinces in the MDV. Therefore, they still maintain strong connections with their relatives who live in their original locations. The last reason leads to the spontaneous emergence in recent years of informal farmland leases between the local farming households and external farmers. These arrangements have accelerated the exchange of farming knowledge and the expansion of social networks. Meanwhile, collective learning is less present in the other two communes. The

[18] These terms represent three types of connectedness under the broader concept of social capital. As indicated by Woolcock (2001), bonding social capital refers to relations between family members, close friends, and neighbours. Bridging implies the connection between people who share broadly similar demographic characteristics including distant friends, associates, and colleagues. A key function of linking is the group's capacity to leverage resources, ideas, and information from formal institutions.

proportion of respondents engaged in learning cohorts in Phu Xuan and Phu Thanh B is 54 percent and 53 percent respectively.

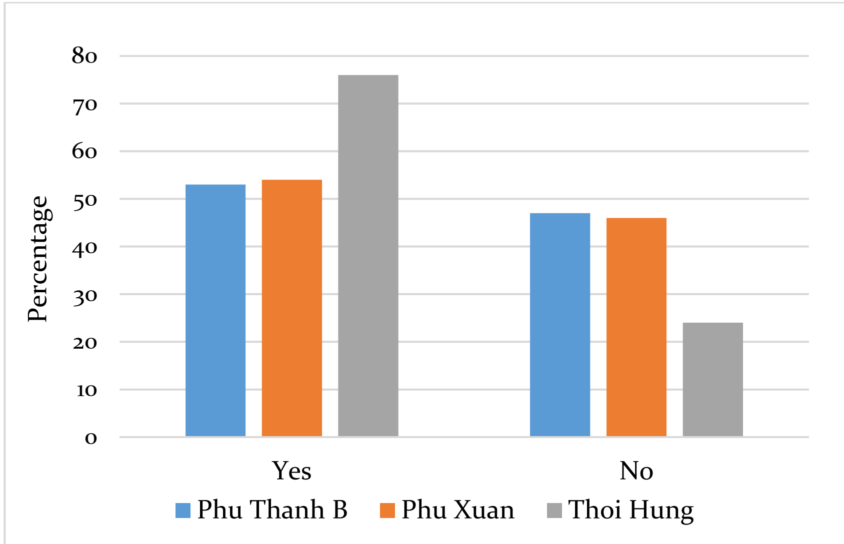


Figure 5.1 Proportion of household participation in learning cohorts by surveyed areas

Source: Figure by Tran Anh Thong; Household survey (2014)

The level of participation in collective learning varies considerably across household groups (Figure 5.2). The data show that the better-off group (81 percent) is engaged in collective learning more frequently than the medium group (58 percent) and poor group (44 percent). Qualitative analysis suggests that better-off households have more opportunities to socialise owing to their broader social networks. Having more resources, they are more willing to take risks in conducting on-farm experimentation in order to explore innovative techniques to improve crop productivity. In contrast, most poor households are under-represented in social activities. They bear a disproportionate burden of meeting family demands, for example, in providing daily meals for the family. Therefore, most of them do not have time to commit to learning. Sensitive issues concerning their limited educational attainment and poor performance in knowledge-based skills constrain them from confidently participating in collective learning with other groups.

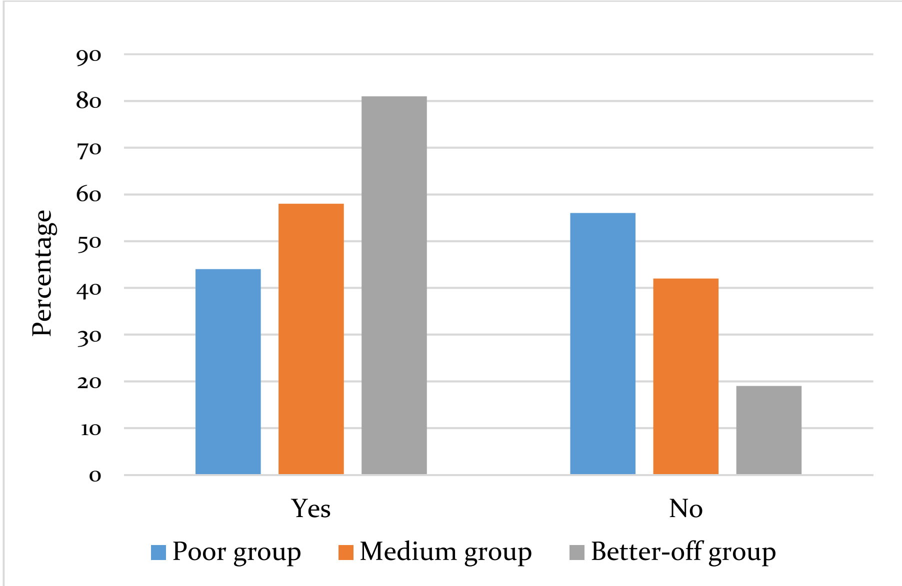


Figure 5.2 Proportion of household participation in learning cohorts by household groups

Source: Figure by Tran Anh Thong; Household survey (2014)

5.2.2 Households' collective learning patterns

Participatory activities involving collective learning among the farming households are shown in Figure 5.3. They take place in many ways. Learning through casual gatherings is the most common pattern for households (59 percent). Focus group discussions across the communes reveal that rural people in the MDV often get together in small groups for morning coffee or tea at home. At times, they are invited to attend a wedding ceremony or a death anniversary commemoration. These casual events are useful occasions for them to update daily information or exchange practical knowledge relevant to their farming practices. Problems with crop production are often raised as a topic for discussion. The convivial settings provide opportunities to judge each other's views. Different perspectives inform the hectic debates among farming households, enabling the participants to explore knowledge in depth. This form of every-day social connection helps to augment the bonds of interactive collectivity among local households, which can assist in dealing with difficulties.

> We share our knowledge of prawn culture in events of drinking or home celebrations. I think everyone has his own experience and strengths to be shared *(Interview with Mr. Nguyen in Phu Thanh B, November 7th, 2013)*.

Farming households learn from each other while working. This activity often occurs in open fields. At noon, farmers in adjacent fields sit together for a tea break where they can consult and share technical advice with each other. They can visit each other's fields to gain empirical understanding of the relevant farming practices. This household-led learning pattern is very handy as the knowledge can be quickly absorbed and put into practice. Other formal learning practices were observed. Household participants often participate in local seminars or training workshops where they can communicate in person or in groups. Successful farmers are invited as guest speakers to share practical knowledge gained overtime. Seminars are the most common formal learning platforms in the rural areas (36 percent). They provide valuable opportunities for technical experts and farming households to exchange technical and local knowledge with each other.

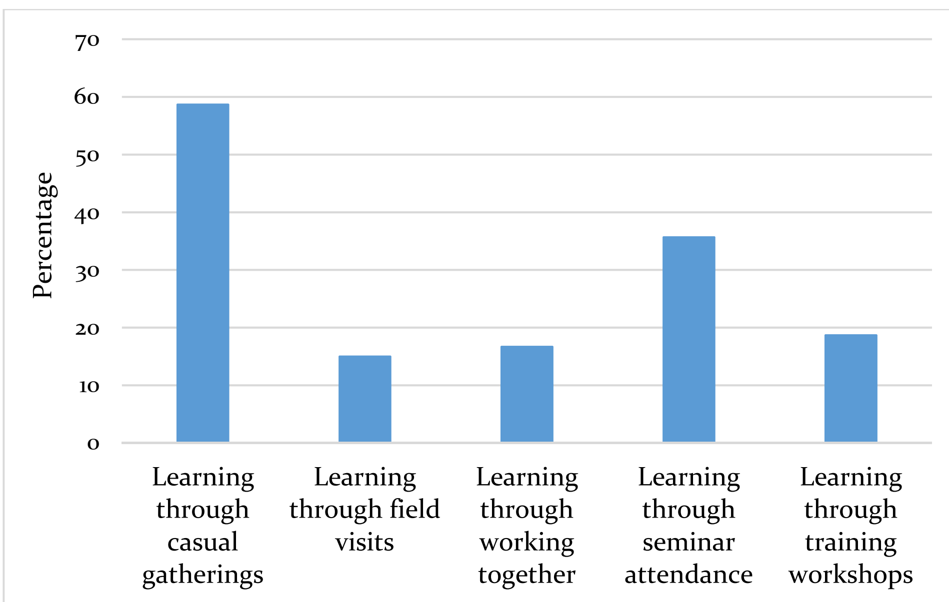


Figure 5.3 Households' collective learning patterns

Source: Figure by Tran Anh Thong; Household survey (2014)

There is a significant difference in households' engagement in collective learning across the communes (Table 5.1). As many as 73 percent of the households in Thoi Hung participated in casual learning compared to Phu Thanh B (52 percent) and Phu Xuan (51 percent) ($p<0.01$). The majority of the households in Thoi Hung acquire scientific knowledge from seminars, where they can get technical support from the nearby academic and research institutions. They also learn through working-together activities ($p<0.001$). The qualitative results indicate that the informal land lease arrangements established between farming households in Thoi Hung and external farmers provide opportunities for the former to adopt technical knowledge from the latter, who possesses substantial knowledge on field crop production. From the organisational learning perspective, Nooteboom (2000) claims that knowledge from outsiders is useful because it may introduce elements of novelty, which may lead to innovation. Most farming households in Thoi Hung find this pattern of knowledge exchange important, as it has contributed to the successful implementation of their on-farm diversification over the last few years.

Table 5.1 Households' collective learning patterns by surveyed areas (N=300)

Household engagement in collective learning patterns (%)	Surveyed areas		
	Phu Thanh B (n=100)	Phu Xuan (n=100)	Thoi Hung (n=100)
Learning through casual gatherings**	52	51	73
Learning through field visits^ns.	14	12	19
Learning while working together***	9	13	28
Learning through seminars***	27	29	51
Learning through technical training^ns.	21	14	21

Note: Test for significant difference is based on Fisher's exact test, * $p<0.05$, ** $p<0.01$, *** $p<0.001$, ns. as not significant

Household groups' participation in collective learning varies significantly (Table 5.2). Learning through casual gatherings is the most common method across the three household groups. It is likely that the poor group has limited opportunity to engage in these collective learning activities. In contrast, the better-off group appears to be the most active agent in the learning process. Qualitative evidence shows that the majority of this group implement on-farm diversification, and thus have stronger motivation to acquire multiple sources of knowledge. Fisher's test shows that the difference among the household groups involved in casual learning, seminars, and technical training is strongly statistically significant ($p<0.001$).

Table 5.2 Households' collective learning patterns by household groups (N=300)

Household engagement in collective learning patterns (%)	Household groups		
	Poor (n=100)	Medium (n=100)	Better-off (n=100)
Learning through casual gatherings***	44	55	77
Learning through field visits$^{ns.}$	11	13	21
Learning while working together**	9	14	27
Learning through seminars***	19	29	59
Learning through technical training***	11	12	33

Note: Test for significant difference is based on Fisher's exact test, * $p<0.05$, ** $p<0.01$, *** $p<0.001$, ns. as not significant

5.2.3 Social actors' involvement in learning with households

Most knowledge sharing begins with personal contact and interaction (Howard, 2005). The data in Table 5.3 suggest that local households in the three communes are more likely to interact with their learning partners in bonding and bridging relationships. Despite undergoing tremendous socio-economic transformation under *Đổi Mới* policy, the rural societies of the MDV still maintain strong bonding relationships. These forms of connectivity represent an appreciation of how social cohesion promotes mutual assistance among community members. This spirit recognises not only shared social responsibility but also reciprocal learning support. It indicates what Woolcock and Narayan (2000: 226) claimed in light of social capital, that "when people fall on hard times, they know it is their friends and family who constitute the final safety net". The cross tabulation results indicate that Thoi Hung commune has the highest proportion of households who connect with these social actors to enable learning. In practice, rural people are more likely to communicate with those with whom they feel intimate or comfortable to seek advice or share knowledge. It is clear that the majority prefers to interact with their nearby friends, neighbours, and relatives whom they trust the most. These findings contrast with Owada-Shibuya's (2002: 3) observations in her case study in the MDV that rural people do not trust each other, including their close neighbours. She found that neighbours rarely visit each other's houses or work together in farming. However, they tend to cooperate and trust their family members. According to Dang Le Hoa et al. (2014), rice farmers in the MDV tend to pass on farming techniques and skills to their family members. These findings are consistent with Bauer's (2011: 168) study, suggesting that individuals nested in family relationships (based on trust, networks, family ties, and friendship reciprocity) demonstrate a higher level of knowledge sharing.

Table 5.3 Social actors' involvement in household learning by surveyed areas (N=300)

Social actors' involvement in learning with households (%)	Surveyed areas		
	Phu Thanh B (n=100)	Phu Xuan (n=100)	Thoi Hung (n=100)
Learning interaction with grandparents$^{ns.}$	3	0	4
Learning interaction with parents$^{ns.}$	11	4	9
Learning interaction with siblings$^{ns.}$	21	26	27
Learning interaction with nearby relatives*	29	28	44
Learning interaction with distant relatives*	3	7	14
Learning interaction with neighbours**	51	52	73
Learning interaction with nearby friends***	21	33	48
Learning interaction with distant friends**	3	8	16
Learning interaction with technical experts*	15	16	30

Note: Test for significant difference is based on Fisher's exact test, * $p<0.05$, ** $p<0.01$, *** $p<0.001$, ns. as not significant

Fisher's exact test shows that there is a significantly greater proportion of households in Thoi Hung who share learning with their nearby friends (2.3 times Phu Thanh B, 1.5 times Phu Xuan, $p<0.001$), neighbours (1.4 times Phu Thanh B and Phu Xuan, $p<0.01$), distant friends (5.3 times Phu Thanh B, 2 times Phu Xuan, $p<0.01$), nearby relatives (1.5 times Phu Thanh B, 1.6 times Phu Xuan, $p<0.05$), and distant relatives (4.7 times Phu

Thanh B, 2 times Phu Xuan, p<0.05). Compared to their counterparts in Phu Thanh B and Phu Xuan, households in Thoi Hung are more likely to have opportunities to interact with technical experts (2 times Phu Thanh B, 1.9 times Phu Xuan, p<0.05). This privilege enables them to gain better access to technical knowledge beneficial for their crop cultivation.

Table 5.4 Social actors' involvement in learning by household groups (N=300)

Social actors' involvement in learning with households (%)	Household groups		
	Poor (n=100)	Medium (n=100)	Better-off (n=100)
Learning with grandparents$^{ns.}$	1	3	3
Learning with parents$^{ns.}$	10	7	7
Learning with siblings$^{ns.}$	23	23	28
Learning with nearby relatives***	30	22	49
Learning with distant relatives$^{ns.}$	7	6	11
Learning with neighbours***	43	57	76
Learning with nearby friends***	24	24	54
Learning with distant friends*	5	7	15
Learning with technical experts***	9	15	37

Note: Test for significant difference is based on Fisher's exact test, * p<0.05, ** p<0.01, *** p<0.001, ns. as not significant

The better-off households are found to have a significantly greater proportion of the household groups engaged in learning with social actors (Table 5.4). In practice, they share experiential knowledge with their neighbours (1.8 times poor group, 1.3 times medium group, p<0.001), nearby friends (2.3 times poor and medium groups, p<0.001), nearby relatives (1.6 times poor group, 2.2 times medium group, p<0.001), and distant friends (3 times poor group, 2.1 times medium group, p<0.05). Meanwhile, their poor counterparts are more likely to be left behind in the collective learning process. The results suggest that the number of poor households involved in learning with technical experts is rather low (9 percent), only half of the medium (15 percent) and 4 times lower than the better-off group (37 percent). It was observed that the poor households, when in need of advice or knowledge, are more likely to be limited to the bonds of spatial proximity and kinship, such as nearby relatives (30 percent), nearby friends (24 percent), siblings (23 percent), and parents (10 percent). Mutz et al. (2005) posit that these bonding networks are vital to less powerful households in times of hardship. Learning with neighbours, compared to other bonding relationships, is the most frequently observed relationship (43 percent). This finding is consistent with Forrest and Kearns' (2001) viewpoint that neighbours are of great importance to the poor, while the majority of the population develop more spatially diffuse networks. In this light, for bridging relationships, the poor group constitutes the smallest proportion; for instance, distant friends (5 percent) compared to the medium group (7 percent) and better-off group (15 percent). These findings are corroborated by Woolcock and Narayan's (2000: 227) observation that "the poor may have a close-knit and intensive stock of 'bonding' social capital to get by" but "lack the more diffuse and extensive 'bridging' social capital to get ahead."

5.2.4 Household learning across administrative level

Learning in the rural areas is not confined to one locality but extends beyond the immediate locality. Traditionally, the adults, after getting married, prefer to live near their parental homes. Over time, these kinships develop more diverse social ties which cluster their settlements in the same place. As previously indicated, the households in the surveyed areas are more likely to share knowledge with those related to their relatives, friends, or families living nearby. Table 5.5 shows that the households' shared learning mostly takes place at the hamlet level ($p<0.05$), within the commune ($p<0.01$), and at the district level ($p<0.05$). A higher proportion of households engaged in learning can be observed in Thoi Hung. This may be explained by their having more social connections ($p<0.01$) than those in the other two communes. This outcome is evident in the qualitative analysis, which shows that this commune received a large number of migrants from surrounding localities during the 1990s. They were the early settlers in the commune. Therefore, it is not surprising that the local households still maintain kinship connections with their original groups.

> I get enthusiastic support from my fellow prawn breeders, who have close relationships with me. In case of not coming over, I can phone them for help. We honestly help each other with true friendships. Sometimes, they come over, stay with me for a few days, and help me with the treatment of the prawn diseases *(Interview with Mr. Nguyen in Phu Thanh B, November 7th, 2013)*.

> I have some close friends in Dong Thap province where I originally come from. They are experienced lotus growers who instruct me how to grow it *(Interview with Mr. Phong in Thoi Hung, February 21st, 2014)*.

Table 5.5 Household learning across administrative level by surveyed areas (N=300)

Household learning across administrative levels (%)	Surveyed areas		
	Phu Thanh B (n=100)	Phu Xuan (n=100)	Thoi Hung (n=100)
Learning within the hamlet*	48	51	65
Learning across the hamlet*	33	31	47
Learning within the commune**	38	35	55
Learning across the commune$^{ns.}$	16	20	29
Learning within the district*	18	20	32
Learning across the district*	5	10	18
Learning within the province**	6	15	23
Learning across the province$^{ns.}$	3	10	8

Note: Test for significant difference is based on Fisher's exact test, * $p<0.05$, ** $p<0.01$, *** $p<0.001$, ns. as not significant

Table 5.6 shows that learning takes place mostly at the hamlet and communal levels across the three household groups. Across these levels, the better-off groups are the most active participants in learning, followed by the medium group. There is a significant difference in the proportion of household groups involved in learning across the administrative levels, particularly at the hamlet level ($p<0.001$), within the commune ($p<0.001$), across the commune ($p<0.01$), and within the district ($p<0.05$). Besides their engagement in bonding relationships, the better-off group is more likely to travel for learning (field visits), as they seek to extend their learning opportunities and build social relationships. In contrast, the poor group migrates in order to make money, rather than to seek opportunities for learning. My observations show that they are likely to be isolated from external social connections. Such marginalisation can be attributed to the growing economic inequality in rural areas. Their voices are often unrecognised by the groups of higher socio-economic status. This social constraint impedes their ability to contribute to shared learning and to establish relationships with various social groups in the rural community.

Table 5.6 Household learning across administrative level by household groups (N=300)

Household learning across administrative levels (%)	Household groups		
	Poor (n=100)	Medium (n=100)	Better-off (n=100)
Learning within the hamlet***	41	52	71
Learning across the hamlet***	26	33	52
Learning within the commune***	29	40	59
Learning across the commune**	13	20	32
Learning within the district*	15	22	33
Learning across the district$^{ns.}$	7	12	14
Learning within the province$^{ns.}$	10	15	19
Learning across the province$^{ns.}$	5	8	8

Note: Test for significant difference is based on Fisher's exact test, * p<0.05, ** p<0.01, *** p<0.001, ns. as not significant

5.2.5 Social learning for household innovations and knowledge diffusion

Social learning evolves across time and space. Traditional Vietnamese culture appreciates one's commitment to learning and knowledge acquisition. A Vietnamese proverb *"Đi một ngày đàng học một sàng khôn"* (Travel broadens the mind) conveys a sense that an individual should not confine himself in one locality. Rather, he should travel to broaden his worldview. The more he travels, the more knowledge he can acquire. Long and Villareal (1994) perceive knowledge as being socially constructed, and formulated from the process of social interaction. As indicated in the subsequent sections, the case studies illustrative of social learning in the 'living-with-floods' context of the delta are graphically demonstrated in Figure 5.4. They present a similar learning trajectory, demonstrating how an individual engages in collective learning and the self-reflection process to acquire new knowledge, and how the learning cohort increases in number over time. Initially, he travels to participate in a learning cohort, trying to absorb knowledge as a working apprentice. After grasping the target knowledge, he sets up an on-farm experiment, trying to test if the acquired knowledge could be applied in new environmental conditions. Experimentation is used as a means for learning during this process. Another Vietnamese proverb *"Học đi đôi với hành"* (Practice makes perfect) illustrates the individual's endeavour to put his knowledge into practice from which he can learn. In new circumstances, the original knowledge is transformed, combined with the learner's personal experience before it becomes new knowledge to be universally adopted. Stolzenbach (1994: 156) posits that "the art of farming is to adapt the posing of the problem to the changing situation and act accordingly." The case studies suggest that the success of the household individual's venture brings learning participants into a new learning cohort. At this time, his role is placed at the centre of learning. He serves as a 'gatekeeper' interacting with external networks (Long and Villareal, 1994). The graphical representation of households' learning trajectory corresponds to the view of Pelling (2011: 59), who sees social learning as "the capacity and processes through which new ideas, values and practices are disseminated, popularised and become dominant in society." This learning trajectory also illuminates how individual knowledge evolves and merges into the local community knowledge (Brown, 2010).

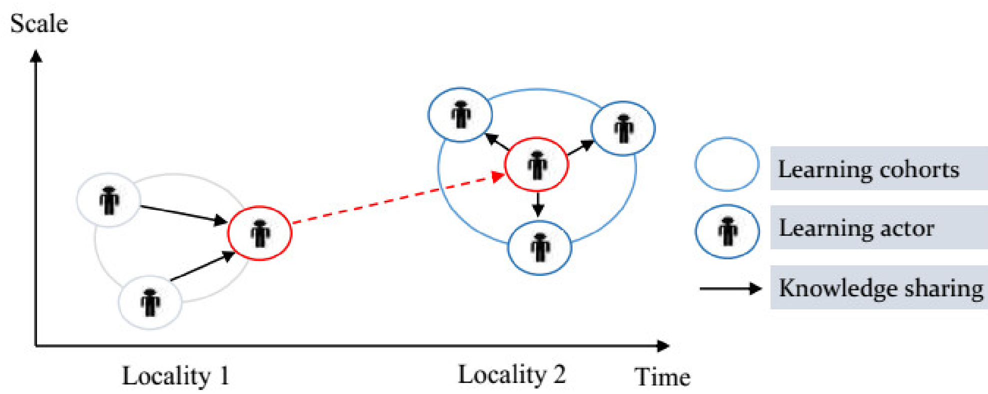


Figure 5.4 Learning trajectory of the farming households in the MDV

Source: Figure by Tran Anh Thong; In-depth interviews (2013-2014)

A multitude of case studies demonstrating farming households' innovations as the result of social learning is found across the surveyed areas. Rogers (2003: 36) defines innovation as "an idea, practice, or object perceived as new by an individual or other unit of adoption." Nooteboom (2000: 70) sees innovations as the process of knowledge exchange. As demonstrated in the case studies, households' innovations derive primarily from their learning interactions, knowledge exchange with others, and their self-reflection (Figure 5.5). They draw on household creativity in using flood conditions and related resources to benefit their livelihoods. Such ingenuity is accumulated throughout their life-long interactions with floods, whereby they can enhance their adaptive skills and capacity to overcome hardship.

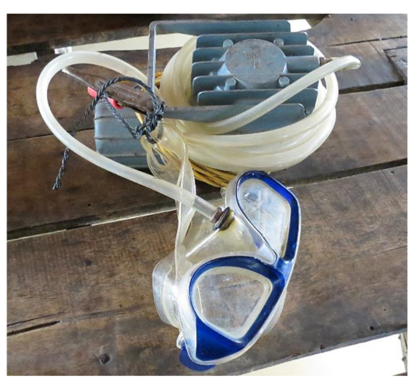


Figure 5.5 A diving device created by a prawn farmer in Phu Thanh B

Source: Photo by Tran Anh Thong (2013)

The first case study demonstrated the freshwater prawn *(Macrobrachium rosenbergii)* culture in Bird Islet *(Cù lao Chim)* of Phu Thanh B commune. The emergence of this model involved the pioneering work of a prawn breeder who attempted to participate in the learning process with his counterparts in the flood-prone districts of An Giang province. From what he had observed in these areas, prawns were stocked in a controlled condition protected by high dyke systems (Figure 5.6). He came to think that prawns could be even more productive if cultured in the free flood conditions in his commune. With this in mind, he decided to pursue this initiative. Undertaken in 2004, his first prawn culture experiment in the free flowing flood environment brought him great success. He stated:

> I initiated this farming model based on what I have learned from others. I am a bit worried about my first experiment. However, the results are exeptionally good. I think that prawns grow well when being cultured in the flooding environment *(Interview with Mr. Nguyen in Phu Thanh B, November 7th, 2013)*.

Figure 5.6 Giant freshwater prawn culture in a controlled system in Vinh Thanh Trung, Chau Phu district, An Giang (left) compared with the new farming model in the free flood condition in Phu Thanh B, Tam Nong district, Dong Thap (right)

Source: Photos by Dang Thanh Phu (2014) and Tran Anh Thong (2013)

The second case study presents the successful swamp eels *(Monopterus albus)* farming model undertaken by a poor farmer in Phu Xuan commune. During the dry season, he paid extensive visits to eel farms across the delta to learn eel-farming techniques from experienced eel farmers. He argues that experiential knowledge accrued over time is the key to his success. Keen observations from the self-treatment of eel diseases consolidate his knowledge. His experience shows that the techniques of mixing various ingredients into feeds are essential in sustaining the survival rate, the growth, and the yields of cultured eels. Over the past few years, he has extended his empirical knowledge with those who are interered in eel culture. He stated:

> I travel a lot to learn how to raise eels. Compared with other farming models, I think eel culture is more profitable. I trap fish to produce feed for eels during the flood season from which I can minimise the cost. I have shared with my neighbours how to raise eels. I was also invited by the commune government to share my experience with the local farmers *(Interview with Mr. Duong in Phu Xuan, December 17th, 2013)*.

Figure 5.7 An intensive eel farming model in Phu Xuan

Sources: Photo by Tran Anh Thong (2013)

Mr. Tam, the Chairman of the Farmer's Association of Thoi Hung, details how informal learning networks contribute to the expansion of local field crop production in the commune. The effects of 'importing-the-knowledge' from external farmers are the keys to the proliferation of the field crop production over the last decade. Under the administration of the Song Hau State Farm, the production of field crops was not formally permitted. However, some farming households secretly leased out their farmlands to external farmers on short-term contracts. The main reason behind this is the latter has experience in cultivating field crops. These informal arrangements are three-fold. Local farmers can both share the yields and acquire the technical knowledge from outsiders. They can take advantage of available trading networks introduced by the external farmers to sell the products. Thanks to these networks, the products can be easily sold. High market demands for the field crops in the flood season induce the local households to learn the farming techniques to self-manage their crops. The learning interactions between the local farmers and the outsiders have contributed substantially to expanding the field crop production in the commune *(Interview with Mr. Tam, a Chairman of the Farmer's Association of Thoi Hung, April 4th, 2014)*.

Figure 5.8 A crop diversification model in Thoi Hung in the flood season

Sources: Photo by Tran Anh Thong (2013)

In the current political, socio-cultural context of the MDV, it was clearly observed that the use of role modelling and slogans echoed from the war-time period remains a dominant approach to assist collective learning and actions. At the farming household level, the title *"Nông dân sản xuất giỏi"* (Model farmers) is granted to the farmers who have excellent performance in agricultural production as stipulated by Vietnam Farmer's Association's regulation No. 944-QD/HNNTW dated September 04th, 2014. These glorified farmers serve as resource persons who can facilitate the propagation of experiential knowledge across the rural community. These exemplary models are of significance in promoting 'passive and active social learning' (Glasser, 2009), which relates to households' creativity in farming production, proactive spirit in learning, and the sharing of empirical knowledge across the rural community. Empirical evidence shows that the 'model farmers' competitions launched by the local organisation (Farmers' Association) and farming success stories play an important role in promoting public attitudes towards the utility of self-learning, sharing of knowledge, and taking collective actions for rural development *(Interview with a sticky rice farmer in Phu Xuan, December 17th, 2013)*. At the academic and scientific levels, such accredited titles as *"Bác Sĩ Lúa"* (Doctor Rice) or *"Anh Hùng Lao Động"* (Heroes of Labour) are awarded to the outstanding figures who make recognised contributions to state development *(Interview with the Deputy Secretary of Party in Thoi Hung, February 21st, 2014)*. They set good examples from which others can learn.

5.3 Socio-demographic characteristics of respondents

Table 5.7 provides a summary of the socio-demographic characteristics of the respondents. The proportion of male and female subjects in the sample is not equally distributed. Approximately three quarters are male (74 percent). It shows that the rural tradition in the MDV conventionally assigns males as household heads, who bear greater responsibility for household-related matters. Most of the respondents are married (94 percent). Their age is distributed across four categories. Those whose age ranges 30-49 years occupy the highest proportion (47.3 percent) in the sample, followed by those aged 50-69 years (41.7 percent). The number of respondents under 30 years of age has the lowest proportion (4.3 percent).

More than half of the sample completed elementary school (51 percent), followed by those completing secondary school (25.3 percent). The illiteracy rate of the respondents in the sample is relatively high (12.3 percent). Meanwhile, those who completed high school and above make up the smallest proportion (11.3 percent).

Table 5.7 Respondents' socio-demographic characteristics

Socio-demographic characteristics (N=300)		Frequency	Percentage
Gender			
	Male	222	74.0
	Female	78	26.0
Age groups			
	17–29	13	4.3
	30–49	142	47.3
	50–69	125	41.7
	70 and over	20	6.7
Marital status			
	Single	6	2.0
	Married	282	94.0
	Widower/Widowed	12	4.0
Educational attainment			
	Illiterate	37	12.3
	Elementary school	153	51.0
	Secondary school	76	25.3
	High school and above	34	11.3
Religion			
	Buddhism	131	43.7
	Catholics	11	3.7
	Hoahaoism	129	43.0
	Caodaism	9	3.0
	Other	20	6.7
Length of residency			
	Less than 5 years	4	1.3
	From 5 to 10 years	17	5.7
	More than 10 years	279	93.0
Surveyed areas			
	Phu Thanh B	100	33.3
	Phu Xuan	100	33.3
	Thoi Hung	100	33.3
Household groups			
	Poor	100	33.3
	Medium	100	33.3
	Better-off	100	33.3

Source: Household survey (2014)

The inhabitants in the rural delta practise various religions. In the sample, nearly 44 percent of the respondents identify themselves as Buddhists, while a slightly lower number reports following Hoahaoism (43 percent). Those practising other religions account for 6.7 percent, followed by Catholics (3.7 percent), and Caodaism (3 percent).

Respondents who have the residency of more than ten years dominated the sample (93 percent). This evidence suggests that the rural inhabitants in the MDV appreciate the traditional values of being attached to their relatives, neighbours and homelands. Taking this into account, it is likely that they have extensive knowledge and profound experience in 'living-with-floods'. The total sample recruited for the survey was 300, with an equal proportion (33.3 percent) distributed across three surveyed areas and household groups.

