Exploring Pathways for Social-ecological Transformation in the Cau Hai Lagoon, Vietnam

by

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A thesis
presented to the University of Waterloo
in fulfilment of the
thesis requirement for the degree of
Doctor of Philosophy
in
Geography

Waterloo, Ontario, Canada 2017

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Author's Declaration

This thesis consists of material all of which I authored or co-authored: see Statement of Contributions included in the thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis will be made electronically available to the public.

Statement of Contributions

Chapters 3, 4, and 5 are based on manuscripts that have been co-authored. The roles and contributions of each co-author are detailed below. The manuscripts are accompanied by introductory, methodology, and concluding chapters that integrate the research purpose and findings. I am the sole author of chapters 1, 2, and 6 that present this integrative material and demonstrate the conceptual whole.

Chapter 3 **Understanding social-ecological change and transformation through community perceptions of system identity**

- Mark Andrachuk: lead author; responsible for definition of manuscript purpose and contributions, all data analyses, and write-up of first draft; revision of all subsequent drafts based on co-author and reviewer comments.
- Derek Armitage: assisted with definition of manuscript purpose and contributions; detailed review and recommendations for re-writing specific sentences and paragraphs.

Chapter 4 **Territorial use rights for fishers (TURF) implementation shaped by underlying characteristics of governance networks**

- Mark Andrachuk: lead author; responsible for definition of manuscript purpose and contributions, all data analyses, and write-up of first draft; revision of all subsequent drafts based on co-author and reviewer comments.
- Derek Armitage: assisted with definition of manuscript purpose and contributions; provided detailed review and recommendations for re-writing specific sentences and paragraphs.
- Hoang Dung Ha: review of manuscript to clarify interpretation of data and provide additional details on case studies.
- Le Van Nam: review of manuscript to clarify interpretation of data and provide additional details on case studies.

Chapter 5 **Building blocks on the pathway to social-ecological transformations**

- Mark Andrachuk: lead author; responsible for definition of manuscript purpose and contributions, all data analyses, and write-up of first draft; revision of all subsequent drafts based on co-author and reviewer comments.
- Derek Armitage: assisted with definition of manuscript purpose and contributions; provided detailed review and recommendations for re-writing specific sentences and paragraphs.
- Hoang Dung Ha: review of manuscript to clarify interpretation of data and provide additional details on case studies.
- Le Van Nam: review of manuscript to clarify interpretation of data and provide additional details on case studies.

Abstract

The concept of transformations is used in this dissertation to engage with questions surrounding what profound social and ecological changes mean for small-scale fisheries communities, and the implications of such change for governance. Transformation is defined here as fundamental reorganization of the ways that societies interact with, and make decisions about, environments and natural resources. Recent research has yielded diverse assessments of transformations that are mindful of the consequences of environmental change and that consider the root causes of unsustainability. Yet there continues to be conceptual ambiguity in how transformations are understood, and much remains unknown about how to support processes of transformation. This research pursued three main objectives: (1) refine a framework for conceptualizing and assessing social-ecological transformations at the community level; (2) empirically characterize social-ecological changes and transformations and their implications for fishers' livelihoods; and (3) assess opportunities within small-scale fisheries governance arrangements to enable and support transformations. The third objective in particular aligns with a burgeoning literature documenting examples of positive transformations and means of advancing transformations.

The research was situated in the Cau Hai lagoon, Vietnam where co-managed territorial use rights for fisheries (TURFs) have been introduced to respond to a declining fishery and to improve wellbeing of fishers. The lagoon supports a multi-species capture fishery and low intensity aquaculture. While more than 30 types of fishing gear have been documented in the lagoon, aquatic resource use is generally recognized within three broad categories: mobile gear fishing, fixed gear fishing, and aquaculture. Research followed a case study approach that emphasized community-based mixed methods. Data collection included 123 semi-structured interviews, 12 focus groups, 68 social network surveys, and participant observation. Research

participants included fishers, government representatives at multiple levels, and other actors involved with fisheries governance.

The core of the dissertation is composed of three stand-alone manuscripts. The first manuscript defines a framework and approach for assessing social-ecological transformations that is based on the notion of social-ecological system (SES) identity. The analysis teases out changes in SES identity in the Cau Hai lagoon through fishers' perspectives on shifts in social and ecological system components. The manuscript builds on earlier evidence that a transformation is underway in the Cau Hai lagoon and argues that it is important to address implications of transformations, rather than only focusing assessments on precise timing of transformation phases. Notably, there are diverse ways that fishers have experienced and been affected by social-ecological change in the Cau Hai lagoon. It is important to be fully aware of locally contested interests and acknowledge competing priorities for fisheries management and human wellbeing. These findings set up the importance of the following two manuscripts that investigate how to improve implementation of co-managed TURFs.

The second manuscript investigates the network of actors involved in co-management in order to identify enabling conditions for implementing co-managed TURFs. The research combined social network analysis of 16 co-managed TURFs in the Cau Hai lagoon with in-depth interviews and focus groups. The findings point to three governance lessons: (1) it is critical for TURF zones to function in complementary ways, rather than as isolated silos; (2) co-management agreements need to be designed with horizontal relationships in mind so that spatial proximity of TURF zones is matched with actor proximity within networks; and (3) as fisheries management responsibilities are decentralized through co-management, TURF leaders need capacity for collaboration. These insights underscore the very pragmatic need to build capacity for fishing association (FA) leaders to communicate with each other and with government counterparts.

The third manuscript introduces *building blocks* as an approach to assess deliberate transformations. Two FAs are assessed to inductively identify building blocks that were instrumental to their success in implementing fisheries management plans. Five building blocks were identified: fisher approval of ecological conservation, co-operation among fishers, support from local government, secure FA funding, and effective leadership. It is argued that such conditions should be replicable in other FAs in the lagoon – given their similar contexts – thus supporting broader transformative change. The notion of *building blocks* offers a novel research approach that can be used elsewhere to support deliberate transformations that are in progress.

Collectively, the three manuscripts make theoretical and practical contributions to literature on social-ecological transformations. In spite of recent academic enthusiasm for the need for transformations, this research points to some reasons for caution about the outcomes of efforts for transformations. Transformations are unlikely to be wholly beneficial for communities – some groups and individuals will benefit more than others. Nonetheless, much work is needed to link transformation theories to approaches for actualizing transformations. This dissertation offers novel approaches to focus on fine-grained instances of success rather than obstacles and traps. It shows how thinking about transformations can reveal important dimensions of community involvement in social-ecological change (i.e., bottom-up) and reveal important normative and practical issues.

Acknowledgements

Earning my PhD has been as much about personal soul-searching as it has been about intellectual achievement. This long journey has been filled with the highest of highs and lowest of lows in my personal life. Down the road I will look back on these years as a period of growth on multiple fronts.

Many people have supported and guided me through various stages of completing this dissertation. I couldn't ask for a wiser advisor or a better mentor and role model in Derek Armitage. I have greatly appreciated the substance of the feedback that you have given me on my work, and also the way that you deliver comments and insights. In our years working together I have observed you experiment with different tactics and try new ways to support myself and other students. This is the real testament to you as a great advisor and mentor: you continue to learn and grow in order to help your students do the same. Thank you!

My committee of Noella Gray, Scott Slocombe, Prateep Nayak, and Fikret Berkes (former committee member) have each brought valuable insights to my work. Although I went through phases with rarely contacting you, I always tried to keep in mind the questions you posed and the angles you pointed out about my research. With each document that I produced, your comments helped refine and improve the arguments I was making.

It has been a real pleasure to be part of the Environmental Change and Governance Group (ECGG) and to learn with a group of outstanding young scholars and friends. The culture around the group has been fun and inspiring. In particular I want thank Samantha Berdej, Tom Dyck, Steve Alexander, Heidi Karst, Kaitlyn Rathwell, Brad May, and Jeremy Pittman for interesting collaborations and helpful feedback on various aspects of my work.

As my research assistants in Vietnam, Hoang Dung Ha and Le Van Nam did countless things to help me with fieldwork. From translations to gaining red stamps of government approval to setting up interviews to answering constant questions – you two were invaluable. More importantly, I am happy to call you my friends and I hope that we can work together again one day. I would also like to thank Truong Van Tuyen for your guidance and Duong Ngoc Phuoc for your helpful insights about the lagoon and showing us around Hue. Nguyen Anh Tuan and Nguyen Hang, I really appreciated your friendship and making us feel welcome in Hue. I am very grateful to the Fishing Association leaders in the lagoon who hosted focus groups, helped recruit research participants, and welcomed us into their homes for meals – thank you to Pham Van Loi, Nguyen Khoai, and Tran Thanh Phuoc.

I was fortunate to receive funding through several sources. My fieldwork was supported by a Doctoral Research Award from the International Development Research Centre (Ottawa, Canada). Upon entering my studies I received a Joseph-Armand Bombardier CGS Doctoral Scholarship through the Social Sciences and

Humanities Research Council of Canada (SSHRC). I also have a couple of friends to thank for offering me work space when I needed it most for writing. Alexandra Gousse, I don't know if my final writing push would have happened without the use of your home office. Jeff Wilson, not only was it helpful to use your desk at 10Carden, the space introduced me to new opportunities to be involved in our community.

Through all these years I have been held up by my wife Leah's unwavering belief in me. Above and beyond all of the day-to-day practicalities of going through my comp exam, living in Vietnam together, and raising our daughters, your encouragement and love have kept this engine going. Thank you. My parents and siblings continue to be central in my life and a source of encouragement. We all miss Heather tremendously and, although I am sad that she is not here to celebrate with, her memory continues to inspire and guide me.

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List of Abbreviations

FA	Fishers association
FAO	Food and Agricultural Organization of the United Nations
FLP	Fishery Livelihoods Project
HUAF	Hue University of Agriculture and Forestry
IDRC	International Development Research Centre
IMOLA	Integrated Management of Lagoon Activities project
NGO	Non-governmental organization
SES	Social-ecological system
SNA	Social network analysis
SSF	Small-scale fisheries
TURF	Territorial use rights for fisheries

CHAPTER 1: **Introduction**

Coastal fishing communities experience interconnected challenges from diverse human activities at the convergence of marine and terrestrial environments. Pressures on coastal communities stem from dense populations, heavy reliance on and use of declining natural resources, pollution, and risks of flooding and extreme weather events (Visser 2004; Halpern et al. 2012; Ramesh et al. 2015). For communities that depend on small-scale fisheries in coastal zones, risks are often exacerbated by high rates of poverty, unclear tenure rights, and limited influence over governance of fisheries and other aquatic resources (Jentoft and Chuenpagdee 2009; Pomeroy et al. 2009; Pomeroy and Andrew 2011; Nayak et al. 2014; Pittman and Armitage 2016). Nearly half of the world's population resides in coastal zones, and 90 percent of people who work in capture fisheries are involved in small-scale fisheries typically in coastal or nearshore areas (UN-Oceans 2011; FAO 2015). Limited attention has been given, however, to the ways that coastal fishing communities engage in efforts to increase their resilience and sustainability (Weeratunge et al. 2014; Armitage et al. 2017a).

Academics and practitioners are using the concept of transformations to examine how communities, institutions, and organizations experiment, learn and foster innovative solutions to complex social and ecological challenges (Olsson et al. 2008; O'Brien 2012; Moore et al. 2014; Patterson et al. 2017). Transformation is defined here as fundamental reorganization of the ways that societies interact with, and make decisions about, environments and natural resources (section 1.2.1). Recent papers have called for approaches to transformations research that are mindful of the urgency of consequences of environmental change and that address root causes of unsustainability (Pereira et al. 2015; Harris and Barkdull 2016; Abson et al. 2017). This dissertation adopts a transformations lens to explore how coastal fishing communities can create or participate in changes towards social and ecological sustainability. A case study of the Cau Hai lagoon in central Vietnam

(section 1.4) provides a rich context where a set of new governance arrangements have been introduced to respond to a declining fishery and to improve wellbeing of fishers. Governance as used in this dissertation refers to the suite of structures, mechanisms, and institutions that guide decisions and actions that affect ecosystems and resources (section 1.2.2). This research shows how thinking about transformations can reveal important dimensions of community involvement in social-ecological change (i.e., bottom-up) and reveal important normative and practical issues.

Several questions and themes run through this dissertation: What is a social-ecological transformation and how can we know if one is occurring? How might we assess the implications of social-ecological transformations for fishing communities and small-scale fisheries? How can a transformation be supported and facilitated in order to improve ecological sustainability and human wellbeing? These questions are inherently tied to governance and ways that communities and individuals make decisions about livelihoods and use of marine resources. The following section draws from these themes and questions to define the central research aim and objectives of this dissertation. Next, the core bodies of literature that informed this research are reviewed and synthesized, including social-ecological transformations, environmental governance, governance networks, and small-scale fisheries governance. These bodies of literature are used to develop an overarching conceptual framework to guide more specific assessments reflected in the three empirical chapters (Chapters 3-5). The Cau Hai lagoon case study is presented and this chapter ends with an explanation of the structure and organization of the remaining chapters in this dissertation.

1.1 Research Objectives

The central interest of this dissertation is to further understand how coastal fishing communities can create or become more engaged in programs to improve livelihoods and ecological sustainability. This interest is in line with a burgeoning literature that is seeking to document examples of positive transformations (e.g.,

O'Brien 2012; Bennett et al. 2016; Armitage et al. 2017b) and means of advancing transformations (e.g., Leach et al. 2012; Abson et al. 2017; Fazey et al. 2017). The concept of transformations is used in this dissertation to engage with questions surrounding what deep social and ecological changes mean for communities and implications of such change for governance. Scholarship on social-ecological transformations has expanded in recent years, yet there continues to be conceptual ambiguity and much remains unknown about how to support processes of transformation (c.f. Olsson et al. 2014; Feola 2015; Pereira et al. 2015; Saunders et al. 2016; Patterson et al. 2017). To address these knowledge gaps, the main objectives of this dissertation are:

1. To refine a framework for conceptualizing and assessing social-ecological transformations at the community level
2. To empirically characterize social-ecological changes and transformations in the Cau Hai lagoon and their implications for fishers' livelihoods
3. To assess opportunities within small-scale fisheries governance arrangements for enabling and supporting social-ecological transformations

These objectives guide three significant contributions made in this dissertation. The first contribution is an extension of the use of perceptions as a method for SES and transformations research. Perceptions have been used to give a 'voice' to communities in relation to the international development, food security, and small-scale fisheries (e.g., Narayan et al. 2001; Nayak and Berkes 2010; Bennett 2016), but there was opportunity to extend these approaches by defining transformations using community perceptions of social-ecological system identity. This approach encourages a re-orientation to place less emphasis on the precise identification of transformations, and in turn, critically more on how people are affected by transformations and perceive the processes of change in which they are embedded. The second contribution is the use of a networks perspective to evaluate the implementation of TURFs – thereby learning about ways to support long-term transformation processes. Social network analysis has been applied in marine (e.g., Weiss et al. 2012; Smythe et al. 2014) and transformations (e.g., Crona and Bodin

2010; Alexander et al. 2015) contexts but the evaluation of a co-managed TURF's governance network is novel. A networks approach helps reveal the presence and absence of relationships between actors that influence collaboration and coordination that are critical for TURFs to function and lead to improved fisheries and livelihoods. The third contribution is the idea of *building blocks* as a way of assessing pathways for transformation. The basis of building blocks is the argument that there are important context-specific lessons that can be gained by examining micro level successes. Such successes have potential for replication in other similar local in order to achieve more system-wide success. In addition to these three major contributions, numerous other contributions are summarized in Chapter 6.

1.2 Theoretical Foundations for Research

This research is informed by literature on social-ecological transformations, environmental governance (especially for dealing with change), governance networks, and small-scale fisheries governance. Each of these bodies of literature are reviewed below with respect to their relevance for studying and understanding how communities may engage with processes of transformation. The bodies of literature that I selected and review here were useful for providing a conceptual context (transformations), physical context (small-scale fisheries), and analytical lens (environmental governance). This section ends with a synthesis and conceptual framework to demonstrate how these bodies of literature complement each other to inform my dissertation research.

There are numerous additional concepts and bodies of literature that relate to coastal communities and transformations and could have also been used here. For instance, commons literature (e.g., Ostrom et al. 2002; Gallardo et al. 2011) was instrumental in earlier research in the Tam Giang – Cau Hai lagoon and identifying TURFs as a useful strategy to deal with open access fishing issues (discussed in section 1.3). Due to the extensive use of this literature for this case, I opted to adopt new lenses for looking at the Cau Hai lagoon. Transitions management is another body of literature (e.g., Rotmans et al. 2001; Geels 2002) that might have been useful

to inform this research. However, transitions management tends to focus on technical transitions and low carbon economies and did not offer any form of political or power analysis. Power is another area of literature (e.g., Giddens 1984; Lukes 2005; Raik et al. 2008) that may have also usefully informed this research and helped further consider inequality and exploration of who may benefit from transformations and why. However, beyond identification of how different groups of fishers stand to benefit or lose from SES change (Chapter 3) and identification of influential actors (Chapter 4), adoption of an explicit framework for analyzing power was beyond the scope of this dissertation's objectives.

1.2.1 Social-Ecological Transformations

Researchers are bringing diverse foci, scales, and meanings to transformations research (Feola 2015). Transformative re-organization has been viewed as intentional on the part of groups with the power and authority to instigate change (Olsson et al. 2008, Biggs et al. 2010, Chapin et al. 2012; Kates et al. 2012), and as a phenomenon that can emerge unexpectedly as a result of anthropogenic and natural forces (Batterbury et al.1997, Scheffer et al. 2001). One point following from these areas of literature is that transformations have high relevance for governance research and questions surrounding deliberate social-ecological change. Another point is that is that these strands of literature are at times complementary and at times contradictory. Consistent among uses of transformations is the suggestion that an object or process of interest converts from one form or function to another. To set the theoretical foundations for this dissertation, this section builds a conceptual position on social-ecological transformations, identifies important issues from the literature on transformations, and examines what it means to foster transformative processes.

The way that transformations are defined in this dissertation has a basis in resilience thinking. First, resilience thinking views social-ecological systems (SES) as linked, co-evolving systems that are not presumed to tend towards a steady, equilibrium state (Berkes et al. 1998; Folke 2006). Relative stability can be

experienced in shorter time frames, although in the long term fluctuations are the norm. The linked interactions are depicted in Figure 1.1, where governance, ecosystem services, and knowledge systems are bridges between social and ecological systems (Berkes et al. 2003; Glaser 2006; Kotchen and Young 2007; Cinner et al. 2009). Second, whereas resilience and adaptability relate to the persistence of a system, the concept of transformations refers to the shaping of new or different systems (Carpenter and Brock 2008; Folke et al. 2010). Resilience can sometimes be an undesirable quality of a SES when it leads to traps or perpetuates undesirable social problems (Scheffer and Westley 2007; Cinner 2010; Folke et al. 2010; Steneck et al. 2011). Walker et al. (2010) note the inherent tension in the need for communities to build adaptive capacity and resilience to deal with social-ecological changes, while at the same time allowing for the possibility that fundamental changes (e.g., to institutions and processes of environmental governance) may be required to shift towards sustainable pathways (i.e., transform). In light of these framings, social-ecological transformations are viewed here as fundamental reorganization of the ways that societies interact with, and make decisions about, environments and natural resources.