5.4 Analysis of social learning and adaptive capacity dimensions

Exploratory factor analysis using principal axis factoring with the varimax rotation method was conducted to examine the social learning and adaptive capacity items. The factor analysis follows Hair et al.'s (2014) criteria, which set up the thresholds to form latent factors. The criteria include (1) Eigenvalues ≥ 1.0; (2) factor loadings ≥0.4; and (3) and cross-loadings dropped from the loading matrix.

5.4.1 Social learning dimensions

The factor structure presents the factor loadings and uniqueness from principal axis factoring for the social learning dimensions (Table 5.8). It produces two latent factors: ELP (external learning performance) and ILP (internal learning performance). These quantitative results are consistent with the social learning theories conceptualised by Reed et al. (2010) and Glasser (2009). While the ELP items demonstrate farming households' proactive behaviour to acquire knowledge through communication and social interactions, the ILP items present the way they engage in a self-learning process, using their experiential and experimental knowledge to deal with situations. The analysis suggests that these learning patterns are salient and co-exist in the adaptation context of the delta.

Seven items were found to be attributable to the ELP. The interpretation of scale items within this factor highlights the general recognition of households' interactions with other social actors as important in effectively supporting their livelihood practices in the flood season. The items cover the learning processes taking place in both a formal and informal manner. The results of factor analysis reveal that the ELP account for 29.87 percent of the common variance and yield an Eigenvalue of 4.34. Four items that load strongly on this factor (loading coefficient >0.7) are related to households' learning engagement with technical staff. High loading values suggest that the items are closely associated with the factor (Walker and Madden, 2009). The last three items are characterised by the households' casual learning activities among their peers. The reliability assessment of the ELP items shows that the Cronbach's alpha is 0.85. This coefficient shows a strong reliability that moves beyond the agreed-upon level of 0.7. In general, the results of factor analysis suggest that the ELP constitutes a strong component of the social learning dimension.

The ILP comprises four items, which have lower factor loadings than the ELP. The item yielding the highest loading coefficient of 0.7 is *"I usually learn from my friends' failures and draw lessons for myself."* The ILP describes the internal learning processes, indicating the process of self-learning engaged in by the households with the lessons learned from self-exploration and observations from others. The households commonly agree that they learn from what they have empirically experienced. The last two items imply a strong sense of innovation and confidence, which is appreciated by the households in their efforts to adapt to change. The ILP explains 14.72 percent of the variance with an Eigenvalue of 1.66. Compared to the ELP, four items of the ILP produce the lower internal consistency level (α=0.67).

Table 5.8 Factor loadings from principal axis factoring for social learning

Social learning items	Factor loadings 1	Factor loadings 2	Uniqueness
External learning performance			
When necessary, I can call on extension officials for help.	0.76		0.42
When attending seminars, I usually take part in discussions with other participants.	0.75		0.41
I am assisted by extension officials enthusiastically.	0.73		0.47
The learning interactions between local farmers and extension officials take place during seminars.	0.72		0.37
I usually visit successful flood-based production models to learn and follow.	0.64		0.58
Shared learning and discussions on production activities in the flood season provide me with compelling initiatives.	0.59		0.56
I usually discuss flood-based production activities when having coffee or parties with friends.	0.48		0.74
Internal learning performance			
I usually learn from my friends' failures and draw lessons for myself.		0.70	0.48
Early failures give me quite a few lessons that are useful for successive efforts.		0.56	0.59
I do not strictly follow what I have learned but create my own ways.		0.54	0.70
I do not easily believe things until I experience them myself.		0.48	0.77
Number of items retained	7	4	
Eigenvalue	4.34	1.66	
Percentage of explained variance	29.87	14.72	
Cronbach's alpha (α)	0.85	0.67	

Note: The items are measured on a five-point Likert scale: (1)=strongly disagree; (2)=disagree; (3)=undecided; (4)=agree; (5)=strongly agree

Eigenvalues greater than 1 selected

Factors retained with loading values greater than 0.4

Four items were dropped from the scale

The two latent factors accounts for 44.60 percent of the total variance within the data. The Cronbach's alpha coefficient for the whole index of social learning is 0.83. Fifteen items were entered in the analysis, from which four of them were dropped. One item with low loading values (<0.4) and three items not uniquely loading onto one factor (cross-loadings) were removed from the scale. The four deleted items include: (1) *"I like communicating with those who have farming experience to advance my knowledge"*; (2) *"I am willing to share what I have learned"*; (3) *"I usually help those who find it difficult to get employment during the flood season"*, and (4) *"I usually perform experimentation on my own production model to learn from it."* Uniqueness measures the variance that is reflected in a single item (Walker and Madden, 2009). In summary, the analysis suggests that the uniqueness values for the ELP items are higher than those for the ILP ones.

Table 5.9 shows the mean values, standard deviation, and the Cronbach's alphas of the scale items. The grand mean calculated for the ELP is ($\bar{X}$=3.60). Four items for the ELP are found to have higher mean values than the grand mean (above 3.7). There is a large deviation for the ELP items from their means. The first item has the largest value (σ=1.02). The 'Cronbach's alpha if item deleted' column implies that the alpha values could change substantially if particular items are deleted. The Cronbach's alpha coefficients for most items of the ELP are lower than its factor coefficient (α=0.85), except for the last item (α=0.86).

The grand mean value for four items of the ILP is calculated ($\bar{X}$=3.93), which is higher than that for the ELP. The mean values for the items in the ILP is generally high, with two items yielding a mean above 4.0. These items are of high importance in the scale. They include: (1) *"Early failures give me quite a few lessons that are useful for successive efforts"* ($\bar{x}$=4.12) and (2) *"I usually learn from my friends' failures and draw lessons for myself"* ($\bar{x}$=4.10). As compared to the ELP, the standard deviation of the items for the ILP is lower, meaning that their values are closer to their means. Similar to the ELP, the values of corrected item-total correlations for the ILP are greater than 0.4. Rules of thumb suggest that these values should be at least 0.4 (Gliem and Gliem, 2003). All items for the ILP obtain a lower Cronbach's alpha coefficient than their representative factor (α=0.67).

Table 5.9 Mean values and reliability for social learning dimensions

Social learning items	Grand mean	Item mean	Standard deviation	Item-total correlations	Cronbach's alpha if item deleted
External learning performance	3.60				
When necessary, I can call on extension officials for help.		3.42	1.02	0.67	0.83
When attending seminars, I usually take part in discussions with other participants.		3.74	0.83	0.69	0.82
I am assisted by extension officials enthusiastically.		3.50	0.98	0.66	0.83
The learning interactions between local farmers and extension officials take place during seminars.		3.72	0.71	0.69	0.83
I usually visit successful flood-based production models to learn and follow.		3.32	0.96	0.61	0.84
Shared learning and discussions on production activities during the flood season provide me with compelling initiatives.		3.78	0.73	0.59	0.84
I usually discuss flood-based production activities when having coffee or parties with friends.		3.73	0.96	0.47	0.86
Internal learning performance	3.93				
I usually learn from my friends' failures and draw lessons for myself.		4.10	0.72	0.53	0.56
Early failures give me quite a few lessons that are useful for successive efforts.		4.12	0.68	0.44	0.62
I do not strictly follow what I have learned but create my own ways.		3.64	0.88	0.45	0.61
I do not easily believe things until I experience it myself.		3.86	0.80	0.42	0.63

Note: Calculation of mean values is based on a five-point Likert scale: (1)=strongly disagree; (2)=disagree; (3)=undecided; (4)=agree; (5)=strongly agree

5.4.2 Adaptive capacity dimensions

The principal axis factoring produces only one factor that makes the most conceptual sense for the dimensions of adaptive capacity. Its factor loadings and uniqueness are presented in Table 5.10. The single factor represents 13 from 18 original items of the adaptive capacity dimensions. Five items below the loading threshold value (0.4) were excluded from the factor loading structure. They include (1) *"I don't think it is difficult to get a loan from the local bank for flood production investment"*; (2) *"I have many relatives who can help me with farming work in the flood season when needed"*; (3) *"I am landless, so I have to rely on seasonal employment in the flood season"*; (4) *"People's voice is not highly recognised in the locality"* and (5) *"Poor households can get a loan from the bank for their livelihood investment in the flood season."* Uniqueness values for the adaptive capacity index are found to be opposite to their loading values. Adaptive capacity obtains an Eigenvalue of 5.04. Its Cronbach's alpha coefficient is 0.88, which suggests a high level of reliability.

Two items make a significant contribution to adaptive capacity. The first item, *"Households' initiatives through flood production models are highly recognised by the local government"*, has the highest loading value (factor loading=0.80) followed by the item *"The local government encourages households' shared experiences and initiatives through flood production activities"* (factor loading=0.76). They emphasise that shared learning and initiatives in local farming practices make a substantial contribution to households' adaptive capacity. The items related to knowledge diffusion and external support from the local government, in terms of providing employment and knowledge acquisition load less strongly on the factor. The households' internal capacity and their participation in dyke policies indicated by the last two items have the lowest loading values.

Table 5.10 Factor loadings from principal axis factoring for adaptive capacity

Adaptive capacity items	Factor loadings 1	Uniqueness
Adaptive capacity		
Households' initiatives through flood production models are highly recognised by the local government.	0.80	0.37
The local government encourages households' shared experiences and initiatives through flood production activities.	0.76	0.43
Technical assistance provided by agricultural experts helps farming households implement their flood production activities successfully.	0.70	0.52
Learning experiences among local households contribute a great deal to emerging, developing, and expanding flood production activities across the region.	0.68	0.54
Shared learning in the community helps increase local household income from flood production activities.	0.67	0.55
I believe that sharing information and knowledge is an effective approach to increase households' knowledge on flood production activities.	0.62	0.62
The local government often organises seminars or training courses on flood production models for local households to participate in.	0.62	0.62
I think that flood production models offer local people a great deal of employment in the flood season.	0.61	0.63
The local government provides great support to households' employment in the flood season.	0.55	0.70
I share my farming experiences with those who not only reside locally but also elsewhere.	0.54	0.71
I always receive support from the local government in the flood season.	0.51	0.74
I believe I have sufficient knowledge and skills to implement flood production models of my own.	0.49	0.76
I think everyone has a say in the decision-making process on local dyke matters.	0.47	0.78
Number of items retained	13	
Eigenvalue	5.04	
Cronbach's alpha (α)	0.88	

Note: The items are measured on a five-point Likert scale: (1)=strongly disagree; (2)=disagree; (3)=undecided; (4)=agree; (5)=strongly agree

Eigenvalues greater than 1 selected

Factors retained with loading values greater than 0.4

Five items were dropped from the scale

Mean values and reliability for the items of adaptive capacity are shown in Table 5.11. The grand mean has a fairly high value ($\bar{X}$=3.78). Two items have the highest mean values of above 4.0, including *"I believe that sharing information and knowledge is an effective approach to increase households' knowledge on flood production activities"* ($\bar{x}$=4.09) and *"I think everyone has a say in the decision-making process on local dyke matters"* ($\bar{x}$=4.07). These results suggest different levels of variation regarding the item values compared to their means, which are represented by the standard deviation. The item "*I always receive support from the local government in the flood season"* indicates the largest standard deviation (σ=0.94). Meanwhile, the item *"Shared learning in the community helps increase local household income from flood production activities"* has the smallest value of standard deviation (σ=0.63).

Most items produce high scale reliability (α>0.87), with the Cronbach's alpha coefficients well above Hair et al.'s (2014) recommended benchmark (α≥0.7). However, they are found to fall below the reliability value of the index (α=0.88). The corrected item-total correlations for all items are greater than 0.4.

Table 5.11 Mean values and reliability analysis for adaptive capacity dimensions

Adaptive capacity items	Grand mean	Item mean	Standard deviation	Item-total correlations	Cronbach's alpha if item deleted
Adaptive capacity	3.78				
Households' initiatives through flood production models are highly recognised by the local government.		3.68	0.75	0.73	0.86
The local government encourages households' shared experiences and initiatives through flood production activities.		3.69	0.66	0.71	0.87
Technical assistance by agricultural experts helps local farming households implement their flood production activities successfully.		3.81	0.77	0.64	0.87
Learning experiences among local households contribute a great deal to emerging, developing, and expanding flood production activities across the region.		3.73	0.65	0.63	0.87
Shared learning in the community helps increase local household income from flood production activities.		3.93	0.63	0.62	0.87
I believe that sharing information and knowledge is an effective approach to increase households' knowledge on flood production activities.		4.09	0.64	0.57	0.87
The local government often organises seminars or training courses on flood production models for local households to participate in.		3.65	0.78	0.58	0.87
I think that flood production models offer local people a great deal of employment in the flood season.		3.63	0.81	0.57	0.87
The local government provides great support to households' employment in the flood season.		3.63	0.87	0.53	0.88
I share my farming experiences with those who not only reside locally but also elsewhere.		3.87	0.82	0.49	0.88
I always receive support from the local government in the flood season.		3.67	0.94	0.49	0.88
I believe I have sufficient knowledge and skills to implement flood production models of my own.		3.72	0.86	0.46	0.88
I think everyone has a say in the decision-making process on local dyke matters.		4.07	0.73	0.44	0.88

Note: Calculation of mean values is based on a five-point Likert scale: (1)=strongly disagree; (2)=disagree; (3)=undecided; (4)=agree; (5)=strongly agree

5.5 Comparison of social learning and adaptive capacity by socio-demographic variables

Comparing the mean values of the latent factors of social learning and adaptive capacity associated with the categories of the socio-demographic variables involves the application of the one-way analysis of variance (ANOVA) technique. Seven explanatory variables including gender, marital status, age group, education level, length of residency, household groups, and surveyed areas were analysed. The mean comparison between the categories in the explanatory variables was examined using the Tukey post-hoc test.

5.5.1 Comparison of social learning and adaptive capacity by gender

The comparison of the mean of the social learning and adaptive capacity factors by gender can be found in Table 5.12. The t-test results suggest that there is a statistically significant difference in the mean of the ELP and adaptive capacity by gender (N=300). Males (M=17.31, SD=2.91) report having significantly higher levels of the ELP than females (M=15.19, SD=3.01), $t(298)=5.49$, $p<0.001$. This result is consistent with the rural context of the MDV where males assume a dominant role in the households, thus affording them better opportunities to socially interact with people. Meanwhile, males and females do not differ significantly on the levels of the ILP. Based on the mean values, males (M=30.72, SD=3.78) show a significantly higher level of adaptive capacity than females (M=28.66, SD=3.97), $t(298)=4.05$, $p<0.001$.

Table 5.12 Comparison of social learning and adaptive capacity by gender (N=300)

Indexes	Male (n=222)		Female (n=78)		T-values (df=298)
	Mean	SD	Mean	SD	
External learning performance	17.31	2.91	15.19	3.01	5.49***
Internal learning performance	9.02	1.23	8.92	1.32	0.63$^{ns.}$
Adaptive capacity	30.72	3.78	28.66	4.13	4.05***

Note: Mean values and standard deviation are shown

Significant levels: * p<0.05, ** p<0.01, *** p<0.001 (2-tail significance), ns. as not significant

5.5.2 Comparison of social learning and adaptive capacity by marital status

A one-way ANOVA was conducted to determine whether the social learning and adaptive capacity factors varied for marital status (Table 5.13). The respondents were categorised into three groups: single group (n=6), married group (n=282), and widower/widowed group (n=12). There is a statistically significant difference between the groups, $F(2, 297)=4.60$, $p<0.01$. A Tukey post-hoc test reveals that the widower/widowed respondents ($M = 14.37$, $SD=3.52$) have a significantly lower level of the ELP (-2.52 ± 0.90, $p<0.05$) than the married respondents ($M=16.89$, $SD=3.03$). However, there is no statistically significant difference in the mean values of the ILP and adaptive capacity among the marital categories. This could be because the married respondents are more likely to socialise than those who are single, a widower, or widowed. It was commonly agreed by respondents that those who had lost their spouses tended to spend more time with their family members. This limited their opportunities to engage in social activities for learning. However, there is not sufficient evidence to support the position that the married respondents performed better in adaptive capacity than the others.

Table 5.13 Comparison of social learning and adaptive capacity by marital status (N=300)

Indexes	Single (n=6)		Married (n=282)		Widower/Widowed (n=12)		F-values (df=297)
	Mean	SD	Mean	SD	Mean	SD	
External learning performance	15.37	2.86	16.89[a]	3.03	14.37[a]	3.52	4.60**
Internal learning performance	8.82	0.53	9.00	1.25	8.83	1.63	0.17[ns.]
Adaptive capacity	28.21	3.29	30.31	3.88	28.26	5.78	2.31[ns.]

Note: Mean values with similar lettered superscripts denote the statistically significant difference at p<0.05 level on the Tukey post-hoc comparison test

Significant levels: * p<0.05, ** p<0.01, *** p<0.001 (2-tail significance), ns. as not significant

5.5.3 Comparison of social learning and adaptive capacity by age groups

Table 5.14 provides the mean comparison of the social learning and adaptive capacity factors by four age groups. The households' level of the ELP differs significantly among the four age groups as determined by one-way ANOVA, $F(3, 296)=4.05$, $p<0.01$. Those in the age range between 50 and 69 ($M=17.34$, $SD=2.96$) have the highest level of the ELP. This could be attributed to the fact that respondents within this age group have the richest experience in living with floods and engaging in various forms of on-farm livelihood production. The Tukey post-hoc test indicates that the ELP is significantly higher for the 50-69 age group compared to the 17-29 years of age (2.54 ± 0.88, $p<0.05$). From a cultural perspective, this age group often achieves a respected position in the rural societies. Therefore, they are likely to have wider social contacts. However, for those beyond this age range (70 and over), their social activities become limited. More often, they would prefer to hold back and spend time with their family. However, no statistically significant difference in the mean of the ILP is associated with the age groups.

Table 5.14 Comparison of social learning and adaptive capacity by age groups (N=300)

Indexes	17-29 (n=13)		30-49 (n=142)		50-69 (n=125)		70 and over (n=20)		F-values (df=296)
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
External learning performance	14.80[a]	2.41	16.55	3.14	17.34[a]	2.96	15.94	3.04	4.05**
Internal learning performance	8.71	0.84	8.97	1.25	9.12	1.25	8.57	1.51	1.41[ns.]
Adaptive capacity	28.33	2.91	29.77	4.18	30.94	3.64	29.65	4.39	3.16*

Note: Mean values with similar lettered superscripts denote the statistically significant difference at p<0.05 level on the Tukey post-hoc comparison test

Significant levels: * p<0.05, ** p<0.01, *** p<0.001 (2-tail significance), ns. as not significant

The research findings demonstrate that respondents' adaptive capacity differs significantly across the age groups, $F(3, 296)=3.16$, $p<0.05$. Similar to the ELP mean when compared to the other age groups, the households within the 50-69 years of age group have the highest mean value of adaptive capacity ($M=30.94$, $SD=3.64$), followed by those of 30-49 years of age ($M=29.77$, $SD=4.18$). Those aged from 17-29 years have the lowest adaptive capacity ($M=28.33$, $SD=2.91$).

5.5.4 Comparison of social learning and adaptive capacity by education level

Households' social learning and adaptive capacity factors are compared across their education levels (Table 5.15). Since the number of households in the 'vocational school' and 'university and above' groups occupies a small proportion of the sample, they are collapsed into 'high school', with a new category of 'high school and above'. The main effect of respondents' education level is found for the ELP, $F(3, 296)=15.36$, $p<0.001$. The ANOVA results indicate that the illiterate respondents have the lowest ELP level ($M=14.71$, $SD=3.15$). This finding represents the hardship facing this group. They rarely get involved in the learning process because of a number of constraints. Firstly, most illiterate households are poor and landless, and thus are often omitted from formal learning platforms (e.g. seminars, training workshops). Secondly, they are often under pressure to earn a living, which keeps them busy all the time. Thirdly, illiteracy restricts their knowledge contribution to collective learning. Their inputs are limited and at times unrecognised. For these reasons, they tend to hold back and lack motivation to participate in learning with other partners. The Tukey post-hoc test suggests that the ELP is significantly higher for respondents completing elementary school (1.59 ± 0.53, $p<0.05$), secondary school (3.44 ± 0.58, $p<0.001$), and high school and above (3.23 ± 0.68, $p<0.001$) compared to illiterate respondents. The findings also indicate statistically significant differences in the ELP between those completing secondary school (1.85 ± 0.40, $p<0.001$) and high school and above (1.64 ± 0.55, $p<0.05$) compared to elementary school. No statistical significance is reported on the difference of the ILP by education level $F(3, 296)=1.00$, $p>0.05$.

However, the respondents' adaptive capacity differs significantly among education level $F(3, 296)=5.17$, $p<0.01$. According to the ANOVA results, those with higher educational attainment tend to demonstrate better performance of adaptive capacity. The effects of the farmers' educational attainment on their adaptive capacity in the MDV correspond with Deressa et al.'s (2009) findings in their study of farmer's choice of adaptation methods in the context of climate change in the Nile Basin of Ethiopia. They found that farmer's education was positively associated with their adaptive capacity. In this research, the respondents who completed high school or above have the highest adaptive capacity (M=31.20, SD=3.34). In the meantime, the illiterate group has the lowest adaptive capacity (M=28.40, SD=4.54). The Tukey post-hoc test suggests that those completing secondary school (2.75±0.78, $p<0.01$) and high school and above (2.80±0.92, $p<0.05$) have significantly higher adaptive capacity than their illiterate counterparts.

Table 5.15 Comparison of social learning and adaptive capacity by education level (N=300)

Indexes	Illiterate (n=37)		Elementary school (n=153)		Secondary school (n=76)		High school and over (n=34)		F-values (df=296)
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
External learning performance	14.71^{abc}	3.15	16.30^{ade}	3.03	18.15^{bd}	2.52	17.94^{ce}	2.59	15.36^{***}
Internal learning performance	8.98	1.30	8.97	1.27	9.17	1.25	8.73	1.16	$1.00^{ns.}$
Adaptive capacity	28.40^{ab}	4.54	29.91	4.00	31.15	3.54^{a}	31.20^{b}	3.34	5.17^{**}

Note: Mean values with similar lettered superscripts denote the statistically significant difference at $p<0.05$ level on the Tukey post-hoc comparison test

Significant levels: * $p<0.05$, ** $p<0.01$, *** $p<0.001$ (2-tail significance), ns. as not significant

5.5.5 Comparison of social learning and adaptive capacity by length of residency

There is no statistically significant difference in the ELP and ILP in relation to the length of residency (Table 5.16). However, the households' adaptive capacity differs significantly between the lengths of residency $F(2, 297)=3.05$, $p<0.05$. Those who have more than ten years of residency have the highest level of adaptive capacity (M=30.34, SD=3.99). This could be due to the fact that they have more experience in 'living-with-floods', from which they are able to develop effective adaptation strategies. Another assumption is that long-term residents could build extensive relationships with local people, whom they can ask for assistance when needed. However, the households who have been settled for fewer than 5 years (M=28.93, SD=3.59) have higher adaptive capacity than those with a 5-10 year residency period (M=27.99, SD=3.07). This could be explained that new settlers receive stronger support from the local community. This finding is consistent with Nguyen Ngoc Thuy's (2007) study on the role of social capital in natural resource conservation in Cat Tien National Park, Southern Vietnam. He found that new migrants received better assistance from the local community than longer-term inhabitants. According to the Tukey post-hoc test, the adaptive capacity of the respondents residing for more than 10 years is significantly higher than those residing within the 5-10 year period (2.35 ± 0.99, $p<0.05$).

Table 5.16 Comparison of social learning and adaptive capacity by length of residency (N=300)

Indexes	Less than 5 years (n=4)		From 5 to 10 years (n=17)		More than 10 years (n=279)		F-values (df=297)
	Mean	SD	Mean	SD	Mean	SD	
External learning performance	16.52	3.44	15.09	1.97	16.87	3.11	2.71[ns.]
Internal learning performance	8.88	1.00	8.49	1.16	9.03	1.26	1.49[ns.]
Adaptive capacity	28.93	3.59	27.99[a]	3.07	30.34[a]	3.99	3.05*

Note: Mean values with similar lettered superscripts denote the statistically significant difference at p<0.05 level on the Tukey post-hoc comparison test
Significant levels: * p<0.05, ** p<0.01, *** p<0.001 (2-tail significance), ns. as not significant

5.5.6 Comparison of social learning and adaptive capacity by surveyed areas

Social learning and adaptive capacity factors are compared across the three surveyed areas (Table 5.17). The ANOVA results suggest that the difference in mean value of the ELP is statistically different, $F(2, 297)=18.97$, $p<0.001$. Thoi Hung has the highest mean value of the ELP ($M=18.23$, $SD=2.72$) compared to Phu Xuan ($M=16.08$, $SD=3.15$) and Phu Thanh B ($M=15.98$, $SD=2.83$). The Tukey post-hoc test confirms that the ELP is significantly higher in Thoi Hung compared to Phu Thanh B (2.24 ± 0.41, $p<0.001$) and Phu Xuan (2.14 ± 0.41, $p<0.001$). In comparing the mean value of the ILP across the surveyed areas, no statistical difference was found. Yet the mean value of adaptive capacity is statistically different, $F(2, 297)=10.65$, $p<0.001$. According to the Tukey post-hoc test, the mean value of Thoi Hung differs significantly from those of Phu Xuan (1.55 ± 0.54, $p<0.05$) and Phu Thanh B (2.49 ± 0.54, $p<0.001$). From these comparative results, it could be inferred that the change in the mean values of the ELP contributes to the corresponding difference in adaptive capacity for each of the surveyed areas. This association will be elaborated through the linear regression models in section 5.6.

Table 5.17 Comparison of social learning and adaptive capacity by surveyed areas (N=300)

Indexes	Phu Thanh B (n=100)		Phu Xuan (n=100)		Thoi Hung (n=100)		F-values (df=297)
	Mean	SD	Mean	SD	Mean	SD	
External learning performance	15.98^{a}	2.83	16.08^{b}	3.15	18.22^{ab}	2.72	18.97^{***}
Internal learning performance	9.11	1.14	8.99	1.36	8.88	1.26	$0.86^{ns.}$
Adaptive capacity	29.04^{a}	3.77	29.98^{b}	3.92	31.53^{ab}	3.86	10.65^{***}

Note: Mean values with similar lettered superscripts denote the statistically significant difference at $p<0.05$ level on the Tukey post-hoc comparison test

Significant levels: * $p<0.05$, ** $p<0.01$, *** $p<0.001$ (2-tail significance), ns. as not significant

5.5.7 Comparison of social learning and adaptive capacity by household groups

A one-way ANOVA was run to compare social learning and adaptive capacity factors by household groups (Table 5.18). There is a statistically significant difference in the ELP level between the household groups, $F(2, 297)=37.35$, $p<0.001$. According to the Tukey post-hoc test, the ELP is significantly higher for the better-off group than the poor group (3.38 ± 0.39, $p<0.001$) and the medium group (1.70 ± 0.39, $p<0.001$). In addition, the medium group differs significantly from the poor group (1.68 ± 0.39, $p<0.001$). The ILP level was found to differ significantly between the better-off group and the poor group, $F(2, 297)=5.69$, $p<0.01$. The results of the Tukey post-hoc test suggests that the better-off group has a higher ILP level compared to the poor group (0.59 ± 0.17, $p<0.01$).

Table 5.18 Comparison of social learning and adaptive capacity by household groups (N=300)

Indexes	Poor group (n=100)		Medium group (n=100)		Better-off group (n=100)		F-values (df=297)
	Mean	SD	Mean	SD	Mean	SD	
External learning performance	15.08^{ab}	3.14	16.76^{ac}	2.80	18.45^{bc}	2.27	37.35^{***}
Internal learning performance	8.70^{a}	1.28	8.99	1.24	9.29^{a}	1.18	5.69^{**}
Adaptive capacity	29.11^{a}	4.59	30.02^{b}	3.59	31.43^{ab}	3.30	9.11^{***}

Note: Mean values with similar lettered superscripts denote the statistically significant difference at $p<0.05$ level on the Tukey post-hoc comparison test

Significant levels: * $p<0.05$, ** $p<0.01$, *** $p<0.001$ (2-tail significance)

A statistically significant difference is found in the strength of adaptive capacity across the household groups, $F(2, 297)=9.11$, $p<0.001$. The Tukey post-hoc test indicates that the adaptive capacity level of the better-off group differs significantly from the medium group (1.41 ± 0.55, $p<0.05$) and the poor group (2.32 ± 0.55, $p<0.001$). The qualitative findings suggest that the better-off households are in a more advantageous position to get access to resources and technical knowledge due to having stronger social connections. By comparison, when interpreting why poor households have less adaptive capacity, the findings shown in Table 5.4 are useful. They suggest that the poor are more likely to seek support or knowledge within the bonds of spatial proximity and kinship. From the perspective of social capital, Adger (2003b: 388) claims that adaptation processes involve the inter-dependence of agents through their relationships with each other, and with the resource base on which they depend. However, in line with Vincent's (2007: 20) argument, these findings suggest that households whose contacts and knowledge are reliant on the village will have less adaptive capacity in the face of climate constraints than those whose networks extend over a large geographical range, or over various institutions.

The adaptation constraints facing the poor group in the MDV are mainly characterised by their inadequate livelihood opportunities and capacity to access available resources. This scenario is similar to the findings in an Oxfam report (2008), indicating that the poor are highly vulnerable to the adverse effects of sea level rise in Ben Tre and extreme flooding in Quang Tri, Vietnam. Dulal et al.'s (2010) study on the communities' adaptive capacity with regard to flood impacts in the Koshi Tappu region, Nepal, produced similar findings. In the latter study, poor households were shown to lack capital assets and government support to sustain their livelihoods and adapt to extreme flood events. Lack of education was one of the main barriers that restricted their capacity to contribute to the local decision-making processes.

5.6 Measuring the relationship between social learning and adaptive capacity

Exploratory factor analysis produced two latent factors for social learning and one factor for adaptive capacity. In this research, it is hypothesised that social learning is associated with households' capacity to adapt to the complexities of forced adaptation in the MDV. Multiple regression analysis is used to test whether the two social learning factors predict adaptive capacity. A correlation matrix is initially constructed to determine the relationships between explanatory variables and their relationships with the response variable. Following Leech et al.'s (2003) procedure in selecting appropriate variables that meet the regression assumptions, two socio-demographic variables (marital status and religion), which do not have significant correlation with adaptive capacity are excluded from the models. Based on the final selection of variables, three regression models have been developed.

The multiplicative interaction terms between the social learning factors and two socio-demographic variables (surveyed areas and household groups) are included to examine how each of the social learning factors influence adaptive capacity in correspondence with the surveyed areas and the household groups. In particular, the interaction terms between the social learning factors (ELP, ILP) and the surveyed areas are entered in Model II, while those and the household groups are entered in Model III. There are theoretical concerns about the threat of multi-collinearity that may occur in the interaction terms with their constituent parts. Mean-centering is a common approach to address this (Aiken and West, 1991). However, in this research I follow Echambadi and Hess's (2007: 438) approach, i.e. that mean-centering should not be applied, since "mean-centering neither changes the computational precision of parameters, the sampling accuracy of main effects, simple effects, interaction effects nor the R-squared." In this light, the explanatory variables in the interaction terms are not mean-centered. In order to meet the assumptions of residual normality for linear regression, I transform the dependent variable (adaptive capacity) and the two independent variables (ELP, ILP) using the logarithmic transformation method (Chatterjee et al., 2000). These continuous variables are again standardised before being entered in the multiple regression models.

Table 5.19 OLS regression estimates for the effects of the social learning factors and socio-demographic variables on households' adaptive capacity

Variables	Model I Adaptive capacity (β)	SE	Model II Adaptive capacity (β)	SE	Model III Adaptive capacity (β)	SE
ELP (Standardised)	0.54***	0.05	0.80***	0.10	0.48***	0.07
ILP (Standardised)	0.30***	0.05	0.23**	0.08	0.59***	0.07
Gender (Base: Male)						
Female	−0.05	0.11	−0.04	0.11	−0.06	0.10
Age groups (Base: 17-29)						
30-49	0.01	0.22	−0.01	0.22	0.03	0.22
50-69	0.08	0.23	0.06	0.23	0.12	0.22
>70	0.05	0.27	0.04	0.27	0.05	0.26
Communes (Base: Thoi Hung)						
Phu Thanh B	−0.12*	0.12	−0.07	0.12	−0.14**	0.11
Phu Xuan	0.01	0.11	0.05	0.12	−0.03	0.11
Household groups (Base: Poor group)						
Medium group	−0.07	0.11	−0.08	0.11	−0.09	0.11
Better-off group	−0.09	0.12	−0.10	0.12	−0.10	0.12
Education level (Base: Elementary school)						
Illiterate	−0.02	0.14	−0.03	0.14	−0.03	0.14
Secondary school	−0.03	0.11	−0.03	0.11	−0.05	0.11
High school and above	0.03	0.14	0.03	0.14	0.01	0.14
Length of residency (Base: <5 years)						
5-10 years	0.03	0.40	0.03	0.40	0.05	0.39
>10 years	0.05	0.37	0.04	0.36	0.06	0.35
Interaction terms						
Phu Thanh B*ELP			−0.13	0.13		
Phu Xuan*ELP			−0.24**	0.12		
Phu Thanh B*ILP			0.08	0.12		
Phu Xuan*ILP			0.01	0.11		
Medium group*ELP					0.02	0.11
Better-off group*ELP					0.02	0.13
Medium group*ILP					−0.29***	0.10
Better-off group*ILP					−0.21***	0.11
N	300		300		300	
Prob>F	***		***		***	
R-squared	0.52		0.54		0.56	
Adjusted R-squared	0.49		0.51		0.53	

Note: (β) as standardised beta coefficients; SE as standard errors
Significant levels: * p<0.05, ** p<0.01, *** p<0.001

The effects of social learning and six socio-demographic variables on adaptive capacity are presented in Table 5.19. The regression results from Model I suggest that 51.80 percent of the variance in adaptive capacity can be explained by the predictors (R^2=0.52, $F(15, 284)$=20.36, $p<0.001$). The social learning factors have the strongest effects ($p<0.001$) on adaptive capacity. In particular, the standardised coefficient (beta) for the ELP is 0.54, which suggests that after controlling for other variables, every 1 standard deviation (SD) increase in the ELP will result in a 0.54 SD increase in adaptive capacity. Compared to the ELP, the ILP makes a less significant contribution to households' adaptive capacity (0.30 SD). The Pearson product-moment correlation between the ELP and adaptive capacity emerges as large in size (r=0.65, $p<0.001$), while that between the ILP and adaptive capacity is relatively smaller (r=0.45, $p<0.001$). Overall, it can be inferred from the findings in Model I that the external learning performance is likely to play a more dominant role in household adaptation. Phu Thanh B has significantly lower adaptive capacity than Thoi Hung ($p<0.05$). Other socio-demographic variables do not contribute significantly to the regression model.

In Model II, the explanatory variables produce the following statistics: (R^2=0.54, $F(19, 280)$=17.33, $p<0.001$). Similar to the first model, the social learning factors have significant positive effects on adaptive capacity ($p<0.001$). Compared to the ILP, the ELP has much greater effects (0.80 SD) on adaptive capacity. The regression results show the significance in the interaction term between the ELP and Phu Xuan ($p<0.01$). This reflects the statistically significant difference in the effects of the ELP on adaptive capacity between Phu Xuan and Thoi Hung.

Significant effects of the social learning factors are again reported in Model III (R^2=0.56, $F(19, 280)$=18.79, $p<0.001$). In contradiction to the first two models, this regression model shows that the ILP (0.59 SD) makes a higher significant contribution than the ELP (0.48 SD) in association with adaptive capacity. Across the surveyed areas, Phu Thanh B has a significantly lower adaptive capacity than Thoi Hung ($p<0.01$). This regression model suggests that there are significant interaction effects between the ILP and the medium and better-off groups ($p<0.001$). In other words, it reveals a statistically significant difference in the effects of the ILP on adaptive capacity of the medium and better-off groups compared to the poor group. Qualitative evidence confirms the inequality and livelihood challenges posed to the poor group in the delta's rural societies. A large number of the poor households lack adequate opportunities to engage extensively in communication and social interactions. Struggles for daily survival keep them busy and frequently working far from home. These constraints make it difficult for them to maintain bonding relationships in their residential areas and build new relationships in new working environments. The social marginalisation resulting from the widening poverty gap in rural areas has caused difficulties for them with respect to engaging in collective learning. Therefore, they have to capitalise on their self-learning capacity to sustain their livelihoods when dealing with the impacts of forced adaptation.

In conclusion, the three regression models that both the ELP and the ILP have significantly positive effects on adaptive capacity. Farming households in Thoi Hung commune are likely to gain greater opportunities to engage in extensive learning networks than their counterparts in the study. Gender, age groups, educational attainment, and length of residency do not make significant contribution to the models. The interaction effects in Model III suggest variation in learning patterns among household groups in association with adaptive capacity. While the medium and better-off households are more capable of acquiring diverse sources of knowledge through wide social networks, the poor group depends on their self-learning capacity to respond to change.

5.7 Conclusion

Household adaptation to the forced adaptation complexities in the MVD is socially constructed. Their adaptive capacity is inextricably linked to the social engagement from which they can acquire new knowledge to manage their livelihood activities. This research contributes to gaining a deeper understanding of how collective learning patterns shapes the way farming households respond to change, which is empirically portrayed in their everyday adaptation practices.

The factor analysis produces two latent factors of social learning, which are of distinctive, but complementary characteristics in households' learning performance. External learning performance corresponds to Reed et al.'s (2010) social learning concept, which is concerned with households' proactive attempts to acquire new knowledge through communication and social interactions. This social learning typology is portrayed in both informal and formal fashions. While the informal learning pattern involves social interactions occurring through casual gatherings and get-together activities, the formal learning episodes are associated with households' interactions with local government officials (extension officials) through seminars or training courses. Internal learning performance, which reflects the characteristic of the passive social learning as defined by Glasser (2009), refers to 'reflection-in-action' practices. The qualitative evidence suggests that these two social learning typologies complement each other in supporting household adaptation.

There are variations in social learning patterns across the surveyed areas and household groups. Learning through casual gatherings was the most favourite method. Compared to the other two communes, Thoi Hung had the largest number of households engaging in collective learning. Compared to their counterparts, the better-off households were more likely to engage in collective learning.

Most farming households were found to have closer attachment to the bonding social capital (nearby relatives, nearby friends, and neighbours) for shared learning. A greater proportion of households in Thoi Hung had frequent learning interactions with their neighbours and nearby friends. Most of them also had extensive learning networks at the district and provincial levels. Compared to the other two groups, the better-off households are more likely to connect to extensive networks across administrative levels. This provides them with greater opportunities to broaden boundaries of communication and interactions, whereby they can seek access to required resources and acquire new knowledge. In this regard, social capital plays an important role in building collectives and individuals' capacity to respond to environmental complexities. The individuals in the family-network not only provide reciprocal support in times of crisis, but also share lessons learned, experience, and relevant knowledge. Metaphorically, I see social capital as 'the lubricant' that oils the 'learning wheels' of farming households, expediting their progress towards successful adaptation.

The quantitative analysis confirms the positive relationship between social learning and adaptive capacity across the surveyed areas and the household groups. According to the regression results in Models I and II, the external learning performance had greater effects on adaptive capacity. However, greater contribution of internal learning performance to adaptive capacity was found in Model III. The significant interaction effects in this model suggest that the poor household group had higher self-learning capacity than its counterparts. In summary, this research suggests that social learning makes a significant contribution to the farming households' adaptive capacity to the complexities of forced adaptation in the MDV. It supports the hypothesis, as previously discussed in this chapter.

The next chapter will investigate how social learning contributes to institutional change. From the perspective of social learning, across the informal and formal interaction boundaries there emerges a range of key strategic alliances with various forms of learning interactions and relationships. In the analysis of the relational practices at the interface of flood management and adaptation, this chapter attempts to investigate how social learning facilitates the reframing of policy options and the institutionalisation of local knowledge for institutional change.

Chapter 6

Social Learning for Institutional Change

"I'll let you be in my dream if I can be in yours"

Bob Dylan[19]

6.1 Introduction

The complex and dynamic nature of social-ecological problems requires flexible institutional arrangements that embrace diverse forms of knowledge (Reed, 2008). The traditional, top-down, short-term and target-driven management approach may not be appropriate to deal with 'wicked' problems (Wilby and Keenan, 2012). Additionally, the use of knowledge in the absence of a collaborative approach often fails to achieve desired solutions. Meanwhile, Næss et al. (2005) see flexible institutions and social learning as pre-requisites for the optimisation of local adaptation. Hildén (2011) assumes learning is closely entwined with policy evolution. Drawing on these theoretical underpinnings, this research will analyse the claim that institutional structures that offer openness and flexibility for joint learning and exchange of knowledge are essential to the successful performance of local adaptation. Given the prevailing flood governance context in the MDV, this chapter investigates how social learning plays a role in the processes of learning, production and exchange of knowledge between relevant actors towards the adjustments of local flood management and adaptation practices.

The rural societies in the MDV possess substantial knowledge in flood management and adaptation. Gerke et al. (2012) offer the term 'knowledge clusters', indicating a local innovation system organised around academic and research institutions, government research agencies, and knowledge-intensive firms. While this formal interaction boundary has encountered a relative degree of knowledge fragmentation

[19] Adapted from Sol, J., Beers, P. J., and Wals, A. E. J. (2013), 35-43

(Bauer, 2011), the iterative learning interactions with the formal knowledge boundary represents the shadow systems, which facilitate the integration of the formal and informal knowledge systems to tackle flood management and adaptation challenges in the MDV. This chapter argues that social learning plays a central role in facilitating the learning interactions and exchange of knowledge across these epistemic boundaries. This argument is illuminated by achieving a robust understanding of the evolution of strategic alliances and their interaction patterns across the formal and informal boundaries in attempts to enhance the local flood management and adaptation. This chapter contributes to delineating the social configuration of the governance networks operating in the contemporary flood governance system in the MDV. In practical terms, this matter has not been addressed from the perspective of social learning. Drawing on the flood management and adaptation contexts, the chapter offers empirical insights into how social learning facilitates institutional change to better deal with the constraints of forced adaptation.

The chapter is structured as follows. The first section commences with an overview of institutional structures and processes that have implications for flood management practices in the MDV. The second section investigates the relational practices of relevant actors engaged in the local flood management and adaptation contexts. This section particularly reflects the emergence of strategic alliances and how they play out within and beyond the interaction boundaries. The third section elucidates the important role of the shadow systems and how they serve as learning platforms facilitating the interactions of the existing knowledge systems. The chapter concludes by discussing how the institutionalisation of local knowledge comes to terms with the drawbacks of the contemporary flood management policies, and mediates an institutional change to bring about better adaptation outcomes.

6.2 Governance framework for flood management in the delta

An extensive literature on the domains of climate change and natural resource management identifies institutional factors as closely linked to flood management (Næss et al., 2005) and adaptation practices (Agrawal et al., 2009; Glaas et al., 2010;

Berman et al., 2012; Mandryk et al., 2015). Institutions are defined as formal and informal mechanisms that govern social and individual expectations, interactions and behaviour (Berman et al., 2012). Pahl-Wostl (2009) claims that regulatory processes in bureaucratic hierarchies are based mainly on formal institutions where government actors hold a dominant position. This section elaborates on the delta's institutional framework on flood governance and the role governments across administrative levels play in the operation and management of hydraulic systems.

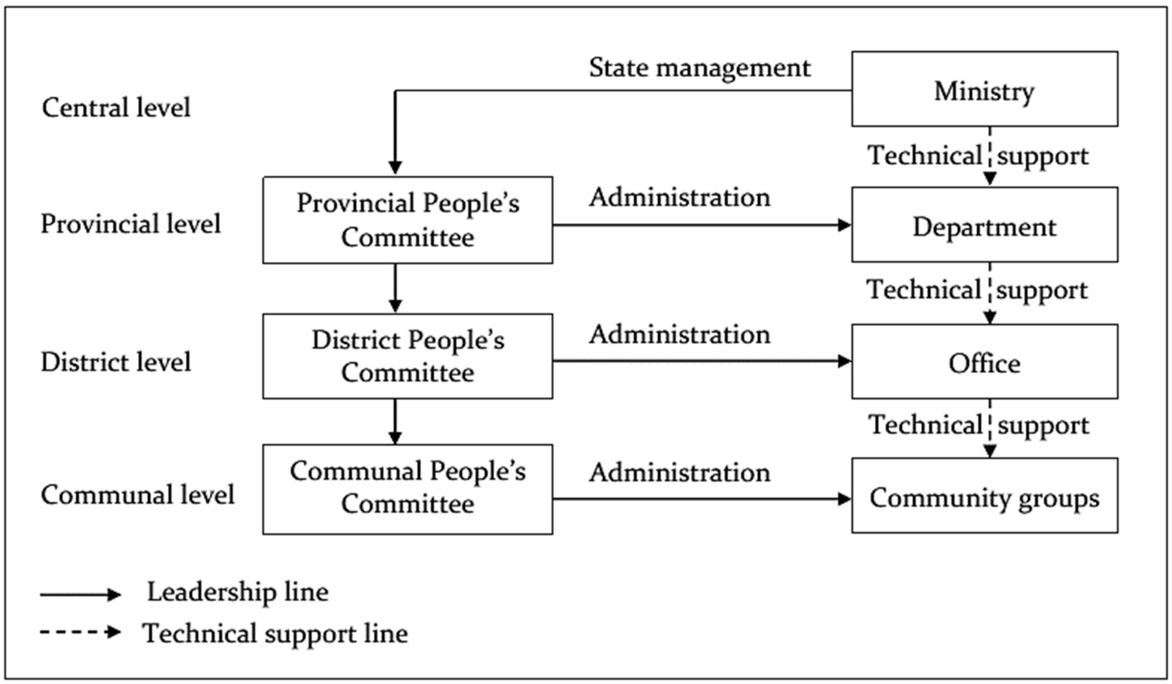


Figure 6.1 Governance framework for flood management in the MDV

Source: Modified from Hansen and Do Hong Phan (2005)

The Law on Water Resources (LWR), which came into effect in early 1999, underpins the management of water resources in Vietnam. It identifies the MARD as the administrator of the water law and is accountable for water resources management (Taylor and Wright, 2001). Given this responsibility, MARD plays the coordinating role in approving the planning of river basins, and hydraulic systems under the delegation of the central government (Hansen and Do Hong Phan, 2005). Accordingly, the provincial governments and cities are responsible for the management of water resources in their own jurisdictions.

Flood governance in the MDV is contextualised in the decentralisation process, where administrative and fiscal responsibilities concentrate in local administrations, particularly at the provincial level (Fritzen, 2006). This ‘centralisation’ provides the provincial authorities with greater autonomy in decision-making and performing administrative functions in order to link central decrees and development programs to their local interests. According to Benedikter (2014), in the performance of its functions, the Department of Agriculture and Rural Development (DARD) is shaped by dual subordinations at the provincial level (Figure 6.1). It both acts as the specialised agency vertically linked to MARD and obtains horizontal directives from the provincial people’s committee. Until 2005, hydraulic engineering, water services delivery and flood and storm control are assigned to MARD and its subordinate state management organisation and planning institutes (Waibel et al., 2012). In the vertical decision making procedure, these responsibilities have been moved to DARD, including planning, construction, and maintenance of all kinds of hydraulic works, particularly dykes, irrigation schemes, and sluices (Nguyen Thi Phuong Loan, 2010). At the district level, the OARD coordinates its functions with the DARD to implement flood control and irrigation policies. At the lowest administrative level, the communal government is assigned to perform support functions for the operation and management of the flood control schemes in association with local community institutions, mass organisations, community groups, and farming households.

Flood control and irrigation in the delta depend largely on the hydraulic systems. However, there exists a heterogeneity in the way these systems are governed across the provinces. According to the Decision (No. 03/2015/QD-UBND) issued by An Giang People’s Committee, the provincial irrigation management company is responsible for the management and exploitation of the local hydraulic systems. However, in Can Tho and Dong Thap, the same responsibilities are performed by the Sub-Department of Water Resources.

The delegation of institutional responsibilities for the operation and management of the hydraulic systems varies a great deal, according to the size and scale of construction (Waibel et al., 2012). In line with Circular No. 65/2009/TT-BNNPTNT issued by the MARD, An Giang People's Committee has promulgated Decision No. 03/2015/QD-UBND, specifying that the provincial irrigation management company should take over larger hydraulic schemes (level-one and level-two canals). Meanwhile, the Sub-Bureau of Water Resources manages level-two canals within districts and level-three canals within communal and inter-communal jurisdictions. The management and maintenance of interior schemes (on-field irrigation systems) rests with the commune people's committee and the local farmers' groups.

The North Vam Nao scheme adopts a hybrid governance paradigm that integrates hierarchical administration with the participatory approach for its flood management (Figure 6.2). This innovative model includes two entities: the scheme management board (SMB) and CMBs, serving as the support instruments to the hierarchical decision-making system. As clearly specified in An Giang People's Committee's Decision (No. 44/2007/QD-UBND), the SMB functions under the administration of the provincial people's committee, assuming the overall operation and management of the scheme. This entity includes 39 members with 16 representatives across the provincial government agencies and the representatives of 23 compartments[20]. The SMB coordinates with the CMBs in the scheme's management system. Meanwhile, 23 CMBs are social organisations, elected by the local farming community, and represent their privileges in supervising the provision of the irrigation and drainage services and managing and maintaining dykes and interior canal systems in the compartments. Working under the SMB's direction, the Irrigation Management Company (IMC) performs the technical operation and management of the scheme and its infrastructure (canals, dykes, culverts, sluices). As a subsidiary to the IMC, the Irrigation Management Enterprise (IME) has the role to operate and maintain the

[20] There was an adjustment of compartments in the North Vam Nao scheme. The merging of compartments 20 and 22 which covered three communes (Hiep Xuong, Phu Xuan, and Phu Hung) of Phu Tan district reduced the total number of compartments in the scheme from 24 to 23 as present.

scheme and its infrastructure in the district. The Irrigation and Drainage Service Units (IDSUs)[21] are the local economic sectors that are charged with providing irrigation and drainage services for local farming households.

The modern and innovative sets of institutional arrangements of the North Vam Nao flood control scheme suit the national agenda in public administration reforms, decentralisation, and regulations concerning grassroots democracy (AusAID, 2007). These policy initiatives, as Bach Tan Sinh (2002) noted, enable the transfer of irrigated water management rights to local communities. There is evidence of public accountability and local ownership in the scheme management. The local farming community participated in multiple cycles of consultation at the planning stage and the scheme instalment process (AusAID, 2007). Through their representatives (CMBs), the farming community can openly articulate their concerns and voices to local government agencies, which informs the better decision-making process. These practices are consistent with Small's (1996: 249) claim that "collective action through farmer's organisations often has advantages over action by a government agency." In this context, the CMBs perform three main responsibilities: (1) representing the local farming community; (2) supervising local construction and maintenance works; and (3) coordinating with the commune and hamlets concerning flood management and supply of irrigation and drainage services for the farming community (AusAID, 2007).

> Local community is actively involved in the planning stage of the North Vam Nao flood control scheme. For the sluice instalments in particular, they participate in recording daily frequency and density of aquatic and land transports. They also participate in recording flood levels. Such information is essential for the design of sluice breadth and instalment locations *(Interview with the Vice Director of North Vam Nao Enterprise for Hydraulics and Agriculture, April 9th, 2014)*.

[21] The IDSUs refer to the local pumping groups or cooperative groups *(tổ hợp tác)* which are in charge of providing irrigation and drainage services to the rural farming community.

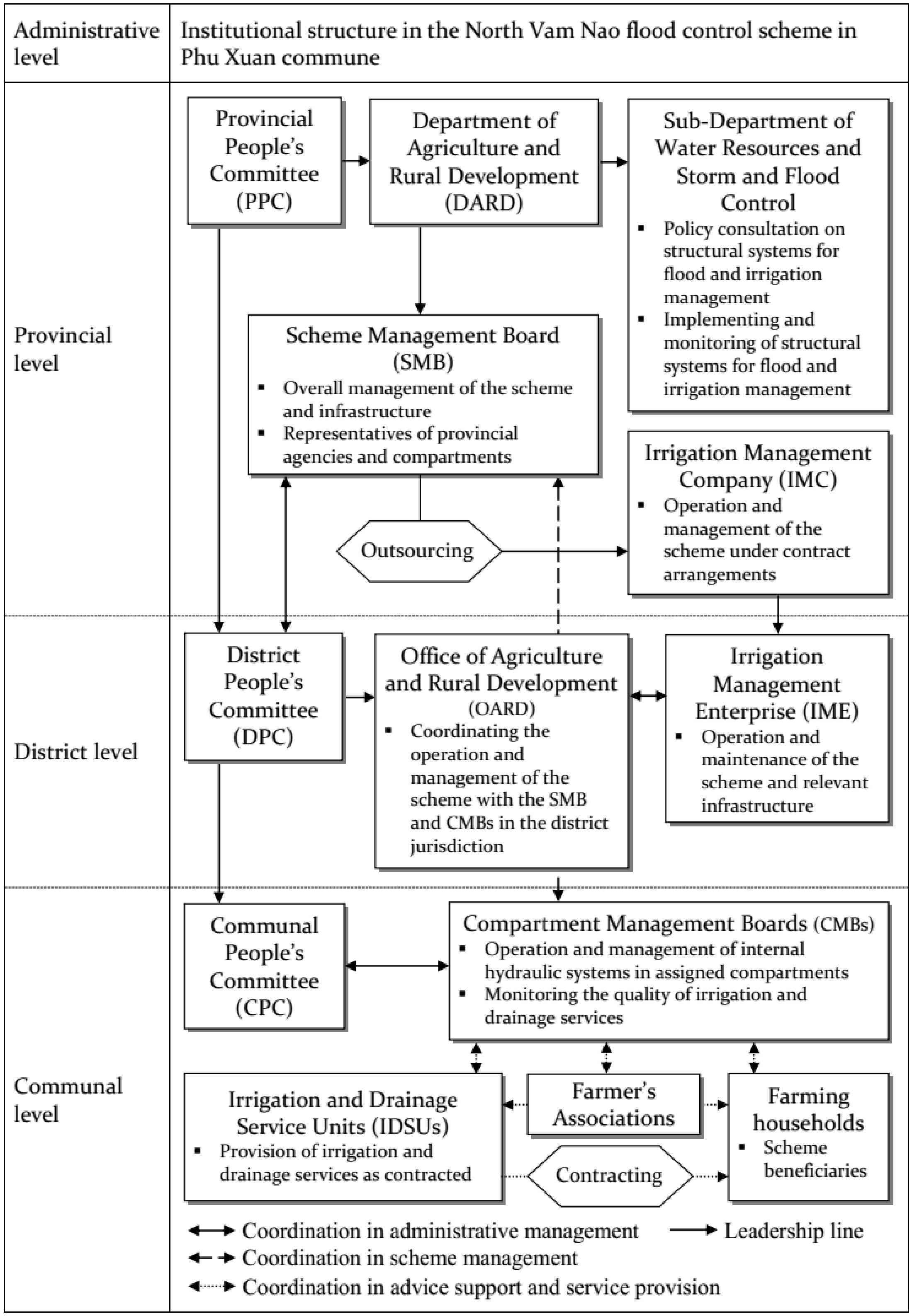


Figure 6.2 Institutional framework for the North Vam Nao flood control scheme

Source: Figure by Tran Anh Thong; In-depth interviews (2013-2014); Doan The Loi (2010)

Phu Xuan commune spans four compartments in the North Vam Nao scheme. Two compartments (V15, V16)[22] are entirely located within the commune's administrative boundary, while the other two (V19, V20) are shared with Hiep Xuong and Phu Hung communes of Phu Tan district. Operating in compliance with the overarching institutional framework of the North Vam Nao flood control scheme, the flood governance arrangements in Phu Xuan present a well-connected learning network among associated actors. Qualitative analysis reveals a high level of interactions between local CMBs, IDSUs, farmer's associations, and the local government in efforts to ensure the effective performance of hydraulic systems in their compartments.

> We have a plenary meeting every month with the representatives of the CMB, the irrigation and drainage service unit, the hamlet, and a cadre in charge of irrigation from the commune people's committee. The meeting agenda concerns such issues as dyke protection, maintenance of waterways and drainage systems. Farming households are invited to attend the meetings *(Interview with a Head of the CMB of V16 in Phu Xuan, November 5th, 2013)*.

There is strong acknowledgement of the key role that the CMBs play in Phu Xuan commune. It ascribes to them the mandate to coordinate the flood control, irrigation and drainage services for local farming households. For example, the formulation of the coordination arrangements highlights the shared responsibilities of the CMB of V16 and the local irrigation and drainage service unit (Phu Ha hamlet) in monitoring the local farming practices and the quality of irrigation and drainage services to farming households (Phu Xuan People's Committee, 2012). As commonly agreed, these two entities share information on cropping activities and collaboratively monitor the management and maintenance of interior schemes, take field visits, and ensure the safety of farming production in their compartment during the flood season.

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[22] These contracted forms are used to label the number of compartments within the North Vam Nao scheme. The letter V stands for *tiểu vùng* (compartment) in Vietnamese.

> As the staff of the CMB, we are supposed to keep track of the flood situation in the flood season, inform the local government of the breakage of interior dykes and coordinate with the irrigation and drainage service units to monitor the functions of the irrigation and drainage systems *(Interview with a Head of the CMB of V16 in Phu Xuan, November 5th, 2013)*.

> We coordinate with the commune leaders, farmers' associations and the irrigation and drainage service units. The irrigation and drainage service unit is mainly responsible for providing irrigation and drainage. If there is any complaint emerging from farmers in terms of the service quality, we firstly check the situation before informing the commune leader and sitting with the irrigation and drainage service units to address the concerns *(Interview with a Head of the CMB of V19 in Phu Xuan, November 5th, 2013)*.

Unlike the institutional model of the North Vam Nao scheme, the flood governance mechanisms of Thoi Hung and Phu Thanh B communes are strongly driven by a technocratic ideology (Figure 6.3). The early development of the Song Hau State Farm in the pre-Renovation period represents the strict implementation of top-down policy in the planning and construction of its flood control system and collective production activities. This administration clearly illustrates the centralised governance system. The Song Hau State Farm exclusively provided input resources, irrigation and draining services, and technical support to local farming production. The national policy on flood security together with the local adverse flood impacts necessitated the Song Hau State Farm to design its hydraulic structures in an innovative way to better support local rice production and integrated farming systems. In the case of Phu Thanh B, local 'living-with-floods' practices have proved that the established low-dyke systems seem to be the optimal choice. Research findings show that this alternative technology, compared with either no protection or full-dyke protection, offers greater advantage for the practices of the rice double-cropping and various flood-based livelihoods during the flood season (Le Anh Tuan et al., 2008). Understanding the substantial economic benefits generated by floods, together with critical considerations of structural development, the local government has agreed to the maintenance of the low dyke structures, and developed a strategic plan to scale up the freshwater giant prawn culture across the commune.

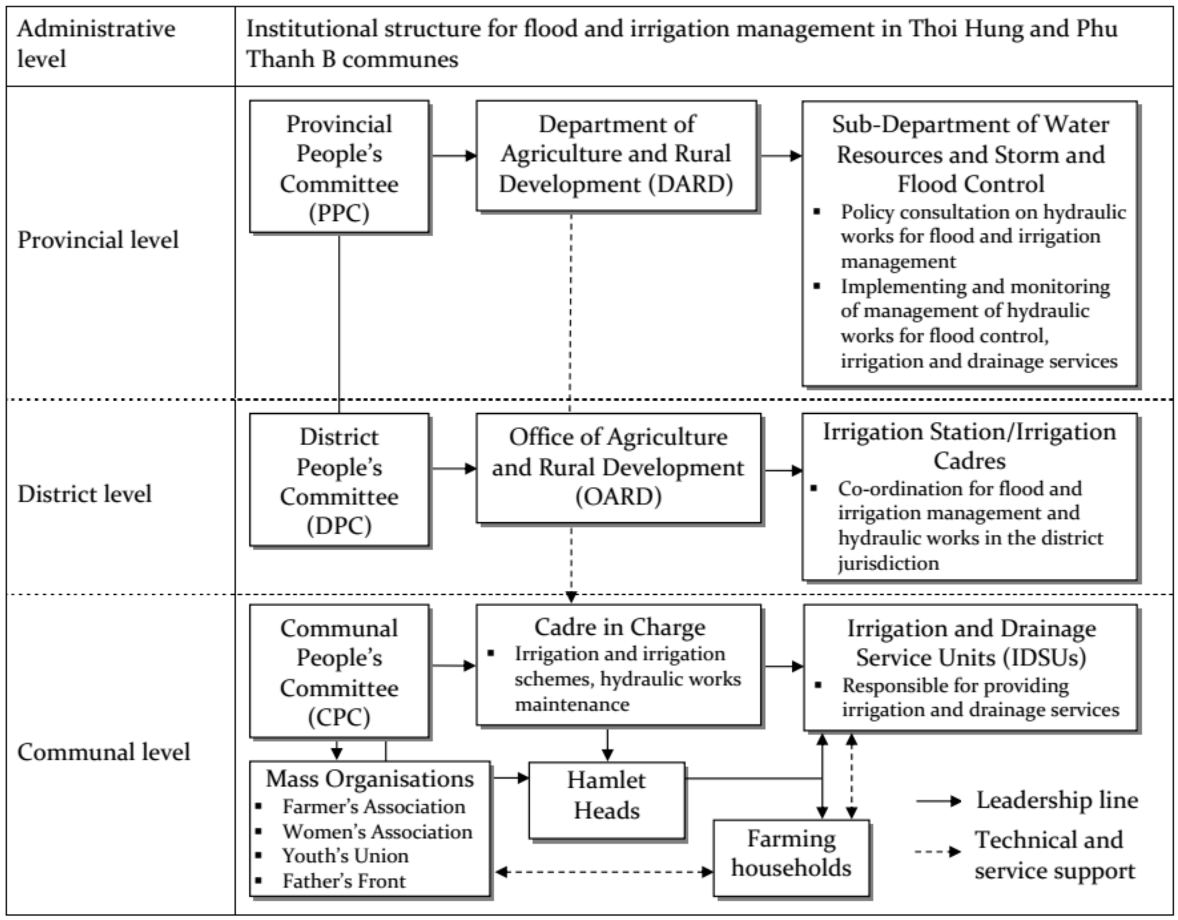

Figure 6.3 Institutional framework for the flood and irrigation management in Thoi Hung and Phu Thanh B communes

Source: Figure by Tran Anh Thong; In-depth interviews (2013-2014); Benedikter (2014)

> The Song Hau State Farm was built on waterlogged land which was very susceptible to acid sulphate. The flood heights varied from 1.2-1.5m in the flood season. Formerly, only one single rice crop was cultivated per year. Thanks to the strong determination of the Director's Board, the dyke systems were built to enable double-cropping and integrated farming systems *(Interview with a former official of the Song Hau State Farm in Thoi Hung, February 24th, 2014)*.

> With the dyke elevation of 1.8m, the dyke systems in Phu Thanh B are designed to enable the double cropping of rice. It assists in protecting the summer-autumn crops from early floods. The flood peaks surpass the dykes and inundate the fields, which provides advantageous conditions for sediment accumulation and prawn breeding *(Interview with a Head of a freshwater giant prawn cooperative in Phu Thanh B, November 7th, 2013)*.