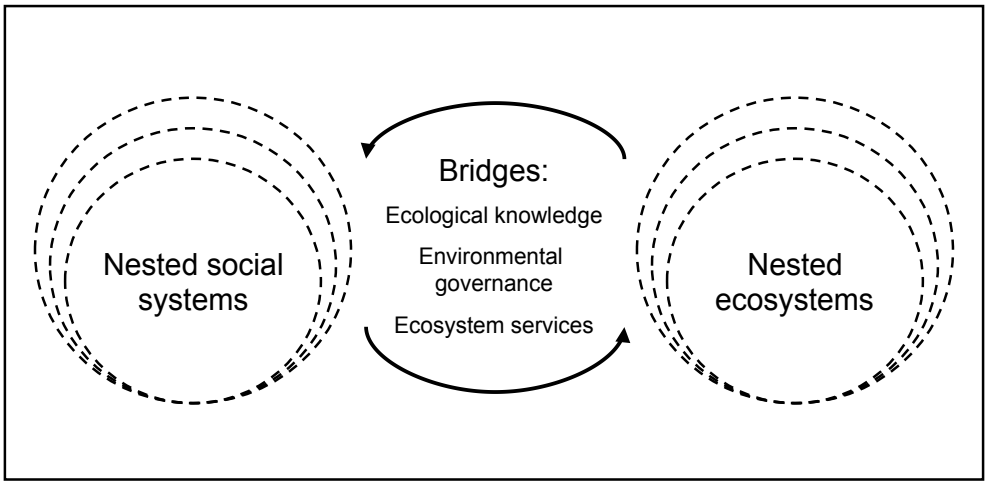

Figure 1.1: Conceptual framework for thinking about linked social-ecological systems (based on Berkes et al. 2003 and 2011).

Table 1.1 summarizes several themes synthesized from transformations literature that are relevant for governance. Some research has questioned what combination

of socio-economic and biophysical changes constitute *fundamental changes* for social-ecological transformations (e.g., Ferguson et al. 2013; Moore et al. 2014; Patterson et al. 2017). In ecological domains transformations may manifest as new assemblages of species, different landscape/seascape patterns, or new ecosystem services (Carpenter and Folke 2006). In socio-economic domains, transformations may involve new governance arrangements, new institutions, altered norms and values, or different livelihood practices (Gelcich et al. 2010, Rosen and Olsson 2013). In adopting a SES perspective for this research, however, I sought to understand the interplay of change across both social and ecological systems, rather than within the separate subsystems. Additionally, transformations involve more than the physical, measurable aspects of SES – they can include changes in mental models, perceptions and understanding of SES. Several other similar concepts that are used to describe social and ecological change are presented in Table 1.2 to distinguish them from transformations.

Table 1.1: Transformations themes that are important for governance.

Theme	Brings Attention to…
Fundamental Changes	• A transformation signifies shifting from one dependent pathway to another. • In the social domain transformations may involve new governance arrangements, new institutions, altered norms and values, or different livelihood practices (Walker et al. 2009; Gelcich et al. 2010). • In the ecological domain transformations may involve new assemblages of species, different landscape/seascape patterns, or new ecosystem services (Carpenter and Folke 2006). • The notion of a different system configuration hints at system identity as a way of comprehending transformations (Cumming et al. 2005).
Path Dependence	• Path dependence refers to local patterns of interaction that perpetuate the current SES trajectory and the ways that previous actions constrain future options (Folke 2006; Gelcich et al. 2010). • In essence, elements that maintain current pathways (e.g. attitudes, worldviews, economic incentives, power relations, institutions) are also barriers to transformation (Chuenpagdee and Jentoft 2007; Gelcich et al. 2010). • The persistence of untenable regimes ('undesirable' resilience) is related to lock-in traps (Scheffer and Westley 2007; Cinner 2011; Steneck et al. 2011).
Drivers of Change	• Drivers of transformations can range from local (e.g. land use conversions, introduction of a new commercial activity, or shifts in wildlife distribution) to global (e.g. climate change, economic globalization, or financial crises) (e.g. Nayak and Berkes 2014; Patterson et al. 2017). • Drivers of change may slowly act upon social-ecological system controlling variables and may not become apparent until multiple thresholds are crossed (Norberg and Cumming 2008).
Thresholds	• A threshold refers to a hypothetical point in space-time that separates

	alternative dependent pathways (Scheffer and Carpenter 2003; Briske et al. 2010). • There are indications that as SES approach thresholds, environmental variations become amplified and instability can be observed at multiple levels (Carpenter and Brock 2006; Dakos et al. 2008; Scheffer 2009). • Crossing a threshold can occur through a single event (sharp and abrupt) or manifest through a series of small, incremental changes (slow and gradual) (Scheffer and Carpenter 2003; Duit and Galaz 2008). • Literature on social thresholds considers actors' points of view and implication for livelihoods and wellbeing (Béné et al. 2011; Christensen and Krogman 2012; Parlee et al. 2012).
Actor Agency	• The issue of controllability is critical since SES cannot be predictably influenced by command-and-control or top-down interventions (Adger 2003; Folke et al. 2010; Moore et al. 2014). • Critiques from some scholars suggest that social-ecological transformations may only occur when there are wider changes to the political economy (Nadasdy 2007; Fisher-Kowalski and Rotmans 2009; Olsson et al. 2006, 2010). This brings questions about the effectiveness of local initiatives and emphasizes the importance of multi-level governance. • Important questions about power asymmetries and who navigates transformations need to be addressed (Lebel et al. 2006; Crona and Bodin 2010). • Leverage points and windows of opportunity focus attention on policies, plans, and events that can initiate action and influence change (Burch 2010; Robinson and Berkes 2010; Pereira et al. 2015).

Table 1.2: Terms related to transformations.

Term	Definition
Regime shift	Abrupt and often irreversible change in a system state from one regime or stability domain to another (Biggs et al. 2009; Folk et al. 2010).
Resilience	The capacity of a social-ecological system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same structure and identity (Walker et al. 2004).
Technological transitions	Major or fundamental technological changes in the way societal functions such as transportation, communication, housing, feeding, are fulfilled (Geels 2002; Shove and Walker 2007).
Thresholds	Represents the boundaries between system states; and the amount of change to controlling variables that can be sustained before the system re-organizes along a different trajectory (Chapin et al. 2010; Folke et al. 2010).

Some scholars have looked at the persistence of a system in terms of *path dependence* (Table 1.1), which refers to the local patterns of interaction that perpetuate current SES conditions and the ways that previous actions constrain future options (Folke 2006, Heinmiller 2009, Gelcich et al. 2010, Boonstra and Nhung 2011). In this line of thinking, processes that contribute to resilience and adaptive capacity can be the same as those that contribute to path dependence and

traps (i.e., perpetuating undesirable social problems). Correspondingly, elements that maintain current pathways, such as attitudes, worldviews, economic incentives, power relations and institutions, can also be barriers to transformation. Forces that confront and challenge current conditions and the status quo can contribute to transformations. When ecosystems and livelihoods are perceived to be in decline or tending towards undesirable lock-in traps, discourses promoting resilience may be inappropriate since the primary challenge is to overcome the path dependencies of such untenable systems (Adger 2000; Cumming et al. 2005; Scheffer and Westley 2007; Gelcich et al. 2010).

The concept of *thresholds* (Table 1.1) has been applied as a means of exploring the significance of shifts towards different SES configurations (Biggs et al. 2011). Threshold refers to a hypothetical point in space-time that separates alternative system states or dependent pathways (Scheffer and Carpenter 2003; Briske et al. 2010). Several studies have demonstrated the utility of investigating socially defined thresholds through the desirability of alternative system configurations or identities (e.g., Béné et al. 2011; Biggs et al. 2011; Parlee et al. 2012; Blythe 2014). Christensen and Krogman (2012) suggest that thresholds can be conceived as fuzzy boundaries that separate desirable and unacceptable conditions. Similarly, O'Brien and Wolf (2010) argue that the ways that people respond to social-ecological changes depends on what those changes mean for them and whether changes affect their wellbeing or not. In this dissertation, there is less emphasis on the precise location of thresholds, and more attention on the implications of thresholds for ecosystems and livelihoods. Chapter 3 explores these issues in depth, conceptually and empirically.

According to Moore et al. (2014) the outcomes of transformations are shaped by both the *agency* (Table 1.1) of actors and underlying social and biophysical conditions. Actors cannot control transformations (Table 1.1) but they do nudge SES towards their goals by resisting undesirable conditions or working to establish new norms and patterns of development (Moore et al. 2014). Several authors have

examined governance conditions that are conducive to transformations. Burch et al. (2014) identify a set of eight enabling conditions for transformations: participatory governance and social inclusion; considering synergies and tradeoffs with other priorities; set ambitious targets (e.g., for greenhouse gas reduction) with specific deliverables; employing a diverse set of tools to reach targets; monitoring and evaluation of key indicators; iterative, adaptive management; strategic partnerships that coordinate efforts and integrate decision-making; and leadership. Pereira et al. (2015) identify a set of principles for 'safe operating space' that are seen as necessary for transformations to sustainability: emancipation and empowerment, ensuring reflexivity, knowledge co-creation, transformative learning, and nurturing innovations. These insights set the stage for further discussion of governance and transformations in section 1.3.2.

In light of themes and issues in the transformations literature there are two main gaps that this dissertation seeks to address. First, much uncertainty remains about how to know if a transformation is occurring and how to empirically characterize a transformation. Chapter 3 of this dissertation describes and tests the use of *system identity* for assessing transformations, and accomplishes this by drawing on the perspectives of people within the Cau Hai lagoon system. If transformations research is to yield useful and novel contributions to our understanding of social-ecological change, scholars need to consider whether it is relevant and accurate to label changes in SES as transformative. Second, little is known about how to support transformations in progress. Transformations research has inherently been limited by our ability to only perceive and confirm the occurrence of social-ecological transformations in hindsight (Carpenter et al. 2005). Emphasis on deliberate transformations especially demands more tools and techniques for understanding and supporting transformative processes. Chapters 4 and 5 of this dissertation address this need by examining collaborative networks and means of replicating successes, respectively.

1.2.2 Attributes of Environmental Governance for Dealing With Change

Environmental governance is a wide-ranging term that refers to the suite of structures, mechanisms, and institutions that guide decisions and actions that affect ecosystems and resources. The term governance generally denotes the roles that both government and non-governmental mechanisms play in guiding society (Stoker 1998). A focus on governance denotes recognition that a central authority (government) may not have the appropriate information or ability to steer society unilaterally. In this perspective, governance includes consideration of new forms of decision-making that are pluralistic, have an emphasis on processes rather than structures for governing, and changes in the ways that actors relate to each other (Van Kersbergen and Van Waarden 2004).

The definitions of environmental governance that are offered in Table 1.3 all highlight governance as a multi-dimensional process. The definition from Biermann et al. (2010) is distinct in that it includes an emphasis on scale, social interaction, and environmental change. This definition also includes an element of visioning through the normative goal of sustainable development, rather than focusing only on conflict resolution. With respect to transformations, the shift in perspective towards governance includes appreciation that the mechanisms of governance itself may be part of the problem (Voß and Bornemann 2011). That is, the networks that comprise a governance system require self-reflection, learning, and the ability to reform expectations and practices. The governance definition from Bridge and Perreault (2009) in Table 1.3 offers the possibility that environmental governance can be understood as the combination of processes that may or may not be intended to 'govern the environment'. Although this dissertation primarily concerns deliberate transformations, these distinctions are important to recognize in light of the possibility of emergent and deliberate transformations.

Table 1.3: Selected definitions of environmental governance.

Reference	Definition
Lemos and Agrawal 2006	Environmental governance refers to the set of regulatory processes, mechanisms and organizations through which potential actors influence

	environmental actions and outcomes
Lebel et al. 2006	Governance, the structures and processes by which societies share power, shapes individual and collective actions
Paavola 2007	Environmental governance [is] the establishment, reaffirmation or change of institutions to resolve conflicts over environmental resources
Biermann et al. 2010	We understand earth system governance as the interrelated and increasingly integrated system of formal and informal rules, rule-making systems, and actor-networks at all levels of human society (from local to global) that are set up to steer societies towards preventing, mitigating, and adapting to global and local environmental change and, in particular, earth system transformation, within the normative context of sustainable development
Bridge and Perreault 2009	The manner, organisations, institutional arrangements and spatial scales by which formal and informal decisions are made regarding uses of nature

The term environmental management still has a prominent place in the literature and is complementary to environmental governance. Whereas management is concerned with the practical application of policies under shorter time frames, governance considers longer time frames and expands inquiry to broader social contexts (norms, values) that influence individual and collective actions and human interactions with ecosystems (Glasbergen 1998; Folke et al. 2005; Kooiman et al. 2008). That is, environmental management is influenced by institutions, norms, values, and social networks, which are all considered within governance frameworks (Lebel et al. 2006; Paavola 2007).

This dissertation is especially concerned with attributes of environmental governance that may be useful for dealing with social-ecological change and transformations. What types of governance structures and process may be required to deal with social-ecological transformations? Who may be positioned to influence and navigate social-ecological transformations? There are several important insights from literature on adaptive, collaborative and multi-level forms of governance that inform the ways that this dissertation approaches these questions. First, governance of ecosystems and natural resources is influenced by a suite of processes, institutions, and value systems (Lebel et al. 2006; Lemos and Agrawal 2006). The complexity of driving forces influencing social-ecological change over long time periods in the Cau Hai lagoon is addressed in chapter 3. Second, no single actor or organization has sufficient knowledge or resources required for addressing

complex, contested, and multi-level environmental problems (Stoker 1998; Cash et al. 2006; Lemos and Agrawal 2006; Armitage 2008; Weber and Khademian 2008). The response to questions about "who" navigates social-ecological change is not singular. Third, non-linear change in SESs and inherent uncertainty require adaptive governance approaches that are based on flexibility, learning, knowledge pluralism, and continual reflection on expectations (Holling and Meffe 1996; Pahl-Wostl and Hare 2004; Armitage et al. 2008; Voß and Bornemann 2011). Fourth, implementation of adaptive governance draws attention to the importance of communication and deliberation among stakeholders for trust building, social learning, and conflict resolution (Lebel et al. 2006; Lemos and Agrawal 2006; Armitage 2008; Duit and Galaz 2008; Pahl-Wostl 2009).

Collaborative governance literature highlights various forms of partnerships and places an emphasis on fostering horizontal and vertical linkages between government and non-government actors (Duit and Galaz 2008; Armitage and Plummer 2010). Lemos and Agrawal (2006) outline a variety of hybrid environmental governance strategies that have taken shape as a result of support from multiple domains of state, private sector, and civil society. Figure 1.2 depicts these domains and highlights how environmental governance is realized through interactions across traditional domains of decision-making and power. In practice, environmental governance and decision-making usually occurs through a mix of these structures (Plummer et al. 2013) where groups join together under a common purpose (Kooiman et al. 2008). Chapter 4 elaborates on these topics with specific reference to fisheries governance and evaluates how actors from these domains interact to influence implementation of co-managed TURFs.

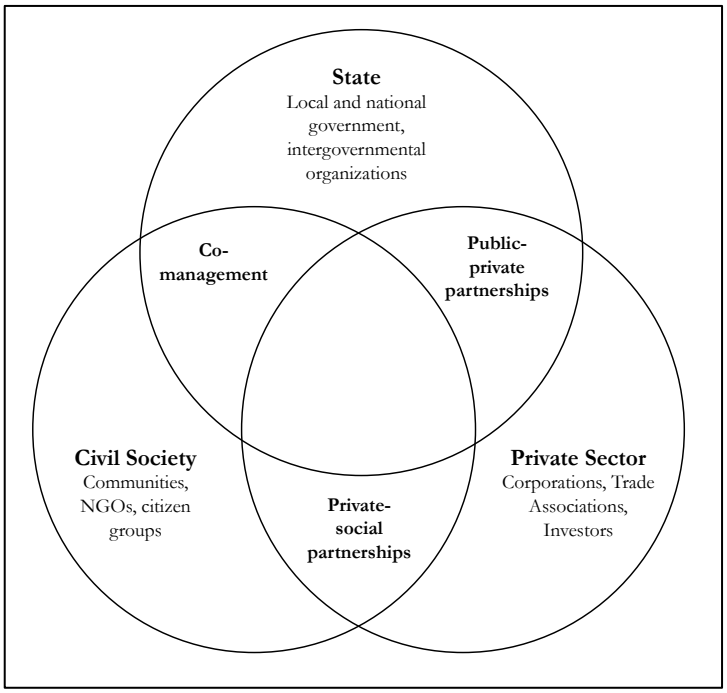

Figure 1.2: Modes of environmental governance, emphasizing emerging hybridization (modified from Lemos and Agrawal 2006; Delmas and Young 2009).

Local communities and resource users often require resources from higher levels of government, and are not necessarily able to perceive long-term future risks from climate change or other large-scale drivers of change. Central authorities often lack contextual, rich knowledge of ecosystem dynamics and the particular challenges that resource users face. Factors that facilitate or discourage collaborative governance between these groups have been summarized as: prior history of conflict or cooperation, incentives for stakeholders to participate, inclusion of important stakeholders early in the process, power and resources imbalances, leadership, and institutional design (Chuenpagdee and Jentoft 2007; Ansell and Gash 2008). Ansell and Gash (2008) add that communication and development of, and commitment to, a shared understanding are key for collaboration.

In addition to the benefits that collaborative forms of governance are thought to provide, several challenges have also been identified in the literature. Since no single actor in a governance system is accountable for outcomes, and interest groups may play a large role in governance, there may be less motivation to take

responsibility (Rhodes 1996). Thus, delineating roles and responsibilities, ensuring transparency, and building trust are important for ensuring accountability and legitimacy (Glasbergen 1998; Van Kersbergen and Van Waarden 2004). Accountable decision-making promotes just distribution of benefits and intra and intergenerational equity (Lebel et al. 2006). Another issue is that numerous vertical and horizontal interactions can be consuming in terms of time and energy and lead to unnecessary organizational complexity (Glasbergen 1998) and excessive organizational rules and "checks and balances" can inhibit capacity for action (Van Kersbergen and Van Waarden 2004). Additionally, actors often have competing objectives and motivations, which may not be consistent with an ecological conservation mandate (Sørensen and Torfing 2007). Conflicts of interest can arise when individuals with vested interests in exploiting resources are able to define standards for environmental protection (Lemos and Agrawal 2006). The various modes of multi-level and hybrid governance in Figure 1.2 each suggest ways of dealing with some of these concerns, although there are trade-offs and no single mode has been found to satisfy all of these issues. Co-management is in use in the Cau Hai lagoon and Chapter 4 in particular provides some evaluation of how issues have arisen for implementation of co-management.

Attributes of environmental governance that may be useful for dealing with social-ecological change have not necessarily been developed in the context of dealing with transformations. We need a better understanding of governance *of* transformations and governance *for* transformations (Patterson et al. 2017). The distinction between *of* and *for* alludes to the possibility of governance that intentionally triggers and steers a transformation, versus governance that creates conditions for transformations to emerge (Patterson et al. 2017). How are changes in governance related to broader social-ecological change? Chapter 3 delves into this question. Another important area of inquiry relates to how governance processes may initiate or support social-ecological transformations. What processes or aspects of governance are required to support transformations? Chapters 4 and 5 delve into

these questions by exploring the roles of governance networks and identifying ways of building on early signs of success, respectively.

1.2.3 Governance Networks

In light of the importance of the attributes identified above, a network perspective on governance has been adopted for research in this dissertation. The emphasis on networks offers a theoretically informed strategy to understand collaboration for fisheries governance in the Cau Hai lagoon. Network research approaches recognize that actors are embedded in systems of social relations and, in doing so, can attempt to explain – at least in part – the influence of patterns of relations on the success of governance arrangements (Straton and Gerritsen 2005; Prell et al. 2009; Bodin et al. 2011; Ernoul and Wardell-Johnson 2013; Alexander et al. 2016). Governance networks are thought of here as collections of actors that are joined together under a common purpose (Kooiman et al. 2008; Sandstrom and Rova 2010; Holley 2012), which in this case relates to livelihoods and aquatic resources in the Cau Hai lagoon. Governance networks are heterogeneous: governments contain multiple agencies at centralized and local levels; communities are comprised of multiple groups with overlapping and sometimes competing interests; and there are actors including researchers, NGOs or business interests that are involved with various aspects of natural resource use and management (Carlsson and Berkes 2005; Lemos and Agrawal 2006; Kooiman et al. 2008).