6.3 Spheres of relational practices: Learning platforms for the exchange of informal and formal knowledge

Interview results with key informants suggested a framework that highlights the relational practices taking place within and across the domains of flood management and adaptation in the MDV (Figure 6.4). This section investigates the emergence of key strategic alliances that operate in formal and informal boundaries, and how their learning interactions contribute to the construction of these two knowledge systems. In particular, I elaborate on three analytical themes relevant to social learning, including 'boundary organisations', 'bridging organisations', and 'shadow systems' (Nilsson and Swartling, 2009). Taken together, figures 6.1, 6.2, and 6.3 show the totality of individual, community, expert, organisational, and strategic alliances identified as being available for adaptive social learning (Brown and Lambert, 2013); however, the relational practices that take place within and across these knowledge systems are far from straightforward.

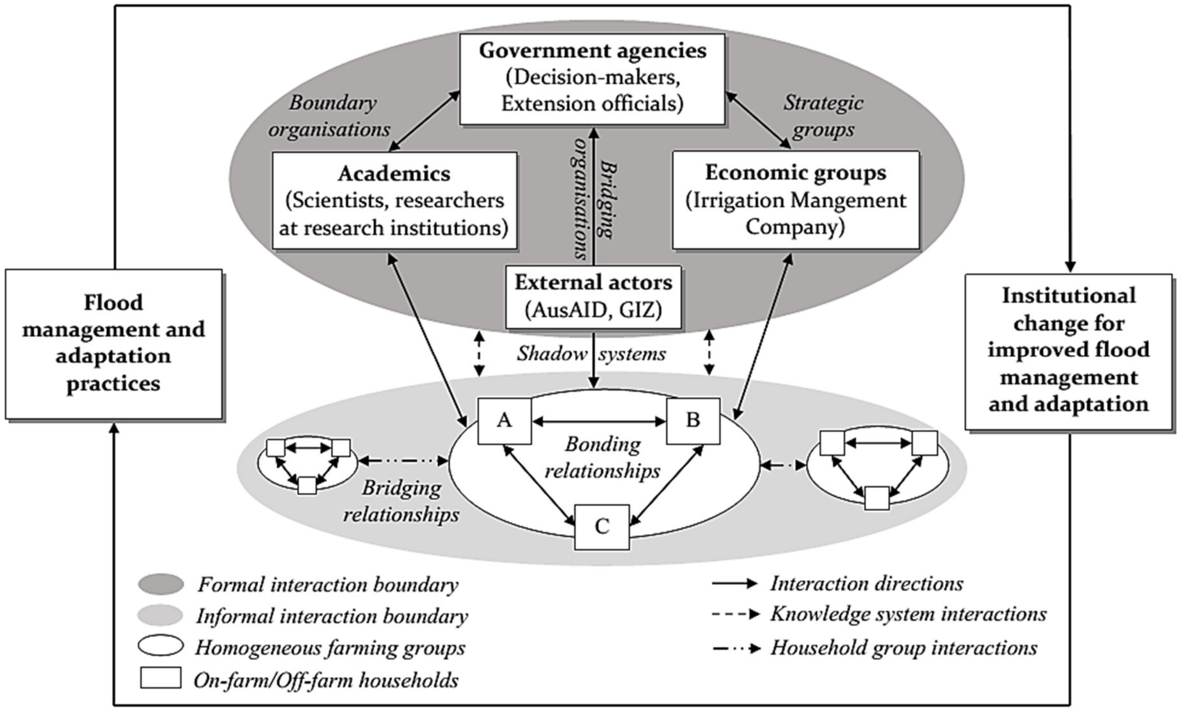

Figure 6.4 Structure of strategic alliances within and across interaction boundaries for flood management and adaptation

Source: Figure by Tran Anh Thong; In-depth interviews (2013-2014)

The formal interaction boundary of flood management presents three dual linkages where the government agencies hold a dominant position in decision-making: (1) the government agencies and academics (boundary organisations); (2) the government agencies and economic groups (strategic groups); and (3) the government agencies and external development agency (bridging organisations). In the informal boundary of adaptation, there a wide range of connections among social groups. Among them, farming households are key actors. Empirical evidence illuminates the salient interaction (shadow systems) between the agricultural extension officials (government agencies) and farming household groups and individuals. I argue that this strategic alliance plays a significant role in bridging the informal and formal knowledge systems. It allows for the full range of potential knowledge domains identified by Pelling et al. (2008) and Brown (2010) to engage constructively, in ways not allowed for in the formal relationships. The iterative interactions between these epistemic systems are instrumental to the institutional change to address the policy gaps in local flood management and adaptation.

6.3.1 The relational practices in the flood management context

The relational practices in the flood management context are contextualised in the formal interaction boundary. Following Lebel et al. (2010b), I adopt coordination platforms to examine how the learning practices actually take place. They demonstrate that vertical coordination is well established and dominates in the government management system *(Interview with a senior official at the Steering Committee of the Southwest Region, January 13th, 2014)*. The functions of government agencies represent a top-down approach, which adheres to formally mandated routines (Waibel, 2010). The absolute compliance with such formalised interactions drives the unequal learning exchange among involved actors, which inhibits the capacity of institutional innovations. There is little evidence of critical feedback in the vertical coordinating mechanism. When coordinating with other sectors, the government agencies play a dominant role in the decision-making process (Benedikter and Waibel, 2013). Similarly, horizontal coordination is relatively modest (Gerke et al., 2012). These empirical findings are consistent with Clemens et al.'s (2015) case study of the learning interactions of the Working Group concerning climate change adaptation in Can Tho City. It was found that the learning process was characterised by limited feedback and knowledge exchange among actors involved at both vertical and horizontal levels. Contrary to the perceived constraints of the social learning process in the formal boundary, this research reveals the openness and flexibility in the adaptation boundary, where uncontrolled learning interactions among the actors involved take place. This enabling environment facilitates the proliferation of local adaptation initiatives that subsequently inform the redressing of flood management policies.

The decentralisation innovation driven by *Đổi Mới* policy reforms has transferred the centralised decision-making power to the local administration. This transformation lessens the policy interventions from the central-level technical groups, but offers more options for the local authorities to seek alternative resources to support local hydraulic development. The construction of the North Vam Nao scheme is a joint effort between An Giang People's Committee and the Australian Agency for International Development (AusAID) (AusAID, 2007). Qualitative analysis shows that the scheme's effective performance is largely attributed to the 'experimentation' of the Australian partner's participatory governance model in local flood management and the mobilisation of multiple sources of knowledge from the relevant stakeholders (*Interview with the Head of Phu Tan OARD, October 30th, 2013*). The local communities were consulted during the project planning stage. There was active involvement of professional experts from two local research institutions (An Giang and Can Tho Universities) in implementing the project. These learning synergies facilitate the incorporation of multiple knowledge systems into the local decision-making process, which contributed substantially to the effective operation and management of the scheme (*Interview with the Vice Director of the NVN Enterprise for Hydraulics and Agriculture, April 9th, 2014*).

As noted by Bach Tan Sinh (2002), the state and business sectors are two key players in national development. His position makes a good sense in the context of hydraulic development in the MDV. Evers and Benedikter (2009) use the term 'strategic groups' to reflect the linkage between the state bureaucracy and hydraulic construction businesses. They argue that the emergence of this alliance is attributed to increasing demands for hydraulic development to accelerate agricultural production. Given the construction of the North Vam Nao scheme, the provincial irrigation management company allied itself with the SMB as a key contractor to undertake the scheme's functions. The coordination between these two strategic groups is indicative of the fulfilment of assigned responsibilities in the contract agreement.

Boundary organisations define the interface between science and policy. In the flood management context, they represent the relationship between local government agencies and scientists. Historical evidence of the flood governance approach in the MDV illustrates how this linkage has changed over time. In the post-war period, the centralised state policies, strongly supported and legitimised by a technocratic ideology, imposed their conventional control-oriented approach used in northern Vietnam on the delta's flood regimes (Evers and Benedikter, 2009; Waibel et al., 2012). This antagonistic approach demanded that a structural measure should be taken to pursue its objective in achieving the 'all-rice-strategy'. Such economically-oriented development pressures hindered the contemporary state's deliberations on environmental and social factors. While the large majority of local decision-makers were politicians who had limited knowledge of hydraulics or environmental science, the scientists from research institutions in the MDV were alienated from decisions about structural development. Instead, they were driven into intense research efforts of how rice could be produced in large quantities in order to secure the national food supply *(Interview with the Vice Director of Institute of Climate Change, Can Tho University, January 5th, 2014)*. All planning and decision-making processes for the delta's hydraulic development were therefore directed to the hydraulic engineers from the central government agency.

The science-policy interface has recently introduced a new 'strategic group' which is portrayed as being in a 'teacher-student' relationship. An increasing number of cadres at local government agencies hold political leadership positions with high professional profiles. This resonates with Benedikter's (2014: 283) point that "political and epistemic power is concentrated in a technocratic group of knowledge-commanding professional officials." Given the expertise and political power in their hands, they have a dominant influence over local planning and decision-making. I observed that a great number of cadres working across the administrative levels are graduates from academic institutions in the delta where they can build good personal relationships with senior scientists. The Confucian-influenced spirit of "*Tôn sư trọng đạo*" (Venerating teachers and respecting morals) accords the scientists recognised privileges in association with the cadres. Bauer (2011) points out that selecting reliable partners for project cooperation in Vietnamese organisations tends to favour personal preference more than meeting the formal project requirements. As such, having good relationships with the local cadres provides the scientists with privileged access to local development projects. This can be seen an effective strategy for the scientists to engage in rural development and incorporate their research-based evidence into efforts to negotiate the desired policy change.

Phu Xuan commune provides flexibility for the local actors' learning engagement. It identifies the CMBs as meaningful bridging organisations. As defined, bridging organisations act as intermediaries that facilitate collaborative learning, and knowledge co-production across different levels of governance (Hahn et al., 2006; Berkes, 2009; Leys and Vanclay, 2011a). In this context, the CMBs stimulate participatory knowledge and information exchange among the actors in the learning networks. Empirical findings show that they frequently interact with local farmers, aiming to assemble updated cropping situations to immediately inform the local coordinating agencies. When dealing with contingencies relevant to irrigation and drainage services, they coordinate with the IDSUs, farmer's associations, and the communal government to provide solutions. The CMBs also act as key messengers who channel communication flows to the SMB where they are the active members.

> As required, the heads of the CMBs must have rice fields in their compartments. During the field visits, they can informally talk to nearby farmers and share experiential knowledge on pest management and weeding techniques *(Interview with the Head of the CMB of V16 in Phu Xuan, November 5th, 2013)*.

The learning interactions between the local government agencies and farming households are not always formally institutionalised. In the case of Thoi Hung commune, the local government agencies and farming households engaged in a joint learning process to deal with the poor performance of sluice gate systems on Thom Rom canal. These headworks were installed to regulate floodwaters from this primary canal into the lateral secondary canal networks in the flood season. Adverse flood impacts in the 1980s implied that such infrastructure played a crucial role in flood protection for interior agricultural land areas. Over the past decades, the sluice systems have not been used much. Local complaints mentioned excessive sedimentation at the sluice gates and the overgrowth of water hyacinth, which hampered flood flows and blocked waterways. Perceived alterations of hydrological regimes and farming households' demands for alluvial accumulation draw increasing attention to the adjustments of current structural systems. Research findings suggest that informal and formal consultations with local farming households increased the local government's knowledge of the negative effects of the sluice gates. This shared understanding enabled the local government to modify their management decision to address the issue. From 2009 to 2012, the Sub-Department of Water Resources of Can Tho City provided technical support for removing the sluice gates and dredging silted canals, returning the free-flowing floods to the commune.

> Local farming households' petitions enable the local government to reconsider the impacts of sluice systems. They agree that these sluices have impounded floodwaters from entering into the rice fields. As observed in An Giang where farmers leave dykes open to obtain alluvium-rich floodwaters during the flood season, I think we can also do it here to fertilise the soils. It is essential to build consensus with farmers in the local decision-making *(Interview with Mr. Tam, a Chairman of the Farmer's Association of Thoi Hung, April 4th, 2014)*.

Attempts to undertake an effective flood management program in Phu Thanh B see the learning interactions between the local government agencies and freshwater giant prawn farmers as vitally important. The iterative learning processes through on-farm seminars and workshops have led to the formal recognition that the prawn farming initiative should be incorporated into the commune's adaptation policy. This reframing process enables the local authority to review the existing land use policy, agreeing that the low dyke systems should be maintained to support local flood-based livelihood practices. Consistent with Keskinen et al.'s (2010) claim that efforts to enhance local adaptation capacity should build on existing livelihood conditions, this policy response has resulted in the scaling up of prawn culture across the commune.

> The success of freshwater giant prawn culture motivates further exchange of knowledge among government officials, prawn breeders, and technical experts. Policies for building high dykes to enable the triple cropping system are not prioritised as this commune is devoted to the prawn culture. Low dyke systems are maintained to protect the summer-autumn crop and offer natural flood conditions for rural households' livelihood systems to develop *(Interview with the Vice Chair of Phu Thanh B, December 27th, 2013)*.

> I still find it productive to raise prawns in the low-dyke embankment. Despite its relative impacts on reducing flood flows, this structural system successfully mitigates the adverse effects of big waves in open fields during high flood inundation *(Interview with Mr. Nguyen in Phu Thanh B, November 7th, 2013)*.

External actors have a recognised role in the policy-making process in flood management in the MDV. It is apparent that AusAID worked closely with the local government of An Giang in the process of building the North Vam Nao flood scheme. Additionally, GIZ[23] played a significant role in facilitating the approval of a collaborative water management agreement by the People's Committee of An Giang and Kien Giang in the Long Xuyen Quadrangle (LXQ)[24] in 2013. The flood complexities faced by rural and urban populations and iterative learning processes taking place at the government level show that such collaborative flood governance arrangements need to be in place to promote adaptive strategies and harmonise the shared economic benefits of the two provinces in the turbulent contexts of climate change and

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[23] GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit) was established on January 1st, 2011. It is a federally own enterprise that supports the German government in achieving objectives in the field of international cooperation for sustainable development. In Vietnam, environmental policy is one of the three areas prioritised by GIZ. Refer to Chu Van Cuong and Dart (2011) for further information.

[24] Located in the northwest of the MDV, the Long Xuyen Quadrangle (LXQ) has an area of 4,900 km^2, covering the large part (about 97 percent) of An Giang and Kien Giang provinces and a small part of Can Tho province (Quang Dinh et al., 2012). This region frequently experiences high flood inundation from July to December.

upstream development (see Chapter 7). In this regard, the Memorandum of Agreement (MOA) can be seen as a 'boundary object'[25] that supports the inter-provincial coordination of flood control, salinity control and water quality improvement[26]. As emphasised in the signed document, the existing flood control systems should be carefully managed and operated to accommodate agricultural and aquacultural production in the two localities. This confirms that GIZ functions as a bridging organisation that advances the establishment of such an unprecedented collaborative flood governance mechanism. This collective effort is a milestone for the potential development of collaborative governance in the water sector across the MDV.

6.3.2 Salience of shadow systems in the adaptation context

Adaptation can be defined as a social-cultural norm that influences the unique lifestyle of the rural inhabitants in the MDV. In contrast to the rigid decision-making approach as observed in the flood management context, the rural adaptation practices highlight the flexibility in the informal interaction boundary. Therefore, it provides greater room for empowering farming household to engage in learning and to conduct on-farm experimentation. My observation echoes Lebel et al.'s (2010b: 336) claim that "informal self-organising social systems and networks are more flexible and often can respond faster than formal organisations and hierarchies." According to Pahl-Wostl (2009), learning may flourish in such informal networks. In the informal boundary, farmers are the key actors. It is apparent that farming households are arduous learners who contribute a large proportion of the local knowledge. Nguyen Quy Hanh and Evers (2011) conceive of them as 'knowledge brokers' who diffuse knowledge to a variety of users. According to Meyer (2010: 119), knowledge brokers can be defined as

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[25] Boundary objects are often referred to as technologies. They can also be drawings, sets of rules, research projects or documents (Kimble et al., 2010). According to Carlile (2002, cited in Kimble et al., 2010: 438), boundary objects can play a role in "supporting the different forms of coordination found in collaborative working."

[26] More information on *'Thỏa thuận về quản lý nguồn nước vùng Tứ Giác Long Xuyên'* (Agreement on Water Management in the Long Xuyen Quadrangle) can be found at http://www.vtvcantho.vn, [accessed July 25th, 2014].

those who facilitate the creation, sharing and use of knowledge. As stated by Wisner (2010: 132), the slow evolution towards climate change adaptation can be attributed to traditional land use patterns and natural resource management practices, which requires the assistance of agents of ecological modernity such as agricultural extension agents. This research identifies the strong connection between local farming households and extension officials that effectively facilitates the shared learning and co-production of knowledge through the farming practices. As evidenced across the research areas, such learning interactions do not occur within the formal interaction boundary, but are prevalent in the interstice known as shadow systems.

As noted by Agrawal et al. (2009), reciprocal interaction between formal and informal institutions is critical to rural adaptation. This research finds salient evidence of the shadow systems in the adaptation context in the MDV. As Vietnamese culture promotes informal procedures (Gerke et al., 2012), the open space of the informal interaction boundary offers a greater latitude for the shadow systems to operate (Figure 6.5). The shadow systems are defined as the space of informal interaction that lies outside of, but interacts with, formal institutions and relationships (Stacey, 1996). As recognised in the organisational context, the shadow systems contribute most to learning and innovation (Pelling et al., 2008). High et al. (2004) claim that shadow systems can provide a significant resource for rural adaptation. In the adaptation context in the MDV, the shadow systems represent the learning interactions between the extension officials and the farming households. These joint learning processes facilitate the exchange between local initiatives and scientific knowledge, from which farming households can advance their local knowledge. In return, the interactions with local farming households allow extension officials to obtain practical understanding of farming initiatives and consolidate their theoretical knowledge. These findings are consistent with Chambers et al.'s (1993) and Fforde's (2008) perspectives on the positive roles of farmers in rural development. I assume that such learning reciprocity provides an empirical basis for grounding the validity of the local initiatives before they are legitimately translated into the local policy system.

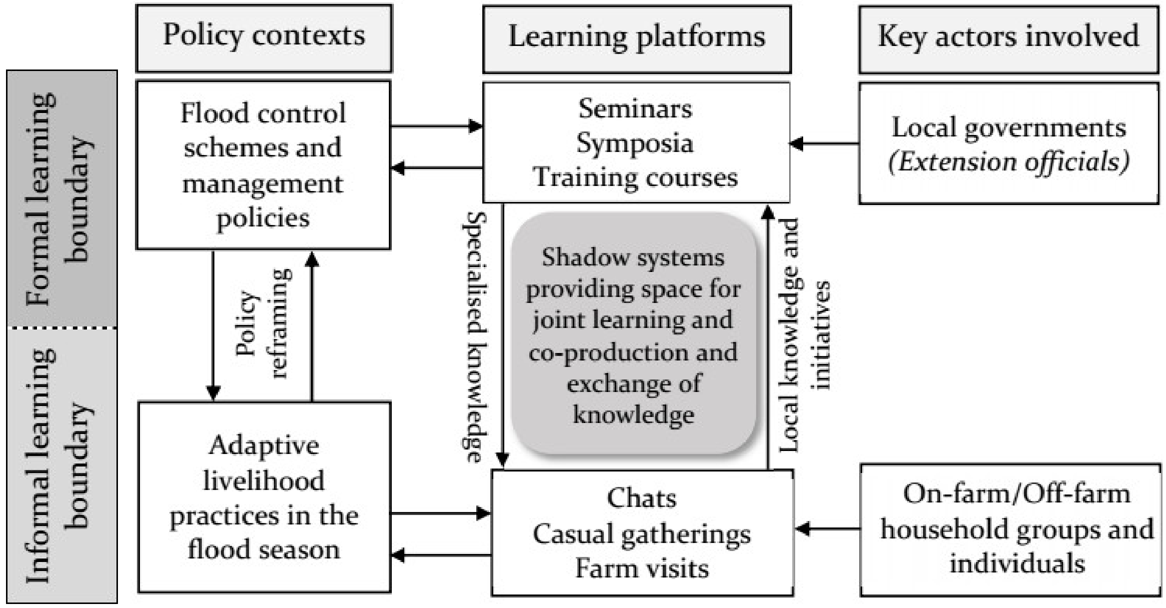

Figure 6.5 Learning interactions between farming households and extension officials in the shadow systems

Source: Figure by Tran Anh Thong; In-depth interviews (2013-2014)

The extension officials are formally recognised as technical experts working across specialised agencies at the local level. They hold specialised knowledge and work closely with local farming communities through regular extension programs. These functional identities give them a facilitating role. According to Millar's (1994: 164) view, integrating local knowledge with formal science has to begin with a process of dialogue. In this research, I observe that the learning interactions between the local farming households and extension officials take place in an informally dialogic fashion to achieve their own goals. On the one hand, the extension officials transfer technical knowledge to the farming households with the objective of gaining high farming productivity (Tran Thi Ut and Kajisa, 2006). This reflects strong consistency with the roles played by extension officials as Hicks (2005) described in her case study in Long An province. On the other hand, they learn from their counterparts through livelihood initiatives. Empirical evidence shows that farming households are the masters of experiential knowledge. When engaging in the learning process, they attempt to acquire the extension officials' technical instructions. Such learning synergies strengthen their knowledge interdependence and consolidate the farmers' experiential knowledge. These learning outcomes engender multiple lessons learned, prompting the local government to reframe their flood management policies to support the adaptation practices better.

Extension officials hold a dual-actor position as both professionals and members of the local community. Evidence shows that they are closely attached to social and kinship networks (bonding relationships). It is observed that when working with local farming households, their behaviours do not strictly conform to the formal working routines, but adhere to the informal practices and customs. These intimate behaviours determine to what extent knowledge could be shared. Unlike the formalities in learning interactions as frequently evidenced in seminars or training workshops, this informal learning platform surpasses the limitations of time and space. Particularly, the spatial proximity and emotional sympathy offers convenience for open communication, thus enabling prompt information exchange and promoting collaboration between the learners. In the rural setting, communication can take place on any informal social occasion (see Chapter 5). As observed in Phu Thanh B commune, the freshwater giant prawn farming groups frequently interact with the extension officials from the aquaculture station of Tam Nong OARD. Factual evidence indicates that the extension officials frequently take farm visits and stay back for having teas or drinks with local households. These close relationships secure open communication for honestly exchanging the knowledge and elaborating on farming initiatives with each other. While Hicks (2005) argues that the district level represents the primary interface between the grassroots and higher authority, this research suggests that the communal level should be highly recognised as it is the place where most learning activities take place and initiatives are generated.

Examples of shadow systems can be observed in Thoi Hung and Phu Xuan communes. The interview results present the collaborative learning performance between the extension officials and local farming households. The extension officials can be viewed as trust-worthy partners who get along with the local farmers during the cropping season. I observe that the knowledge the extension officials gain from working with a farming group could be shared with others who grow the same crops. This explains how the generated knowledge is disseminated across the farming community.

> I have grown sesame for several years. During the cropping season, I usually get technical assistance from the extension officials from the district. The knowledge I gain from them combined with my own experience helps me gain higher sesame yields *(Interview with a sesame farmer in Thoi Hung, February 21st, 2014)*.

> I discuss the eel farming practices with the extension officials of Phu Tan district from time to time. They frequently visit the eel-farming models in the commune, communicating with successful farming households and learning from their experience *(A male participant in a FGD in Phu Xuan, December 7th, 2013)*.

6.4 Beyond the social learning process: Institutionalisation of local knowledge for policy change

Recent work indicates that adversarial and oppositional tactics may be effective in influencing decision-making (Lebel et al., 2010b). However, this research sees knowledge as dynamic, socially constructed and in constant interplay with politics (Nilsson et al., 2012) which subsequently leads to change in decision-making. Drawing on Lundmark et al.'s (2014: 641) perspective, I claim that the learning process can facilitate the incorporation of knowledge into the management process. The local adaptation context of the MDV suggests that the farming community is the cradle where most farming initiatives are generated. In practical terms, a number of local initiatives have been produced as a result of farming households' self-reflection and learning interaction processes, formulating what I term the informal knowledge system. The adaptation context also highlights the iterative learning interactions between extension officials and farming households through collaborative farming practices. These learning partnerships provide opportunities for sharing local and scientific knowledge systems to better tackle local adaptation complexities.

Flood management policy and adaptation responses reinforce each other. This represents the analogy of 'state-society' relations in rural development. The former provides structural safety for adaptation practices which, in turn, give feedback to improve it. The research findings suggest that the flood management policies have mixed impacts on the local adaptation process as experienced by farming household groups and individuals (see Chapter 4). The reciprocity of these two domains illustrates the learning loops through local household adaptation (farming practices) and the flood management policy (irrigation and flood control policies). While the implementation of flood management policies obviously illustrates a top-down technocratic approach, the local adaptation endeavours provide the bottom-up implications to address the flood management policy deficiencies. In the flood management context, the government agencies are the main agent in the operation and management of hydraulic systems. However, farming households, in the adaptation context, are the key practitioners. They are conceived of as both the beneficiaries and the 'clients' who directly monitor and assess the performance of irrigation schemes on the ground. In the face of adverse impacts driven by hydraulic systems, the farming households are often the pioneers who develop adaptive initiatives to address altered environmental conditions. The wisdom behind these local adaptation processes implies that more efficient flood management alternatives are developed to address the policy deficiencies. Such policy-oriented learning, as Ingold and Varone (2012) noted, is an essential component of policy change. From the perspective of polycentric governance, Chu Thai Hoanh et al. (2014: 66) emphasised that, albeit bound in the context of strong state power, an 'inclusive' decision-making process can take place. In this research, successful adaptation initiatives provide supportive feedback that enhances the local governments' decision-making capacity of flood management, from which adaptation constraints could be better addressed. This interaction process demonstrates the ways the government actors and the farming households, to some extent, shape and reshape 'the rules of the game' that meet their respective needs (Chu Thai Hoanh et al., 2014).

Nilsson et al. (2012) define institutionalisation of knowledge as the process of both translating the adaptation-relevant knowledge into existing institutions and creating new norms, regulations and decision-making procedures. Historical analysis of the adaptation process in the MDV has documented substantial evidence of how local initiatives have been incorporated into the formal policy-making process. It highlights the implications of 'dialogic' interactions in the sense of communicating ideas and preferences between the authority and various sectors of society (Kerkvliet, 2005). In particular, a small group of farmers in Kien An commune, Cho Moi district, An Giang province built dykes to protect the growing rice in response to the early flood arrivals in 1978 (Howie, 2011). Their pioneering endeavours soon gained credibility with the local and central governments, which subsequently stimulated the formalised adoption of this initiative on a larger scale (Duong Van Nha, 2006). This illustrates the impact of everyday politics in the form of 'fence-breaking' on the breakdown of the cooperative systems that led to the transformation of *Đổi Mới* in the late 1980s. Kerkvliet (2005) presents an analysis of the emergent pressures that the social forces and groups place on the state, leading to policy change.

Local knowledge has been recognised as an integral part in the policy formulation process (Bach Tan Sinh et al., 2009). However, it has been realised that though farming households are the original creators of the local knowledge, their contribution tends to be invisible to managers (Nguyen Quy Hanh and Evers, 2011). In practical terms, their wisdom is far from being immediately recognised and formally incorporated into policy. In light of Kerkvliet's (1995) implications, I believe that, if expressed through authorised channels, local endeavours can gain the attention and approval of policy-makers. My qualitative analysis suggests that extension officials play an important role in incorporating local knowledge (farmers' initiatives) and specialised knowledge (extension officials' expertise) into organisational knowledge (government policies)[27] *(Interviews with Mr. Nguyen in Phu Thanh B, November 7th, 2013; the Vice Head of Tam Nong OARD, December 27th, 2013; and Mr. Tam, the Chairman of the Farmer's Association of Thoi Hung, April 4th, 2014)*. These qualitative findings coincide with Fforde's (2008) observation that local-level officials give support to local farmers' practices. In this regard, I claim that, while the farming households are the 'knowledge brokers' in generating and diffusing initiatives, the extension officials act as the 'policy brokers' who sharpen the household's 'raw knowledge' and feed it into local decision-making processes to improve adaptation performance. As Van den Hove (2007: 809) puts it, knowledge "is a very common ingredient of policy making."

The case of Phu Thanh B offers an illustrative example of how the prawn farming initiative is formally translated into local adaptation strategies. As revealed by an informant, "When my prawn farming model is successfully implemented, the local government promptly takes part in the learning process" *(Interview with Mr. Nguyen in Phu Thanh B, November 7th, 2013)*. Interview results with key informants in the commune suggest that the extension officials of Tam Nong OARD have been actively engaged in gaining empirical understanding of how the initiative can be further developed. The formal recognition of prawn farming as a pre-emptive livelihood strategy implies that the initiative has been successfully incorporated in the local decision-making. Similarly, the expansion of field crop areas in Thoi Hung commune explains how the spontaneous initiative has informed local policy formulation. During the early period of the Song Hau State Farm's administration, farming households initiated a farming model, intercropping vegetables with mango trees at an early growth stage. This initiative is two-fold, aiming to control weeds and provide fresh vegetables for family consumption. Through the technical support from local extension officials and shared learning between local households with external farmers, this initiative has received recognition from the district government agencies as a potential farming model to be strategically practised in the flood season. They

[27] Refer to V. Brown (2010) 'Collective inquiry and its wicked problems', 61-83.

assume that field crop commodities are frequently scarce during this time of the year. This makes the policy orientation highly feasible as Thoi Hung commune possesses well-regulated hydraulic systems. The productive results achieved on the ground have led to the proliferation of field crop practices across the commune.

> The initiative of planting vegetable crops stems from the local farming households. Initially, they aimed to fill up the spare space on fruit bunds. Advocated by extension officials, the vegetable crops are shifted to be planted on the fields after the rice crop season. Envisaging the crop potential, the district government agencies approve of the large-scale crop farming in the commune (*Interview with Mr. Tam, the Chairman of Farmer's Association of Thoi Hung, April 4th, 2014)*.

Understanding how the policy-making process takes place across the administrative levels with regard to flood management and adaptation is critically important. Empirical findings suggest that policy influence predominantly revolves around the commune-district boundary (Figure 6.6). The close connection of these two administrative levels can be attributed to the fact that the district administration is more immediate to the communal level, and more responsive to local demands. There is ample evidence that demonstrates joint efforts made by commune-district administrations in dealing with local adaptation pressures *(Interviews with the Vice Chairman of Phu Xuan, November 5th, 2013; the Vice Director of Song Hau State Farm, April 13th, 2014; and the Chairman of Thoi Hung, October 22nd, 2013)*. However, these collaborative outcomes do not sufficiently penetrate into the high-level policy making process at the provincial level, but are mostly felt at the district level (Hicks, 2005). This policy-influencing gap corroborates Fritzen's (2006) perspective that state decentralisation remains 'centralised' at the provincial level. Although there are political dynamics through flood management and adaptation processes across the case studies, this research asserts that the provincial administration retains its dominant power in planning and decision making.