Network theory has a basis in graph theory mathematics, while social network analysis (SNA) refers to a set of methods that have come out of disciplines looking at social relationships and their influence on society (Bodin and Prell 2011; Prell 2012; Borgatti et al. 2013). Such structural approaches to analyzing governance networks rest on the premise that social networks themselves (i.e., patterns of social interactions) are important variables that provide some explanatory power in the processes and outcomes of resource management (Straton and Gerritsen 2005; Sandstrom 2011). Relationships in governance networks (ties) are assessed by looking at the connections from person to person (nodes). Although the questions

asked in network research can be similar to those of other forms of social science, the emphasis on relationships and attributes that connect people is distinct (Hanneman and Riddle 2005; Mandarano 2009). Much of the interest in governance networks for environmental governance stems from analytical insights that network structure and connectivity can provide with respect to knowledge sharing and co-production, cooperation, and multi-level interactions within governance arrangements (Newman and Dale 2005; Bodin et al. 2006; Ernstson et al. 2008; Crona and Bodin 2010).

Application of SNA in resource management literature is broadly concerned with what network characteristics and patterns of network interactions reveal about relationships among actors and how these ultimately influence social and ecological objectives (e.g. conservation projects or sustainable use of resources). The insights thus far in the literature seem to be that networks in and of themselves do not lead to successful resource management and there isn't a single ideal network structure to strive for. Livelihood and ecological conservation goals for a given context will dictate the types of network patterns and structures that are most beneficial, and particular contexts should dictate how we may attempt to enhance interactions among actors (Henry and Vollan 2014). For instance, network density – the proportion of actual ties compared to all potential ties among actors – is a common indicator of trust and social capital, which are important for collective action and resolving conflicts (Carlsson and Sandstrom 2008; Mandarano 2009). If trust is detected to be low in a network, efforts can be directed towards building relationships among all actors or among particular groups. Conversely, too much cohesion can limit creativity and novelty that are critical for adaptive management because diversity is useful for innovation, integrating multiple knowledge system, and leveraging additional resource (Crona and Bodin 2006; Carlsson and Sandstrom 2008; Fischer et al. 2014).

Research has shown that highly centralized networks – characterized by a small number of actors having a high number of ties – are effective for gathering interest

around a problem and building support (Crona and Bodin 2006; Prell et al. 2009; Newig et al. 2010). On the other hand, novelty in social networks tends to come from the periphery and is most prevalent where a diversity of actors and viewpoints are present (Prell et al. 2010). The working hypothesis in much of the literature on resource management networks, thus, is that networks with a balance between cohesiveness without too much homogeneity will best be able to make (and enact) decisions and resolve conflicts (Carlsson and Sandstrom 2008; Prell et al. 2009; Sandstrom and Rova 2010; Vance-Borland and Holley 2011; Smythe et al. 2014).

It can also be valuable to consider the horizontal and vertical distribution of ties in governance networks. As Ernoul and Wardell-Johnson (2013) explain, horizontal connections can arise from formal or informal relationships and tend to be among actors with roughly equal status and power. Vertical linkages are typically formed through formal relationships and agreements where actors tend to have asymmetrical socio-political status and power (Ernoul and Wardell-Johnson 2013). In practice, governance networks require both horizontal and vertical linkages to foster collaborative development of appropriate approaches to resource-related challenges.

1.2.4 Small-scale Fisheries Governance

The physical setting of the research in this dissertation is based around coastal communities and small-scale fisheries (SSF). As such, bodies of literature related to SSF, coastal fisheries, and community-based management are drawn on here to synthesize governance issues for fisheries. The discussion in this section specifically brings attention to co-management and territorial use rights for fishers (TURFs) since these tools are in use in the Cau Hai lagoon.

A basic description of SSF is that they are distinct from industrial fishing fleets in the size of their vessels, quantity of catch per vessel (if they even use fishing boats), and distance they travel from shore (Berkes et al. 2001). The terms artisanal or subsistence fisheries are sometimes also used interchangeably with SSF. All of these

terms tend to refer to fisheries based out of rural communities that are often distant from urban centers of political influence (Berkes et al. 2001). Although it is impossible to offer a universally applicable characterization of SSF, the synthesis here focuses on those fisheries located in developing countries in tropical regions, dependent on open-access aquatic resources, and based in communities that are often impoverished and marginalized (Allison and Ellis 2001; Bene 2003; Allison et al. 2012).

Coastal fishing communities – notably those in southeast Asia – are affected by pressures from regulatory constraints on fishing activities, overcapacity of fishing effort, increasing coastal development, shifting demographics, as well as suites of local-level factors that can affect specific communities (Stobutzki et al. 2006; Tuler et al. 2008; Pomeroy 2012). Coastal fisheries have frequently been deemed difficult systems to govern because they are dynamic, spatially variable, information about aquatic resources is rarely complete, and diverse stakeholders attempt to compete and negotiate for incompatible demands (Kooiman et al. 2005; Chuenpagdee and Jentoft 2009; Lebel 2012). Chuenpagdee and Jentoft (2009) state that coastal fisheries governance is as much political as it is scientific. Degnbol et al. (2006) argue that interdisciplinary approaches that go beyond technical fixes are required for fisheries governance. Integrated perspectives that are attuned to the ecological, social, and economic realities of fisheries are needed for dealing with diverse and multi-faced fisheries challenges (Degnbol et al. 2006).

Authors such as Pomeroy (2012) advocate that any efforts to address overfishing and overcapacity of fishing effort necessarily require involvement of fishing communities. The benefits of involving communities in fisheries management have been articulated as reduced conflicts, acceptance of policies and plans, resolution of unequal distribution of benefits, and feelings of empowerment and shared responsibility among fishers (Pomeroy 1996; Pomeroy et al. 2007; Hauzer et al. 2013; Fabinyi et al. 2015; Brewer and Moon 2015). Brewer and Moon (2015) highlight how co-management involves more actors than fishers and centralized

government. Fishers, governments, and scientists each have partial knowledge of SES and governance challenges – including perspectives on how systems are changing and anticipated consequences – which necessitates the integration of their knowledge (Ommer et al. 2012). Collaboration and coordination among these groups has been shown to improve the function and implementation of fisheries management (Lebel 2012; Hauzer et al. 2013). This multi-actor perspective is an important starting point for Chapter 4 on governance networks where I assess communication among a wide variety of stakeholders who influence co-management.

The effectiveness of community-based management and conservation has been found to benefit from multi-level linkages that connect local fishing communities to higher levels of government (Wilson et al. 2006; Cudney-Bueno and Basurto 2009). Governments can play important roles in providing legal and institutional settings and can ensure complementary regulations across larger geographic areas (e.g., to prevent encroachment upon a protected area). There are various ways that management responsibilities are devolved to communities but co-management is often advocated for coastal fisheries. Whatever form fisher involvement takes, of central importance is that local communities are engaged in the development of fisheries regulations and rules, and the enforcement of those rules (Crawford et al. 2004). In a review of adaptive co-management practices Berkes (2011) found that decentralization of resource management and effective community involvement often takes a long time due to processes of building social capital and trust, deliberation, visioning, and establishing networks and partnerships. Additionally, community-based and co-management arrangements often require new legal and institutional settings at national and local levels (Pomeroy 1996).

Since ownership of aquatic resources is rare, access and use rights are often discussed in terms of tenure. Tenure denotes "*which resources can be used by whom, how long for and under which conditions*" (FAO 2011 as quoted in Charles 2013). Rights-based management approaches often involve a combination of use rights and

management rights. Rights can be held by individuals, groups, or whole communities, and they can be based on catch, fishing effort, or geographic territory (Charles 2009). A governance lens on SSF opens an appreciation of the need to understand use rights (access) and management rights, and also attention to the ways that those rights take shape (Charles 2013). For instance, rights-based approaches can be socially detrimental if they concentrate power among a subset of a community (Charles 2009). Some researchers have argued that specific rights or spatial approaches to SSF management may be less important than addressing social and livelihood issues such as social inequality (Fabinyi et al. 2015) or overcoming poverty (Allison and Ellis 2001; Allison et al. 2012). These are important points to keep in mind since the Cau Hai lagoon fisheries management incorporates a system of collective property rights but there are clear indications of social inequality and persistent poverty (discussed in the following section and throughout chapters 3 and 4).

TURFs have been introduced in coastal areas and lagoons to clarify access and management rights, mitigate conflicts, and reduce ecological impacts (Ruddle 1987; Marschke et al. 2012; Aburto et al. 2013). Auriemma et al. (2014) defined TURFs as "*a marine area in which individuals or communities are given some level of exclusive access to marine resources within a clearly defined boundary*". Many TURF initiatives also involve some form of co-management arrangement, where fisher organizations enter into agreements with government agencies and other stakeholders. As with other applications of co-management, bundles of territory-based rights for groups of fishers are linked to devolution of responsibilities for fisheries management (Berkes 2011; Cinner et al. 2012b).

Design of TURF features has taken different forms to suit the needs and goals of local fisheries. Through a review of 103 TURFs internationally Auriemma et al. (2014) identify four characteristics that tend to lead to success of TURFs (with success being defined internally by each fishery's goals): (1) the presence of co-management where the involvement of communities and government is roughly

equal; (2) enclosure by geographic features that aid with exclusion (e.g. bays or lagoons versus open water reefs); (3) targeting of species that have low mobility or tend to stay within the TURF; and (4) longer terms of tenure that incentivize sustainable stewardship by fishers. They also found that the presence of no-take zones and the size of TURFs don't appear to have strong influences on TURF success – although this depends on the management goals of the TURFs (Auriemma et al. 2014). In a recent review of TURFs literature Quynh et al. (2017) found that there has been insufficient research on enforcement issues and how the design of institutions for TURFs influences performance. These research needs are important insights that resonate in the Cau Hai lagoon and come up repeatedly in Chapters 3, 4, and 5.

1.2.5 Synthesis and Conceptual Framework

The bodies of literature reviewed above collectively inform and guide this dissertation research. Figure 1.3 links core concepts from each body of literature and outlines how the manuscripts have drawn on these concepts. The bodies of literature tend to overlap and each are used in multiple manuscripts; the one exception is literature on governance networks that is only used in Chapter 4. Figure 1.3 also shows the use of the Cau Hai lagoon empirical case (section 1.3 below) in all three manuscripts.

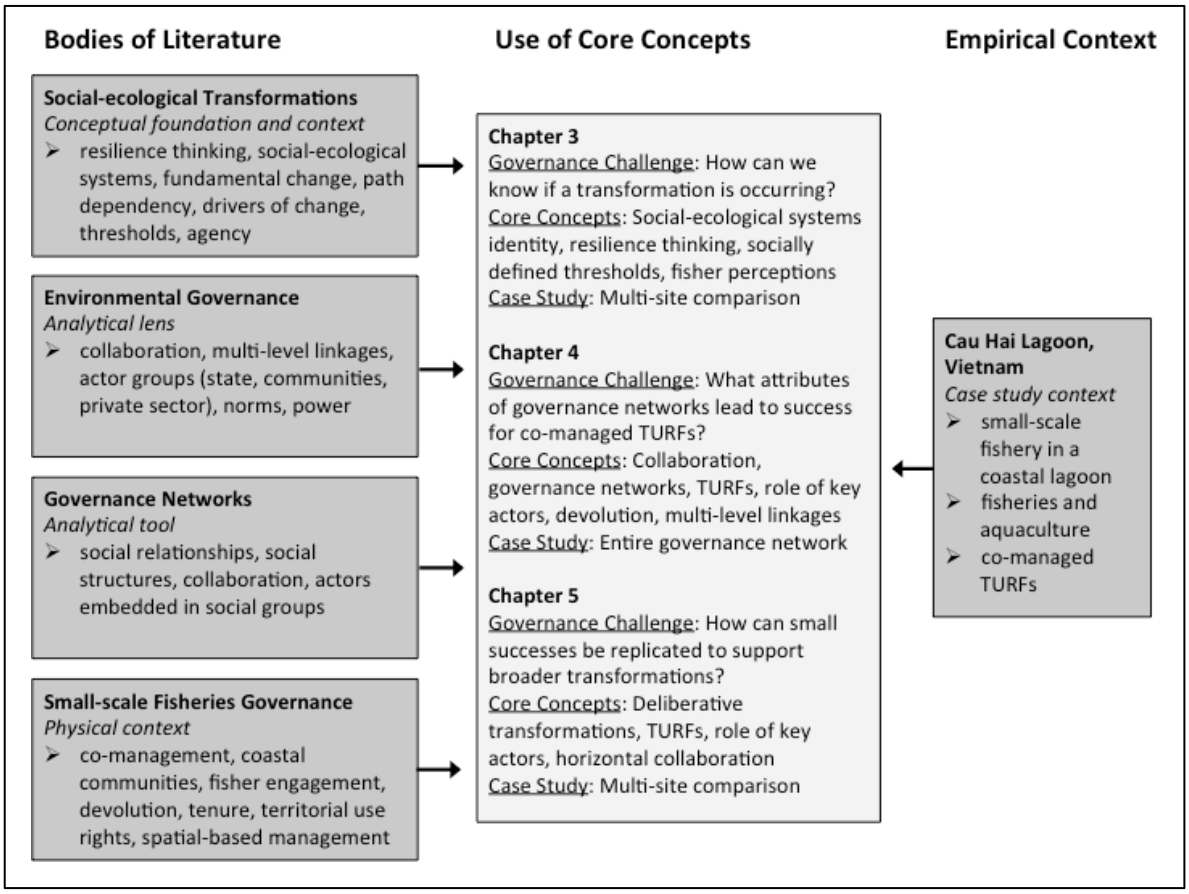

Figure 1.3: Conceptual framework for dissertation research, showing how main concepts from literature informed manuscripts.

Several themes and points of interest run across the bodies of literature. First, genuine engagement of fishers in management is crucial for building trust, ensuring information flow, generating mutual understanding, and supporting adaptive responses. Fisher relationships are necessarily horizontal (among fishers) and vertical (multi-level with fishers and government representatives). Second, devolution of fisheries management requires co-ordination of many actors from government, fishing communities, and other supporting agencies. Actors within each of those areas can play key roles. Third, local knowledge systems and fisher perceptions can be important sources of understanding social and ecological change. Furthermore, drawing on local knowledge helps devise management plans and strategies that are suitable for local conditions. Fourth, there is a need to understand drivers of change and transformation. Relevant drivers include large-

scale forces such as climate change, social pressures, and international economic trends. Governance changes themselves can also be important drivers of change that alter SES dynamics. Lastly, there are tensions between change and stability that are critical for communities. Stability is necessary for attributes such as fisher livelihoods. On the other hand, path dependencies that perpetuate current SES characteristics can keep communities in unsustainable traps. These cross-cutting themes are important for informing this dissertation research but are also key areas that need further understanding in the context of social-ecological transformations.

1.3 Empirical Context

This section provides a broad overview of the Cau Hai lagoon as the focal area of empirical research for this dissertation. Chapters 3, 4 and 5 reiterate much of this information and add more detail as relevant for the topic of each chapter. The fieldwork component for Chapter 3 involved a historical analysis of fishing and livelihood changes and provides the most in-depth characterization of the lagoon's social and ecological systems.

The Cau Hai lagoon is the southernmost region of the Tam Giang-Cau Hai lagoon complex (Figure 1.4). The Cau Hai lagoon itself covers 9,800 hectares and has a single outlet to the South China Sea (the Tu Hien opening). Freshwater flows into the lagoon from rivers within the Hue basin, carrying agricultural runoff and residential waste (Nga 2006). With a range of marine and brackish water conditions and varied habitats, the lagoon supports a multi-species capture fishery and low intensity aquaculture (Mien 2006; Thung 2007; Tuyen et al. 2010). There are three broad categories of aquatic resource use in the lagoon: mobile gear fishing, fixed gear fishing, and aquaculture. More than 30 types of fishing gear have been documented in the lagoon (Mien 2006), although only a few types of gear are most prominent now. Among mobile gear, Chinese *lu* bottom trap nets have been widely adopted in the last decade (Figure 1.5). These nets are typically 15 meters long and by some estimates there are more than 100,000 *lu* nets in use in the Cau Hai lagoon alone (see Chapter 3, Andrachuk and Armitage 2015). Fixed gear includes *fish*

corrals and *chuom* (fish aggregating device). Aquaculture takes the form of highland ponds (mud walls separated from lagoon) and fish cages, and formerly included lowland ponds (water flowing through lagoon).

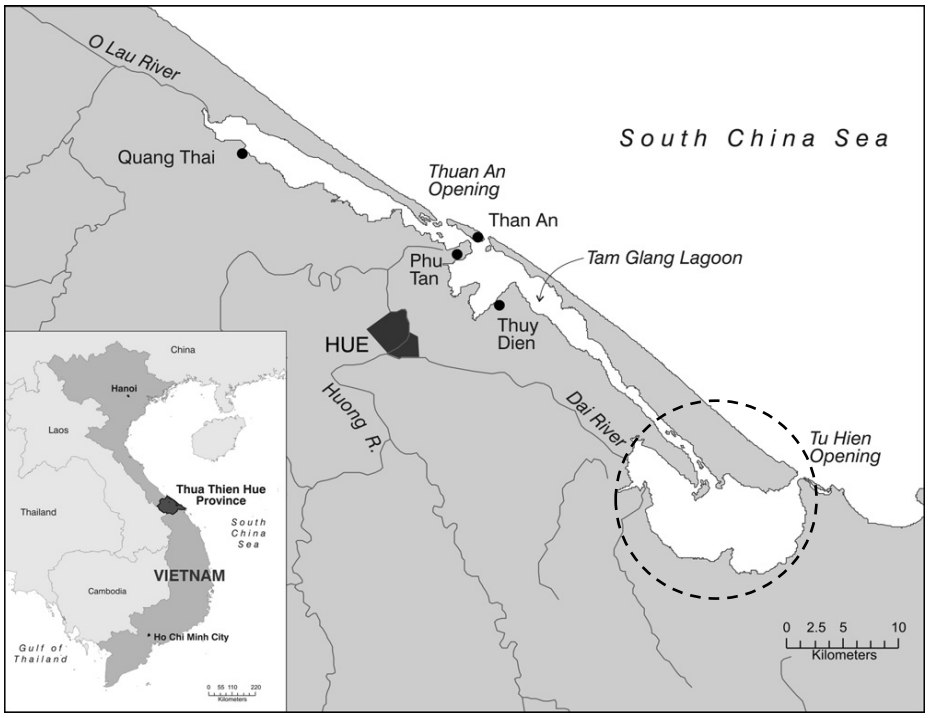

Figure 1.4: The Tam Giang-Cau Hai lagoon system in central Vietnam (map from Armitage et al. 2011). The Cau Hai area of the lagoon is the open water area in the southeast corner (indicated with dotted circle).

Figure 1.5: Examples of gear commonly used in the Cau Hai lagoon. Clockwise from top left: Chinese *lu* net, fish corral, fish cage aquaculture, *chuom*.

Jurisdictionally, the Cau Hai lagoon is mostly within the Phu Loc District, with a small portion within the Phu Vang District. Eight communes and one town border the lagoon (Table 1.4). Each commune contains several fishing and agricultural villages. There are indications that poverty is more severe in fishing villages – those adjacent to the lagoon and relying primarily on aquatic resources – than in the surrounding agricultural villages (Hong and Thong 2000; Tuyen et al. 2010). Amongst the most impoverished are former *Sampan* dwellers who previously lived year-round on boats but the government has settled them into communities more recently (Hong and Thong 2000; Tuyen et al. 2006; DaCosta and Turner 2007).

Table 1.4: Communities around the Cau Hai lagoon and corresponding Fishing Associations.

District	Commune / Town	Fishing Association	Year Fishing Association Established	Year of TURF Allocation	Lagoon Area (ha)	Number of Fishing Households
Phu Loc	Vinh Giang	Giang Xuan	2008	2009	997	216
	Vinh Hung	Trung Hưng	2012	2012	370	205
	Loc Binh	Loc Binh 1	2003	2010	987	107
		Loc Binh 2	?	2010	367	220
	Vinh Hien	Dam Pha Vinh Hien	2008	2011	924	200
		Nuoi ca long Vinh Hien	2010	2011	224	90
		NTTS Vinh Hien	2008	2011	230	200
	Phu Loc town	Phu Loc	2009	2010	1130	190
	Loc Dien	Luong Chanh	2008	2011	441	99
		Mieu Nha	2008	2011	651	120
		Thach Son	2008	2011	714	110
		Trung Luong	2007	2011	566	210
	Loc Tri	Dong Hai	2009	2010	530	150
		Le Thai Thien	2009	2010	557	164
	Loc An	(no FA)	n/a	n/a	200	30
Phu Vang	Vinh Ha	Ha Trung 5	2007	2013	32	90
		Ha Giang	2012	2013	37	115

In large part due to the *Doi Moi* ('renovation') economic policy introduced in the late 1980s, Vietnam transitioned rapidly from a centrally planned economy to a market-oriented economy (Adger 2000). As new emphasis was placed on agriculture, the Tam Giang – Cau Hai lagoon was targeted as an ideal location for aquaculture since it is sheltered from the open ocean and has an abundance of shallow water areas (Tuyen et al. 2010). Aquaculture rapidly expanded in the 1990s as fishers claimed areas to build ponds and net enclosures. By the early 2000s aquaculture production peaked and then declined due to rising costs for feed and equipment and onset of aquatic diseases (Armitage et al. 2011; Andrachuk and Armitage 2015). Social and ecological changes in the lagoon have also been driven by adoption of more effective capture fishing gear (e.g. Chinese *lu* nets) and urbanization in the surrounding region (Nga 2006; Tuyen et al. 2010; Armitage et al. 2011). Evidence of ecological decline has included dwindling fish stocks and catch rates, habitat loss, and water quality issues such as pollution and algae blooms (Brzeski and Newkirk 2002; An and Hoang 2007; Frignani et al. 2007; Marconi et al. 2010).

Closely linked with ecological stresses have been wellbeing issues stemming from poverty, lack of livelihood alternatives, unclear property rights, and historical exclusion of fishers from management institutions (e.g., DaCosta and Turner 2007; Tuyen et al. 2010; Boonstra and Nhung 2011; Huong and Berkes 2011; Marschke et al. 2012). While aquaculture and improved fishing gear technology have provided economic benefits for some households, the intensification of resource use also further marginalized impoverished fishers (Brzeski and Newkirk 2002; Ngu 2010; Tuyen et al. 2010). Economic fortunes for some households were also short-lived if disease struck their aquaculture ponds.

The customary view among fishers was that the open water areas of the lagoon were open access (Tuyen et al. 2006). Open access became restricted as large areas of the lagoon were occupied with aquaculture and fixed-gear nets (Marschke et al. 2012). The presence of fixed gear nets (e.g. fish corrals; stake nets) provided some households with *de facto* property rights and exclusive access to specific areas of the lagoon (Tuyen et al. 2006; Huong and Berkes 2011). Meanwhile, mobile fishers took on a "first come, first served" mentality to exploit resources in remaining open areas and at times have been reported to fish within and around fish corrals (Marschke et al. 2012). Space constraints were also associated with challenges for fishers navigating formerly open water areas (Tuyen et al. 2010; Huong and Berkes 2011).

Tuyen et al. (2006) highlight how resource management decisions in the TGCH lagoon had primarily been led by government planners who are not familiar with the context of the lagoon and are mostly interested in economic development. For instance, in 2001 the provincial government developed a new policy that required the forced removal of fish corrals to open waterways for navigation and alleviate water stagnation. The top-down approach in making these decisions was met with strong local resistance, causing the policy to fail and, ultimately, contributed to awareness of the need to involve fishers and village representatives in policy decisions (Tuyen et al. 2010; Armitage et al. 2011). Government officials and fishers

alike recognized that new approaches were required to avoid ecological collapse (Armitage et al. 2011; Boonstra and Nhung 2011).

At the national level, a working group chaired by the Vietnam Institute of Fisheries Economics and Planning proposed a definition of co-management for Vietnam (in IMOLA 2006, p.55):

> *Co-management is a participatory management process involving local communities, government at different levels and other stakeholders where agreement is reached on a share of benefits and responsibilities regarding the sustainable utilization of renewable natural resources.*

In the context of this broad vision, Tuyen et al. (2010) identify two factors that enabled the emergence of co-management arrangements in the lagoon: (1) revisions to the Fishery Law as well as a Provincial Decision (no. 4260) in 2005 to legally support co-management; and (2) district level governments became agreeable to participatory approaches to fisheries management following external support from university researchers and internationally funded projects that helped establish and organize fishing associations (FAs). Commune and district level government officials recognized the benefits of decentralized management approaches and greater involvement of village-level groups (Tuyen et al. 2010; Marschke et al. 2012).

With recognition that modern technology, introduction of aquaculture, and increasing population density undermined the relevant customary fisheries management practices (more discussion in Chapter 3), a team of Vietnamese and Canadian scholars developed a model for territorial use rights for fisheries (TURFs) for the lagoon (for full details of this project see Tuyen et al. 2010; Armitage et al. 2011; Huong and Berkes 2011). The water surface of the lagoon was mapped – led by another international project with researchers from Italy in partnership with the Phu Loc District government – into territories based partially on existing use by each community – some zones were further subdivided based on geographic orientation and density of fishing activity. Through educational workshops for fishers organized by the Provincial Fishing Association, researchers, and the District

government FAs were encouraged to form. If the FAs represent all resource use groups – mobile gear, fixed gear, and aquaculture – they can enter into co-management agreements with local government agencies and receive allocations of collective property rights and responsibilities for a defined territory in the lagoon (Armitage et al. 2011; Marschke et al. 2012). In this context, FAs receive bundles of exclusive spatially-defined rights for fishing and aquaculture and are responsible, in cooperation with commune governments, for monitoring and enforcement of fisheries policies.

The Phu Loc District government demarcated the lagoon into 16 fishing zones and moved forward with TURF allocations for all FAs in the region (Figure 1.6). Between 2005 and 2012, international NGOs and university researchers supported the formation and capacity building of FAs and supported them with applications for rights allocations. Table 1.3 summarizes basic information about the FAs, including their date of establishment and spatial coverage. One requirement for a FA to gain TURF rights was development of a fisheries management plan. These management plans set out goals for reducing gear, which was mandated by provincial laws. Another part of the rights allocation process involved removal of all lowland ponds and rearrangement of fish corrals to allow for improved water flow and open waterways for navigation (Tuyen et al. 2010). Chapter 5 provides further

description and discussion of the allocation of TURF rights.

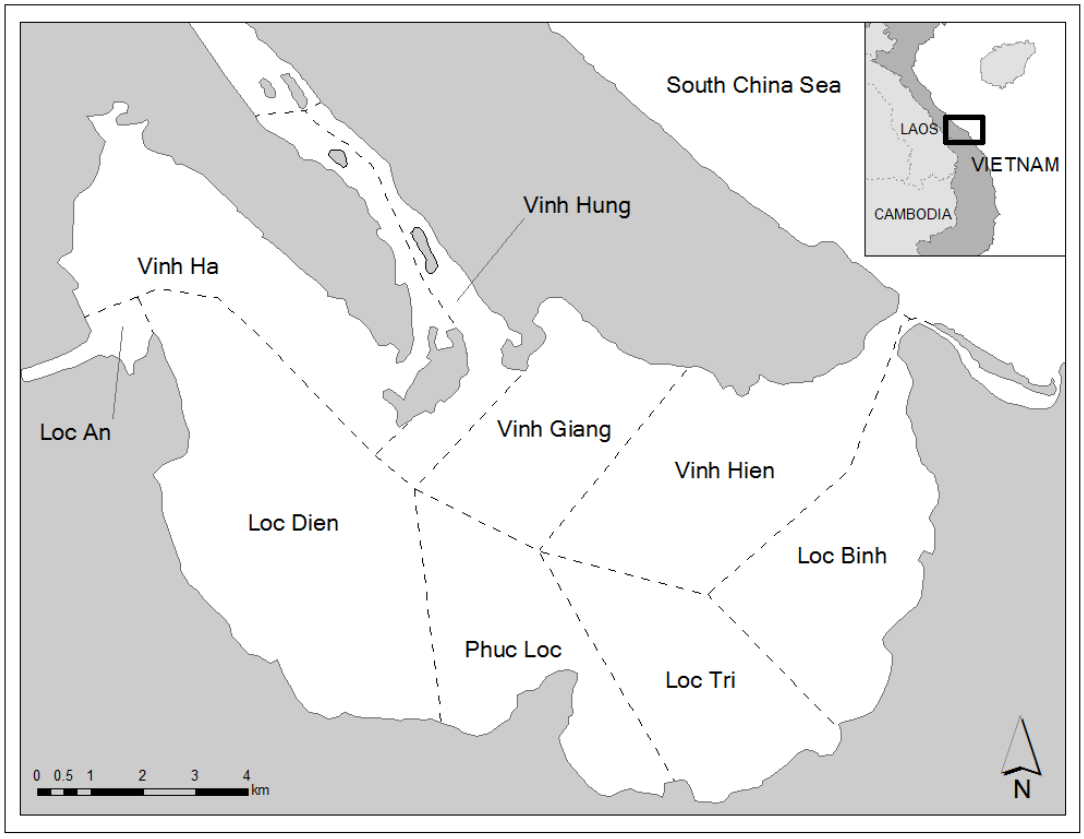

Figure 1.6: Map showing the TURF zoning, although several communes contain multiple FAs and further subdivisions; see also Table 1.3 for subdivisions.

The co-managed TURFs have helped address overcrowding and property rights issues, and have shown promise in reducing ecological impacts from intensive fishing (Armitage et al. 2011; Boonstra and Nhung 2011; Marschke et al. 2012; Andrachuk and Armitage 2015). Several recent studies have demonstrated how FAs have served as hubs for raising awareness about environmental issues and benefits of conservation, reducing conflict between resource user groups, building trust between fishers and government officials. and providing some patrolling and monitoring to enforce regulations (Huong and Berkes 2011; Tuyen et al. 2011; Armitage et al. 2011; Marschke et al. 2012). However, as Boonstra and Nhung (2011) cautioned, the development pathways that led to problems in the lagoon are persistent and difficult to overcome. Social and ecological conditions in the lagoon

are the outcome of complex interactions between competing resource users, decisions by multiple levels of the Vietnamese government, market forces, and the lagoon environment itself (Boonstra and Nhung 2011). In spite of their benefits, it has never been clear if co-managed TURFs are sufficient for reversing or preventing further ecological decline or alleviating longer-term issues such as poverty (Armitage et al. 2011; Boonstra and Nhung 2011; Marschke et al. 2012).

Several relevant studies took place during the same period as this dissertation. Notably, Nga Thi Thanh Ho (University of Queensland, Australia) has published a series of papers from her dissertation examining the establishment of co-management in the Tam Giang – Cau Hai lagoon. These papers include critiques of the benefits and drawbacks of the international donor-funded projects that were instrumental in forming FAs and establishing co-management, noting that government officials were sidelined at times during this process (Ho et al. 2015; Ho et al. 2016a); an evaluation of social and ecological outcomes of co-management, concluding that compliance with regulations has improved, fish stocks have stabilized, but that proliferation of Chinese *lu* nets may cause further fishery degradation if consistency in implementation of co-management is not achieved (Ho et al. 2016b); and a comparison of successful leadership qualities among FA leaders (Ho et al. 2016c). Ho's work drew on a different sub-set of case communities from those in this dissertation (several outside the Cau Hai lagoon) but her work is cited throughout the manuscripts in this dissertation to highlight her contributions and complementary findings. Notably, whereas Ho focused more on the process of establishing co-management, my research emphasizes outcomes of co-managed TURFs and accompanying social-ecological changes. Boonstra and Hanh (2015) have also highlighted how many maladaptive and destructive practices, particularly for aquaculture, persist in the lagoon and contribute to a social-ecological trap. More work is needed to identify pathways forward through adjustments to policies and designing governance interventions for improving livelihoods ecological sustainability. Chapters 4 and 5 address these problems by evaluating how to

improve implementation of co-managed TURFs and devise policies to further engage fishers in effective fisheries management.

1.4 Organization of Dissertation

This dissertation was prepared in a manuscript style format. Three stand-alone manuscripts written for publication in peer-reviewed journals make up the core of the dissertation. The relationship between these manuscripts is depicted in 1.7, with the two large boxes representing gaps in the literature that were identified in section 1.2.1. Respectively, those research needs are analytical tools to identify real-world transformations as they unfold, and a better ability to support transformations through evaluation of collaborative networks and means of replicating successes. Following this Introduction chapter is a Methodology chapter that describes the research philosophy, case study approach, data collection, analysis, ethical considerations, and reflection on the research process and limitations.

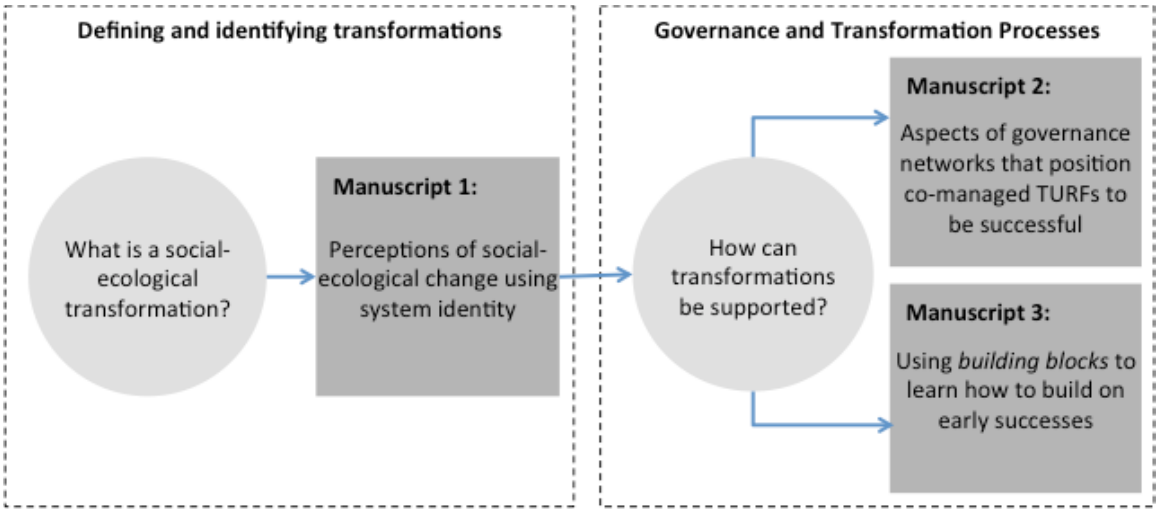

Figure 1.7: Relationship between three manuscripts in this dissertation, broadly addressing: How can coastal fishing communities create or participate in change towards sustainability? The left side addresses objectives 1 and 2. The right side addresses objective 3.

Chapter 3 is the first stand-alone manuscript and addresses objectives one and two of this dissertation. Specifically, the chapter elaborates on a framework to

empirically identify social-ecological transformations using the notion of system identity (Cumming et al. 2005; also discussed in section 1.2.1) and draws on the perspectives of people within a resource use system (Robinson and Berkes 2010; Bene et al. 2011). Conceptually, this manuscript lays the foundation for how social-ecological transformations are treated in this dissertation. Data collection includes focus groups and interviews. The manuscript confirms earlier evidence that a transformation is underway in the Cau Hai lagoon (Armitage et al. 2011) and argues that it is important to address implications of transformations, rather than only focusing on precise timing of transformation phases. This manuscript has been published in *Ecology & Society* (Andrachuk and Armitage 2015).

Chapter 4 presents the second manuscript and investigates the network of actors involved in co-management in order to identify enabling conditions for implementing TURFs. The manuscript presents a mix of social network analysis and qualitative analysis to identify patterns of communication across the network. The results address objective 3 of this dissertation and point to the need for more emphasis on relationships at the local level (especially between FA leaders) in order to strengthen the effectiveness of TURF arrangements. Such relationship building can be accomplished through modification to co-management agreements and greater resources for collaborative capacity. This manuscript has been submitted to *Global Environmental Change* (submitted June 2017) and is currently under review.

Chapter 5 presents the third manuscript and also contributes to objective 3. The manuscript examines governance processes that can support transformations by introducing the notion of *building blocks for transformations*. Two FAs in the Cau Hai lagoon are examined in-depth to identify conditions that have led to their success. It is argued that such conditions should reveal lessons on building blocks that are replicable in other FAs in the lagoon, thus supporting broader transformative changes. The key building blocks for supporting transformations in the Cau Hai lagoon found in this research are fisher approval of ecological conservation, co-operation among fishers, support from local government, secure funding for fishing

associations, and good fishing association leadership. This manuscript has been submitted to *Ecology and Society* special issue on "transformations beyond social-ecological traps" (submitted June 2017) and is currently under review.

Chapter 6 summarizes the main findings and contributions from the manuscripts individually and collectively. The findings are discussed with respect to the overall aim and objectives of the dissertation, and with regard to contributions to the main bodies of literature used to frame this dissertation research. This final chapter also includes recommendations for further research.

Literature summaries and case material that were collected as part of this research have also been used in manuscripts and book chapters that are not included in this dissertation. They are included in Appendix A to fully summarize and collate research related to this dissertation's central objective of understanding how communities can engage in deliberate transformations.

CHAPTER 2: **Methodology and Methods**

In this chapter I present the methodological orientation of my research and summarize the entirety of fieldwork and research methods. Each of the manuscript chapters (Chapters 3, 4, and 5) in this dissertation is based on empirical research, and each of those chapters provides further details on specific methods. This chapter reviews the philosophical stance of my research, case study selection, and procedures for data collection and analysis. Additionally, research limitations and challenges are examined, ethical considerations are discussed, and experiences with fieldwork are reflected upon.

2.1 Methodology

This research is underpinned by a critical realist perspective, comparative case-study approach, and participatory community-based research. A critical realism perspective was adopted as a philosophical basis for incorporating subjective dimensions in interpretations about meaning and causality with regard to social-ecological transformations. Critical realism posits that a real world exists independent from our knowledge of it, but that our understanding of the world is mediated by discourses and disciplinary viewpoints (Sayer 2000; Bhaskar 2011). This philosophical perspective is typically positioned as an alternative to more extreme views on subjectivity (e.g., relativism; claims that the world is a product of our thought) and objectivity (e.g., positivism; claims that we can objectively understand the world). Values, norms, and culture are social constructions but they are also real (Maxwell 2012).

Underpinning my research with a philosophy of critical realism encouraged reflexivity on the objective and subjective understandings of processes of social-ecological change and transformation (in particular for the first manuscript, Chapter 3). By situating research as a social practice, critical realism thus allows for diversity of interpretations and understanding of the real world (Bhaskar 2011). A central

implication of this perspective is that various pieces of evidence are not considered as singularly valid. That is, I present my interpretation of the analyses but allow that alternative interpretations about social-ecological transformations may be equally valid (e.g., other researchers may make different determinations about the timing and presence of critical thresholds).

Subjectivity within the research surfaced in relation to the presence of multiple actor groups, each with unique sets of values, ways of interacting with the lagoon resources, and perceptions and attitudes about social and ecological changes. Through evaluation of fishers' perceptions (as a reflection of lived experiences and their ability to draw on local and traditional knowledge to articulate real changes in the environment), Chapter 3 engages with questions about place-based observations and how these differ by actor groups. Use of perceptions as a means of evidencing subjectivities (i.e., social construction of environment) has a solid foundation in fisheries and natural resources literature (e.g., Kyle et al. 2004; Christie 2005; Gelcich et al. 2008), and holds promise for investigating the subjective dimensions of social-ecological transformations. Manuel-Navarrete and Pelling (2015) argue that transformations inherently involve politics and power, and these must be addressed to reduce inequalities and risk. These considerations of subjectivity and perceptions provide a foundation for the ways that transformations are viewed and assessed in this dissertation.