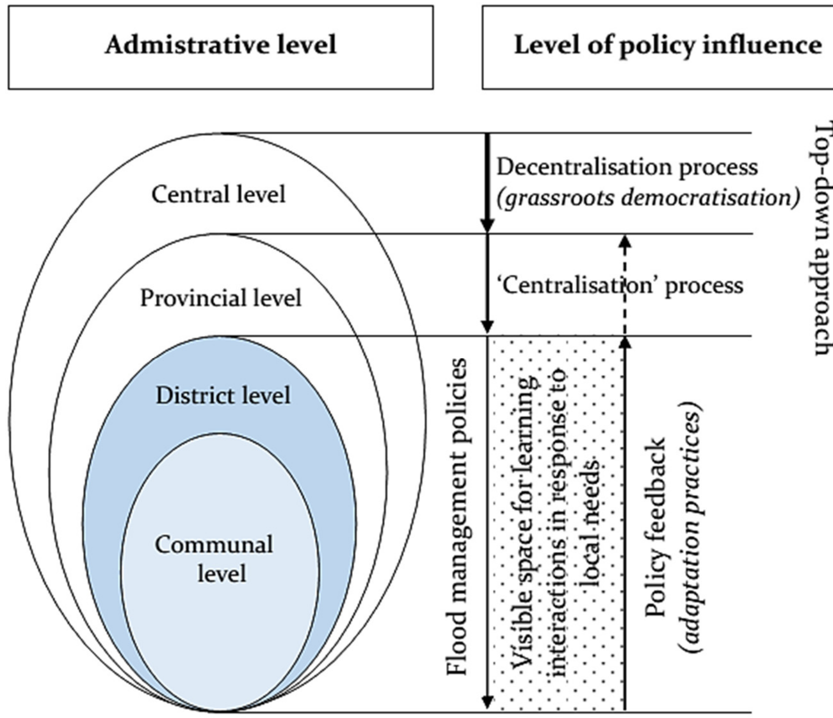

Figure 6.6 Level of policy influence across administrative level

Source: Figure by Tran Anh Thong; Fritzen (2006); In-depth interviews (2013-2014)

6.5 Conclusion

This chapter discusses how the decentralisation process contributes to the fragmentation of institutional structures on flood management, leading to the emergence of diverse irrigation and flood control schemes across the MDV. Accordingly, there are functional differences in management arrangements and participation of relevant stakeholders involved in the flood management and adaptation processes. In the case of the North Vam Nao scheme, a hybrid flood governance model has been constructed in consultation with local farming households, local scientists and local government agencies. It particularly incorporates the conventional state management mechanism and the grassroots engagement into the overall process of construction, operation and management of the scheme. Empirical evidence suggests that effective resource mobilisation and utilisation of multiple sources of knowledge help strengthen local capacities to achieve common objectives. There is much evidence of social learning, which is clearly illustrated by the collaborative engagement in the learning process and knowledge exchange among the relevant actors. These interactive learning and knowledge exchange processes reveal the institutional flexibility of the North Vam Nao scheme, which provides space for the mixed implementation of top-down and bottom-up approaches. This form of institutional interaction formulates the collaborative approach that guides the local decision-making and grassroots participation in flood management and adaptation. The demonstrated success of this governance approach should be seen as an exemplary model to support adaptation in the delta.

Given the different institutional contexts, the flood management practices in Phu Thanh B and Thoi Hung communes remain strongly influenced by the bureaucratic approach. At the institutional level, the role of government agencies in the management and operation of the hydraulic systems is strongly emphasised. There is an absence of social learning in the coordination process. Vertical coordination suggests a key working procedure to perform the administrative and professional functions. Such absolute compliance with legal rules may discourage officials from seeking innovative thinking, thereby minimising opportunities for shared learning and participative knowledge within and beyond the bureaucratic system. At the local level, despite articulating critical demands to adjust hydraulic structures to accommodate the local needs better, local farming households have spontaneously self-organised their livelihood practices. Their actions are simply to adapt to the flood impacts, rather than demanding a radical transformation in policy-making.

Engagement of external actors in the flood management in the MDV is apparent. AusAID played a significant role in facilitating the formulation of innovative institutional arrangements for the operation and management of the North Vam Nao scheme in Phu Tan district, An Giang province. On a larger geographical level, GIZ contributed significantly to facilitating the establishment of collaborative flood management agreement between An Giang and Kien Giang provinces. The involvement of this external agency in the formulation and implementation of such collaborative flood governance arrangements has significant implications for promoting potential inter-jurisdictional flood management collaboration across the MDV.

Multiple strategic groups have been identified at the formal interaction boundary of flood management. They are in dual relationships where the government agencies hold a hegemonic position. The limited interactions among these strategic groups have induced increasing fragmentation of knowledge. In the flood management context, it appears that these linkages aim to gain better access to resources rather than formulate collective support to address the flood challenges. The changes of the socio-economic political context of Vietnam has influenced the science-policy interface over time. In the post-Renovation period, there are a large number of decision-makers are politicians who lack technical qualifications in environmental sciences and hydraulics. However, the present political situation witnesses the emergence of younger cadres with good professional profiles engaged in the political arena. With political powers derived from their important decision-making positions, they are more likely to make better informed decisions with regard to local flood management. As the representatives of the local government agencies, they tend to build good relationships with university scientists. This strategic alliance offers opportunities for the latter to engage in dialogue more and gain further access to local development projects, from which they can influence local policy decisions.

The informal interaction boundary in the adaptation context presents the sustained commitment of extension officials to local farming practices. This provides space for the emergence of shadow systems that foster informal learning interactions and the exchange of scientific and local knowledge between the extension officials and local farming households. The outcomes of these interaction processes strengthen trust and relationships between the learning partners. It creates windows of opportunity for the formal integration of local knowledge into technical knowledge, from which policy change can emerge.

The evolution of the epistemic linkages between the extension officials and the farming households helps to formulate a new strategic group to enhance local institutional capacity. While the role of farming households as local knowledge producers is well recognised, the extension officials act as intermediaries in formalising and institutionalising this innovative knowledge. Extension officials hold two identities, one as fellow community members, and the other as government officials. This dual position gives them two benefits. On the one hand, they have opportunities to engage in shared learning with rural farming households so that they can obtain practical knowledge in the field. On the other hand, working in the formal administration system gives them a great deal of advantage to interact frequently with local decision makers. This enables them to bring the local initiatives into the decision-making process. In this regard, the extension officials come to play a role as policy brokers who facilitate the incorporation of local knowledge (farming initiatives) and specialised knowledge (scientific knowledge) into organisational knowledge (government policy). In practical terms, policy change can take place as the result of such bottom-up endeavours. I claim that this observation makes an important contribution to the literature in this research area.

This research contributes to unpacking the multi-level governance structure where policy influence takes place across the administrative levels. To some extent, learning interactions between farming households and extension officials can be used as a lens to highlight these political dynamics. There is evidence illustrating various levels of support and coordination between the communal and district levels in response to local contingency planning for flood management and adaptation. The 'centralised' position that provincial authorities hold in governing the rural societies is apparent.

What governance approach is appropriate to deal with the forced adaptation context in the MDV? The next chapter attempts to investigate how the iterative interactions between the state and society during the 'opening-up and closing-off' processes in the delta characterise the governance approach to address its social-ecological constraints. It illuminates how adaptive co-management is defined at the interface of flood management and adaptation, and discusses its significance in informing the long-term adaptation strategies in the delta.

Chapter 7

Adaptive Co-management at the Interface of Flood Management and Adaptation

7.1 Introduction

There has been increasing recognition of the utility of adaptive co-management in addressing social-ecological complexities (Armitage et al., 2009), as it combines "the dynamic learning characteristic of adaptive management with the linkage of collaborative management" (Olsson, 2007: 268). The burgeoning literature shows that this governance approach has been utilised to deal with the challenging conditions of climate change (Baird et al., 2015; Plummer and Baird, 2013) and natural resources management (Ruitenbeek and Cartier, 2001; Marschke and Nong, 2003) across various geographical contexts. It particularly reflects on how local social groups self-organise, learn, and actively adapt to increase their adaptive capacity in response to change (Olsson et al., 2004). In terms of flood management, as posited by Pahl-Wostl (2007), this governance approach plays a significant role in filling policy gaps and continuously refining the prediction-and-control management practices and institutional bias of technical solutions.

In this research, I used Folke et al.'s (2002: 20) definition of adaptive co-management, defining it as "a process by which institutional arrangements and ecological knowledge are tested and revised in a dynamic, on-going, self-organised process of learning-by-doing." This concept has not yet been defined and understood in the turbulent context of forced adaptation in the MDV. This chapter aims to investigate how the government-led flood management (irrigation and flood control schemes) and household-led adaptation (adaptive livelihood performance) processes evolve towards adaptive co-management. It argues that the adequacy of the state's policy support for rural development have created a strong impetus for farming households to self-organise their production activities, which demonstrates a high level of spontaneity. From the public policy perspective, this chapter discusses how the adaptive co-management approach may contribute to the long-term adaptation strategies in the delta. This informs the formulation of a collaborative and adaptive decision framework to tackle the contemporary complexities of forced adaptation.

This chapter begins by reflecting on the fragmented landscapes of flood governance across the flood-prone areas in the MDV. This is followed by examining how adaptive co-management is defined and illuminated through the delta's flood management and adaptation processes. This section elaborates on institutional changes as the outcomes of the 'learning-by-doing' process with reference to government's adaptive flood management in interaction with household adaptation practices. The chapter concludes by discussing the significance of the adaptive co-management approach in informing the long-term adaptation strategies in the delta.

7.2 Contested flood governance in the MDV: Institutional fragmentation, disconnected landscapes

The decentralisation process in the post-Renovation period is one of the underlying factors responsible for policy divergence in flood management in the MDV. Traditionally, flood control forms a key part in water resources management and agricultural production (Waibel et al., 2012; Chu Thai Hoanh et al., 2014). It utilises an engineering approach to derive solutions, as evidenced in the state's sustained efforts in large-scale investment in irrigation systems in the 1990s (Garschagen et al., 2012). A plethora of adaptation narratives and scientific evidence have shown contested discourses on flood impacts associated with dyked versus non-dyked and upstream versus downstream areas (Le Anh Tuan et al., 2007; Le Thi Viet Hoa et al., 2008; Chu Thai Hoanh et al., 2014). Recent delta-wide master planning phases (NEDECO, 1993; Biggs, 2009; MONRE et al., 2013) have constituted the important basis for the contemporary water resources management practices (Waibel et al., 2012), and defines shared responsibility across governance scales (Chu Thai Hoanh et al., 2014). However, the collaborative flood management across adjacent jurisdictions in this region has not yet received adequate attention in practical terms. This has eventually led to the institutional fragmentation and disconnection of its ecological landscapes.

Two key issues have led to the institutional fragmentation for flood operation and management in the delta. The external factor relates to distinctive geographical and hydrological conditions across flood-prone areas. Flood levels determine what kinds of dykes should be built. The internal factor concerns the divergent socio-economic development policies prioritised by local governments. For instance, the government in Phu Thanh B preferred to maintain the low dyke systems because they can effectively support the double-cropping system and flood-based production activities in the flood season. Meanwhile, the construction of the North Vam Nao flood control scheme brings the government in Phu Xuan the conviction that this embankment system can protect the local community from adverse impacts of high floods and enable the intensification of rice production. The practice of the '3 years, 8 crops' model in the commune demonstrates the local government's ambition for increasing household income. In the case of Thoi Hung commune, the Director Board of the Song Hau State Farm maintains that high dykes should be needed to promote the local integrated farming systems in the flood season. At present, this flood control system still plays an important role in supporting the rural livelihood activities.

Qualitative analysis reveals that local governments often boast that their own irrigation and flood control scheme is unique. They tend to make a comparison, deliberately highlighting the significant contribution of their scheme compared to others to local agricultural production activities. This unitary perception, to some extent, has hindered efforts to advance a shared vision for collaborative flood management across adjacent flood-prone jurisdictions.

> The dyke systems in Thoi Hung are designed to prevent and control floods. While rice farmers in An Giang province have to pump water into rice fields, the sluice systems in Thoi Hung make it convenient for farmers to do it. Thus, floodwaters can be easily released into the fields when needed *(Interview with the Chairman of Thoi Hung, October 22nd, 2013)*.

> In An Giang province, the performance of the North Vam Nao flood control system in Phu Tan is the most effective. Its monitoring and maintenance works during the flood season do not incur high expenditure compared to the neighbouring irrigation systems *(Interview with the Chairman of Phu Xuan, November 5th, 2013)*.

Adger et al. (2003b: 1100) depict the stratification of nested structures where "higher level institutions set limits to the procedures and alternatives that are available at lower level." This governance approach narrows the scope for effective implementation of institutional functions and responsibilities between the higher and lower levels. Qualitative evidence suggests that the governments at the communal and district levels have little input into formulating flood management policies, of which the responsibility belongs to the higher-level management agencies. As noted by Fritzen (2006) and Waibel et al. (2012), decision-making power, under the impacts of decentralisation, concentrates at the provincial level. Therefore, with regard to collaborative flood management, provincial authorities conventionally have adequate capacity, decision-making power, resources, and legitimate discretion to undertake this responsibility.

7.3 Adaptive co-management practices in flood management and adaptation

7.3.1 Adaptive co-management in flood management

As recognised by O'Rourke (2004: 31), "Vietnam offers a 'natural experiment' through which to analyse development changes and environmental impacts, and to compare theory to practice." In the context of flood management, the MDV offers an appealing 'natural experiment' associated with the co-evolution of flood management and adaptation (Figure 7.1). This section examines how the adaptive management approach evolves along with the progressive development of flood management in the delta, which Biggs et al. (2009: 216) conceive of as a 'work without end.'

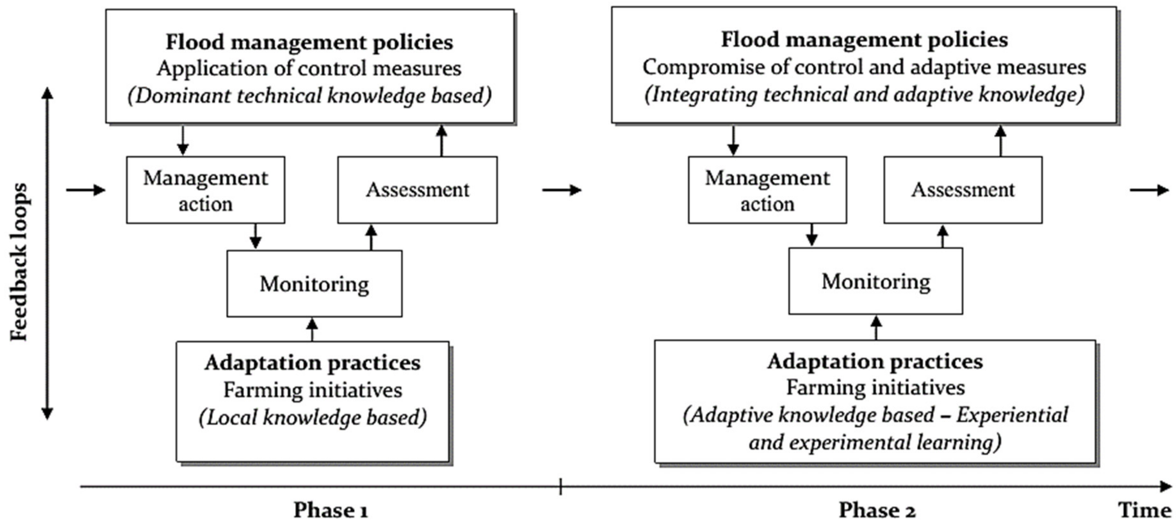

Figure 7.1 Adaptive learning at the interface of flood management and adaptation in the MDV

Source: Modified from Williams (2011)

The 'learning-by-doing' approach is a non-linear process. Eriksen and Lind (2009) see it as a set of adjustment processes. Adaptive flood management in the delta represents the multiple learning cycles between the construction and operation of flood control systems and adaptation practices over time. These interactions provide the feedback loops mediated by the monitoring and assessment processes, which are conducive to the adjustment of flood management actions. This resonates with Williams' (2011) position that greater understanding gained from monitoring and assessment informs institutional adjustments for deliberating over plausible management actions. As illustrated in Figure 7.1, the management shortcomings of the flood control measures in the first phase, identified from the monitoring and assessment processes, provide the need to integrate the farming community's adaptive responses into the local flood management decisions in the second phase to better accommodate local adaptation circumstances. Local initiatives are included in the revised flood management policies. This adaptive flood management process demonstrates the importance of reflective learning that facilitates the compromise between control and adaptive measures whereby the local flood management evolves.

Table 7.1 highlights three key milestones, through which various flood management strategies have been implemented and modified. These processes involve the significance of how past decisions are linked to present-day adjustments. In other words, they suggest pragmatic learning from past decisions while persistently seeking novel management approaches to fit contemporary political, socio-economic, and environmental conditions. Agrawal and Perrin (2009: 350) noted that analysing past impacts and responses is critically important in understanding the feasibility of future initiatives. In his study on the history and the politics of hydraulic infrastructure development and conservation in the delta, Biggs (2011) sees the floodwater control and hydraulic development as the process of finding alternative remedies, where the learning loops support continuous fixations of the side effects of past decisions and policy adjustments to emerging situations (Benedikter, 2014). Tvedt and Jakobsson (2006: xii) agree that "with water, the past definitely reveals itself in the future, and the future is embedded in the past."

Although the delta experienced the development processes of large-scale infrastructure to support water transportation, agricultural production, and settlements during the pre-1975 period (Phan Khanh, 2005; Biggs et al., 2009), there is ample evidence of free adaptation practised by the rural inhabitants to natural flood conditions, particularly in the upper part of the delta (see Chapter 4). It highlights the profound imprints of nature on the local rural societies (Taylor, 2001). This form of adaptation, as Biggs (2010) pointed out, characterises the authentic practices of the *'văn minh sông nước'* (riverine culture), and the harmonisation of the human-nature relationship in this early period.

The second period (1976-2010) presents the domination of the flood control policy, drawing on the North's engineering approaches to control the very different environment of the MDV (Benedikter, 2014). This management option is based on the state's monolithic ideology, seeing it as "a well-bound, clearly defined, and relatively simple system" (Holling and Meffe, 1996). Advocated by this simplified ideology, massive hydraulic systems were developed across the delta during the 1990s, especially in the deeply flooded zones of the Long Xuyen Quadrangle and the Plain of Reeds. However, the delta had experienced the periodical adjustments in flood management policy in this period, moving from control-oriented to adaptation-oriented measures. In the third period, adaptive measures have received greater attention to promote the 'living-with-floods' approach to address the complexities of forced adaptation.

Table 7.1 Flood management towards adaptive co-management in the MDV

Timeline	Policy change	Explanation	Emergence of adaptive co-management practices
2010 to date[e]	*Re-adaptation to forced adaptation challenges*	*Revisiting adaptive measures to respond to incremental impacts of climate change and upstream development in the Mekong Basin[b]* Adjustments of flood management options towards adaptation-oriented alternatives Promoting farming diversification to improve rural households' standard of living	Policy adjustments underpinned by pragmatic 'learning-by-doing' under adverse impacts of structural management options[b] Integration of local initiatives and scientific knowledge into flood management[b] Calling for deferral of high dyke building in support of autumn-winter rice crop in tandem with reduction of triple-crop cultivated areas in An Giang province[28] Formation of large-scale (inter-provincial) collaborative flood management mechanism in the Long Xuyen Quadrangle[b]

[28] Official document No. 1259/UBND-KT issued by An Giang People's Committee (2013) dated November 1st, 2013 on the deferral of the cultivation of the autumn-winter crop since November 15th, 2013.

	Flood control policy	*Structural development for rice expansion (1975-1990), rice intensification (1991-1999) and agricultural diversification (2000-present)*[i]	
	2000-present	Promotion of 'living-with-floods' that combines structural and non-structural measures in the wake of the disastrous flood event in 2000[f] Policy on agricultural diversification (shift from rice to aquaculture, cash crops, and livestock production)[29]	Revising the 'living-with-floods' strategy by exploiting floodwaters and minimising negative flood impacts through flood control and drainage[f] Modification of existing irrigation systems in service of diversification[d] Integrating non-structural with structural measures into adaptation approach[g]
	- 1996-2000	Flood control measures (hydraulic development) approved in 1999 for implementation from 2000[30]	Gaining a compromise between partial flood protection and 'living-with-floods' practices[d]
1976-2010[e]	- 1986-1995	Controversy over 'full flood protection' and 'living-with-floods' alternatives Development of the Mekong Delta Master Plan (1993) and sharing responsibility across administrative levels in infrastructure investment[31]	
		Government's policy decisions to expand cultivated areas for increasing agricultural production	Collaboration between governments and farmers in rice intensification[d]
	- 1976-1985	Increasing rice production	Adaptive learning and self-organisation in flood management at the household level (1978)[h]

[29] Decree No. 09/2000/NQ-CP promulgated by the Government of Vietnam dated June 15th, 2000 emphasises the key role of agricultural diversification as part of structural change policy in the economy sector, giving more focus on cash crops, aquaculture, and livestock production.

[30] Decision No. 99/TTg issued by the Prime Minister of Vietnam dated February 9th, 1996 on long-term direction and 5-year planning for irrigation, transport, and rural development in the MDV from the period 1996-2000.

[31] NEDECO (1993).

Before 1975[e]	*Free adaptation (exploitation) to natural flood conditions*	*Traditional 'living-with-floods' with subsistent livelihood patterns in the floodplains[k,l]*	
	- Late stage of exploitation (1945-1975)[a]	Construction of new settlements, improvement of rural transport, serving flood control programs	Irrigation development without plan (1975)[d] Farmers' ventures into experimentation of high yielding varieties in the MDV[l]
	- French colonisation (1858-1945)[a]	Acceleration of canal excavation for transportation, security, and irrigation	Canal excavation during the French colonial period (1974-1884) taken as early structural experiments[c]
	- Early stage of exploitation (1705-1858)[a]	Three main canals excavated to strengthen national defence, land exploitation for settlements and rice cultivation	

Sources: Summarised by Tran Anh Thong with adaptation from the following sources:

[a] Nguyen Van Sanh et al. (1998); [b] In-depth interviews (2013-2014); [c] Phan Khanh (2005); [d] Chu Thai Hoanh et al. (2014); [e] Can Tho University (2011); [f] Benedikter (2014); [g] Nguyen Hieu Trung et al. (2013); [h] Howie (2011); [i] Garschagen et al. (2012); [j] Yasuyuki (2001); [k] Biggs (2004); [l] Vo Tong Xuan (1975)

Extensive investments in flood control works parallel the occurrence of floods and accompanying hardship (Kundzewicz, 2002). Holling and Meffe's (1996: 329) noted that "the command-and-control approach when extended uncritically to treatment of natural resources, often results in unforeseen and undesirable consequences." These points were confirmed by the catastrophic flooding that occurred in the delta in 2000. If the control policy period represents the state's large-scale experimentation to accelerate the delta's agricultural production, the third period (2010 to date) has revealed their considerable efforts in redressing the hydraulic development policies, with adaptive measures being increasingly adopted on the ground. This policy shift suggests the transformation of the conventional approach from 'fighting against floods' to 'living-with-floods' (Ehlert, 2012), which aims to exploit floodwater availability and minimise negative impacts through flood avoidance, control, and drainage (Benedikter, 2014). Lebel and Bach Tan Sinh (2007: 40) critically noted that "authorities may make nostalgic appeal to the 'living-with' discourse as an excuse for inaction or when protection efforts fail." While the control measures are seen to be flawed or incomplete because they do not take human behaviour and activities into account, the 'living-with-floods' approach appears to be highly amenable to local environmental conditions and the traditional adaptation practices of the rural societies. Empirical evidence demonstrates that farming households have successfully developed innovative initiatives to increase their adaptive capacity and reduce flood damage (Nguyen Hieu Trung et al., 2013). The re-adaptation approach which was implemented in the third period apparently characterises the attributes of adaptive co-management. It demonstrates the evolution of water and land use for agricultural production towards adaptive management approach rather than resource control and exploitation (Garschagen et al., 2012: 98). The on-going policy orientation towards the 'living-with-floods' practices suggests the significance of the adaptive co-management approach in flood management, which is based on 'learning-by-doing' and cross-level interactions. Evidence of these practices is apparent across the research areas.

Empirical evidence illuminates how adaptive flood management in the delta derives from local autonomous adaptation to address emerging flood challenges. Howie (2011) recalled an inspiring story about a small group of rice farmers in Kien An commune, Cho Moi district, An Giang, who made collective efforts to build dykes to protect their rice from imminent threats of flooding in the late 1970s. Their attempts were made without any local government intervention. It has been argued that the state's limited understanding of the delta's hydrological conditions at the early stage of flood control campaigns made room for the local households to venture into 'learning-by-doing' and self-organisation to solve local problems. The early success of this locally-based experiment soon influenced the national and local policy-making, which subsequently led to the widespread adoption of this initiative across the delta. This case corresponds to Pelling's view (2011: 30), seeing adaptive management as "the spread of successful innovations from individuals to become common practice."

Adaptive flood management is well reflected at the institutional level. Local governments' attempts in addressing negative impacts of dyke systems associated with the flow alterations, erosion, plant diseases, and soil fertility decline in recent years (Tran Nhu Hoi, 2005; Duong Van Nha, 2006; Le Thi Viet Hoa et al., 2007a) provide the rich evidence of the 'learning-by-doing' practices. In recognition of these dyke-induced constraints, the An Giang People's Committee has promulgated an official document (No. 1259/UBND-KT) stipulating the deferral of high-dyke construction and the termination of financial support for the autumn-winter crop cultivation in the province (An Giang People's Committee, 2013). In addition, this legal document requests the discontinuation of this third crop, which has been cultivated in localities exposed to high risks of dyke failures. It concurrently amends the former Decision (No. 1320/QD-UBND) on land use planning for the extensive cultivation of the autumn-winter rice crop until 2015.

> In An Giang, the cultivated areas for the autumn-winter rice crop will not be expanded since 2014. This policy change indicates shared understanding between local policy makers and scientists of concerns about this crop production over the last few years. It is proposed that non-dyke areas will be devoted to promoting the 'living-with-floods' practices and aquaculture farming in the flood season *(Interview with the Head of Sub-Department of Water Resources of An Giang, December 19th, 2013)*.

'Pilot testing' is the term that represents the 'learning-by-doing' approach, which is often used to guide the experiments on irrigation and flood control systems in the delta. The effective operation and management of the North Vam Nao flood control scheme is attributed to the valuable insights drawn from the high dyke experimentation in support of the triple-cropping system in Tan Hoa and Phu An communes of Phu Tan district combined with the observed shortcomings of the closed dyke systems in the neighbouring Cho Moi district (Tran Nhu Hoi, 2005). The qualitative analysis suggests that the outcome-based evaluation obtained from two piloted CMBs in 2006 provides an important foundation for the subsequent formation of 23 CMBs functioning across the scheme area *(Phu Tan OARD Report, 2014)*[32].

> The operation and management of the North Vam Nao flood control scheme that enables the '3 years, 8 crops' rotation pattern adopts our experiment in a high dyke system model in two compartments of Tan Hoa and Phu An in Phu Tan district in 1999. This initiative is drawn from the flood management drawbacks observed in the neighbouring Cho Moi district, where floodwaters are not allowed to flow into compartments all year round *(Interview with the Head of Phu Tan OARD, October 30th, 2013)*.

The first-phase implementation of the North Vam Nao project was coordinated by the MARD under the state's budget support in 1999. However, this early project revealed significant shortcomings. According to AusAID's review, the termination of the project was mainly attributed to poor engineering, construction plans and management with inadequate levels of ownership and understanding of national and local government, and the absence of beneficiary involvement in planning and implementation (AusAID, 2007). Drawing on experiential learning and the effects of the decentralisation process, the second-phase project implementation in 2002 requested that the An Giang People's Committee should take the responsibility for coordinating the project. This shift of management responsibility is well aligned with Bach Tan Sinh's (2003: 372) argument that local authorities are in a better position to understand local conditions and formulate and implement local development.

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[32] Report on assignment results of the operation and management of hydraulic systems for CMBs in the North Vam Nao project areas released by Phu Tan OARD dated April 04th, 2014.

> The project was based on a strong process of analysis and learning, conducted jointly with counterpart government agencies and local communities, which has resulted in high quality outputs. The design was based on a thorough analysis of the lessons from the NVN-I [the North Vam Nao I] and it responded to many of the shortcomings in the earlier project. *(AusAID, 2007: 4)*

> Due to functional shortcomings arising from the first-phase project implementation, three sluices (Phu Binh, Cai Dam, and Muong Khai) are subject to significant changes. It is worth highlighting that the first one [Phu Binh] was completely rebuilt as it is not compatible with the new project design in the second phase *(Interview with a senior staff of SMB of the North Vam Nao flood control scheme, December 12th, 2013)*.

The 'learning-by-doing' approach that facilitates the modification of the high dyke system in Thoi Hung commune was also observed. Frequent interactions with the local government through formal and informal deliberations stimulated farming households to raise their concerns about the adverse effects of sluice systems that hampered local waterway transport and alluvial deposit needed for local farming. These activities provide opportunities for shared understanding, learning, and consultation between them, which eventually leads to structural adjustments. This evidence corroborates Schreiber et al.'s (2004) position that consultation is a key ingredient of adaptive management. In this case, the farming community is the key actor who monitors and evaluates the operation of the sluice systems. These monitoring and evaluation results provided significant inputs in the decision-making process, which enabled the local government to remove all of the sluice systems. The adaptive flood management in Thoi Hung commune corresponds to Chu Thai Hoanh et al.'s (2014: 77) perspective that "the existing technical characteristics of the irrigation systems should not be treated as a static element in irrigation development" but render changes over time. In the case of Phu Thanh B, successful flood-based livelihood initiatives developed by the farming households together with iterative learning interactions with the local government have influenced the local government's decision that the existing low dyke systems should be maintained to promote flood-based livelihood activities in the flood season.

> The closed dyke systems built from the Song Hau State Farm's administration period are not suitable for the present-day farming production demands. To satisfy local demands, sluices at main channels are cleared off, creating more room for free flood flows. The structural modification allows a greater entry of alluvium into rice fields in the flood season *(Interview with Mr. Tam, a Chairman of the Farmer's Association of Thoi Hung, April 4th, 2014)*.

These case studies suggest the importance of social learning in facilitating policy change. They reveal how the shared understanding between the local governments and farming households influences the formulation of joint decisions in flood management options. Policies in this regard, as noted by Lee (1999) and Plummer and Baird (2013), can be perceived as experiments, from which knowledge is cumulatively gained through the feedback mechanism (Fennell et al., 2008: 63). In view of active social learning, Glasser (2009) claims that co-learning supports change, based on critical evaluations of existing knowledge and problem, generation of knowledge, and application of this new knowledge to policy change.

There is a paradox in flood management from the perspective of active and passive adaptive management approaches (Walters and Holling, 1990; Gregory et al., 2006). The implications of the active adaptive management are well stated in the UNDP and the Netherlands-prepared NEDECO Master Plan in the early 1990s (NEDECO, 1993), which attempted to develop the integrated water resources management that incorporated the multiple uses of water resources in the delta (Waibel et al., 2012). Additionally, a novel Mekong Delta Plan (MONRE et al., 2013) presents an ambition for the delta-wide long-term development plan, proposing the flood control approach with experimental management alternatives ('no-regret' and 'priority' measures) to address the complexities and uncertainties of the delta from the present to 2050, and from 2050 towards 2100. In the meantime, the passive adaptive management approach prevails at the local level. It reflects the local governments' short-term visions in pursuit of social-economic development based on their own interest and adaptive knowledge of local environmental conditions. It is clear that the flood management policies, which have been implemented in the delta over the last few decades, favour "rapidly developed short-term incentives and control" (Holling and Meffe, 1996: 329). The inconsistency in the delta-wide versus localised water resources management policies, therefore, could hinder potential opportunities for inter-jurisdictional collaboration in flood management which needs to be strengthened to deal with the complexities of forced adaptation in the delta.