The intent of using case study research was to build an understanding of a whole system. Case study research design entails the study of real life phenomena and their contextual conditions using multiple methods to facilitate a holistic and integrative perspective (de Vaus 2006; Yin 2008; Bryman 2012). The case study approach implies attention to cross-level linkages and gathering in-depth knowledge about communities, places and events that can provide different insights than comparative studies that are more superficial (Gerring 2007). Within the framing of critical realism, Maxwell (2012) states that case studies are analogous to narratives that provide rich context and some insights into causality. My research

uses multiple case studies within the Cau Hai lagoon to facilitate within-case analysis and cross-case comparisons. The intended outcome was not to generalize beyond this case study (Kennedy 2006; Maxwell 2012); rather it was to provide in-depth insights about this particular case – which, along with other cases, may eventually provide a basis for refining broader understandings of social-ecological transformations in the literature (Flyvbjerg 2006; Yin 2008).

Working with local people and conducting community-based research – as opposed to reliance on extensive literature reviews or computer-based modeling – was important for this research. In keeping with the case study approach, I aimed to understand local issues and fisher perspectives related to social-ecological change in the Cau Hai lagoon (i.e., place-based case studies). The community-based research literature places an emphasis on sensitivity to local interests and cross-cultural issues and, therefore, guided some specific considerations for the fieldwork (see Gibbs 2001; Pearce et al. 2009). First, involvement of researchers from the Hue University of Agriculture and Forestry (HUAF) was critical for the design and refinement of research protocols and plans. Collaboration with local researchers who have previously worked in the Cau Hai lagoon helped modify interviews, surveys, and focus groups to suit the interests and needs of fishers and other research participants. A second consideration from community-based research was embracing local knowledge and the expertise of local resource users (Berkes et al. 2000). In particular, this meant that responses from research participants were valued as sources of in-depth information about the case study sites. Third, the role that local collaborators and community members played in the research process was fully acknowledged. This was done by inviting fieldwork partners as co-authors on papers (provided they also contributed to writing and/or editing) and ensuring written acknowledgements of all forms of support within this dissertation. Fourth, research results were reported back to communities and stakeholders who participated in the research, and efforts were made to ensure that reporting was provided in a manner that is accessible to those people. This was achieved through a follow up visit after the main field season, where I hosted focus groups aimed at

presenting preliminary results and solicited feedback for verification and refinement.

2.2 Case Study Selection and Overview

Selection of the Tam Giang-Cau Hai lagoon as the research site offered interesting opportunities to investigate ongoing transformation processes. For example, there were opportunities to build on a previous International Development Research Centre (IDRC) project that helped establish the co-managed TURFs (Tuyen et al. 2010; Armitage et al. 2011; Marschke et al. 2012), as well as other recent studies that identified livelihood stresses in the lagoon (IMOLA 2006; DaCosta and Turner 2007; Boonstra and Nhung 2011; Huong and Berkes 2011; Nguyen and Kim 2011). These studies documented significant social and ecological changes across the Tam Giang-Cau Hai lagoon leading to the need for a new approach to fisheries governance. At the onset of my doctoral work, there was opportunity to further investigate the interplay of environmental, economic, and livelihood changes, especially following the implementation of co-managed TURFs.

To build a case study with rich information, I opted to focus all primary research on the Cau Hai region of the lagoon. There were several reasons for this decision. First, the communes around the Cau Hai lagoon share a common ecosystem that helped delineate system boundaries. Second, 16 FAs have been established around the Cau Hai lagoon, all of which received allocation of territorial use rights prior to commencement of my fieldwork (outlined in Table 1.3). No other regions of the Tam Giang-Cau Hai lagoon have this characteristic. The FAs vary in age, levels of capacity, wealth, and access to different parts of the lagoon (e.g., proximity to the sea opening offers more access to marine species that enter the lagoon). This diversity yielded opportunity to investigate different experiences with TURFs and to compare across sub-cases. Third, the Giang Xuan FA (in Vinh Giang) is an interesting case in itself since it was the first FA with a co-managed TURF and was the model that other FAs followed. In many ways the Giang Xuan FA represents a best-case scenario and offered unique insights into ways forward for other FAs. Fourth, HUAF researchers

had previous experience working in this area and could confirm a willingness among fishers to participate in research.

Three FAs were chosen as sub-cases for certain parts of the research. Chapter 3 used all three sub-cases and Chapter 5 used two of the sub-cases; Chapter 4 covered all communities around the lagoon. Selection of the three sub-cases was made in consultation with HUAF researchers and commune officials, and was based on geographic variety (e.g., proximity to the sea opening influences salinity and composition of species), differing levels of progress in implementing TURF rights allocations, and history of relationships with HUAF researchers. Focus on sub-cases was necessary to make the amount of fieldwork manageable. These FAs were in Giang Xuan (Vinh Giang commune), Loc Binh I (Loc Binh commune), and Phu Loc (in Phu Loc town). The three communities share demographic characteristics such as high population density, high rates of poverty, presence of all modes of aquatic resource use (fixed gear, mobile gear, and aquaculture), and minimal alternative livelihoods available. In areas neighbouring the lagoon, activities include primarily agriculture, such as rice production (paddies). Photos in Figure 2.1 provide a visual sense of the physical settings.

Figure 2.1: Photographs of the physical setting of the case communities. Top left and top right photos show typical housing; bottom left shows boats at shore and aquaculture ponds; bottom right shows rice paddies adjacent to the lagoon.

2.3 Data Collection Procedures

A preliminary scoping trip to Hue, Vietnam took place in February 2012 where I was introduced to faculty and graduate students at HUAF, participated in focus groups with FA members in two communes in the lagoon, became more familiar with Vietnamese culture, and assessed options for long-term accommodation. The main fieldwork took place over five months (October 2012 to March 2013), plus a one month follow-up trip (June 2014). The research activities followed overlapping stages, and several activities were ongoing throughout my field seasons, including Vietnamese language lessons, meetings with colleagues at the HUAF for sharing of ideas and information, and preliminary analysis of information derived from focus groups, interviews and surveys. The preliminary analysis allowed for some verification and follow-up during the main field season.

This dissertation is primarily based on qualitative data and analysis. Chapters 3 and 5 rely on qualitative data, while chapter 4 draws on both qualitative and quantitative data. Use of mixed methods is common in this type of case study research because it allows for examining issues from multiple angles and corroboration across different types of data sources, which supports a better understanding of the case (Yin 2008; Hay 2010; Hesse-Biber 2010). In mixed methods research, researchers combine elements of qualitative and quantitative approaches in order to answer the same research question(s) (Johnson et al. 2007; Creswell 2014). Use of multiple methods is often rationalized for corroboration (triangulation) of a single conclusion. However, some authors also argue that multiple methods can be more useful for revealing complementary and different aspects of phenomena (Maxwell 2012). Johnson et al. (2007) outline a list of important issues in mixed methods research, including: At what research stage should mixing of methods occur? Is it beneficial to mix methods at particular stages? What are effective strategies for integration of methods at different stages of research? Although these issued are not addressed specifically in this research, the order of mixing – and attempts to weight qualitative and quantitative methods equally – are detailed below and within each manuscript in order to be transparent.

The main methods for data collection were focus groups, semi-structured interviews, and surveys (Table 2.1). Each of the fieldwork methods were conducted in Vietnamese, with a translation provided into English by research assistants. Literature review was also an important method that informed the theoretical and empirical aspects of the research. Peer reviewed and grey literature related to environmental conditions, economic factors, and livelihoods in the Cau Hai lagoon was sought in order to support triangulation of findings, compare insights from multiple time periods, and position my research within existing discourses. Participant observation was also helpful as an informal method. Conversations during meals with fishers and boat trips to observe different types of fishing and aquaculture provided a fuller perspective of the cases and helped contextualize

what was discussed during focus groups and interviews. The following sections outline the main methods used.

Table 2.1: Summary of research method and participants. Each row represents a discrete data set. There is some overlap of participants taking part in multiple research activities. For instance, almost all participants from the second set of focus groups were also in the first set. Also, the surveys and governance processes interviews largely overlap.

Method	Topic	Number of Participants	Data Use in Manuscripts	Protocols in Appendices
Focus groups	Social-ecological change	75	Chapter 3	B
Focus groups	Results verification	27	Chapters 3, 4	C
Interviews	Scoping key issues	15	Chapter 3	D
Interviews	Governance processes	73	Chapters 4, 5	E
Interviews	Operation of FAs	31	Chapter 5	F
Interviews	Conditions for FA success	4	Chapter 5	G
Surveys	Network relationships	68	Chapter 4	H

2.3.1 Focus Groups

Focus groups hold unique benefits due to the discussion and interactions among participants that is not possible during individual interviews. Participants tend to react to each other and, whether they agree or disagree, topics and insights can be deliberated (Palys 1997; Seal et al. 1998). The visuals generated were sources of data and, more importantly, the group discussions were rich sources of information for understanding viewpoints about the lagoon.

Two sets of focus groups were conducted. The first set (November – December 2012) sought information about SES identity and changes in the lagoon over time. A total of nine focus groups (with approximately 8-10 participants in each; total n = 75) were conducted with fishers in three communities (Vinh Giang, Loc Binh, and Phu Loc) in the Cau Hai lagoon. Each FA is composed of aquaculture farmers, fixed gear fishers, and mobile gear fishers; these groups were targeted separately in order to avoid unequal power dynamics that may prevent the marginalized mobile gear fishers from participating in discussions. Participants for the focus groups were selected with assistance from FA leaders, who were requested to find fishers who live in different parts of the community, represent various levels of wealth, and use various types of gear.

Similar to the participatory diagnostic approach used by Béné et al. (2011) and Robinson and Berkes (2010), the focus groups worked through a series of exercises to define environmental and socio-economic components of the resource system, local and external disturbances that threaten key components, sources of stability, changes in the system over time (including identification of key events), possible thresholds for livelihoods and wellbeing, and identify possible management interventions (e.g., see Figure 2.2). As an example, once influence diagrams were developed (left image in Figure 2.2), participants were asked about implications of removing particular elements. If 'x' is removed, will the lagoon or your livelihoods still be the same? (modeled after Robinson and Berkes 2010). Full protocols for these focus groups are located in Appendix B.

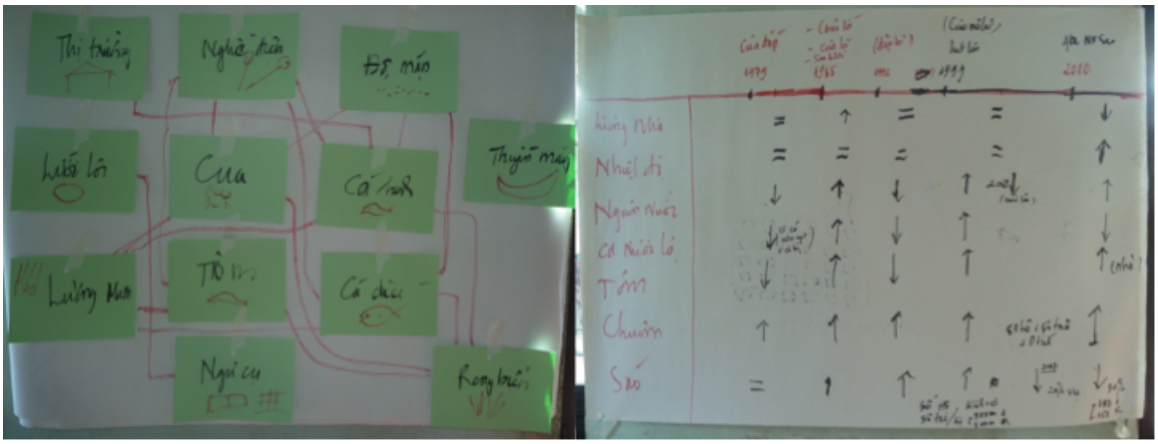

Figure 2.2: Examples of visual tools used during focus groups (writing in Tieng Viet). The left photo shows influence diagrams used to generate discussion about key SES elements and the interactions between them; the right photo shows a participant-generated timeline with symbols indicating direction of change in key elements.

The second set of focus groups (June 2014) reviewed preliminary findings with fishers and verified interpretations. Participants for these focus groups were sought out in the same three communities (one in each community, with 7-10 participants in each; total n = 27), but this time representatives from each subgroup of fishers were included together. Participants were selected based on their participation in the earlier focus groups (i.e., several participants from each focus group were

solicited). Key results related to SES identity and governance networks were presented to fishers. With each set of results, participants were asked if they saw any discrepancies from their own experiences or if they felt that they wanted to provide additional information. Participants were also asked to discuss what aspects of co-management TURFs were successful and which aspects were not working. On the whole, the focus groups agreed with the results and appreciated that the research team had returned with results. These focus group protocols are located in Appendix C.

2.3.2 Semi-structured Interviews

Semi-structured interviews are useful because they are flexible and allow interviews to proceed according to the interests and knowledge of interviewees (Huntington 1998). A distinguishing feature of semi-structured interviews is that they are intended to be conversational, with interviewers prompting discussion based on topics in an interview guide, rather than following rigid set of questions (Palys 1997; Berg, 2001; Legard et al., 2003). Questions about specific events and actions will be used to elicit information from interviewees that goes beyond their opinions or generalizations (Maxwell 2012).

Four sets of interviews were conducted to address various topics and actors. The first set of interviews (November 2012) involved key informants, including local university researchers, government representatives, and other fisheries/scientific experts (n =15). Interviewees were purposively sought out based on their knowledge and experience working in the lagoon. These key informant interviews were used to clarify up-to-date information about policies and activities in the Cau Hai lagoon; acquire information and references for reports and publications that may be pertinent to the research (e.g., unpublished reports that were not otherwise accessible); and gather preliminary insights into relationships among SES variables, drivers of change, and key events (see Appendix D for interview guide). The benefits of these key informant interviews included drawing on the knowledge of local researchers who have extensive knowledge of the lagoon and governance processes;

thereby alleviating research fatigue among fishers and village members (i.e., participants in later research activities) by directing attention to specific issues and questions.

The second set of interviews (n = 73) related to processes and interactions within governance networks (February – March 2013). These semi-structured interviews were held in conjunction with structured surveys (described in the following section). Interviews concentrated exclusively on key people involved with management, such as FA chairmen, vice-chairmen, and government officials; selection of participants began with a list of actors based on their formal roles in governance and also included snowball sampling. The purpose here was to complement social network analysis (using survey data) and gather more in-depth, qualitative information about operation of FAs and interactions between FAs (within and among) and government. For instance, information was sought pertaining to: (1) examples of how challenges in the lagoon have been addressed; (2) organizations, groups, or individuals who have been particularly helpful in overcoming challenges; (3) any events or policies that have been influential in the ways that challenges have been addressed; (4) historical relationships between different resource user groups; and (5) sources of innovation and flexibility (see Appendix E for interview guide). Note that a subset of these interviews (n = 16) related to governance processes was also used in the third manuscript (Chapter 5).

A third set of interviews took place with 53 households in Vinh Giang, Loc Binh, and Phu Loc (December 2012 – January 2013) and sought information about wellbeing and social thresholds. Selection of interviewees was carried out by research assistants in conjunction with FA leaders; criteria for sampling involved exclusion of participants from focus groups, a distribution of levels of wealth, and ensuring that all types of gear users were included. The emphasis of these interviews was intended to be on the implications of further ecological and livelihoods changes for local wellbeing. However, the outcome of these interviews was not suitable as data for its intended use. More discussion of these challenges is provided in section 2.6

below. A segment of the data (n = 31 interviews) from Vinh Giang and Loc Binh was used in the third manuscript (Chapter 5) as evidence of perspectives on the operation of FAs. Appendix F documents the broader interview guide that was used.

A fourth set of short interviews was conducted with specific individuals with knowledge about the formation of FAs and the role of FA leaders (June 2014). These interviews (n = 4) followed a narrative format where interviewees were asked open-ended questions and encouraged to speak about conditions that contributed to FA successes. Interview protocols are located in Appendix G.

2.3.3 Surveys

A survey (February – March 2013) was used to gather data about interactions amongst governance actors. These surveys specifically asked about who respondents interact with in relation to fisheries and lagoon issues, and were used to generate the dataset for social network analysis (SNA) and the creation of social relation maps. Survey protocols are located in Appendix H. These quantitative surveys (n = 68) were paired with interviews (second group of interviews described in the previous section). As outlined above in relation to the interviews, the surveys were targeted specifically to people who are involved with governance networks, including FA leaders, government officials (commune, district, and provincial levels), and other relevant stakeholders. A list of actors was initially generated by identifying people who fill lead roles in all relevant organizations. As interviews and surveys progressed, additional names were added to the list through snowball sampling (Prell 2012; Sandstrom 2011). In order to look at governance of the Cau Hai lagoon broadly, participants included FA and government representatives in all eight communities and 16 FAs.

2.4 Data Analysis Procedures

Questions about what is 'knowable' and how we can 'know' things are paramount for research. Critical realism is situated along the spectrum between positivism and constructivism. Positivism posits that the world and phenomena in the world are

knowable through objective empirical observation (Creswell 2014). Constructivism, on the other hand, considers reality to be made up ('constructed') of meanings and impressions held by individuals (Creswell 2014). These definitions are oversimplified for the sake of brevity but approximate the two extreme positions. As stated above, critical realism comes from the philosophical position that there is a real world independent of human consciousness but that it is difficult to objectively know those realities because our ability to observe the world is often incomplete and value laden (Yeung 1997; Maxwell 2012). For this dissertation I have taken the stance that the perceptions of individuals are important because they tell us more about how and why people respond to environmental change and make decisions related to natural resources. As such, perceptions are considered as valuable sources of data in themselves (c.f. Christie 2005; Bennett 2016).

As Maxwell (2012) explains, validity is less important for critical realists than the kinds of *understanding* that can be generated through research. Rather than seek – or make claims about – absolute "truth" the emphasis is on generating evidence about the phenomena of interest (Maxwell 2012). With respect to the main interest of this dissertation, I sought to gather evidence of ways to understand social-ecological transformations. The manuscripts that make up Chapters 3 and 5 are heavily influenced by this point of view. Chapter 4 has additional considerations for validity with respect to network analysis (described in section 2.4.2).

Specific analyses used in the manuscripts are detailed in Chapters 3, 4 and 5 with respect to particular research questions. Each manuscript used mixed methods and multiple data sets (refer to Table 2.1). General procedures for qualitative and network analyses are outlined below.

2.4.1 Qualitative Analysis

In this section I briefly overview how focus group and interview data were analysed. These data sets were qualitative and included a mix of visual materials (focus groups) and field notes (interviews). All data were first organized transcribing them

into word processer documents (i.e., Microsoft Word). Visual tools (e.g. maps and influence diagrams) from the focus groups were electronically re-drawn. Individual types of data – for instance, influence diagrams from all nine focus groups – were then examined for similarities, differences, and themes. Similarities and differences were contextualized in order to seek an understanding of the various ways that research participants experience social-ecological change.

Interviews were coded and analysed using both (1) open coding to identify emergent themes and (2) predefined themes to aid interpretation of SNA results. This coding was performed manually. The predefined themes were derived from research objectives within each manuscript, while the open coding allowed for unexpected patterns to be drawn from the data (Miles and Huberman 1994). This approach was used in Chapter 3 for the interviews with experts on environmental change in the lagoon, Chapter 4 for interviews on governance processes, and Chapter 5 for interviews on governance processes and the operation of FAs. When multiple types of evidence were available with respect to a topic, emphasis was placed on evaluating whether the evidence was corroborating or conflicting. In all cases quantitative and qualitative data were viewed in parallel, rather than positioning one as primary and the other as supportive (Creswell and Plano-Clark 2007). For instance, the surveys for social network analysis generated a quantitative means of analyzing and describing relationships among resource users and actors involved in governance networks, while interviews provided more explanatory and in-depth information.