Collaborative management was evidenced in the *'mặt trận thủy lợi'* (irrigation front) to build irrigation and flood control infrastructure through public labour campaigns to implement the state's 'rice everywhere' strategy in the MDV after 1975 (Waibel et al., 2012; Benedikter, 2014). Under the auspices of local state agencies, the rural population was mobilised to participate in these irrigation campaigns. The grassroots democratisation initiative enacted in 1998 offers formal encouragement to promote the collaborative flood management in the delta. The 'socialisation'[33] process engenders shared responsibilities between the local government and the farming community in the building and management of hydraulic systems, which is defined in the slogan *'Nhà nước và nhân dân cùng làm'* (State and people work together). This was again recalled during the decade (1986-1995) when the government and farmers worked collaboratively towards expanding irrigated areas and shifting crop systems (Chu Thai Hoanh et al., 2014). Benedikter (2014: 130) noted that this socialisation process aims to pragmatically articulate the state's intent on promoting decentralisation and democratising decision-making and community participation. However, while governments give support to participatory governance, they seek to maintain their control through government-community partnerships (Marshall, 2008;

[33] Socialisation refers to the shift from the state's responsibility in providing full costs for public services to that of the society. In this context, the fact that farming households are subject to contribute money to dyke construction is indicative of an aspect of the socialisation process.

Leys and Vanclay, 2011a). This is consistent with Nguyen Kim Dung et al.'s (2013) claim about the Vietnamese 'administrative' typology of collaboration in forest conservation governance. It was similarly found in this research that, even though there is increasing recognition of the rural community's role as stipulated in the Grassroots Democracy Decree, the decision-making power on flood management in the MDV remains in the hands of local governments, especially at the provincial level.

> The state covers the expenses for main hydraulic systems. We contribute to compensating those who lose their farmland due to dyke building *(Interview with Mr. Nguyen in Phu Thanh B, November 7th, 2013)*.

The recent emergence of co-management in Vietnam marks a significant milestone in the domain of natural resources management. It is seen as a promising alternative approach to *de jure* exclusive state control over natural resources (Oh, 2010). In the MDV, collaborative flood management between local government and farming households can be shown in different ways. The Decision (No. 03/2015/QD-UBND) issued by An Giang People's Committee integrates the spirit of the above-mentioned slogan into the operation, management and protection of local irrigation systems. It determines the responsibilities and exercise of power across the administrative levels according to the scale and sizes of respective structural systems. While local governments are responsible for large-scale schemes, farmer groups take care of small-scale irrigation works (see Chapter 6). The fact that farmers contribute their money to the scheme's construction and their labour in flood protection represents the 'tokens' of collaboration. Evidence also suggests that they are willing to coordinate with local government and mass organisations when dealing with serious flooding.

> Given the Mekong Delta Master Plan designed in the 1990s, the state embarked on building hydraulic systems in the MDV. In An Giang, farming households are required to pool money into the construction and maintenance of dykes, sluices, and pumping stations, making them available for cultivating the autumn-winter crops *(Interview with the Head of Sub-Department of Water Resources of An Giang, December 19th, 2013)*.

The North Vam Nao flood control scheme represents a typical example of the collaborative flood management paradigm in the MDV. The operation of this hybrid governance approach pioneers the institutionalisation of the horizontal and vertical linkages of flood management (Figure 7.2). The empirical evidence in Phu Xuan illustrates how these linkages function in the operation and management of the scheme. The CMBs serve as the bridging organisations at this juncture, facilitating the cross-level interactions for the effective management of irrigation and drainage services for farming production in the compartments (see Chapter 6). The vertical linkages involve interactions between the farming community and local government agencies. In coordination with the local government and their supervisory bodies (OARD and SMB), the CMBs are supposed to address concerns raised by the farming community. The horizontal linkages demonstrate the coordination between the CMBs and IDSUs in the management of interior schemes and the irrigation and drainage supply. In this regard, the CMBs play a central role in facilitating transactions between the IDSUs (irrigation and drainage suppliers) and the farming households (clients). The horizontal linkages are also indicative of the CMBs' frequent engagement in updating crop production activities, seeking advice, and sharing technical knowledge with farming households. The collaborative governance arrangements implemented in Phu Xuan commune offer unprecedented opportunities for the local farming community to engage in the management of its irrigation and flood control systems. In the long term, it provides the rural community with greater capacity to adapt to the incremental challenges of forced adaptation.

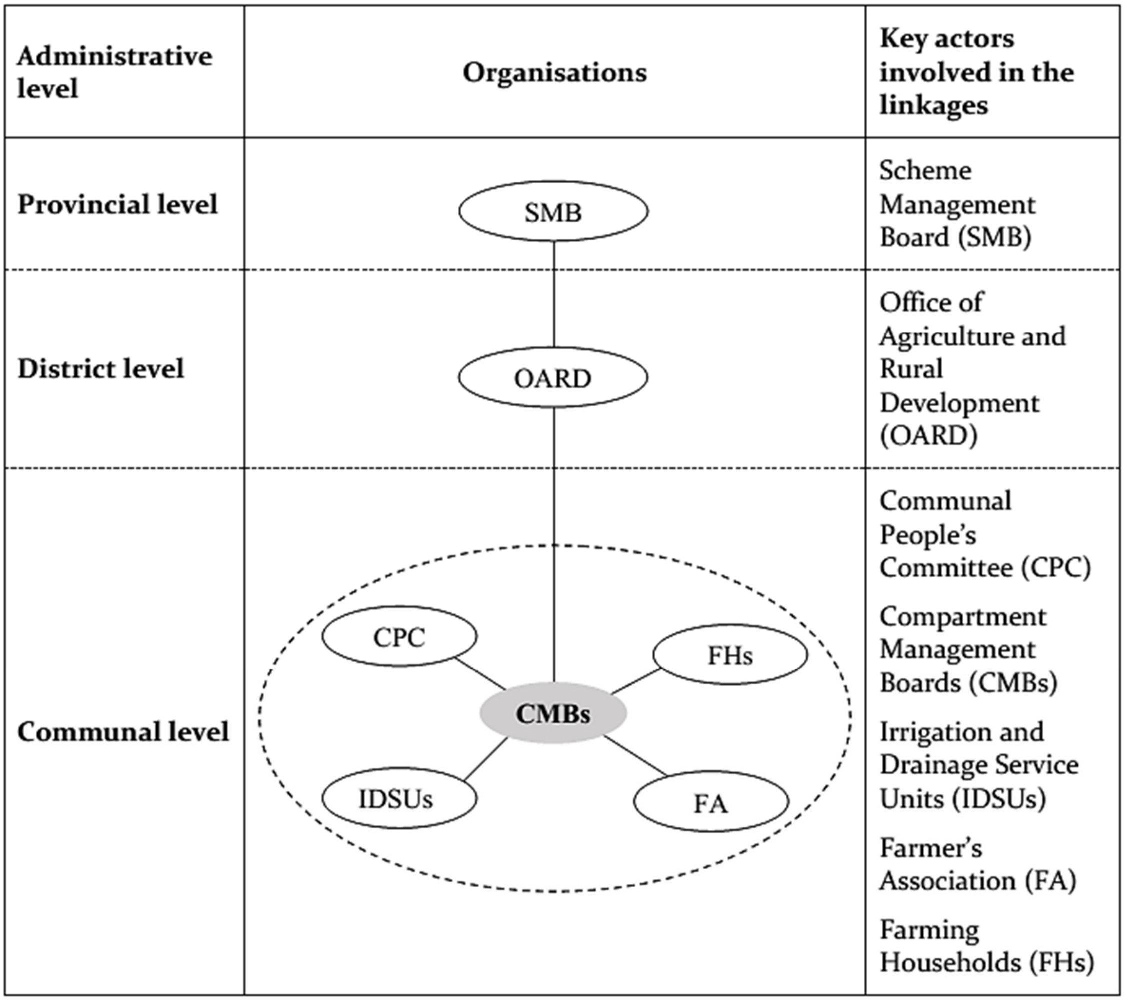

Figure 7.2 Horizontal and vertical linkages in the flood control and irrigation management in the North Vam Nao flood control scheme

Source: Figure by Tran Anh Thong; In-depth interviews (2013-2014)

7.3.2 Adaptive co-management in local adaptation

Although adaptive co-management is well established in natural resources management, its contribution to rural adaptive livelihoods is largely unexplored. In the MDV context, household adaptation is largely undertaken in a self-organising process. It suggests their keen determination in exploring farming initiatives to sustain their livelihoods, which is independent from the state's orientation. However, these 'learning-by-doing' practices evolve on a more spontaneous rather than a planned basis to respond immediately to local adaptation contingencies. According to

Taylor (2001), this identity highlights the distinct characteristics of the local inhabitants in dealing with externalities.

Farming households pool their experiential and experimental knowledge with their fellows and specialised agencies into collective efforts to manage their farming practices. They are engaged in various learning activities (mostly informal), where they can communicate and share knowledge (see Chapter 5). These findings are consistent with Gunderson's (1999) observation that learning and innovation often emerge and flourish in informal settings. In this case, the social learning process provides them with greater impetus to further explore and experiment with innovative livelihood practices to increase crop yields. It is worth noting that farming households in the MDV are highly appreciative of their experiential and experimental knowledge, which takes much of their 'sweat and tears' during the learning process. It actually contributes a great deal to the outcomes of their farming work.

Changing orientation of rural households towards alternative livelihood strategies can be attributed to several social-economic constraints they encounter. The first factor is related to the remaining gaps between the rural development policies and actual practices in rural areas. The effects of the national target program for sustainable poverty reduction program 2011-2015 remain limited (Do Kim Chung et al., 2015; Government of Vietnam, 2015). In the MDV, most rural low-income and poor households are still faced with numerous constraints in accessing formal sources of credit to fund their farming activities (Phan Dinh Khoi et al., 2013). The second factor links to the frequent fluctuation of agricultural products in the market. The late 1990s witnessed a significant transformation from monoculture policies to agricultural diversification and aquaculture in the delta. However, the proliferation of these agricultural patterns came along with the breakdown of rice prices on the global market (Vormoor, 2010). The refrain of *'được mùa, mất giá'* (bumper crop, low price) has become an obsession for the great majority of farming households over the last few years. The large surpluses of rice in the market combined with the failures of the government's policy instruments in ensuring the stability of rice consumption have posed additional challenges for rice farmers in selling their products. These difficulties make them more vulnerable to economic losses, which makes their lives more insecure (Taylor, 2004; Stewart and Coclanis, 2011). The last factor is concerned with to the dyke construction policies. The altered social-ecological landscapes driven by structural systems have had substantial impacts on the traditional livelihood practices of local farming households. Thus, they have to self-organise their livelihood activities to secure daily income, and to better adapt to emerging complexities (see Chapter 4). Migration is likely to be the preferred adaptation-oriented option that has been adopted by the majority of poor households in the delta (Dun, 2011). Qualitative analysis suggests that rural households' self-organisation in adaptation is predominantly spontaneous, which supports the argument in this chapter. Apparently, 'learning-by-doing' is a key approach that guides the farming households to deal with these policy-driven constraints.

> When I started my prawn culture, I was faced with challenges in the treatments of water intakes, prawn diseases, or dirty breeding ground. Dealing with these headache problems for years gave me much experience. We often share such learning experience on occasions of getting-together *(Interview with Mr. Nguyen in Phu Thanh B, November 7th, 2013).*

> I have grown lotus for three years. This farming model gives me good income. It is obvious that the price of rice is unstable. That's why I decided to grow lotus *(Interview with Mr. Phong in Thoi Hung, February 21st, 2014).*

> Those who make a good guess on the farming market are more likely to earn good profit. I apply this experience in my crop farming for many years. From my experience, if a certain crop gets a low price this year, I will invest in this type of crop next year. I am sure that I will get high profits as farmers stop growing it *(Interview with Mr. Nha in Thoi Hung, February 21st, 2014).*

Collaborative partnerships are evident in the way farming households manage their livelihood activities. My observation reveals the significance of horizontal linkages in sustaining iterative interactions of farming households within bonding networks. They are more inclined to coordinate with those within their kinship ties to communicate and share knowledge of similar livelihood practices, from which they can help each other *(A FGD in Phu Thanh B, January 22nd, 2014)*. This social learning process constitutes the collective spirit of the rural communities. It typically denotes their social characteristics when dealing with stressors (Taylor, 2001).

The flexibility of rural informal institutions, together with frequent interactions between the learning actors, facilitates the formulation of long-term collaborative partnerships and creation of opportunities for open communication and trust building. Evidence of vertical linkages demonstrate the collaborative learning between farming households and the local government, which facilitates the integration of local farming initiatives and scientific knowledge into flood management decisions and policies *(Interview with the Chairman of the freshwater giant prawn cooperative in Phu Thanh B, November 7th, 2013)*. For example, the collaborative learning and knowledge exchange between prawn breeders and the local government officials in Phu Thanh B commune influenced the decision-making process that the low dyke systems should be maintained in order to support the freshwater giant prawn cultivation in the flood season. Qualitative findings suggest that not only formal interactions (seminars or training courses), but also informal communications (casual meetings or chats) are pivotal learning platforms that help strengthen these horizontal and vertical linkages, on which farming households can capitalise to increase their adaptive capacity.

> The modification of sluice systems in Thoi Hung rests mainly with the collaborative learning between farmers and the local government. The consensus process starts with the opinions raised by the farmers, on which the decisions are made *(Interview with Mr. Tam, a Chairman of the Farmer's Association of Thoi Hung, April 4th, 2014)*.

7.4 Implications of adaptive co-management for the current complexities of flood governance and the long-term adaptation strategies in the MDV

Adaptive co-management has received increasing prominence as a potential governance approach to deal with today's social-ecological complexities. I believe that this governance approach holds a strategic position in facilitating the adoption of adaptive learning and cross-level collaboration to effectively implement the flood management policies in the complicated contexts of climate change and upstream development in the Mekong Basin. Since the flood regimes in the MDV over the last few decades have been increasingly uncertain and complex, 'learning-by-doing' could be an optimal approach to remedy defective responses of contemporary flood management policies. The decision-making in light of 'learning-by-doing' can be perceived as a process that progresses through multiple stages of problem-solving exercises (Adger et al., 2003b). These learning cycles provide greater capacity for the local government to make more judicious decisions on flood management. For example, the deferral of high dyke expansion policy by An Giang People's Committee was drawn from the perceived flood impacts in the wake of high dyke construction and the instability in the rice market facing the local farming households over the last few years. In addition, the institutionalisation of collaborative flood arrangements between An Giang and Kien Giang provinces arises from increasing demands of the local communities for addressing the flood control and saline intrusion complexities. In summary, the governments' policy adjustments, as evidenced from these empirical findings, suggest the significance of the adaptive co-management approach in tackling the prevailing complexities of forced adaptation in the delta. This approach, as stated by Plummer and Baird (2013), characterises 'good governance.'

From the perspective of adaptive co-management, I identify a compelling analogy when recalling the national reform process which, as Fforde (1991: 95) asserted, is "the mixture of spontaneous and conscious process." I claim that the pragmatic processes of learning by doing, accumulation of experience, informal experimentation demonstrated during the reform period authentically mirror current efforts in flood management and adaptation in the MDV. These characteristics, according to Fforde (1991: 96), reflect the concrete realities and the national character. For example, farming households' enterprise in building dykes to protect their rice from flood risks in the late 1970s and their enduring efforts in experimenting adaptation alternatives over the last few decades have awakened local governments' consciousness in policy change. I contend that the adaptive learning performance of the rural societies in the reform era, as implied by Fforde (1991), is still of profound significance when referring to the contemporary policy contestation between flood management and adaptation.

Judgment on the current social-ecological complexities in the MDV should be made with reference to the critical understanding of its historical and political contexts. A senior official at the Steering Committee of the Southwest Region argued that it is understandable to criticise the state decisions on flood control in order to accelerate rice production in the post-1975 era, if one takes into account the adverse effects of structural measures. As a common practice, policy decisions are often made in accordance with a particular situation. However, he admits that a policy change should be made along the way. In light of adaptive management, his perspective implies that the state's policies are literally akin to experiments that can be learned from, and modified over time to fit evolving situations.

> Policy formulation is driven by practice and development targets. We should not employ modernised views to judge what happened about 30 years ago. At that time, rice production was the first priority in the state's policy. It seems unfair if we merely use negative dyke impacts as currently encountered as a pretext to blame the state's structural development policy undertaken to achieve urgent national food security. At present, we can minimise our rice cultivated lands in favour of other diversified crop activities to increase profits. Ironically, at that time we did not have such options but planted rice. I agree that policy needs to be adjusted over time *(Interview with a senior official at the Steering Committee of the Southwest Region, January 13th, 2014)*.

Water resources management in Vietnam is essentially a political process, which is formally defined as a 'political mission'. It represents the 'administrative' governance practices of the state and limited participation of relevant stakeholders in decision making. From the perspective of polycentric governance, Chu Thai Hoanh et al. (2014) unveil the fragmentation in the state-directed irrigation policy formulation processes, revealing other stakeholders are not incorporated in the overall policy decisions. However, empirical observations in the flood governance context in this research suggest that the flood management practices are also influenced by informal institutional arrangements at the local level.

Multiple efforts have been made at the global scale to put into practice the principles of the integrated water resources management (IWRM) approach. The Global Water Partnership (2000b: 22) defines IWRM as

> A process which promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.

As an umbrella concept that includes multiple comprehensive and holistic principles, IWRM can be seen as "the most appropriate overall strategy for managing water resources" (Gain et al., 2013: 11). This approach is also advocated as an instrument to explore measures for climate change adaptation (Kundzewicz et al., 2007). However, Gain et al. (2013) argued that the IWRM approach cannot improve the flexibility and adaptability that are seen as essential to tackle the complexities and uncertainties related to climate change and sustainable management of water resources. They agree with Pahl-Wostl (2007) that there should be a change towards adaptive and flexible water management approaches.

In Vietnam, the IWRM approach has received growing awareness and importance from the early 2000s. It demonstrates the state's profound interest and willingness to learn and explore from experiences and new initiatives in the world regarding the successful implementation of IWRM (Hansen and Do Hong Phan, 2005: 224). IWRM principles have been incorporated into the National Water Resources Strategy Towards 2020 (Prime Minister's Decision No. 84/2006/QD-TTg), which sets a comprehensive framework for national water-related policies and implementation plans (Waibel et al., 2012). In the context of sea level rise and climate change in the MDV, the central government has attempted to integrate IWRM principles into the planning of hydraulic systems (2012-2020) and development orientations towards 2050 (Prime Minister's Decision No. 1397/QD-TTg). However, the water management practices in the MDV, according to Waibel et al. (2012: 167), have largely deviated from the legal frameworks, policies, and strategies built on IWRM principles. In parallel with their position in this regard, Fritzen (2006: 1) realised that the prevailing governance structure can be seen as the primary constraint by which the incentives that enable bureaucratic actors to transfer meaningful control downwards are weak or even non-existent. I ascribe this problem to two primary reasons. Firstly, although the water governance arrangements are designed to manage the river basins across the country, their legislative enforcement does not take account of the distinctive cultural, physical, and social-ecological characteristics of the MDV. It has been admitted that the establishment of three River Basin Organisations (RBOs), including the Red River, Dong Nai River and the Mekong Delta River, are responsible for various functions related to the supply, distribution, protection and allocation of water (Taylor and Wright, 2001; Nguyen Phuoc Ngoc Ha et al., 2013). However, the performance of these functions is not configured on the geographical boundaries of the river basins. Secondly, the decentralisation process underpins the provincial government's autonomy in formulating plans and policies that solely meet their own development needs. In a statement at the workshop in Can Tho in October, 2015, the former Deputy Minister of MARD pointed out the persistent drawbacks of the current flood management practices in the MDV, which are predominantly exercised on an ad-hoc basis[34]. In this regard, he argued that the potential planning should be grounded on region-wide strategic thinking. The former Deputy Minister's recommendation on the planning and development of the delta is relevant to the principles of adaptive co-management, which needs to be employed as the essential governance approach to guide pathways towards effective flood management in the region.

When indicating the role of governance in water resource management in the context of climate change, Pahl-Wostl and Kranz (2010: 567) stressed that "many problems can be attributed to governance failures, rather than resource base itself." Policy considerations to address the contemporary complexities of flood governance and the long-term adaptation strategies in the delta have raised the challenging question of what mode of governance should be adopted. Armitage et al. (2007: 5) asserted that "adaptive co-management may represent a potentially important innovation in natural resource governance under conditions of change, uncertainty and complexity." Even if this may prompt critical policy debates, empirical evidence of flood management and adaptation through 'opening-up and closing-off' processes in the delta provides a robust foundation to reinforce the importance and rationality of this governance approach for the long-term adaptation strategies. While the complexities of forced adaptation may exceed the response capacities of the rural societies, the effective implementation of the adaptive co-management approach could help to deal with them successfully.

The formulation of the long-term adaptation strategies in the delta should be based on the systematic understanding of how the adaptive co-management approach operates on the ground. There is much evidence that 'learning-by-doing' has contributed successfully to policy change in flood management. Despite being circumscribed by the top-down governance approach, the farming communities are

[34] More details on '*Quy hoạch Đồng Bằng Sông Cửu Long cần theo tư duy vùng*' (Region-wide strategic thinking is needed for the overall planning of the Mekong Delta of Vietnam) can be found at http://www.thesaigontime.vn, [accessed on November 1st, 2015].

actively involved in the monitoring and assessment of scheme performance. They provide evidence of structural defects, whereby proposing adjustments and management options to meet their production needs. Two collaborative paradigms are identified in this regard. In addition to the 'administrative' co-management nested in the government-household relationship (vertical co-management), there emerges the government-government linkage (horizontal co-management) in managing flood constraints across the administrative border (Figure 7.3). This research contributes to a nuanced understanding of vertical (relational) co-management and horizontal (inter-jurisdictional) co-management in the flood governance context of the MDV. The case studies suggest that the 'learning-by-doing' and the collaborative paradigms in flood management and adaptation create diverse learning platforms where multiple sources of knowledge can be mobilised, exchanged, and integrated into decision making. The innovative knowledge that emerges from informal and formal interactions can fill the formal knowledge deficiency in the contemporary management policies. Drawing upon these empirical findings, I believe that adaptive co-management can integrate the bottom-up and top-down approaches into the overall decision-making framework to guide the long-term adaptation strategies in the delta. It particularly addresses the policy gaps in the polycentric decision-making in irrigation development and the deviation of IWRM practices. On a broader context, the adaptive co-management approach, when incorporated into the long-term adaptation strategies, can better tackle the persistent flood management problems associated with 'upstream versus downstream' and 'dyke versus non-dyke' in the delta.

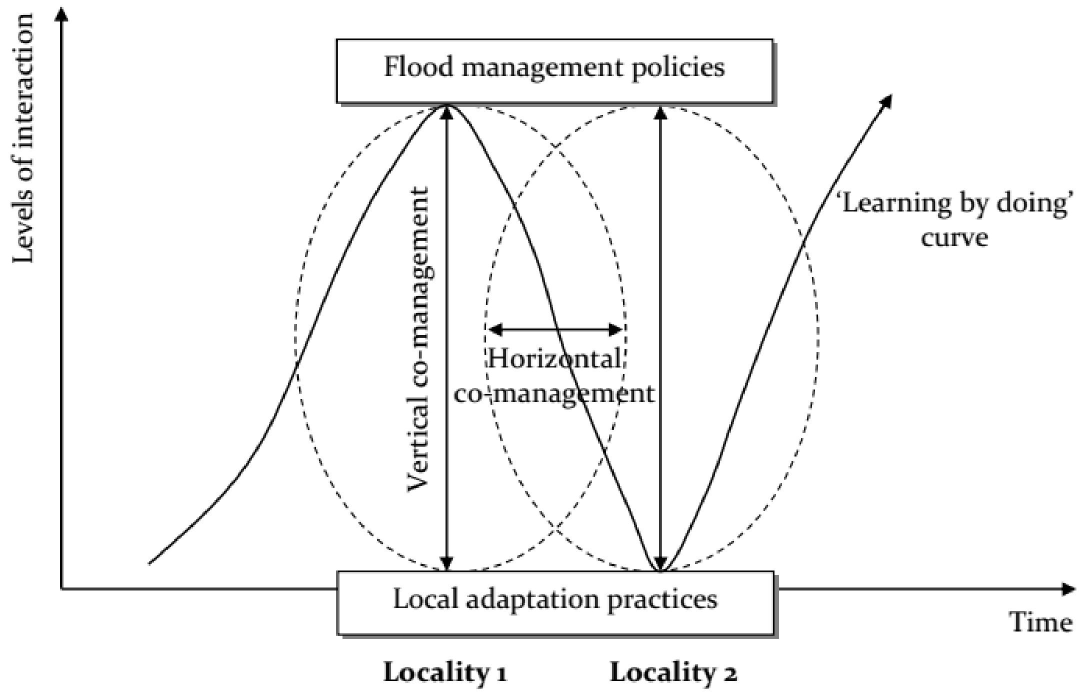

Figure 7.3 Adaptive co-management approach at the interface of flood management and adaptation in the MDV

Source: Figure by Tran Anh Thong; In-depth interviews (2013-2014)

7.5 Conclusion

Flood management and adaptation practices in the MDV have evolved towards the adaptive co-management governance approach. There is substantial evidence of the 'learning-by-doing' approach that underpins the management processes of natural exploitation, flood control, and re-adaptation in the delta. The case studies demonstrate that flood management options are largely driven by feedback learning, with a certain extent of flexibility in institutional practices together with the increased integration of locally-based knowledge into the decision-making process. Whether influenced by the top-down governance approach or the bottom-up deliberative processes, there is ample evidence of collaborative learning and exchange of knowledge between farming households and government agencies in response to local social-ecological complexities.

The collaboration between the local government and the farming community is clearly demonstrated in the flood management process. It illustrates their collective endeavour in building and adjusting irrigation and flood control works to support agricultural production. Recent years have witnessed the emergence of collaborative flood management across the administrative border. The fact that the governments of An Giang and Kien Giang provinces formulated collaborative water management arrangements provides an exemplary case of the inter-jurisdictional collaboration. Qualitative evidence suggests that this synergy merely demonstrates localised reactions to local water constraints, e.g. flood control and salinity intrusion control, which adversely affected the local socio-economic development, rather than set an exemplary flood governance approach to be potentially adopted for the entire delta. However, this initiative has received special attention from local authorities and professional experts that it could lay a key foundation for the delta-wide development of water resources management in the future.

This research provides an empirical understanding and rationale of how the adaptive co-management approach should play a central role in guiding the long-term adaptation strategies, given the inevitable nature of forced adaptation impacts in the delta. The historical repertoire of the 'opening-up and closing-off' processes suggests that this governance approach should be formally incorporated into the reform agenda and practice of flood management and adaptation. The traditional 'command and control' approach of the contemporary governance system, which has rendered multiple failures, should be replaced with the adaptive co-management approach. Relevant policy decisions need to draw upon this approach. However, the ready-made formulae of adaptive co-management cannot be simply captured from elsewhere, and imposed on the delta, but should be based on 'situated thinking' (Plummer and Hashimoto, 2011), and tailor-made to enhance adaptability (Armitage et al., 2007). This approach corresponds to the perspective of the former Deputy Minister of MARD that the flood governance in the delta should be based on the region-wide strategic planning. Last but not least, the effective implementation of adaptive co-management for the long-term adaptation strategies in the delta requires better implementation of grassroots democracy and the promotion of the inclusive decision-making process on the ground. Accordingly, the experimental and experiential knowledge accumulated from flood management and adaptation practices should be further integrated into vertical and horizontal collaborative mechanisms, and implemented on a participatory and deliberative basis.

Chapter 8

Conclusion, Policy Recommendations, and Suggestions for Future Research

8.1 Introduction

This thesis investigates the implications of social learning for household and institutional adaptation in the complicated context of forced adaptation in the MDV. Four research objectives corresponding to the research questions are respectively examined (Table 8.1). The first objective examines the impacts of forced adaptation on rural farming household and institutional adaptation practices (see Chapter 4). The transformation of the post-dyke landscapes in association with altered livelihood patterns across three selected research areas is investigated. The second objective quantitatively examines to what extent social learning influences farming households' adaptive capacity (see Chapter 5). The third objective elaborates how social learning facilitates the knowledge exchange between social actors nested in formal and informal boundaries that leads to institutional change (see Chapter 6). The last objective examines how the hydraulic development and adaptation processes in the delta are evolving towards the adaptive co-management approach (see Chapter 7). It particularly attempts to gain better insight into how the learning interactions of the two competing domains of flood management and adaptation have taken place, and how the evolution of such epistemic boundaries informs the long-term adaptation strategies to address the complexities of forced adaptation in the MDV.

Four sections will be included in this chapter. The first section is the introduction. The second section encapsulates the empirical analyses of the research. Key findings in response to four research questions will be highlighted respectively in this section. The research limitations and policy recommendations that arise from the research will be discussed in the next two sections. The last section proposes the research focus for future investigation.

Table 8.1 Overview of research objectives and questions

Research objectives	Research questions
1. Examine how the forced adaptation context shapes rural farming household and institutional adaptation practices in the MDV.	1. How does the forced adaptation context shape rural farming household and institutional adaptation practices in the MDV? *1.1 How does the evolution of flood control schemes reflect the local government's ideologies in development?* *1.2 How do the social-ecological landscapes change in the wake of dyke construction?* *1.3 How have the household groups implemented their adaptation strategies to respond to the social-ecological change?*
2. Explain to what extent social learning influences rural farming households' adaptive capacity to floods in the MDV.	2. To what extent does social learning explain rural farming households' adaptive capacity to floods in the MDV? *Hypothesis: Social learning is associated with the level of capacity available to farming households to adapt to the forced adaptation context in the MDV.*
3. Examine how social learning facilitates institutional change in flood management and adaptation practices in the MDV.	3. How does social learning facilitate institutional change in flood management and adaptation practices in the MDV? *3.1 How is social learning characterised in formal and informal interaction boundaries?*

	3.2 *How are the learning patterns shaped by strategic groups in the formal and informal learning boundaries?* 3.3 *How do the integrated knowledge systems constructed from these learning interactions mediate the institutional change in local flood management and adaptation?*
4. Examine how adaptive co-management informs the long-term adaptation strategies in response to the forced adaptation complexities in the MDV.	4. How can adaptive co-management inform the long-term adaptation strategies in response to the forced adaptation complexities in the MDV? 4.1 *How do flood management and adaptation processes over the course of the delta development evolve towards the adaptive co-management approach?* 4.2 *How is adaptive co-management demonstrated at the interface of flood management and adaptation practices?* 4.3 *How can these adaptive co-management practices inform the long-term adaptation strategies in the MDV?*

8.2 Key findings of the research

8.2.1 Forced adaptation context, household and institutional re-adaptation

The first research question addresses how the forced adaptation context influences the local farming household and institutional adaptation practices in the MDV. Research findings indicate that the local inhabitants' adaptation practices evolve with natural forces to sustain their living. Three key milestones are sequentially discussed: (1) natural adaptation, (2) flood control, and (3) adjustments in adaptation practices in addressing the forced adaptation complexities. The first adaptation period involved the early inhabitants' exploitation of available natural resources, expansion of settlements and excavation of canal systems for crop cultivation. The 'opening-up' of the delta accelerated in the era of French colonialism. Canal excavation remained the prioritised policy to serve the colonial regime's demands for local rice production and inland waterway transport. Traditional cropping systems continued their dominance during this period, especially in the Long Xuyen Quadrangle and the Plain of Reeds in the delta.

The 'closing-off' process parallels the extensive implementation of the flood control approach during the post-1975 period. This policy implied that the construction of large-scale hydraulic schemes was crucially important to serve the expansion of rice cultivation areas (1975-1990), rice intensification (1991-1999) and farming diversification (2000 to date). The implementation of the state's development strategies during these periods has transformed the social-ecological landscapes of the delta significantly.

The re-adaptation in the sense of adjusted 'living-with-floods' practices has been implemented in the wake of engineering processes deriving social-ecological complexities as experienced at present. Biggs et al. (2009) stated that what the rural societies are currently dealing with is essentially the legacy of past actions. Adaptation strategies are built on the basis of past knowledge and continuous exploration for novel approaches. At the household level, the transformation of rural households' livelihood patterns confirms their re-adaptation efforts to adapt better to emerging situations. At the institutional level, there are substantial efforts made by the local governments in adjusting flood management options to more effectively support local adaptation.