A narrative approach was used for focus groups in Chapter 3 and key informant interviews in Chapter 5. The first set of focus groups described in section 2.3.1 (total participants $n = 75$) involved fishers developing and describing relationship diagrams to elicit information about how they interact with the lagoon. The small set of interviews ($n = 4$) in Chapter 5 involved personal stories about specific aspects of FAs. For both of these data sets a form of narrative categorization was used so that contextualization was retained (c.f. Maxwell 2012). In other words, I

did not want to code and disaggregate the data. It was more important for the personal accounts to be analysed with respect to the entire story and explanations provided. To conduct these analyses, I looked at the basic story line within each data source (focus group influence diagram or interview notes) to identify ways that information was connected and meaning was created. With these analyses it was more important to retain perceptions and narratives of research participants than to expect that individuals hold specific 'truths' about phenomena (Bryman et al. 2009). One disadvantage of this type of analysis is that it limits opportunities for comparisons with findings in different contexts (Maxwell 2012). However, since (1) my main research objectives were not concerned with comparison across other cases and (2) this was only one among several types of analyses that I used, these were not significant limitations for my research.

2.4.2 Network Analysis

For network analysis, validity concerns the extent that the data collected reflects the network that I was trying to measure (Prell 2012). For Chapter 4, the intent was to investigate relationships among actors who are directly or indirectly involved with co-management. One way of ensuring that all relevant actors were captured within the analysis was to use free name-recall instead of allowing participants to select from a predefined list. Predefined lists of actors (rosters) can artificially limit respondents' choices (Wasserman and Faust 1994; Prell 2012). Since the emphasis of Chapter 4 was to detect the communication network, another way of ensuring validity was to ask a general question ("who do you talk to?"). This approach was preferable over asking a series of more complicated questions that rely on reciprocal ties (Prell 2012).

Social network analysis (SNA) encompasses a set of interrelated concepts, methods and assumptions about the nature of social interactions. Several properties of social networks are important to note for the structural analysis of the Cau Hai lagoon governance network in Chapter 4 (Carlsson and Sandstrom 2008; Bodin and Prell 2011; Alexander et al. 2016): (1) networks are dynamic – the actors involved in

networks, and the nature of linkages between actors, are continually changing; (2) multiple networks overlap in space and time – individuals participate in multiple networks at any given time; (3) relationships between actors are mediated by institutions and norms – thus, placed-based context of history, politics, economics, and ecology are important for understanding networks. Although network analyses oversimplify the complexity and nuances of social-ecological contexts and the factors influencing actors, they provide unique insights into collaboration (Sandstrom 2011).

A pair of software programs called UCINet and NetDraw were used to carry out the SNA. Data from surveys on governance networks were first entered into Microsoft Excel spreadsheets. The files were then reformatted and uploaded to UCINet (Borgatti et al. 2002), which was used to perform several network analyses (including cross-group analysis, Gould and Fernandez brokerage, and betweeness centrality). Full details of these analyses are provided in Chapter 4. NetDraw (Borgatti et al. 2002) was used to generate visual network maps from UCINET's output files. The structural analysis via SNA was not viewed here as a stand-alone means of assessing the governance network. The SNA outcomes were combined with interview and focus group data in a mixed methods design (Hollstein 2014). For the network analyses, the quantitative SNA was used to uncover network communication patterns and, the qualitative data helped explain why certain network characteristics emerged and how they are relevant for fisheries management.

2.5 Ethical Considerations

This research received ethics approval by the University of Waterloo's Office of Research Ethics (ORE# 17930). Matters addressed through this review process included: recruitment of research participants, consent of participants to participate in particular research activities (e.g., interviews, focus groups, or surveys), confidentiality and anonymity for research participants, and providing feedback to research participants. Research participants in Vietnam were made aware of the

intent of the research, had the ability to remove themselves from the research process at any time, and are not identified in research reports by their names. Since interviews and focus groups were conducted in Vietnamese with a translator, they were not recorded with an audio device. Documentation of participant responses was in the form of written notes and diagrams, maps, survey responses, and other materials generated through participatory tools.

2.6 Reflections on the Research Process and Limitations

This research strongly benefitted from a partnership with researchers at HUAF. My research assistants were invaluable in providing translations, navigating regulatory and legal permissions for fieldwork, making logistical arrangements, and answering my continual questions about local customs and contexts. Likewise, my research assistants reported that they too benefitted from experience with new concepts and field methods and the opportunity to build more relationships with FAs around the lagoon. Since Vietnamese universities have limited funding sources for fieldwork, the opportunity to carry out extensive fieldwork meant that they now have personal relationships with fishers that they can build on for future work.

Fieldwork was entirely conducted in Vietnamese (Tieng Viet). At the outset of my fieldwork I began language lessons with the aim of becoming passably able to communicate. While I did not expect to be able to hold interviews on my own, I had hoped to be able to convey simple ideas and understand some words and phrases. Learning Vietnamese – a tonal language – proved to be very difficult. My timelines for learning were surely optimistic, but I was also confronted with learning from a teacher who focused on using a different dialect than the one commonly used in central Vietnam. Consequently, all focus groups were conducted with two research assistants. One assistant would guide participants through exercises, while the second assistant was a 'whisper' translator for me. This dynamic proved to work well, as all three of us were able to facilitate the focus groups together. Interviews were typically conducted with one assistant, who would direct translate from Vietnamese to English (and vice versa). Some interviews were conducted by an

assistant on their own and they would provide me with a typed transcript. The network surveys required a lot of work with an assistant to document and cross-reference each person named in the surveys (approximately 270 people) and assign each of them a numerical identity before analysis could begin.

The opportunity to return to Vietnam for follow-up and verification in June 2014 proved to be very beneficial. During workshops fishers confirmed that my findings were consistent with their perspectives. On multiple occasions fishers expressed an appreciation that the research team was taking the time to listen to their opinions about issues that they face, and that they felt that the attention to details was good. Other successes during the field seasons relate to activities based at HUAF. In March 2013 and June 2014 I provided small presentations on my SNA methods and results. This resulted in an additional intensive workshop (June 2014) with several researchers who were interested in employing SNA in their own work.

There were several limitations associated with my research. First, neither of my main research assistants had previous experience with translation work, which at times surfaced as limitations in their ability to express ideas in English (i.e., during focus groups and interviews). These problems were mitigated by my assistants making notes in Vietnamese and then following up after focus groups or interviews were completed. Second, there was disproportionate participation of men in interviews and focus groups. The research design did not in any way exclude women from participation, but it also did not involve active attempts to achieve a gender balance among research participants. Participants were solicited based on their involvement with fisheries and fisheries management. In most cases, possibly due to culture or convenience, representatives from households were men. Third, my research assistants were not familiar with the nuances of semi-structured interviews. Instead of starting with broad topics and then using probing questions to guide deeper discussion of important topics, the interviews more aptly resembled surveys with short interviewee responses. When I was present, these challenges were overcome as I was able to add probing questions to the interviews. However,

as mentioned above, the third set of interviews did not unfold in this way. Research assistants (my two main assistants plus three additional assistants) from HUAF carried out the majority of these interviews alone and provided translations of interview transcripts. The resulting data set was interesting but not as useful as originally intended for this dissertation. The data set ultimately did not contain the necessary details and nuance for writing a paper on wellbeing and social thresholds. Fortuitously, the final form of other data collected during fieldwork enabled analyses and results that led to the final manuscript on building blocks for transformations. Overall, the problems that I note here did not cause deviation from the central aim of my research.

CHAPTER 3: **Understanding social-ecological change and transformation through community perceptions of system identity**

Overview

In this paper we develop an empirical approach to consider social-ecological system change and transformation by drawing on resource users' knowledge and perceptions. We apply this approach in the Cau Hai lagoon, a coastal area dominated by small-scale fisheries in central Vietnam. Nine focus groups with more than 70 fishers were used to gather information about key social-ecological system elements and interactions, historical social-ecological dynamics, and possible thresholds between distinct social-ecological system identities. The patterns of change in livelihoods and resource exploitation in the Cau Hai lagoon are similar to those seen in other coastal lagoon and small-scale fishery contexts. Our findings show some promise for the use of local knowledge and the perceptions of resource user communities to understand and characterize social-ecological transformations – but importantly we also demonstrate how social-ecological transformations are complicated processes driven by many factors beyond the control of any single individual or group. We argue that (1) the occurrence of social-ecological transformations can result in either positive or negative outcomes, and (2) that we need to direct our thinking away from drawing tidy conclusions about if and when social-ecological transformations take place. Our research also encourages scholars to carefully consider how we frame the benefits of participatory, community-based governance initiatives. Importantly, we need to examine the ways that governance initiatives will be beneficial for some people and detrimental for others, and we need to be fully aware of locally contested interests and acknowledge competing priorities for fisheries management and human wellbeing. Community-oriented assessments informed by resilience thinking can help to open up questions about economic, political, cultural and environmental aspects of undesirable path dependencies and traps.

3.1 Introduction

The concept of transformations provides an enticing language for interdisciplinary environmental change and resource management scholars (e.g. Gelcich et al. 2010, O'Brien 2012). However, we need to be careful about the labels we place on the types of changes taking place in social-ecological systems (SES) (see Blaikie 1989). In resilience literature, transformations have been defined as processes that involve fundamental reorganization of SES structures, properties and controls (Biggs et al. 2010, Chapin et al. 2010). We explore some questions that are often overlooked in transformations literature: How can we empirically know if a transformation has occurred? What types of empirical evidence are used to support conclusions about the occurrence of transformations? How are efforts to know when a transformation has occurred influenced by who is making the determination? These subjective dimensions of transformations research bring attention to the ways that people perceive SES (e.g., system boundaries, feedback) and how these perceptions influence what we think of as real or potential transformations.

In this paper, we outline an approach for conceptualizing and perceiving transformations that works around some of the challenges of measuring resilience and transformations. Our approach draws on fishers' perceptions of system identity to consider long-term SES change (Cumming et al. 2005, Robinson and Berkes 2010). We apply this approach in the Cau Hai lagoon in central Vietnam to reflect on the ways that local fishery-based livelihoods both contribute to and are impacted by a social-ecological transformation.

3.2 Making Sense Of Social-Ecological Transformations

Researchers are bringing diverse foci, scales and meanings to transformations research. O'Brien and Synga (2013) describe several recent strands of literature broadly concerned with SES transformations or socio-technical transitions, which they refer to as transformational adaptation, transformations to sustainability, transforming behaviors, and social transformations. These strands of literature are at times complementary and at times contradictory. Consistent among uses of

transformations is the suggestion that an object or process of interest converts from one form or function to another. Transformations have alternatively been positioned as a deliberate, anticipatory response to environmental change (e.g., Nelson et al. 2007, Kates et al. 2012), a process of shifting towards sustainability (e.g., Geels 2002, Frantzeskaki et al. 2012), a concept to potentially help confront power imbalances and sources of vulnerability (e.g., Pelling 2011, O'Brien 2012), or as a SES phenomenon associated with the loss of resilience (e.g., Folke et al. 2010, Walker et al. 2010).

Strunz (2012) argues that conceptual vagueness can be an asset for enabling interdisciplinary communication and allowing for creativity in problem solving. Despite conceptual and empirical ambiguity in the literature we can see the overlap and interplay among uses of transformations. The tradeoff is that inconsistent conceptualizations can lead to confusion and communication breakdowns, false inferences about real-world problems, and subsequently, challenges for application in management (Brand and Jax 2007, Strunz 2012). We provide here the conceptual and normative foundations for the way we explore social-ecological transformations in this paper (cf. Strunz 2012, Nielsen and D'haen 2014). Our intent is to provide a descriptive definition that clarifies our interpretation of the meaning and essence of social-ecological transformations, rather than offering a specific, universal definition (see Jax 2007).

Our perspective has a basis in resilience thinking, which emphasizes the ability of systems to accommodate ongoing change (Walker et al. 2004). A key to understanding transformations from this perspective is recognizing tensions between persistence and renewal, and recognizing that resilience can sometimes be an undesirable quality of a SES when it leads to traps or perpetuates undesirable social problems (e.g. Scheffer and Westley 2007, Cinner 2010, Folke et al. 2010, Steneck et al. 2011). Some scholars look at the persistence of a system in terms of path dependence, which refers to the local patterns of interaction that perpetuate current SES conditions and the ways that previous actions constrain future options

(Folke 2006, Heinmiller 2009, Gelcich et al. 2010, Boonstra and Nhung 2011). In this line of thinking, processes that contribute to resilience and adaptive capacity can be the same as those that contribute to path dependence and traps. Correspondingly, elements that maintain current pathways, such as attitudes, worldviews, economic incentives, power relations and institutions, can also be barriers to transformation. The forces that confront and challenge current conditions and the status quo contribute to transformations.

We understand SESs as interdependent and co-evolutionary, where social and ecological domains are linked by ecological knowledge, governance arrangements, and ecosystem services (Berkes et al. 2003, Glaser 2006, Kotchen and Young 2007, Cinner et al. 2009). In ecological domains transformations may manifest as new assemblages of species, different landscape/seascape patterns, or new ecosystem services (Carpenter and Folke 2006). In socio-economic domains, transformations may involve new governance arrangements, new institutions, altered norms and values, or different livelihood practices (Gelcich et al. 2010, Rosen and Olsson 2013). In adopting a SES perspective for our research, however, we are seeking to understand the interplay of change across both social and ecological systems, rather than within the separate subsystems. Correspondingly, transformations involve more than the physical, measurable aspects of SES – they include changes in mental models, perceptions and understanding of SES.

Social-ecological change will mean different things to different people because they place values on certain ecological or livelihood elements, carry cultural and emotional ties to places and activities, or express other interests related to livelihoods and wellbeing (Larson 2007, Bischof 2010, Bennett and Dearden 2014, Loring et al. 2014). The desirability of different SES identities is thus normative and subjective, and that influences our characterization of social-ecological transformations in terms of system identity. Determinations about the occurrence of transformations often depend on where one 'sits in the system' (Waltner-Toews et al. 2003) and whether SES changes challenge or aid their own interests. We contend

that these normative dimensions must be more explicitly taken into account in transformations research since opinions about what people consider as important ultimately guide decisions and actions to respond to change (Cronon 1992, O'Brien and Wolf 2010, Amundsen 2012, Armitage et al. 2012). Thus, the framework we present in this paper draws on local resource users' perceptions about their livelihoods within the context of SES and their role in environmental changes.

The potential for alternative SES configurations hints at *system identity* as a way of comprehending transformations (Cumming et al. 2005). A social-ecological transformation can be considered as a fundamental shift in system characteristics that results in a qualitatively different system identity (Cumming et al. 2005). The example that Gelcich et al. (2010) provide for this type of transformation involved a coastal marine ecosystem in Chile that was overfished and facing other drivers of degradation. Destabilization of the political regime opened the opportunity for new governance arrangements based on local tenure rights for fisher collectives that promoted new fishing policies and practices. Thus, the identity shifted to small-scale artisanal fisheries and a governance network of cooperative fisher collectives, yet the authors do caution that the new system is still taking shape as adjustments are made (Gelcich et al. 2010).

Transformative re-organization has been viewed as intentional on the part of groups with the power and authority to instigate change (Olsson et al. 2008, Biggs et al. 2010, Chapin et al. 2012), and as a phenomenon that can emerge unexpectedly as a result of anthropogenic and natural forces (Batterbury et al.1997, Scheffer et al. 2001). Regardless of whether transformations are intentional or emergent, we need rigorous research frameworks to assess what constitutes transformational change. We suggest that a broad understanding of what is transforming – as well as cross-scale interactions, sources of novelty, and agency of various actors – is an important entry point for engaging with debates about political and normative aspects of SES change and deliberate transformations. Ultimately, we seek to develop an approach that helps provide insights into the governance implications of social-ecological

transformations once an empirical understanding of their occurrence has been developed.

3.3 A Framework To Assess Transformations Through System Identity

If transformations research is to yield useful and novel contributions to our understanding of social-ecological change, scholars need to consider whether it is relevant and accurate to label empirical cases as transformative. We address this need by placing a greater emphasis on the relevance of social-ecological changes for livelihoods and situating the research within inherent normative and value-laden contexts, rather than expecting objective and apolitical information (Armitage 2008, Brown and Westaway 2011, Béné et al. 2012).

Resilience literature contains a robust collection of methods for assessing resilience and transformations (e.g., Resilience Alliance 2010), yet there are well-known pragmatic issues with empirical research (Walker et al. 2004, Carpenter et al. 2005). Models are often data intensive and require observations of variables at multiple levels over long time periods, quantifying variables that provide system continuity (slow variables) and those that drive change, and then parsing out feedbacks and noise with limited degrees of certainty. These problems are amplified in data poor cases, such as developing countries where long-term monitoring has not been established (Béné et al. 2011). Furthermore, studies that privilege ecosystem data are not geared towards capturing normative dimensions of resource management challenges. Beyond these limitations, there has also been discussion among resilience scholars about the value of measuring individual components of a SES when we are most interested in using *resilience thinking* as a mindset and an approach for understanding the resilience of a system as a whole (for example, see Quinlan 2014 and Gordon et al. 2014).

We draw inspiration from a framework by Cumming et al. (2005) that uses four categories to define features of a SES identity: *elements,* such as objects, species, and people that make up a system; *relationships*, meaning the interactions between and

processes that link components; sources of *continuity*, which we interpret as factors that maintain resilience and system identity and may be slow-changing; and sources of *innovation*, which are endogenous or exogenous factors that introduce novelty to the SES and may contribute to or erode resilience. These categories are captured within our approach, although we prioritize the value of local resource users' experiences and knowledge for understanding SES identity to assess whether a system has crossed key thresholds.

We appreciate the conceptual basis of approaches that attempt to track potential thresholds for individual system elements (e.g., governance arrangements, landscape patterns) as a basis for ultimately determining if system identity has transformed (e.g., Huong 2010, Robinson and Berkes 2010, Blythe 2014). However, there remain significant challenges and limitations in attempting to determine which are the controlling, slow-changing variables that determine resilience. We argue that transformations research must also include studies that take a broad view of how the introduction of novel elements or processes alter interactions and performance across the system as a whole. Accordingly, we explore the utility of using a broad SES lens for defining the object of study and a holistic consideration of SES characteristics and processes.

Recent convergence of resilience with socio-technical transitions literature has helped inform the ways that we understand how historical phases unfold (e.g., van der Brugge and van Raak 2007; Foxon et al. 2009; Fischer-Kowalski and Rotmans 2009; Smith and Sterling 2010). We do not directly address the commonalities and differences in these literatures, although we hope that our framework and empirical work can contribute to ongoing advancements in thinking. Whereas socio-technical transitions literature offers useful ways of looking at mechanisms and pathways of change, the emphasis from resilience thinking on social-ecological linkages and the use of thresholds as a concept were particularly important for the development of our framework.

In resilience literature a threshold refers to a hypothetical point in space-time that separates alternative basins of attraction or dependent pathways (Scheffer and Carpenter 2003; Briske et al. 2010). There are indications that as SESs approach thresholds, environmental variations become amplified and instability can be observed at multiple levels (Carpenter and Brock 2006; Dakos et al. 2008; Scheffer 2009). Crossing a threshold can occur through a single event (sharp and abrupt) or manifest through a series of small, incremental changes (slow and gradual). Recent studies have demonstrated the utility of investigating socially defined thresholds through the desirability of alternative system configurations or identities (e.g., Béné et al. 2011; Biggs et al. 2011; Parlee et al. 2012). The concept of 'thresholds of potential concern' has been applied as a means of exploring the relationship between real biophysical thresholds, social construction, and preferences (Biggs et al. 2011). Christensen and Krogman (2012) suggest that thresholds can be conceived as fuzzy boundaries that separate desirable and unacceptable conditions. Similarly, O'Brien and Wolf (2010) argue that the ways that people respond to social-ecological changes depends on what those changes mean for them and whether changes affect their wellbeing or not. Similarly, our interest lies less in the precise location of thresholds, and more on the implications of thresholds for ecosystems and livelihoods. To identify possible thresholds between unique SES identities, we use resource user knowledge and perceptions as qualitative surrogates (Bennett et al. 2005; Carpenter et al. 2005) of current and historical SES elements, interactions, and sources of continuity and novelty.

The ways that we understand and empirically assess social-ecological transformations is summarized through four points of interest (Table 3.1). Our assessment flows from defining the object of study, identifying key SES elements and interactions, analyzing historical SES dynamics, and reflecting on the possibility of thresholds and a SES transformation. There is some progression in moving from one point of interest to the next, although the assessment need not be rigidly sequential. The inclusion of a historical analysis is inspired by the Resilience

Assessment workbook (Resilience Alliance 2010) and is common in livelihoods research (e.g. timelines used in participatory rural appraisal tools).

Table 3.1: Analytical points of interest for conceptualizing and perceiving social-ecological transformations.

Points of Interest	Analytical Attention
Object of study	Define the scope and boundaries for the system or object of interest. What is the system that is undergoing transformation? Any consideration of transformations requires delineation of the system's spatial, environmental and social dimensions. Involves transparency about why things are treated as part of the system or as externalities. Whether or not a transformation is perceived is closely connected to the scale of analysis.
Key SES elements and interactions	Identify key elements and interactions among them. Selection of SES elements that are relevant for system identity focuses on system attributes that researchers and/or local actors are most interested in. The process of selecting key elements is guided by earlier selection of scope and scales for analysis. Elements can include human actors, ecosystems/habitats and abiotic variables. The interactions between elements can include natural cycles (e.g., nutrient, hydrological), food webs, economic incentives, or governance arrangements. The focus of analysis relates to the question: how do changes in key elements lead to changes in other elements and the SES as a whole?
Historical SES dynamics	Analysis of historical events and patterns of interaction help to tease out long-term processes that influence SES resilience and transformation. Sources of continuity can be analysed as slow variables that control and perpetuate the system, and can also be considered in terms of path dependence or lock-in traps. Novelty within the system can arise bottom-up or top-down and, depending on scope, may be viewed as endogenous or exogenous drivers of change.
Thresholds for system identity	Critical reflection on earlier points of interest help to assess the possibility that thresholds have been crossed or may be approaching for the object of study (rather than for individual elements). Of interest is the social context of thresholds in terms of how people anticipated or responded, and the implications of a new system identity for wellbeing.

If a transformation has occurred, it should be possible to describe and characterize whether the transformation was emergent or if there was intention (with specified goals), the potential for reversal, predictability, and the pace of changes. The approach we present here could be tailored to provide a starting point to further investigate barriers to change (Burch 2010), possible leverage points (Westley et al. 2011), or consequences for wellbeing (Armitage et al. 2012, Coulthard 2012). Assessments of transformation based on resource users' knowledge and perceptions can help to surface information about desirability of alternative system

identities for local people and how different actors have played a role in fostering change (see also Narayan et al. 2001; Nayak and Berkes 2010).

3.4 Methods

The case study presented here is based on field research conducted primarily with small-scale fishers and aquaculture farmers. The intent of the field-based methods was to gather in-depth knowledge about SES changes as they relate to local livelihood activities and ecosystem conditions (de Vaus 2006, Yin 2006). Our approach requires recognition of the importance of epistemological pluralism and acknowledgement that there can be multiple interpretations of system identity and thresholds (Miller et al. 2008, Nielsen and D'haen 2014). Our aim was to build up a rich and holistic understanding of this particular case, rather than make generalizations about social-ecological transformations (Flyvberg 2006, Maxwell 2012). The case study approach was paired with an emphasis on community-based research that is sensitive to local interests, cross-cultural issues and is oriented towards embracing local knowledge and the expertise of local resource users (Gibbs 2001, Tuyen et al. 2002, Pearce et al. 2009). Collaboration with researchers at the Hue University of Agriculture and Forestry (HUAF) was integral for vetting and refining specific field-based tools and facilitating the research.

There is a strong foundation of research that has established the value of local and traditional knowledge – especially from resource users – as a source of detailed information about ecosystem processes and changes over long time frames, as well as an expression of local values (e.g., Blaikie et al. 1997, Berkes et al. 2000, Krupnik and Jolly 2002). A caution when relying on local knowledge is that resource users' experiences and observations are often most useful for confirming system interactions that relate directly to their livelihoods, rather than objective information about underlying SES processes (Gilchrist et al. 2005, Ruddle and Davis 2011). A second limitation of this approach is that gradual changes may not be perceived in any meaningful way by local stakeholders, yet drivers of change on different levels could be pushing a SES towards thresholds (Norberg and Cumming

2008; Boonstra and Nhung 2011). Elevated levels of phosphorous, for instance, cause eutrophication but phosphorous is generally not detectible without instrumental measurements.

We drew on the personal experiences and specialized knowledge of local resource users and other stakeholders in the Cau Hai lagoon to understand the implications of SES change in relation to their livelihoods and wellbeing. We used a form of thematic narrative analysis (Bryman et al. 2009) to elicit information from resource users' reflections on, and interpretations of, their experiences and their perceptions of changes ongoing in the lagoon, rather than expecting them to directly uncover specific 'truths' about key characteristics of the system (i.e., elements, relationships, continuity, and novelty) or changes in SES identity. Our approach is dependent on openness to multiple types and sources of data to triangulate our analysis.

3.4.1 Study Location

The Tam Giang lagoon complex comprises four interconnected lagoons and we resolved to focus on one of these areas to allow for clear delineation of system boundaries. The southernmost area, the Cau Hai lagoon (Figure 3.1), was selected due to a combination of physical characteristics as a distinct open water area. The brackish water Cau Hai lagoon receives saltwater from a single opening (Tu Hien opening) to the South China Sea and fresh surface water runoff from numerous rivers originating in the hill regions that surround the lagoon on the inland side. Political boundaries also roughly follow these physical features. The open water area of the Cau Hai lagoon is approximately 9,800 hectares and is bordered by seven communes and one town. Fishing communities around the lagoon have been identified as having high rates of poverty, even in comparison to national averages for rural areas (Tuyen et al. 2010). For analytical purposes we defined physical boundaries *a priori* as the water environment and adjacent communities. As we explain in the Results and Discussion below, these classifications were not unconditionally accepted, but research participants generally accepted the Cau Hai lagoon as the focus of the research.

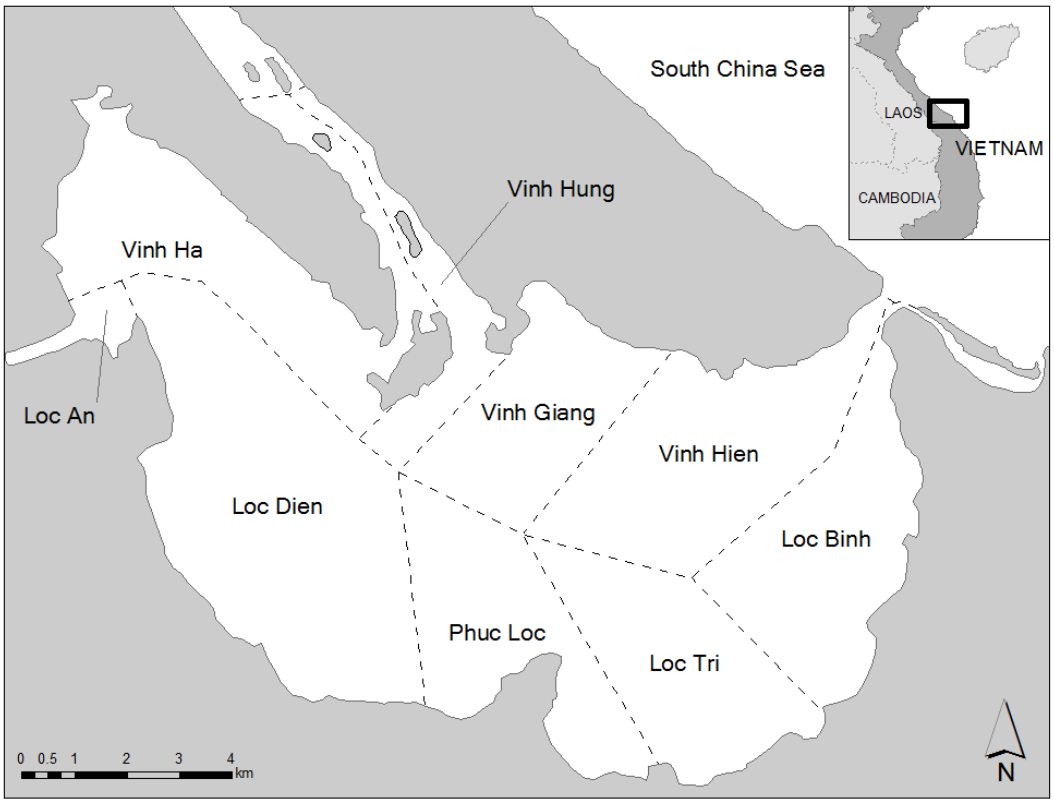

Figure 3.1: Communes and towns around the Cau Hai lagoon, central Vietnam. Dotted lines indicate the territories within the lagoon typically occupied by each commune/town.

Earlier studies related to transformations have identified significant social and ecological changes across the Tam Giang lagoon (e.g. Huong 2010, Armitage et al. 2011, Boonstra and Nhung 2011). The details of interplay between environmental change, economic change, livelihoods and governance will be discussed later in this paper. The Cau Hai lagoon brings together an interesting context for transformations research due to several decades of SES changes and the recent introduction of new property rights and co-management arrangements. A total of 16 Fishing Associations (FAs) have been established in the Cau Hai lagoon, as summarized in Table 3.2. Each FA contains members from each of the major groups of resource users in the lagoon: mobile gear fishers, who are typically the poorest households and employ simple fishing gear (e.g., bottom-traps called *lu* nets); fixed gear fishers, who own gear that is attached to the bottom of the lagoon (e.g., fish corrals); and aquaculture farmers (can take the form of ponds or fish cages). The

lagoon has now been zoned to facilitate the establishment of a territorial user rights for fishers (TURFs) system and co-management between FAs and local government.

Table 3.2: Summary of Fishing Associations in the Cau Hai lagoon. Main research activities involved Giang Xuan FA, Loc Binh 1 FA, and Phu Loc FA.

Name of Commune / Town	Name of Fishing Association	Lagoon Area (ha)	Year Fishing Association Established	Number of Fishing Households	Number of FA Member Households	Year of Rights Allocation
Vinh Giang	Giang Xuan	997	2008	216	125	2009
Vinh Hung	Trung Hưng	370	2012	205	139	2012
Loc Binh	Loc Binh 1	987	2003	107	100	2010
Loc Binh	Loc Binh 2	367	?	220	98	2010
Vinh Hien	Dam Pha Vinh Hien	924	2008	200	100	2011
Vinh Hien	Nuoi ca long Vinh Hien	224	2010	90	70	2011
Vinh Hien	NTTS Vinh Hien	230	2008	200	148	2011
Vinh Ha	Ha Trung 5	32	2007	90	62	?
Vinh Ha	Ha Giang	37	2012	115	70	?
Phu Loc town	Phu Loc	1130	2009	190	182	2010
Loc Dien	Luong Chanh	441	2008	99	75	2011
Loc Dien	Mieu Nha	651	2008	120	97	2011
Loc Dien	Thach Son	714	2008	110	102	2011
Loc Dien	Trung Luong	566	2007	210	175	2011
Loc Tri	Dong Hai	530	2009	150	130	2010
Loc Tri	Le Thai Thien	557	2009	164	120	2010
Loc An	(no fishing association)	200	n/a	30	n/a	n/a

3.4.2 Field Methods

The research took place over a five month period in 2012-13 and a verification field season in 2014 and investigated the perspectives of fishers in three FAs around the Cau Hai lagoon (Giang Xuan FA, Loc Binh 1 FA, and Phu Loc FA). Selection of the FAs was based on geographic variety (e.g., proximity to the sea opening influences salinity and composition of species), differing levels of progress towards TURF rights allocations, and history of relationships with HUAF researchers (see Table 3.2). Fieldwork included a set of nine focus groups with fishers that formed the main data set described in this paper, together with 15 semi-structured interviews with key informants (e.g., FA leaders, researchers, government agents). Three focus

groups took place in each community (8-10 participants in each focus group) and were designed to promote discussion among participants to generate new insights and facilitate open deliberation of differing views (Crang and Cook 2007, Seal et al. 1998). The three sub-groups of fishers (mobile gear, fixed gear and aquaculture) were targeted separately in order to prioritize the opportunity for marginalized groups (particularly the mobile gear fishers) to express their views. Focus groups took place in the homes of FA leaders or in community buildings.

The focus groups worked through a series of exercises to elicit information about key SES elements, interactions among elements, sources of stability, local and external disturbances that threaten key elements, and significant historical events and trends. These tools were inspired by community dashboards developed by Béné et al. (2011) and participatory diagnostic approaches used by Robinson and Berkes (2010), although we note that other approaches such as scenarios could also have been used to address desirability of system identities. By combining the expertise of Canadian and Vietnamese researchers, the focus group activities were tailored to be suitable for local culture, and appropriate for the interests of the research participants (i.e., based on local knowledge). Table 3.3 summarizes these activities and highlights their connections to the system identity framework described above (see Table 3.1).

Table 3.3: Steps and activities in the focus groups.

Activities	***Relevance for system identity***
Generate list of important livelihood and environmental elements in the lagoon. Create influence diagram by drawing and explaining connections between system elements.	Provide a basis for understanding key SES elements and their relevance from the perspective of participants.
Remove elements one at a time from influence diagrams and discuss consequences for other elements and their livelihoods. Card sort elements into three piles: most important, somewhat important, least important.	Further examine the importance of elements relative to the broader system. Removal of certain elements reveals some sources of stability and drivers of change. Encourage participants to think about which elements are most important for the lagoon ecosystem and for their wellbeing.
Participants create a timeline of important historical events, and then indicate changes to system elements	Pull out historical information about system elements to understand trajectories of change over time with respect to participants' interests. Further information

over this time.	about longer term and broader scale influences on system SES resilience and novelty. Provides insights into changes in SES identity over time, and the possibility of distinct phases and thresholds for system identity.

3.5 Results And Analysis

3.5.1 Object Of Transformation

We defined the scope of the SES as the lagoon and surrounding land, and administratively as the commune, district and provincial government agencies that correspond to the Cau Hai lagoon. Focus group participants then determined what elements were included with respect to fishing and aquaculture in the lagoon. Larger-level processes such as climate and economic forces were viewed as part of a nested system. As we will reflect on in the Discussion, our framing of the object of transformation was somewhat different from local resource users' point of view and this was problematic in some ways. For example, fishers tended to focus on very specific areas within the lagoon where they conduct their livelihood activities and they seldom brought attention to the interconnections with larger level processes. Nonetheless, we adopted a set of boundaries that best suited our object of transformation and a synthetic perspective of feedback from the diversity of research participants.

3.5.2 Key SES Elements And Interactions

Part of our methods entailed detailed discussion with fishers about important system elements and the interactions among them. As shown in Table 3.4, the types of SES elements identified by participants were extensive (grouped categorically in the table for ease of presentation), although the ways that participants in each focus group placed emphasis on different elements was highly variable. We anticipated differences in perceptions between different gear users but expected that we would see more consistency among fishers who use the same gear across all communities (e.g., similarities among mobile gear fishers in Vinh Giang, Phu Loc and Loc Binh). Instead, a key insight generated from these results is that even within this relatively small area there is significant diversity in the ways that people interact with the

lagoon, which in turn frames their perceptions of how this system functions. We learned to appreciate how people experience and perceive change (and the scope and extent of change) in the lagoon in diverse ways. The reporting below emphasizes the similarities and differences in the ways that focus group participants explained the relevance of SES elements, as well as the interconnections between elements.

Table 3.4: Key SES elements identified in focus groups. All elements identified during focus groups are listed; elements identified as 'most important' are indicated with 'x'.

Categories	Vinh Giang			Loc Binh			Phu Loc		
System Elements	Aquaculture	Fixed gear	Mobile gear	Aquaculture	Fixed gear	Mobile gear	Aquaculture	Fixed gear	Mobile gear
Environment & Climate									
Water quality	x	x	x	x	x	x	x	x	
Water temperature				x		x	x	x	
Salinity							x		
Rainfall		x		x				x	
Storms									
Floods									
Protected areas									
Wind									
Fishery products									
Shrimp		x			x	x		x	x
Crab									x
Fish (freshwater or brackish species)		x			x	x		x	x
Seagrass									x
Seaweed									
Aquaculture									
Area of aquaculture ponds	x						x		
Shrimp fry/fingerlings	x						x		
Crab fry/fingerlings	x								
Fish fry/fingerlings	x			x					
Feed for aquaculture (natural & industrial)	x			x					
Fishing									
Boats									
Gear (all types)									x
Fish corrals (fixed gear)					x			x	
Chuom (fixed gear)								x	
Lu nets (mobile gear)			x			x			
Seine nets (illegal mobile gear)									
Electric fishing (illegal mobile gear)			x						
Open water ways			x						
Number of gear			x						
Community									
Support from community (e.g. labour)									
Support from local government									
Fishing Association					x	x			
Local knowledge (sharing of)									
Number of fishing households									
Fishers from outside (illegal)									
Market									
Market demand and prices		x							
Capacity									
Financial capital	x	x		x			x		
Technique / experience	x	x							

We asked whether any of the system elements, if removed or changed, would shift dynamics across the entire SES. Rather than a single element (e.g., a key species or social relationship), virtually all focus groups talked about "water conditions" (Table 3.4) as way of indicating the combination of factors that influence habitat and availability of the species they typically catch. The interrelationships between rainfall, wind, currents, and water temperatures create an uneven gradient of salinity over time, which in turn impact different groups in unique ways. For instance, Loc Binh mobile fishers explained that goby fish (*Gobio gobio*) are currently their most profitable target species and that these fish require salinity between 15-25 percent and temperatures between 20-32 degrees Celsius. When seawater intrusion pushes water conditions outside of these ranges the goby migrate further inland and away from Loc Binh's fishing zone. Comparably, Loc Binh fixed gear fishers described how heavy rainfall in the nearby mountains can cause flooding in the lagoon, especially as the rainy season commences in October and November. If flooding lasts for three to five days it can be beneficial for bringing more nutrients and potentially push mass movements of fish towards their corrals since they are adjacent to the sea mouth. However, they also noted that floods lasting longer than five days cause them stress because salinity levels drop too low and desirable species are washed out of the lagoon. The focus groups, thus, were effective for uncovering and explaining how users of different gear types in the same location led to different perceptions about the feedbacks and importance of different system elements.

Research participants consistently brought attention to specific factors that impact the ways that they practice their livelihoods. For fixed gear fishers – who chiefly rely on fish corrals, which are stationary "V" shaped net structures that according to current regulations span 150 by 350 meters – this generally surfaced around their ability to access economically valuable species of fish and shrimp. In Loc Binh, fixed gear fishers pointed to the size and position of their fish corrals as playing the

strongest role, whereas in Vinh Giang they felt that salinity levels and incursion of fishers from other communities using illegal electrical gear had the most significant impact on their livelihoods. In contrast, mobile fishers in Vinh Giang placed greater importance on the density of both fixed and mobile fishing activities in the lagoon (expressed as the number of households involved in these activities). They explained that open waterways, which is the space around fish corrals where they are allowed to fish and which they use for navigation, were a key factor in their ability to fish.

When we inquired about the influence of the FAs and government, participants often framed their responses as though these institutions exist 'on paper' but are not active in reality. This was particularly evident in Phu Loc since local FA currently does not receive much support from the town government or have capacity to enforce bylaws. In contrast, Loc Binh has a strong and functioning FA that is involved with micro-financing for members and supports management activities such as establishment of a habitat protection area. The reality for fishers in the Cau Hai lagoon is that the new TURF arrangements and FAs have uneven impacts across the communities – thus, they were often excluded as key elements that influence their livelihoods or SES interactions.