A significant transformation in farming households' livelihood patterns can be observed in the post-dyke context across research areas. The research findings reveal polarisation among the household groups as a result of the dyke construction policy. Better-off and medium household groups are likely to gain more benefits than their counterparts (poor group). On the one hand, the dyke systems can accommodate the practice of multiple cropping systems to increase household income. On the other hand, they have caused more hardship to the poor group in sustaining their survival. In Thoi Hung commune, the high dyke systems provide year-round safety for the integrated farming systems. However, qualitative evidence suggests that wild fish stocks and aquatic species which constitute the traditional sources of income for the poor have been increasingly jeopardised by high dyke systems. The rapid decline in these aquatic products has put their means of survival at stake. Similarly, the North Vam Nao flood control scheme in Phu Xuan commune provides favourable conditions for the proliferation of machinery-based services in agricultural production, but causes many difficulties for fish farmers. The controlled floodwater conditions within the compartments have caused them to move to more distant areas where floodwaters are available to fetch fish. In Phu Thanh B commune, the widespread utilisation of rice harvesting machines tends to replace the manual work on which most of the poor have depended. The precariousness of rural employment together with the low wages of hired labours has exacerbated their living conditions. Given the complexities of forced adaptation, the better-off and medium groups are more likely to diversify farming systems or switch to other livelihood alternatives. Meanwhile, the poor group persistently depend on seasonal employment for daily subsistence or migrate to urban areas in search of work. While Dun (2011) claims floods as a prime push factor for the labour migration in the MDV, this research advances the contemporary knowledge that this movement relates directly to the shrinking employment opportunities driven by the dyke-oriented policies and the rapid agricultural mechanisation in rural areas. Migration, as this research confirms, constitutes an essential re-adaptation strategy for the majority of poor households in dealing with the constraints of forced adaptation.

8.2.2 Social learning for household adaptation

Social learning has gained prominence in the domains of water resources management and adaptation to climate change. In the forced adaptation context of the MDV, social learning is a new concept. It is no surprise that as such its relationship with adaptive capacity at the household level has not been investigated. Chapter 5 contributes to gaining an empirical understanding of how social learning is defined in quantitative terms and associated with adaptive capacity at the household level.

The analysis of households' demographic characteristics suggests that there is much variation with regard to gender, marital status, educational attainment, length of residency, primary occupations, and religions. These demographic variables are selected to be put into the regression models. In the household survey, the number of household groups (poor, medium, better-off) is equal, with an even distribution of 100 respondents in each surveyed area.

Collective learning varies across household groups and surveyed areas. This learning practice is defined as the ways households form into cohorts for shared learning. The quantitative results present the largest proportion of better-off households involved in collective learning. Qualitative analysis confirms that they have greater opportunities to access resources and are more willing to take risks in conducting farming experiments. Of three communes, Thoi Hung has the largest number of households involved in learning. It is likely that those who attain higher education level would be more likely to have higher demands for obtaining new knowledge. It is true that Thoi Hung has the largest number of households who complete high school compared to its counterparts.

Various patterns are identified in households' collective learning. Learning through casual gatherings is the most common practice, which characterises an important aspect of the rural lifestyles in the delta. Local inhabitants often get together for morning coffee or tea at their homes or local coffee shops, and are invited for family celebrations. These informal routines offer them great opportunities to update daily news and exchange experiences or knowledge of farming activities. They are also conceived of as good practice to foster bonding relationships in the rural community.

Social learning often occurs at the hamlet and communal levels. Of the household groups, the better-off are found to be the most active participants in learning activities. The research findings suggest that the better-off group is more likely to travel in order to extend their social relationships and gain more opportunities to acquire new knowledge. Meanwhile, the poor group tends to stay closely connected to their local kinship networks. They also move far from home, mostly migrating to cities or larger rural towns to make money, rather than to seek learning opportunities. Qualitative evidence reveals that the poor group is often excluded from the formal learning activities (seminar, training workshops) which orientate towards landholders. This social marginalisation undermines their ability to contribute to collective learning and to acquire formal knowledge, and limit their opportunities to interact with various social groups in the rural community.

The traditional culture of Vietnamese people appreciates one's commitment to learning and knowledge acquisition. This spirit is inherently linked to farming household adaptation practices in the MDV. In this context, social learning can be defined as the process of social interactions and self-reflection where farming households are the key actors. Social learning can be identified from households' engagement in daily communications and social interactions and their self-learning efforts in exploring and developing farming initiatives. The qualitative analysis suggests that both of these social learning typologies constitute households' adaptive responses. It illustrates that adaptive knowledge, through the social learning process, can be acquired, transformed, and disseminated across household groups and administrative levels. The evolution of such farming initiatives as the cultivation of giant freshwater prawns in Phu Thanh B, eel farming in Phu Xuan, and crop diversification in Thoi Hung demonstrates the important role of social learning in household adaptation.

Exploratory factor analysis using principal axis factoring was conducted to examine the items of social learning and adaptive capacity. It identified two latent factors for social learning, composed of external learning performance (ELP) and internal learning performance (ILP) and one factor for adaptive capacity. Corresponding to the social learning theories conceptualised by Reed et al. (2010) and Glasser (2009), the ELP items represent the households' proactive behaviour to acquire knowledge through communication and social interactions, whereas the ILP items indicate individual learning indicated through 'reflection-in-action' practices. In other words, the ILP factor illustrates the way households engage in a self-learning process, using their experiential and experimental knowledge to develop innovative farming initiatives. These empirical findings make a significant contribution to the literature of flood governance in the MDV, and corroborate the contemporary theory of social learning. In this research, the examination of the effects of social learning on households' adaptive capacity involves the inclusion of these two latent factors and six socio-demographic variables in three regression models.

The t-test and one-way ANOVA techniques were used to compare the mean values of the latent factors derived from factor analysis by selected socio-demographic variables (gender, marital status, age groups, education level, household groups, and surveyed areas). The analysis results show that the means of the ELP are commonly found to be higher than those of the ILP. This finding suggests that the ELP plays a dominant role in households' social learning practices. While there exists the significant difference in the means of the ELP between the groups, the same results of the ILP are not reported. Interestingly, the results of the mean comparison suggest that there seems to be an underlying association between the ELP and adaptive capacity. In particular, when the ELP means are high, a similar trend can be observed in the means of adaptive capacity. Nevertheless, three multiple linear regression models were developed to further examine the effects of the social learning factors on adaptive capacity. The interpretation of these regression models helps to confirm these causal relationships.

The disaggregated social learning models represent the extent to which the ELP and ILP predict local households' adaptive capacity, as demonstrated in the analysis of three regression models. Quantitative findings suggest that these social learning factors have statistically significant effects on adaptive capacity. It means that the households with a higher level of social learning are expected to demonstrate better adaptive capacity. In Models I and II, the ELP has greater positive effects than the ILP in association with adaptive capacity. The significance in the interaction term between the ELP and Phu Xuan in Model II reflects the statistical difference in the effects of the ELP on adaptive capacity between Phu Xuan and Thoi Hung. Other demographic variables do not contribute significantly to the model. With regard to Model III, the ILP has stronger effects on adaptive capacity compared to the ELP. The interaction terms suggest that there is a statistically significant difference in the effects of the ILP on adaptive capacity between the medium and better-off groups and the poor counterpart. This finding highlights the important role of the ILP, which supports the poor households' adaptive capacity in response to the challenging context of forced adaptation in the delta.

In summary, adaptive capacity corresponds to the level of social learning that households engage in. This association varies across household groups and research areas. Qualitative findings confirm that better-off households are likely to have greater opportunities to learn in comparison to their counterparts. Unlike the poor and medium groups, the better-off households are more likely to access a variety of resources brought by their extensive social networks. Therefore, they are in a better position to communicate and learn from these epistemic networks, and more confidently try out experiments in farming production. Given the socio-economic constraints, poor households are more likely to rely on their self-learning capacity to sustain their livelihoods. These forms of learning interactions have led to the proliferation of farming initiatives, whereby innovative knowledge is continuously polished and disseminated beyond the household level. Given the higher level of social learning effects, Thoi Hung seems to have better adaptive capacity than Phu Thanh B and Phu Xuan communes. Based on these empirical findings, the research confirms that social learning contributes positively to household adaptation in the MDV.

8.2.3 Social learning for institutional change

The third research question concerns the ways in which social learning facilitates institutional change in flood management and adaptation practices in the MDV. As illustrated in Chapter 6, flood management is subject to the decentralisation process, through which provincial authorities gain greater autonomy in decision-making and performing administrative functions, particularly in the construction, operation, and management of hydraulic systems. The findings suggest that specialised agencies have dual functions with vertical and horizontal linkages to perform their assigned responsibilities. At the provincial level, for example, the Department of Agriculture and Rural Development (DARD) has to maintain the vertical link to the MARD for technical support, and horizontal directives from the provincial people's committee. The responsibilities for the operation and management of hydraulic systems are delegated across the administrative levels in accordance with the size and scale of the structures.

Flood control and irrigation are crucial components of the delta's flood management. The research findings identify much variation in the coordination framework of flood management across the communes. Unlike the North Vam Nao scheme in Phu Xuan that integrates the hierarchical administration with the participatory approach into decision making, the management of flood and irrigation systems in Thoi Hung and Phu Thanh B communes are predominantly subject to the top-down governance mechanisms. The hybrid governance model in the former case introduces two entities: the SMB and CMBs, which serve as the support instruments to the hierarchical decision-making framework. Empirical findings suggest that the collaborative nature of this innovative governance approach has brought about effective flood management in the commune. Meanwhile, the latter cases identify the local governments as the key actor in the decision-making process. This formalised nature of the bureaucracy has constrained opportunities for shared learning among the associated stakeholders. There is little evidence of critical feedback in the vertical coordinating mechanism. The extent of horizontal coordination is also found to be relatively modest.

The social learning process identifies the emergence of multiple strategic alliances that are nested in the relational practices of flood management and adaptation. In the formal interaction boundary, flood management suggests three dual linkages: (1) the government agencies and academics (boundary organisations); (2) the government agencies and economic groups (strategic groups); and (3) the government agencies and external development agency (bridging organisations). The commonality that comes from these dualities relates to the dominant position taken by the government agencies in the decision-making process. This research particularly highlights the important role of the shadow systems that revolve around the formal interaction boundary. As illustrated in the case studies, the shadow systems represent the learning interactions between agricultural extension officials and farming household groups and individuals.

The research findings reveal that the emergence of the linkage between the state bureaucracy and hydraulic construction businesses (strategic groups) can be attributed to increasing demands for hydraulic development to accelerate agricultural production. In the flood management context of the MDV, the boundary organisations involve the relationship between the local government agencies and scientists. Empirical evidence suggests that this linkage has changed over time. In the post-war period, the control-oriented approach, which is based on the socialist ideology, was uniformly imposed on the delta's flood management. At this particular stage, the local decision-makers who were responsible for structural development were predominantly politicians. Thus, they had limited knowledge of hydraulics or environmental science. In the meantime, scientists from research institutions in the MDV were deliberately distracted from this 'hydraulic mission'. The present-day science-policy interface has introduced a new 'strategic group' that is nested in a 'teacher-student' relationship. It is clear that the greater number of cadres working across the management levels have earned professional qualifications at academic institutions, where they can build good relationships with scientists. Having good connections with the local cadres means that the scientists have better opportunities to access local development projects. This strategy, to some extent, allows the scientists to engage productively in rural development, whereby they can influence local policy change.

The CMBs in the North Vam Nao scheme are recognised as meaningful bridging organisations. Evidence shows that these entities offer stimulus to participatory knowledge and information exchange between the actors in the learning networks. Frequent communications with local farmers provide them with updated knowledge of local farming situations, which helps them respond effectively to emerging situations. They coordinate with the irrigation and drainage service units (IDSUs), farmer's associations, and local government to deal with complexities relevant to the flood regulation and provision of irrigation and drainage services for farmers.

Shadow systems are prominent in the adaptation context. The flexibility of the informal interaction boundary allows farming households to engage in shared learning and implement on-farm experimentation. The informal boundary identifies farming households as masters of local knowledge who contribute substantially to the production of a wide range of farming initiatives. They are also conceived of as 'knowledge brokers' diffusing knowledge to a variety of users. The extension officials are formally recognised as technical experts working across specialised agencies at the local level. They hold specialised knowledge and work closely with local farming communities through regular extension programs. In the adaptation context, the shadow systems provide greater latitude for the learning interactions between the extension officials and the farming households. These joint learning processes facilitate the exchange between local initiatives and scientific knowledge, through which local policies are influenced. Research findings suggest that extension officials play an important role in incorporating local knowledge (farmers' initiatives) and specialised knowledge (extension officials' expertise) into organisational knowledge (government policies). While farming households are the 'knowledge brokers' in creating and diffusing initiatives, the extension officials act as the 'policy brokers' who formalise such 'raw knowledge' and translate it into policy. In this research, the shared learning and exchange of knowledge between the prawn breeders in Phu Thanh B commune and the extension officials of Tam Nong OARD successfully facilitated the institutionalisation of this initiative into the local 'living-with-floods' policy.

There is a reinforcement between flood management policy and adaptation responses. This represents the analogy of the 'state-society' relations in rural development. The interplay illustrates the learning loops that circulate through the government's flood management policy (irrigation and flood control policies) and the local households' livelihoods (farming practices). While the implementation of flood management policies dictates the dominance of a top-down technocratic approach, local adaptation supports bottom-up ventures on the basis of household-based innovative knowledge to address management deficiencies. This corresponds to Blanco's (2006: 140) position that "the bottom-up approaches may produce best results by building on local experiences and knowledge." These confrontational but complementary interactions have contributed a lot to improving the adaptive performance of the delta's society.

However, there is a limitation as to what extent these interactions work out across administrative level. Empirical findings reveal that the policy change is more likely to take place at the commune-district boundary. While the flood management policies are directed downwards from the provincial administration, household-led adaptation initiatives have not been adequately taken into the policy making process at this level, but mostly reside at the district level. This complements Hicks' (2005) findings on the important role the district administration plays in rural development. This research also supports Fritzen's (2006) claim that, given the existing governance structure, the state decentralisation has resulted in the 'centralisation' process that the decision-making powers are in the hands of the provincial administration. The top-down approach remains the dominant bureaucratic rule in management.

8.2.4 Adaptive co-management at the interface of flood management and adaptation

The fourth research question concerns how adaptive co-management is practically defined at the interface of flood management and adaptation in the MDV. Drawing on substantial evidence of the historical development process in the delta in this regard, the research advances empirical knowledge of how this governance approach informs the formulation of the long-term adaptation strategies to tackle the contemporary complexities of forced adaptation.

The MDV offers ample evidence of the evolution of flood management through its historical development. It sees ‘learning-by-doing’ as a key approach to the building, operation, and management of hydraulic systems (canals, dykes, sluices) to enable agricultural and aquacultural production. The adjustments of various flood management options over the course of the delta’s development suggests the state’s pragmatic learning from past decision-making, while persistently exploring new approaches to better fit contemporary political, socio-economic, and environmental conditions. During the pre-1975 period, free adaptation practices to natural flood conditions were predominant, particularly in the upper part of the delta. It involved the local inhabitants’ exploitation of available natural resources for their subsistence. However, the imposition of the engineering approach through the flood control strategy (1976-2010) made massive transformation in the social-ecological landscapes of the delta. Large-scale investments in flood control works increased tremendously, which were accompanied by a greater flood adversity. The disastrous flood event in 2000 (Chaudhry and Ruysschaert, 2007; Le Thi Viet Hoa et al., 2007b) revealed the drawbacks of the contemporary flood management policies, which has prompted the local governments to shift their attention towards adaptive measures. This policy shift transforms their conventional views from ‘fighting-against-floods’ to the ‘living-with-floods’ alternative. The revised approach has integrated the exploitation of floodwater availability with the minimisation of negative flood impacts through flood avoidance, control, and drainage. This research suggests that the state’s structural experimentation in attempts to accelerate the delta’s agricultural production has revealed negative side effects. Drawing on the ‘learning-by-doing’ approach, the third period (2010 to date) demonstrates cycles of policy adjustments to enhance the rural societies’ adaptive capacity in the face of the incremental complexities and uncertainties of forced adaptation. In this regard, re-adaptation is adopted as an alternative approach. It dictates the re-orientation towards adaptive measures, with greater attention to feedback learning and cross-level interactions. This policy shift illuminates how adaptive co-management has become an important approach in governing flood management and adaptation.

The evidence of adaptive co-management is pronounced across the case studies. The enactment of grassroots democracy illuminates the increased recognition by the state of the importance of public participation in irrigation development. This is evident in the case of the North Vam Nao, where the local community plays an important role in the construction and management process of the scheme. The structural adjustments in the first-phase construction of the project suggest clear-cut evidence of feedback learning and collaboration of the stakeholders involved. It indicates the intensive pooling of local and scientific knowledge, with multiple learning cycles and adaptive actions taken. In the cases of Phu Hung and Phu Thanh B, the formal and informal collaborative learning dynamics between local farming households and local government agencies drives the modification of sluice structures to provide better supply of water resources for crop production and promote flood-based livelihood activities in the flood season. These research findings confirm that social learning plays an instrumental role in facilitating productive negotiation between the state and social actors in the domains of flood management and adaptation.

The *'mặt trận thủy lợi'* (irrigation front) represents the state campaigns for socialist collaborative management in building irrigation and flood control infrastructure in the MDV after the national unification in 1974. After the Renovation period, the slogan *"Nhà nước và nhân dân cùng làm"* (State and people work together) attempts to promote the further collaboration between the government and farming communities in order to expand irrigated areas and encourage the conversion of crop systems. In these collaborative management processes, farmers were required to contribute their funding and labour to the scheme construction. They also participated in maintenance work when needed. These demonstrate an 'administrative' form of collaboration in the 'state-society' partnership, which is typical in the Vietnamese governance system. This research confirms that the government still holds a dominant position in the planning and the decision-making processes of hydraulic development.

In the MDV, the adaptation performance of rural households is mainly autonomous. It suggests households' self-organisation in developing farming initiatives to sustain their livelihoods. These household-led practices, as most cases suggested, often exceeds the state's policy orientation. They demonstrate households' engagement in both collective learning with other households and local experts (extension officials) and self-learning in attempts to improve farming productivity.

The collaborative typology in adaptation represents the horizontal and vertical linkages where farming households are the key actors. The horizontal linkage demonstrates that farming households coordinate frequently with those within their kinship networks so that they can communicate and share knowledge of similar livelihood practices. The vertical linkage formulates the collaborative learning partnerships between farming households and local extension officials. The research findings suggest that farm visits, seminars or training courses are the important learning platforms that contribute significantly to strengthening the horizontal and vertical linkages. It is evident that household groups, especially the better-off, benefit a great deal from these epistemic networks to increase their adaptive capacity.

This research provides an empirical foundation to confirm the significant role of adaptive co-management in the face of the increasing constraints of forced adaptation in the delta. Historical analysis of flood management together with farming households' adaptive responses illuminates that this approach has been long practised by the rural societies. However, critical analysis of these processes reveals that the centralised bureaucracies still have limited capacity to address the social-ecological complexities (Armitage et al., 2009) and that past experience of events and ways of learning are not sufficient for dealing with novel situations (Lebel, 2013). Taking these concerns into account, continued efforts for 'learning-by-doing' together with stronger collaboration on the basis of deliberative processes are needed to better address the incremental complexities and uncertainties of forced adaptation. This research suggests that adaptive co-management should be formally recognised as the key governance approach to guide the long-term adaptation strategies in the delta.

8.3 Research limitations

This research does not involve environmental governance in the broader context of the MDV, but is limited to the flood-prone areas, where three main typologies of irrigation systems were identified and analysed. It employs mixed methods research for data collection and analysis. It should be noted that primary quantitative data were solely obtained from the household survey administered to selected respondents in three surveyed areas. Against the backdrop of 'living-with-floods' in the floodplains, the qualitative research was based on case studies in the restricted spatial and temporal scales. Consequently, the research may not comprehensively reflect the diversity of institutional and household social learning dynamics associated with adaptation across the range of cultural and social-ecological landscapes of the delta. Further extensive research would be needed to explore this.

8.4 Policy recommendations

This research highlights the important implications of social learning for enhancing household and institutional capacity to adapt to the constraints of forced adaptation. To strengthen adaptive capacity in this way, the local government should firstly create a more flexible learning environment that facilitates the pooling of multiple sources of knowledge, especially in the formal administration system. This would provide a strong foundation for informing sound flood management and adaptation policies. Secondly, local seminars and training workshops should be promoted, as they are the most realistic learning platforms where theoretical and practical knowledge can be exchanged and consolidated. In practical terms, they provide crucial means for communication and learning interactions between local government agencies (extension officials) and farming households. Working through this interface, local households, especially the poor ones, can gain better access to scientific knowledge and engage in broader learning networks both formally and informally. Thirdly, open deliberation between the farming households and the government agencies should be strengthened, to ensure that farming households can have an equal voice in monitoring and assessment of the flood management options to suit better the demands of local adaptive livelihoods. The increasing recognition of farming households' role in these respects could both address the policy deficiency in the traditional bureaucratic decision-making and stimulate farming households' incentives in contributing to the adaptation process. Finally, this research recognises the role of agricultural extension officials as being instrumental to farming household adaptation. Their interactions with farming households should be further promoted, so that they can improve their learning capacity, and collaboratively contribute to translating adaptive knowledge into mainstream policy development.

This research highlights the significance of innovative institutional arrangements in irrigation and flood management of the North Vam Nao scheme. In the MDV, it is the first-hand governance model that has incorporated prescriptive and participatory approaches. The demonstrated success of this hybrid governance model implies that it can be considered for further experimentation and replication to other irrigation schemes in the delta. This suggestion also highlights the significance of the adaptive learning and collaborative approach to guide potential adjustments of flood management and adaptation policies.

This research places decentralisation at the heart of policy considerations to accommodate today's rural development context. The decentralisation process in flood management and adaptation in the MDV in particular needs to be promoted at the community level, with adequate engagement of community members in the policy-making process. To achieve this end, there is an urgent need for the critical considerations of the contemporary flood governance approach. As evidenced, the flood management and adaptation throughout the 'opening-up and closing-off' processes in the delta have evolved towards adaptive co-management, with a range of successful cases in adopting learning-based and collaborative approaches. This needs to be further strengthened and formally recognised at the delta's level. In this light, the formulation of the long-term adaptation strategies in the delta to deal with the complexities of climate change and hydropower development scenarios in the Mekong Basin needs to be designed on the basis of this governance approach, with particular emphasis on adaptive learning and cross-level collaboration mechanisms. Accordingly, not only the government-community (relational collaboration), but also the government-government (horizontal collaboration) should be promoted to achieve desired flood management and adaptation outcomes. This research suggests that a 'locally-owned' organisation that involves provincial representatives in the delta needs to be urgently constructed in order to facilitate the implementation of the adaptive co-management approach. In this regard, it is essential to recall Bach Tan Sinh's (2003) argument that local authorities are in a better position to understand local conditions and formulate and implement local development.

8.5 Suggestions for future research

At the household level, this research focuses mainly on how social learning influences adaptive capacity in the 'living-with-floods' context of the MDV. The quantitative analysis to examine this causal relationship employs empirical data collected from the household survey. On-farm and off-farm households were recruited as the key respondents in the survey. However, there is a real possibility that non-farm households that can play a role in this regard. Future research needs to take this matter into consideration.

This research examines the delta's flood governance in qualitative terms. Future research should delve into the social structures in the flood governance system using network theories. This is to map social networks where multiple stakeholders are nested. In terms of research methods, social network analysis should be used to visualise network patterns and social relationships in these 'communities of practice'.

The combined impacts of climate change and hydropower dam development in the Mekong Basin have posed challenges not only to the floodplains, but also to the coastal areas. Future research should incorporate these complexities into the broader context of water governance in the MDV. This research suggests the usefulness of exploring the saline water governance in the coastal region, and how it shapes local household and institutional adaptation. It would be beneficial to explore how social learning plays out in this process. The outcomes of this empirical research could provide the background knowledge to further examine how upstream-downstream water governance contributes to achieving 'sustainable adaptation' in the delta.

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Appendices

Appendix 1. Focus Group Discussion Guidelines

Flood Governance in the Mekong Delta of Vietnam: Implications of Social Learning for Household and Institutional Adaptation

Type of research: PhD research

Principal investigator: Tran Anh Thong

Research sites: (1) Phu Thanh B, Tam Nong district, Dong Thap province

(2) Phu Xuan, Phu Tan district, An Giang province

(3) Thoi Hung, Co Do district, Can Tho City

Introduction and objectives of the focus group discussions

I am very grateful to your willingness to participate in the focus group discussion. Without your help, I cannot do this study.

My name is Tran Anh Thong, a researcher of the Research Centre for Rural Development, An Giang University, Vietnam. I am currently a PhD candidate at the Fenner School of Environment and Society, the Australian National University, Australia. My study is about how you have learned to adapt to flood situations that have implications for your livelihoods in the flood season.

For those of you who have never been involved in a focus group discussion, I would like to provide a brief introduction to what it is. Focus group is a useful way to gather information through a discussion. I will raise a number of questions or issues and your participation in the discussion is strongly appreciated.

There are no right or wrong answers. I am very interested to hear your views, comments and any experiences you may have. Also, I would like this to be a group discussion, so do not wait for your turn to provide a response. However, you are reminded that when someone is speaking, you are requested to wait until they finish their talk. Then you can have your say.

With your permission, I would like to record this discussion. I will do all I can to protect your confidentiality. The recording will help me represent your views accurately.

The overall objective of this study is to gather information on how you have practised your livelihoods in the flood season, your role in the local flood management policies, and how you have learned to adapt to the vagaries of flood conditions. I would appreciate it greatly if all of you can be honest and participate fully in the discussion. Do you have any questions before we get started?

Can I begin by asking each of you your first name, type of farming activity you're engaged in the flood season?

Opening questions

1. What farming practices are prevalent in the flood season?
2. What farming practices are you often engaged in during the flood season?
3. Would you please list the significant flood events you have experienced in your life?

Key questions

A. Flood management policies and implications

4. What specific measures (dykes) are taken to deal with floods in your locality?
5. How do they affect the cultivation practices of the farming communities and your own livelihood practices (pre-dyke versus post-dyke context)?
6. Do you get involved in designing these structural measures? Why or why not?
7. Who plays a key role in the decision-making process?
8. Do you receive any support from the local government to develop your livelihoods in the flood season? Why or why not?
9. Have you seen any alterations in flood intensity, flood frequency, and flood duration in recent years? How did you experience these phenomena before the dyke building? What other factors do you think may contribute to these changes?
10. Do you find it difficult to earn a living during the flood season at present? Why? How do you compare it with what you have experienced before?

B. Learning dynamics and shared knowledge for flood adaptation

11. Do you know the 'living-with-floods' strategy? What does it mean to you?
12. Do you practise the farming activities with others? Why or why not?
13. How do you communicate and exchange knowledge with each other?
14. Do you often participate in local seminar/training workshops on farming practices organised by the local government?
15. Do you think it is essential to get involved in these events? Why or why not?
16. Do you often share experience/knowledge with others during the seminar or workshop? What other occasions do you share your experience?
17. How do these collective learning activities influence your way of thinking and decisions on farming practices?
18. What means of communication do you find the most useful to support your exchange of your information/knowledge with others?
19. Do you often apply what you have learned from your fellows in your livelihood practices? Why or why not?
20. Who do you often interact with when you need technical assistance in your livelihood activities?
21. What are the significant initiatives that have been developed in your community?
22. Have you seen any evidence of how these initiatives influence the change in local policy options towards flood management? Why or why not?

C. Institutional collaboration and implications for improved flood governance

23. Do you think the flood management policy needs to be revised to better deal with the current flood situations? Why or why not?
24. Who do you think should take a main responsibility for flood management?
25. In what ways do you think they could better support flood management?

Do you have any further questions or comments? If not, I would like to express my deep appreciation for your time and contribution to this group discussion.

Close focus group discussion

Participatory Rural Appraisal Tools Used in Focus Group Discussions

Timeline Analysis

Flood events, impacts and intervention

Household group: ______________ (1) Poor (2) Medium (3) Better-off

Commune: __________________________________ District: _______________________________Province ____________________

Investigator: _________________________________ Assistant:______________________________Date: _______________________

Time *(Year)*	**Flood events** *(Arrange flood events in chronology)*	**Impacts and changes**	**Initiatives and intervention** *(Initiatives and intervention to impacts and changes)*		
			Household	Social groups	Local government

Trend Analysis

Changes in households' livelihood activities in the wake of dyke construction

Household group: ______________ (1) Poor (2) Medium (3) Better-off

Commune: __________________________________ District: _______________________________ Province ____________________

Investigator: _________________________________ Assistant: ______________________________ Date: _______________________

Timeline / Livelihood activities	Prior to dyke construction		After dyke construction			
			Low dyke		High dyke	
	Status	Reasons	Status	Reasons	Status	Reasons

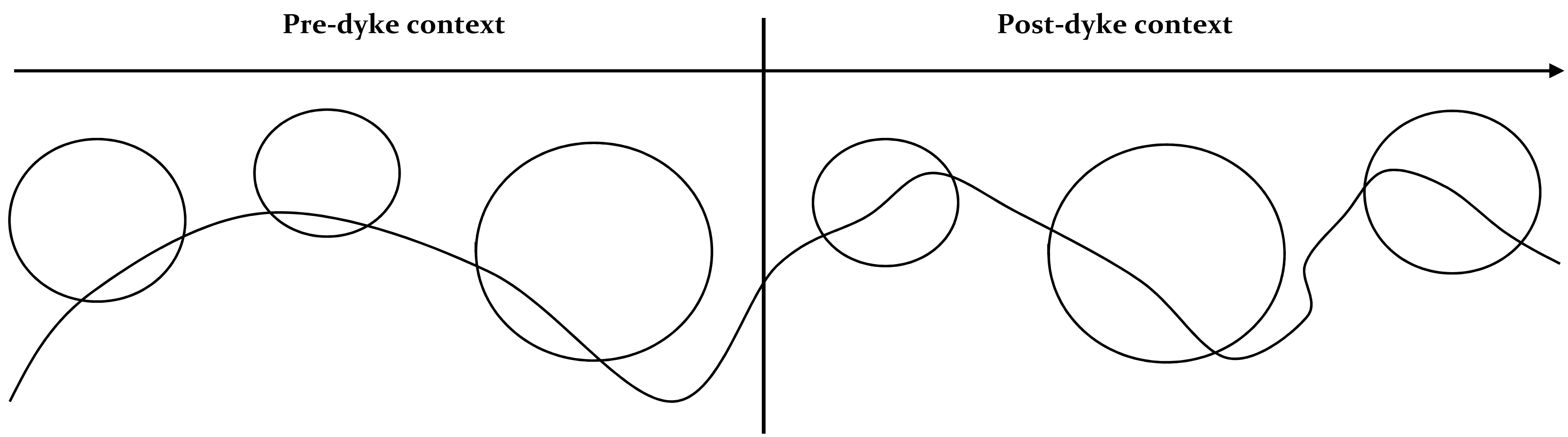
Impact Analysis

Distribution of flood-based resources and its implications for households' livelihoods

Household group: _______________ (1) Poor (2) Medium (3) Better-off

Commune: ____________________________________ District: _________________________________Province _____________________

Investigator: ___________________________________ Assistant:________________________________Date: _________________________



Seasonal Calendar

Households' livelihood activities in months

Household group: ______________ (1) Poor (2) Medium (3) Better-off

Commune: _________________________________ District: ______________________________Province ____________________

Investigator: ________________________________ Assistant:______________________________Date: _______________________

<table>
<tr><th rowspan="2">Time line</th><th rowspan="2" colspan="2">Livelihood activities in the flood season</th><th colspan="12">Months</th><th rowspan="2">Model
1. Individual
2. Group</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th></tr>
<tr><td rowspan="6">Before dyke construction</td><td colspan="2">Alterations of flood levels (meter in height)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="5">Livelihood activities</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td rowspan="6">After dyke construction</td><td colspan="2">Alterations of flood levels (meter in height)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="5">Livelihood activities</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</table>

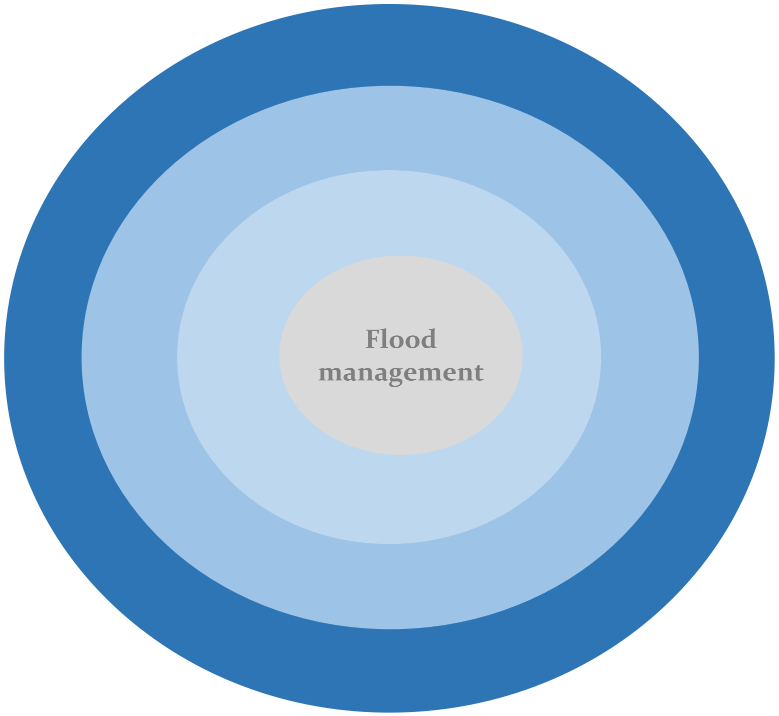
Venn Diagram

Stakeholders' relationships and engagement in flood management

Household group: ______________ (1) Poor (2) Medium (3) Better-off

Commune: __________________________________ District: _______________________________Province ____________________

Investigator: _________________________________ Assistant:______________________________Date: _______________________



●	Provincial level
●	District level
●	Communal level

Appendix 2. In-depth Interview Guidelines to Key Informants (Officials)

Flood Governance in the Mekong Delta of Vietnam: Implications of Social Learning for Household and Institutional Adaptation

Type of research: PhD research

Principal investigator: Tran Anh Thong

Research sites: (1) Phu Thanh B, Tam Nong district, Dong Thap province

(2) Phu Xuan, Phu Tan district, An Giang province

(3) Thoi Hung, Co Do district, Can Tho City

Introduction and objectives of the in-depth interview

Thank you for your agreement to get involved in this interview. Your personal viewpoint is much appreciated and important for my study.

This interview is to investigate how the existing flood management policies respond to the local adaptation process. I am also interested in learning how these lessons learned could be applied into the local decision-making process to improve the flood management performance in better support of households' livelihood activities in the flood season.

This discussion will be recorded, but your confidentiality is assured, so do not feel threatened by the recording. The recording is essential for the transcription and the analysis of information for my research report. During the interview process, please let me know if you are not willing to respond to any questions and we will skip them. It is also eligible for you to refuse or withdraw from the interview any time of your discomfort to the questions.

The expected duration of the interview will be about one and a half hour. The information to be recorded to be kept confidential and no one except me will have authority to access it. Your name will be removed out of the file and a number will be assigned to it instead. Also, a pseudonym will be applied in the report.

Finally, I would hereby like to express my appreciation for your participation in the interview.

Name of interviewer: ....Interview number: ....

Place of interview: ....Date: ....

Name of respondent: ....Age: ....

Respondent's occupation: ....Contact number: ....

A. Overview of flood situations and flood management policies

1. What do you think about the local flooding circumstances?
2. What are the adaptive responses adopted by the local people?
3. How do the local government's development policies respond to the adaptation practices of farming households in the flood season?
4. On what basis is the local dyke system constructed? Does it take the positive aspects of floods into account? Why?
5. How is the local dyke system different from the others? How does this dyke structure contribute to the farming activities in your locality?
6. What are the significant changes after the dyke was built?
7. Given this policy, which household group is likely to be the most vulnerable/profitable?
8. Does the local government support local households' livelihood practices in the flood season? Why or why not?

B. Adaptive learning in flood management

9. What factors foster/inhibit the local flood management process? (Ability to access required resources, institutional arrangements, involvement of relevant actors)
10. What roles do the local farming households play in the construction and management of dyke and irrigation systems in the locality?

11. What are the lessons learned from the flood management policies? How are they incorporated into the decision-making process with reference to farming households' livelihood practices in the flood season?

C. Collaborative approaches for flood management

12. How does the local government coordinate with involved actors in flood management?
13. Do you think the local farming community should play a greater role in the flood management process? Why or why not?
14. How does the local government plan for the long-term adaptation strategies under the incremental impacts of climate change and hydropower development in the Lower Mekong Basin?
15. What do the current flood management policies mean for the effective flood governance approach in the floodplains?
16. In your opinion, what should be done to ensure the concerted flood management mechanism across the adjacent flood-prone localities in the delta?
17. What is the potential of the collaborative flood management approach under the social-ecological complexities of the delta?

Do you have any questions or comments? If not, I would like to express my deep appreciation for your time and contribution to this interview.

Close in-depth interview

Appendix 3. In-depth Interview Guidelines to Key Informants (Households)

Flood Governance in the Mekong Delta of Vietnam: Implications of Social Learning for Household and Institutional Adaptation

Type of research: PhD research

Principal investigator: Tran Anh Thong

Research sites: (1) Phu Thanh B, Tam Nong district, Dong Thap province

(2) Phu Xuan, Phu Tan district, An Giang province

(3) Thoi Hung, Co Do district, Can Tho City

Introduction and objectives of the in-depth interview

Thank you for your agreement to get involved in this interview. Your personal viewpoint is very much appreciated and important to my study.

This interview is to gain an in-depth understanding of the ways you have experienced your flood-based livelihoods in the flood season. I am also interested in examining how government's flood management policies affect your livelihood practices. I wish to learn how you have developed your adaptive initiatives (farming models), how you have mobilised resources to support your livelihood activities, and the ways you have interacted with others to successfully adapt to floods.

This discussion will be recorded, but your confidentiality is assured, so do not feel threatened by the recording. The recording is essential for the transcription and the analysis of information for my research report. During the interview process, please let me know if you are not willing to respond to any questions and we will skip them. It is also eligible for you to refuse or withdraw from the interview any time of your discomfort to the questions.

The expected duration of the interview will be about one and a half hour. The information to be recorded to be kept confidential, and no one except me will have authority to access it. Your name will be removed out of the file and a number will be assigned to it instead. Also, a pseudonym will be used in the report.

Finally, I would hereby like to express my appreciation for your participation in the interview.

Name of interviewer: ....Interview number: ....

Place of interview: ....Date: ....

Name of respondent: ....Age: ....

Respondent's occupation: ....Contact number: ....

A. Overview of local flood situations and flood management policies

1. How was the dyke system built in your locality?
2. What are the differences in livelihood activities after the dyke was built?
3. Do you think dykes should be built in your area? Why or why not?
4. What are the impacts of dykes on your livelihoods in the flood season?
5. How does the local government respond to the local flood-based livelihood activities?
6. Who play a critical role in the dyke construction in your locality?

B. Households' 'living-with-floods' practices

7. Prior to the implementation of your current farming model, what did you do during the flood season?
8. Please tell me the process of how you have developed the model? Why did you choose it?
9. Do you think your model is effective? How does it contribute to your household income in the flood season?
10. What makes your farming model a success? How does your model influence other households' livelihood options?
11. Who is especially interested in your farming model? What are their expectations?

12. What have you learned during the process of conducting the model?

C. Households' shared learning and adaptation to floods

13. Who performs better adaptation to floods in your locality? Why?
14. How do you mobilise necessary resources to invest in your farming model in the flood season?
15. What organisations or individuals do you often ask for technical assistance? Why?
16. How do you share your farming experience/knowledge? Who do you often share with? Why?
17. How does your farming experience/knowledge contribute to the local government's flood management policies?
18. What conditions do you need to expand your farming model?
19. Does the existing flood management mechanism effectively support your model? Why? What should be done instead?

D. Implications of collaborative approaches for flood management

20. How have the local government and farming community worked towards flood management? What do you think about this relationship?
21. Given the cross-border flood complexities in the MDV, do you think there needs to be a collaboration between adjacent localities in sharing their responsibility for flood management?
22. How should the collaboration be effectively implemented?
23. What would you think to be the effective ways to govern floods in a long term under the combined impacts of climate change and upstream hydropower dam construction on the Mekong River?

Do you have any questions or comments? If not, I would like to express my deep appreciation for your time and contribution to this interview.

Close in-depth interview

Summary of key informants involved in in-depth interviews

Levels of investigation	Locations	Key informants
Communal level	Thoi Hung	Government leader Chairman of farmer's association Representative lotus growing farmer Representative sesame growing farmer Representative crop diversifying farmer Vice director of the Song Hau State Farm Senior veteran official
	Phu Xuan	Government leader Representative Compartment Management Board Representative eel farmer Representative sticky rice farmer Head of co-operative group Vice Head of Centre for Community Learning Vice Director of the North Vam Nao Enterprise for Hydraulics and Agriculture
	Phu Thanh B	Government leader Senior official of giant freshwater shrimp cooperative Representative giant freshwater shrimp farmer
District level	Co Do	Office of Agriculture and Rural Development
	Phu Tan	Office of Agriculture and Rural Development
	Tam Nong	Office of Agriculture and Rural Development
Provincial level	Can Tho City	Can Tho Irrigation Agency Can Tho Institute for Socio-economic Development Studies Climate Change Coordination Office of Can Tho City
	An Giang	An Giang Irrigation Agency North Vam Nao Scheme Management Board
	Dong Thap	Dong Thap Irrigation Agency
Regional and national levels	Can Tho City	Steering Committee of the Southwest Region Expert of Dragon Institute of Can Tho University Expert of Mekong Delta Development Research Institute, Can Tho University Expert leading the Vietnamese technical team conducting the strategic environmental assessment of hydropower on the Mekong mainstream for the MRC
	Ho Chi Minh City	Southern Institute for Water Resources Planning

Appendix 4. Questionnaires for Household Survey

Flood Governance in the Mekong Delta of Vietnam: Implications of Social Learning for Household and Institutional Adaptation

Principal investigator: Tran Anh Thong

Surveyed areas: (1) Phu Thanh B, Tam Nong district, Dong Thap province

(2) Phu Xuan, Phu Tan district, An Giang province

(3) Thoi Hung, Co Do district, Can Tho City

This research attempts to investigate the impacts of the flood management policies on local households' flood-based livelihoods, households' adaptive responses in the pre-dyke and post-dyke contexts, households' participation in flood management process, and households' learning dynamics in sharing livelihood initiatives across the surveyed areas. The research results are expected to highlight the significance of collective learning performed by households, which contributes substantially to improving the local flood management and their adaptive capacity.

I would appreciate it greatly if you can honestly provide your responses to this survey. Your information disclosed in the survey is confidential. The researcher really appreciates your taking the time to complete this.

Contact details

Tran Anh Thong, PhD Candidate

The Fenner School of Environment and Society

College of Medicine, Biology and Environment

The Australian National University, Canberra, ACT, 2601

Email: thong.tran@anu.edu.au

Phone: (+61) 0451 226 970

<table>
<tr><th colspan="4">Section 1 – Households' identification</th></tr>
<tr><td colspan="3">Questionnaire number</td><td></td></tr>
<tr><td>Survey areas</td><td colspan="2">1. Phu Thanh B, Tam Nong, Dong Thap province
2. Phu Xuan, Phu Tan, An Giang province
3. Thoi Hung, Co Do, Can Tho City</td><td></td></tr>
<tr><td>Name of interviewer</td><td colspan="3">__________</td></tr>
<tr><td>Date of interview</td><td colspan="3">__________</td></tr>
<tr><td rowspan="7">Respondent's identification</td><td>Name</td><td colspan="2">__________</td></tr>
<tr><td>Gender</td><td colspan="2">1. Male; 2. Female</td></tr>
<tr><td>Age</td><td colspan="2"></td></tr>
<tr><td>Address</td><td colspan="2">__________</td></tr>
<tr><td>Phone number</td><td colspan="2">__________</td></tr>
<tr><td>Relation to household's head</td><td colspan="2">1. Household head
2. Spouse
3. Father/Mother
4. Son/Daughter
5. Brother/Sister
6. Other: __________ (Please specify)</td></tr>
<tr><td>Religion</td><td colspan="2">1. Buddhism
2. Catholics
3. Protestantism
4. Hoahaoism
5. Caodaism
6. Other: __________(Please specify)</td></tr>
<tr><td>Household group</td><td colspan="3">1. Poor
2. Medium
3. Better-off</td></tr>
<tr><td>Number of persons living in the household</td><td colspan="3"></td></tr>
<tr><td>Survey evaluation
(This field should be completed at the end of the interview)</td><td colspan="3">1. The interview was perfectly conducted
2. The respondent refused to respond to the questions
3. The respondent withdrew from the ongoing interview
4. Other: __________(Please specify)</td></tr>
</table>

Section 2 – Overview of households' demographic information									
Line number	Name	Gender	Age	Relations to household's head	Marital status	Educational level	Religion	Primary occupation	Secondary occupation
	Please write full name of all the household members	1. Male 2. Female		1. Household's head 2. Spouse 3. Father/Mother 4. Son/Daughter 5. Brother/Sister 6. Other: _________	1. Single 2. Married 3. Widower/Widowed 4. Separated 5. Divorced 6. Other: ________	1. Illiterate 2. Not attending school 3. Elementary 4. Secondary 5. High school 6. Vocational school 7. College 8. University and above	1. Buddhism 2. Catholics 3. Protestantism 4. Hoahaoism 5. Caodaism 6. Other: _____	1. Agriculture 2. Aquaculture 3. Animal husbandry 4. Gardening 5. Seasonal employment 6. Petty trader 7. Fishing 8. Public servant 9. Hired labourer 10. Housemaid 11. Pupil/Student 12. Other: _____	1. Agriculture 2. Aquaculture 3. Animal husbandry 4. Gardening 5. Seasonal employment 6. Petty trader 7. Fishing 8. Public servant 9. Hired labourer 10. Housemaid 11. Pupil/Student 12. Other: _____
200	201	202	203	204	205	206	207	208	209
01	Respondent								
02									
03									
04									
05									
06									
07									
08									
09									
10									

Section 3 – Households' perceptions of flood processes				
SN	Questions		Responses *(Circle one suitable option)*	Go to
301	How long have you been living here?		1. Less than 5 years	
			2. From 5 to 10 years	
			3. More than 10 years	
302	What is your residency area supported by?		1. Low dyke	
			2. High dyke	
			3. Other: ______________*(Please specify)*	
303	When was this system built?		1. Before the flood event in 2000	
			2. After the flood event in 2000	
			3. Not know	
304	In your opinion, what has happened after the dyke was built?		Observations in the post-dyke context	
	1. Flood situations	a. Flood arrival	1. Earlier	
			2 Later	
			3. Unchanged	
			4. Not know	
		b. Flood level	1. Lower	
			2. Higher	
			3. Unchanged	
			4. Not know	
		c. Flood intensity	1. Stronger	
			2. Weaker	
			3. Unchanged	
			4. Not know	
		d. High flood frequency	1. More common	
			2. Less common	
			3. Unchanged	
			4. Not know	
		e. Flood-based livelihood practices	1. More diverse	
			2. Less diverse	
			3. Unchanged	
			4. Not know	

		f. Distribution of aquatic resources	1. More abundant	
			2. Less abundant	
			3. Unchanged	
			4. Not know	
	2. Employment opportunities	g. Employment opportunities in the flood season	1. More employment	
			2. Less employment	
			3. Unchanged	
			4. Not know	
		h. Number of households employed in the flood season	1. More crowded	
			2. Less crowded	
			3. Unchanged	
			4. Not know	
	3. Farming systems	i. Farming activities in the flood season	Situations	Main reasons
			1. Non-existent *2. Emerging* *3. Prevalent* *4. Unchanged* *5. Decreasing* *6. Disappeared* *7. Other:* ____________	*a. Closed dykes* *b. Reduced cultivation areas* *c. Unfavourable weather conditions* *d. Epidemics* *e. Low cost-efficiency* *f. Over-exploited* *g. Increasing pesticide application* *h. Flood impacts* *i. Other:* _____________
		i1. Floating rice		
		i2. High yielding varieties		
		i3. Upland crops		
		i4. Aquaculture		
		i5. Animal husbandry		
		i6. Gardening		
		i7. Other: _______		
	4. Household income	j. Income level	1. Higher	
			2. Lower	
			3. Unchanged	
			4. Not know	

			Situations	Main reasons
	5. Migration	k. Migration in search of employment in the flood season	*1. Non-existent* *2. Emerging* *3. Prevalent* *4. Unchanged* *5. Decreasing* *6. Disappeared* *7. Other: ___________*	*a. Rural employment is getting scarce* *b. Rural wages are low* *c. To seek a new working environment* *d. To increase household income* *e. To avoid floods* *f. Other: ___________* *g. Not know*
	6. Infrastructural systems	l. Land transport system	1. More densely distributed	
			2. Less distributed	
			3. Unchanged	
			4. Not know	
		m. Premises	1. More densely distributed	
			2. Less distributed	
			3. Unchanged	
			4. Not know	
	7. Rural means of transportation	n. Popular means of transportation in the flood season	1. Boats	
			2. Car	
			3. Motorcycles	
			4. Bicycles	
			5. Other: ____________________*(Please specify)*	

Section 4 – Households' participation in local flood management

SN	Questions	Responses	Go to
401	Have you ever been involved in the local community consultation for flood management?	1. Yes	
		2. No	→ 407
402	How often is the consultation organised?	1. At least once a month	
		2. At least every three months	
		3. At least every six months	
		4. At least once a year	

403	How often do you participate in the consultation?	1. Very frequently	
		2. Frequently	
		3. Sometimes	
		4. Seldom	
		5. Never	
404	Do you have opinions in the consultation?	1. Yes	
		2. No	→ 406
405	How are your opinions taken by the local government?	1. Very seriously	
		2. Seriously	
		3. Moderately	
		4. Inattentively	
		5. Too inattentively	

		Level of commitment					
406	To what extent are the following organisations committed to the community consultation? *(Select as many as apply)*	Very high	High	Moderate	Low	Very how	
	a. Local authority	5	4	3	2	1	
	b. Irrigation station	5	4	3	2	1	
	c. Agricultural extension station	5	4	3	2	1	
	d. Women's union	5	4	3	2	1	
	e. Farmer's association	5	4	3	2	1	
	f. Cooperative groups	5	4	3	2	1	
	g. Compartment management board	5	4	3	2	1	
	h. Fatherland front	5	4	3	2	1	
	i. Youth's union	5	4	3	2	1	
	j. Red Cross	5	4	3	2	1	
	k. Veterans	5	4	3	2	1	
	l. Local rescue teams	5	4	3	2	1	
	m. Local military forces	5	4	3	2	1	
	n. Pupils	5	4	3	2	1	
	o. Local journalism	5	4	3	2	1	
	p. Local media	5	4	3	2	1	
	q. Religion associations	5	4	3	2	1	
	r. Non-government organisations	5	4	3	2	1	
	s. Private sectors	5	4	3	2	1	
	t. Other: ____________*(Please specify)*	5	4	3	2	1	

		Your opinions		
		1. Yes	2. No	
407	Do you like flooding in your fields? *(Select as many as apply)*	a. To obtain aquatic resource into fields	a. Loss of rice crop season	
		b. To replenish alluvial deposits	b. Loss of income	
		c. To reduce pest impacts	c. Soil fertility remains good	
		d. To reduce production costs for the ensuing crop	d. Increased drainage costs	
		e. To prevent localised inundation during the flood season	e. Flooding doesn't help	
		f. Other: ________________	f. Other: _________________	

Section 5 – Households' flood-based practices, shared learning and knowledge exchange				
SN	Questions	Responses		Go to
501	Have you ever shared your farming knowledge with others?	1. Yes		
		2. No		→ 511
502	On what occasions do you participate in learning or knowledge sharing?	Frequency	Effectiveness	
		1. Very frequently *2. Frequently* *3. Sometimes* *4. Seldom* *5. Never*	*1. Very effective* *2. Effective* *3. Moderate* *4. Ineffective* *5. Too ineffective*	
	a. Casual gatherings *(café, ...)*			
	b. Farm visits			
	c. Working together			
	d. Seminar attendance			
	e. Training workshop			
	f. Other: ________*(Please specify)*			

<table>
<tr><td rowspan="17">503</td><td rowspan="2">Who/What organisations do you share your knowledge with?</td><td>Frequency</td><td>Level of influence</td><td rowspan="17"></td></tr>
<tr><td>1. Very frequently
2. Frequently
3. Sometimes
4. Seldom
5. Never</td><td>(Please rank your choices in order of importance; E.g. 1 as the most important)</td></tr>
<tr><td>a. Grandparents</td><td></td><td></td></tr>
<tr><td>b. Parents</td><td></td><td></td></tr>
<tr><td>c. Siblings</td><td></td><td></td></tr>
<tr><td>d. Nearby relatives</td><td></td><td></td></tr>
<tr><td>e. Distant relatives</td><td></td><td></td></tr>
<tr><td>f. Neighbours</td><td></td><td></td></tr>
<tr><td>g. Nearby friends</td><td></td><td></td></tr>
<tr><td>h. Distant friends</td><td></td><td></td></tr>
<tr><td>i. Trainers</td><td></td><td></td></tr>
<tr><td>j. Seminar presenters</td><td></td><td></td></tr>
<tr><td>k. Agricultural extension station</td><td></td><td></td></tr>
<tr><td>l. Aquaculture station</td><td></td><td></td></tr>
<tr><td>m. Technical experts from companies</td><td></td><td></td></tr>
<tr><td>n. Agricultural extension programs on media</td><td></td><td></td></tr>
<tr><td>o. Other: _______(Please specify)</td><td></td><td></td></tr>
<tr><td rowspan="5">504</td><td rowspan="5">Where do your learning partners reside?
(Select the suitable option)</td><td colspan="2">Level of residency
(1) Similar; (2) Different</td><td rowspan="5"></td></tr>
<tr><td>Hamlet</td><td>1 2</td></tr>
<tr><td>Commune</td><td>1 2</td></tr>
<tr><td>District</td><td>1 2</td></tr>
<tr><td>Province</td><td>1 2</td></tr>
<tr><td rowspan="7">505</td><td rowspan="7">What benefits does the shared learning bring to you?</td><td colspan="2">Shared learning benefits
(Select as many as apply)</td><td rowspan="7"></td></tr>
<tr><td colspan="2">1. Quickly updating daily information</td></tr>
<tr><td colspan="2">2. Learning from each other</td></tr>
<tr><td colspan="2">3. Drawing empirical experience for oneself</td></tr>
<tr><td colspan="2">4. Constructing new ideas/initiatives</td></tr>
<tr><td colspan="2">5. Strengthening your trust on others</td></tr>
<tr><td colspan="2">6. Other: _________________(Please specify)</td></tr>
</table>

		Frequency					
	How often do you contact these organisations to get support in the flood season? *(Select as many as apply)*	Very Frequently	Frequently	Sometimes	Seldom	Never	
506	a. Local authority	5	4	3	2	1	
	b. Irrigation station	5	4	3	2	1	
	c. Agricultural extension station	5	4	3	2	1	
	d. Women's union	5	4	3	2	1	
	e. Farmer's association	5	4	3	2	1	
	f. Cooperative groups	5	4	3	2	1	
	g. Compartment management board	5	4	3	2	1	
	h. Fatherland front	5	4	3	2	1	
	i. Youth's union	5	4	3	2	1	
	j. Red Cross	5	4	3	2	1	
	k. Veterans	5	4	3	2	1	
	l. Local rescue teams	5	4	3	2	1	
	m. Local military forces	5	4	3	2	1	
	n. Pupils	5	4	3	2	1	
	o. Local journalism	5	4	3	2	1	
	p. Local media	5	4	3	2	1	
	q. Religion associations	5	4	3	2	1	
	r. Non-government organisations	5	4	3	2	1	
	s. Private sectors	5	4	3	2	1	
	t. Other: ______*(Please specify)*	5	4	3	2	1	
507	How do you apply what you have learned in your situation?	1. I often apply exactly what I have learned before.					
		2. I make some modifications to fit actual requirements.					
		3. I often combine what I have learned from others with my own experience.					
		4. Other: ________________________*(Please specify)*					

508	Have you come up with any farming initiatives?	1. Yes	
		2. No	→ 510
509	What stimulates your initiatives?	1. From what I have observed from reality	
		2. From my own experience	
		3. Research manuals, books	
		4. From discussions with others	
		5. From local technical experts	
		6. From agricultural extension programs on media	
		7. Other: ____________________*(Please specify)*	
510	What are the difficulties for the collaborative engagement in farming work?	1. Difficult to find a suitable partner	
		2. Shared benefits could be affected.	
		3. Loss of employment opportunities	
		4. Low level of trust	
		5. Insufficient capital for farming co-investment	
		6. Different points of view	
		7. No guarantee on maintaining jobs	
		8. Other: _______________________*(Please specify)*	
511	Please state the reasons why you don't like to participate in shared learning with others.	1. Waste of time	
		2. I don't want to share knowledge with people	
		3. I can manage myself	
		4. It is difficult to follow people's ideas	
		5. I don't like hanging around with others	
		6. Other: _______________________*(Please specify)*	
512	How do you manage your farming activities?	1. I search for available knowledge from media	
		2. I learn from my own experience	
		3. I just follow my routines	
		4. Other: _______________________*(Please specify)*	
513	When facing difficulties, who do you often reach for help?	1. My grandparents / 6. My neighbours	
		2. My parents / 7. My employers *(landowners…)*	
		3. My siblings / 8. Local authority	
		4. My friends / 9. Myself	
		5. My relatives / 10. Other:______*(Please specify)*	

Section 6 – Households' property ownership and income					
SN	Questions	Responses			Go to
601	What kinds of property do you own? *(Select as many as apply)*	Yes	Total items *(Numbers)*	No	
	a. Television				
	b. CD/DVD Player				
	c. Mobile phone				
	d. Motorcycle (Honda)				
	e. Bicycle				
	f. Radio				
	g. Boat				
	h. Pumping machine				
	i. Threshing machine				
	j. Combined harvester				
	k. Tractor				
	l. Harvesting machine				
	m. Refrigerator				
	n. Fishing equipment *(nets…)*				
	o. Cattle *(heads)*				
	p. Fish/Prawn farm				
	q. Stalls				
	r. Other: ______________*(Please specify)*				

	Which activities are you involved in during the flood season? *(Select as many as apply)*	Select (✓) specific flooding months below							
		Jun	Jul	Aug	Sep	Oct	Nov	Total (VND)	
		______	______	______	______	______	______		
		Calculation of household income *(Days/month x Average of daily earnings)*							
	a. Autumn-winter rice cropping								
	b. Fish culture on rice fields								
	c. Prawn culture on rice fields								
	d. Net fishing*								
	e. Trawling*								
602	f. Push fishing[35]*								
	g. Growing aquatic vegetables								
	h. Collecting aquatic plants*								
	i. Collecting aquatic species*								
	j. Upland cropping								
	k. Gardening								
	l. Animal husbandry								
	m. Hired labour*								
	n. Rice gleaning*								
	o. Other: __________								
	Total								

Note: (*) Income calculated by daily earnings

[35] *Nghề đẩy côn* – A fishing boat equipped with a V-shaped steel net which is laterally stretched along a bamboo frame at the bow. This fishing equipment is mostly used when the flood level on rice fields is low. When the boat is propelled, the steel net touches fish, causing it to dig into mud. In this case, a bamboo cage *(nơm)* is used to catch the fish.

Section 7 – Social learning and adaptive capacity dimensions							
Social learning							
SN	Please indicate your agreement on these following statements.	Level of agreement					Go to
701	Communication	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	
	a. I usually discuss flood-based production activities when having coffee or parties with friends.	5	4	3	2	1	
	b. I like communicating with those who have farming experience to advance my knowledge.	5	4	3	2	1	
	c. Shared learning and discussions on production activities in the flood season provide me with compelling initiatives.	5	4	3	2	1	
	d. When necessary, I can call on extension officials for help.	5	4	3	2	1	
702	Interaction	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	
	a. I am assisted by extension officials enthusiastically.	5	4	3	2	1	
	b. I am willing to share what I have learned.	5	4	3	2	1	
	c. When attending seminars, I usually take part in discussions with other participants.	5	4	3	2	1	
	d. The learning interactions between local farmers and extension officials take place during seminars.	5	4	3	2	1	
	e. I usually visit successful flood-based production models to learn and follow.	5	4	3	2	1	
	f. I usually help those who find it difficult to get employment during the flood season.	5	4	3	2	1	

703	Reflection	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	
	a. I do not easily believe things until I experience them myself.	5	4	3	2	1	
	b. I do not strictly follow what I have learned but create my own ways.	5	4	3	2	1	
	c. I usually learn from my friends' failures and draw lessons for myself.	5	4	3	2	1	
	d. I usually perform experimentation on my own production model to learn from it.	5	4	3	2	1	
	e. Early failures give me quite a few lessons that are useful for successive efforts.	5	4	3	2	1	

Adaptive Capacity							
SN	Please indicate your agreement on these following statements.	Level of agreement					Go to
704	Access to resources	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	
	a. I don't think it is difficult to get a loan from the local bank for flood production investment.	5	4	3	2	1	
	b. I have many relatives who can help me with farming work in the flood season when needed.	5	4	3	2	1	
	c. I believe I have sufficient knowledge and skills to implement flood production models of my own.	5	4	3	2	1	
	d. I always receive support from the local government in the flood season.	5	4	3	2	1	
	e. I am landless, so I have to rely on seasonal employment in the flood season.	5	4	3	2	1	

705	Institutional effectiveness	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	
	a. I think everyone has a say in the decision-making process on local dyke matters.	5	4	3	2	1	
	b. People's voice is not highly recognised in the locality.	5	4	3	2	1	
	c. The local government provides great support to households' employment in the flood season.	5	4	3	2	1	
	d. Poor households can get a loan from the bank for their livelihood investment in the flood season.	5	4	3	2	1	
	e. I think that flood production models offer local people a great deal of employment in the flood season.	5	4	3	2	1	
	f. The local government encourages households' shared experiences and initiatives through flood production activities.	5	4	3	2	1	
	g. The local government often organises seminars or training courses on flood production models for local households to participate in.	5	4	3	2	1	

	Information dissemination	Strongly agree	Agree	Undecided	Disagree	Strongly disagree	
706	a. Shared learning in the community helps increase local household income from flood production activities.	5	4	3	2	1	
	b. I believe that sharing information and knowledge is an effective approach to increase households' knowledge on flood production activities.	5	4	3	2	1	
	c. Technical assistance provided by agricultural experts helps farming households implement their flood production activities successfully.	5	4	3	2	1	
	d. Households' initiatives through flood production models are highly recognised by the local government.	5	4	3	2	1	
	e. I share my farming experiences with those who not only reside locally but also elsewhere.	5	4	3	2	1	
	f. Learning experiences among local households contribute a great deal to emerging, developing, and expanding flood production activities across the region.	5	4	3	2	1	

Thank you very much for your co-operation.