The main intent of this part of our analysis was to highlight how change can trickle across the SES and potentially contribute to a transformation (Table 3.1). Although there were limitations in obtaining an objective set of key elements, the findings here did illustrate an understanding of the system from fishers' perspectives and provide a basis for our historical analysis. It is clear that biophysical processes such as storms are perceived by fishers to have been greater change agents than recent governance initiatives.

3.5.3 Historical Analysis: Interplay Between Continuity And Novelty

The next step in our analysis of changes in SES identity was to consider historical sources of continuity and novelty through participant-defined timelines that were

collected during focus groups. There is a strong need to understand the ways that past system conditions have shaped the trajectory of development within SESs, especially with respect to the interplay of social versus ecological drivers of change (Heinmiller 2009, Gelcich et al. 2010, Nayak 2014). Discussions were examined to uncover how fishers describe key historical events and changes related to their livelihoods and help understand fishers' perceptions of how SES identity has changed over time. Three distinct phases of social-ecological change are apparent in the lagoon (summarized in Figure 3.2): *economic and technological build-up* (1985-1999), *resource boom and overcrowding* (2000-2007), and *collective planning and rights allocations* (2007-present). Interpretation of these phases was verified through follow-up workshops with fishers in June 2014. We are careful to point out that these phases do not necessarily represent distinct system identities.

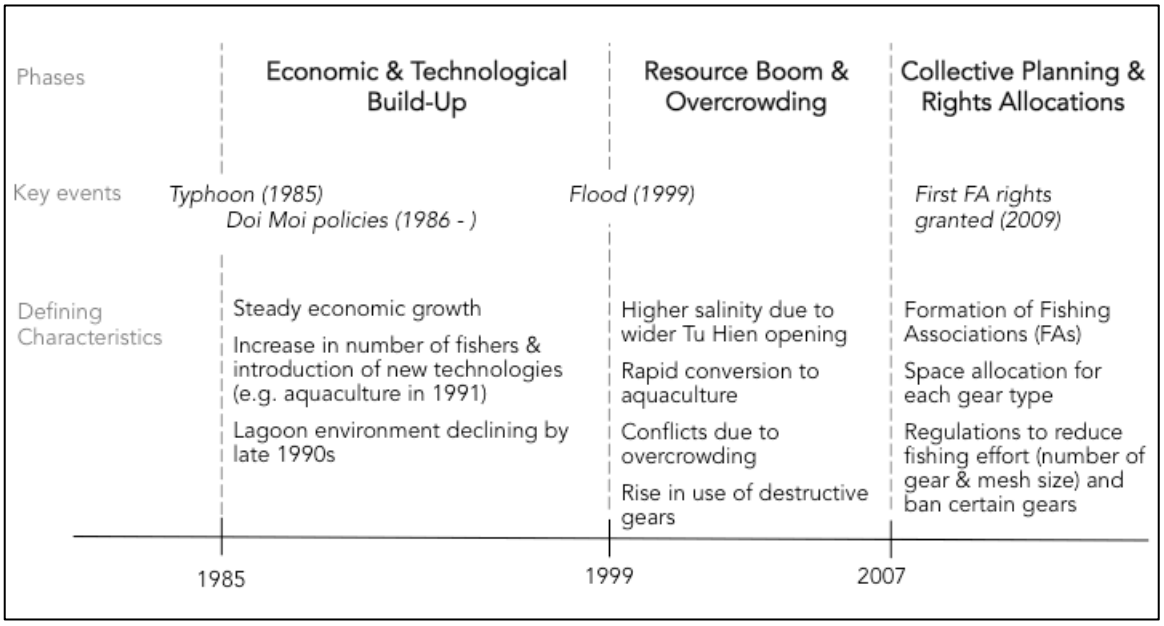

Figure 3.2: Phases of social-ecological change in the Cau Hai lagoon.

The *economic and technological build-up* phase was characterized by expansion and intensification of fishery-related activities. At this time the lagoon was mostly freshwater since the Tu Hien opening to the South China Sea was narrow. A major influence during this phase was the initiation of *Doi Moi* economic reforms by the national government beginning in 1986 that oriented the country towards an open

market economy. Livelihoods for fishers were improving as more opportunities became available for income generation through fishing activities, which in turn enabled acquisition of more gear and livelihood assets. Aquaculture first appeared but was slow to gain in popularity due to (1) the financing required for start up and (2) early adopters were not seeing high profit margins as the freshwater environment not conducive to production of shrimp and market prices for shrimp were still relatively low. From the perspective of focus group participants typhoon No. 8 (Cecil) that struck in October 1985 was significant because of the physical damage and loss of lives in the lagoon (DaCosta and Turner 2007 describe government responses, including settlement of Sampan dwellers into villages). Prior to this storm event fish corrals were built from bamboo but as households rebuilt their corrals they began to make use of more durable and effective gill nets (confirmed also by Mien 2006). These more effective corrals gained in popularity and fishers subsequently made corrals that covered more lagoon space. The array of new activities in the lagoon meant that by the late 1990s ecological conditions had begun to deteriorate.

A flood in 1999 due to heavy rainfall throughout Thua Thien-Hue province had a major role in the system identity of the lagoon. Flooding is not uncommon but this event was exceptional because it widened the Tu Hien opening – a sand formation – and increased exchange of water between the lagoon and the sea. This led to generally higher salinity in the lagoon but also higher variability in temperature and salinity due to faster currents. These new conditions supported a different assemblage of species, and notably an increase in saltwater tolerant species that often have higher market values. Most focus groups noted that the first few years after the flood had ideal conditions for both aquaculture and fishing.

We refer to the period following the flood as the *resource boom and overcrowding* phase (2000-2007), which was characterized by intensification of resource use, overcrowding, and increased marginalization of the poorest fishers. The increased brackish conditions in combination with higher market prices for shrimp led to

substantial profit margins for shrimp aquaculture. Conversion to aquaculture expanded rapidly within the lagoon by enclosing fish corrals (net enclosures) and on land adjacent to the lagoon (upland and lowland ponds), which was enabled by new policies that allowed farmers to convert rice paddies into aquaculture ponds (Nayak et al. 2015). Important policy drivers from national, provincial, and district level that contributed to economic development are discussed in Tuyen et al. (2010) and Armitage et al. (2011). Aquaculture production increased dramatically (Figure 3.3) until a peak in 2004 as diseases began appearing. Without adequate training or regulatory oversight, diseased ponds were being drained into the lagoon, impacting wild species and leading to conflicts with mobile and fixed gear fishers.

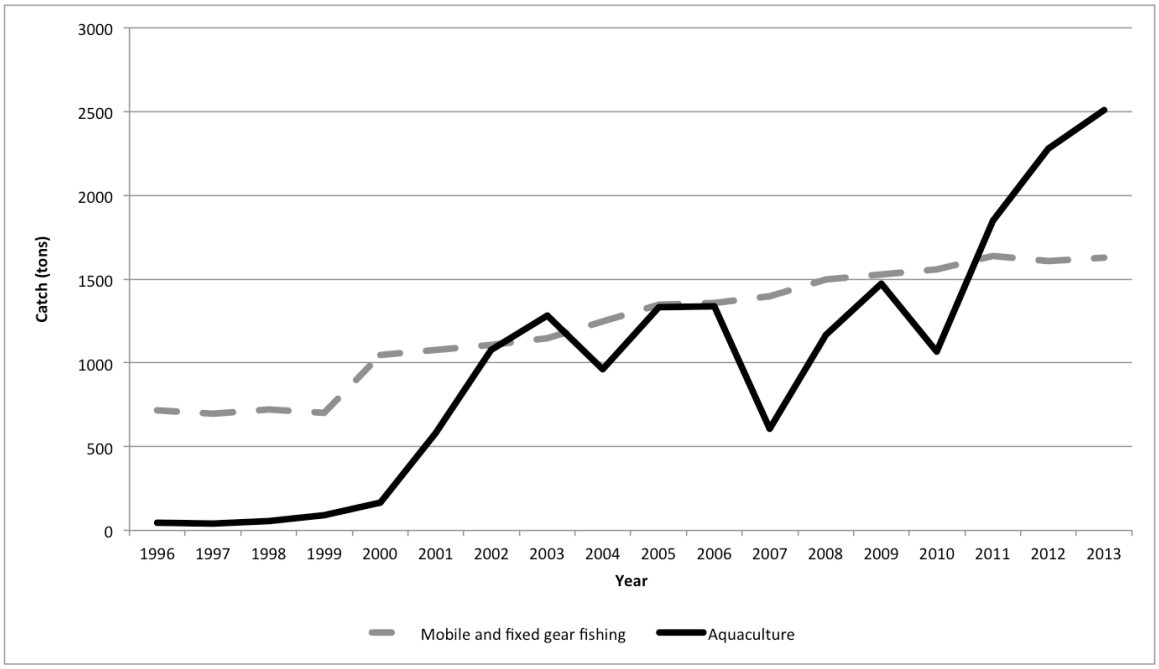

Figure 3.3: Fisheries and aquaculture production in the Cau Hai lagoon, 1996-2013. Data provided by Department of Agriculture and Rural Development, Phu Loc District.

Overcrowding within the lagoon was problematic ecologically and socially. The density of aquaculture and corral nets in the lagoon stagnated water flow to the extent that it led to a host of water quality issues and eutrophication (Marconi et al. 2010). Also within this period cage-line nets (known locally as *lu*) – 15 meter long nets that are placed along the bottom of the lagoon – were introduced and used to

some extent by all groups of fishers, and are now the primary gear type used by mobile gear fishers. The Phu Loc District government estimates that 100,000 *lu* were in use in the Cau Hai lagoon (data provided by Department of Agriculture and Rural Development, Phu Loc District). With very small mesh size, these nets are extremely efficient and have substantial ecological impacts via removal of bottom feeding species. As Tuyen et al. (2010) and Huong and Berkes (2011) explain, traditional property rights regimes based on common pool resources were failing in this period because they couldn't account for new livelihood practices and the ways that aquaculture and fixed gear fishing were in effect privatizing space. The loss of open space was particularly problematic for mobile fishers, who are the poorest households (often formerly sampan dwellers) and faced navigation challenges, dwindling fishing yields, and space use conflicts with fixed gear fishers (see also DaCosta and Turner 2007).

The most recent, *collective planning*, phase in the lagoon (2006 – present) is distinguished by renewed efforts to establish Fishing Associations and co-management through collective property rights and responsibilities in order to improve livelihoods and wellbeing. Government officials and university researchers worked together to devise a model of co-management that would be suitable for local fishers. The processes of forming FAs, capacity building, and development of FA fisheries management plans are described in detail in several recent papers (Tuyen et al. 2010, Armitage et al. 2011, Boonstra and Nhung 2011, Marschke et al. 2012, Ho et al. 2015). Throughout focus group discussions and key informant interviews there was a consistent message that although virtually all FAs in the Cau Hai lagoon have received rights allocations, most are still not performing their management functions. The details of these recent challenges are of interest and key concern, however, with the focus of this paper on way to understand change and transformation, we will focus on the ways that these process related to SES identity.

In spite of limitations among the FAs, the new co-management arrangements have enabled several initiatives: teaching aquaculture operators the benefits of switching

from intensive shrimp monoculture to multi-species 'polyculture'; establishment of three no-take habitat protection areas; and relocation of fish corrals to allow for designated space for fixed and mobile fishing. Ongoing efforts are also aimed towards regulating the number of *lu* nets per household, developing regulations for aquaculture, and planning for more tourism in the lagoon as a livelihood alternative. We note also that interactions between physical changes and fisher perceptions are by no means linear or one-directional. As a result of education programs from HUAF researchers aimed at teaching fishers about the importance of conservation strategies and reducing overfishing, focus groups in Vinh Giang demonstrated new appreciation of their own impacts on the lagoon and changing how they conduct their livelihoods.

3.5.4 Thresholds Between System Identities In A Social Context

As explained above, our interest is not to define a precise tipping point to signify when a critical threshold was, or could be, crossed. Rather, we are interested in the possibility for, and relevance of, a shift from one distinct SES identity to another. What are the livelihood and governance implications of shifting from one identity to another in the Cau Hai lagoon?

Through our historical analysis it was evident that SES elements shifted substantially between the *build-up* and *resource boom* phases. All nine focus groups provided evidence of changes in ecological conditions (e.g., different flora and fauna present in the lagoon), economic conditions (e.g., changes in value of species and availability of different species) and social conditions (e.g., new tensions and conflicts due to space constraints and dwindling fish stocks), as well as new feedbacks between elements. For instance, market prices and saline water conditions were positive feedbacks for the expansion of aquaculture. The confluence of all of these changes led us to unpack the flood in 1999 as a time when a threshold for SES identity was crossed. The flood coalesced a new configuration of system elements and set in motion new feedbacks. We emphasize that the flood was not the

cause of the transformation – its role as part of a fuzzy transition was attributable to the previous series of social-ecological changes.

Several key system elements were not present in the earlier *build-up* phase, such as *lu* nets that were introduced later. Other elements and relationships became much more prominent during the *resource boom* phase, including fish corrals or reliance on shrimp aquaculture. A notable element that disappeared was the traditional property rights regime that was already strained but effectively collapsed as fixed gear fishing and aquaculture farming made common property customs obsolete. We have summarized relevant differences between the SES phases in Table 3.5 with respect to implications for fishers' livelihoods and wellbeing.

Table 3.5: Differences between SES identities with respect to fishers' livelihoods and wellbeing. The Collective Planning phase shows some potential for a third system identity but TURFs and co-management have yet to fully stabilize SES interactions.

Economic and	Resource Boom and	Collective Planning and

Technological Build Up (1985-1999)	Overcrowding (2000-2007)	Rights Allocations (2007-present)
Low salinity water environment; mostly freshwater species	Brackish water environment; mix of freshwater and marine species; stronger currents and higher salinity and temperature variability	Brackish water environment; mix of freshwater and marine species; stronger currents and higher salinity and temperature variability
Open access property right	*De facto* privatization – fixed gear and aquaculture have seized use of lagoon space	Collective property rights – fishers share access rights based on TURFs; limited ability for FAs to enforce regulations without direct government interventions
Wide variety of gear types in use; households mostly follow traditional family practices	Fish corrals and lu nets are dominant gear in use	Fish corrals and lu nets are dominant gear in use; regulations placed on size and number of nets
Few aquaculture pilot sites	Aquaculture enclosures in open water and as mud wall enclosures on shore	Aquaculture only as mud wall enclosures on shore
Limited flushing of lagoon via small sea mouth; slow deterioration of water quality due to household waste effluents	Wide sea mouth opening but rapid deterioration of water quality due to (1) stagnation caused by corral and aquaculture nets, and (2) effluents from household waste aquaculture; occasional algal blooms	Wide sea mouth and improved water flow has led to improved water quality; effluents from household waste still problematic
Households with enough resources purchase equipment for fish corrals	Households with enough resources purchase equipment for fish corrals and/or aquaculture; aquaculture profitability very high	Households feel financial pressure from limitations on gear; aquaculture seen as a greater financial risk due to potential for disease

Focus group participants offered a clear indication that their livelihoods are completely different today compared to their experiences during the *build-up* phase and earlier. This narrative was also supported during interviews with key experts in government and HUAF who reiterated that more has changed in the Cau Hai lagoon than has stayed the same over the last three decades. Expressed through perceptions of local resource users, the social-ecological transformation in the Cau Hai lagoon can be characterized as a shift from (1) a system identity based on a primarily freshwater environment, low fishing intensity and open access property rights to (2) a system identity based on a brackish water environment, high

intensity of fishing and aquaculture activities and a mix of private and collective property rights.

At the onset of this research we expected to see evidence of TURFs and co-management in the Cau Hai lagoon as a catalyst for transformation (see Armitage et al. 2011) and having a stronger role in the current system identity (i.e. a second transformation as a shift from the *resource boom* to the *collective planning* phase). In some ways we do see changes across the SES and there is little question that the Cau Hai lagoon has been under severe stress and was likely heading towards an ecological collapse or crisis before recent interventions. The TURFs and co-management have helped to clarify property rights and reduce conflicts but they have not alleviated persistent poverty traps or significantly reduced the intensity of fishing and aquaculture in the lagoon. Fishers indicated that they still feel trapped – where they have to continue trying to maximize fishing yields in order to make ends meet for their families – in spite of acknowledgement that current practices in the lagoon are still not ecologically sustainable. Furthermore, considering continuing poverty and lack of capacity for developing alternative livelihoods, many focus group participants and key informants do not view the current system identity as more desirable than before TURFs and co-management. As such, there wasn't sufficient evidence to suggest from changes in fishers' perceptions that a second transformation had yet occurred, although the possibility remains open that the lagoon SES is still undergoing a transition.

3.6 Discussion

Grounding our research in the perceptions of local resource users was critical for both characterizing social-ecological change and understanding the normative relevance of different SES identities. Our research emphasized the relevance of drawing on local resource users' perspectives on changes in system identity, and reaffirmed that the ways that fishers perceive social and ecological changes depends on how they are personally affected (consistent with O'Brien and Wolf 2010, Parlee et al. 2012). Our approach enabled useful discussion with resource users that at

times revealed opposing viewpoints, but also qualitatively demonstrated the relevance of drawing on fishers' perceptions of system identity to characterize transformation processes. Rather than isolating and measuring specific controlling variables in the lagoon SES, we were interested in how fishers describe the extent and types of SES changes that may be involved in a switch to a new SES identity. We aim to show that social-ecological transformations cannot be assumed to have either positive or negative outcomes. They are complicated processes driven by many factors beyond the control of any singular individual or group and impact individuals and groups in diverse ways.

Identification of key system elements and perceptions of how historical events have shaped these elements reflect values and interpretations of what people feel is important. We underscore that governance interventions aimed at alleviating persistent problems such as property rights conflicts and poverty (especially those espoused as transformative) need to be sensitive to these community values. During fieldwork and analysis, we observed several ways that the framing of SES change in literature was different from local resource users' perceptions. For example, the ways researchers (vis-à-vis resilience and transformations literature) think about SES thresholds is quite different from the ways that resource users talk about thresholds. Focus group participants discussed thresholds in terms of policies or events that would alter the ways that they are able to pursue their households' needs, such as restrictions on the number of nets per household or the size of mesh allowed for certain gears. Many mobile gear fishers said that plans to require them to use larger mesh size lu would force them to seek income from alternative sources because it is prohibitively expensive to buy new nets. These are important insights that help to understand the implications of governance interventions in the Cau Hai lagoon, but they are quite different from the ways that we set out to think about thresholds between system identities. Thus, in addition to considerations of real versus social construction of thresholds, we point to the relevance of considering

practical differences between researchers and resource users ideas about relevant thresholds (c.f. Biggs et al. 2011).

Our research helps reconsider the relevance of how we, as scholars, frame the benefits of governance initiatives that alter social relationships or resource use systems. We acknowledge the subjectivity in our own conclusions about changes in system identity (see also Cumming et al. 2005, Blythe 2014), and we argue that there are important questions about what counts as a real transformation and how perceptions relate to objective interpretations of SES change. The introduction of FAs, allocation of rights under the TURF system, and establishment of co-management have not (at least yet) led to another new and distinct system identity. The ways that fishers talked about the FAs and TURFs indicated that these elements play only a minor role in the ways that they carry out their livelihoods and that these new arrangements simply introduced new rules for them to follow. Analytical interpretations of this case can be taken in multiple ways: (1) a transformation occurred between the *build up* and *resource boom* phases and a second transformation may now to be underway as a result of governance changes in the *collective planning* phase; (2) a transformation occurred between the *build up* and *resource boom* phases and the current *collective planning* phase is characteristic of localized experiments and re-alignment of SES interactions that can take many years to stabilize. Objective conclusions about ongoing transformations, however, cannot be separated from the diversity of subjective views of, and interactions with, social and ecological processes.

Assessments of "governance transformations" (e.g. new collaborative or participatory processes) need to be aligned with evidence of material changes in human wellbeing and ecological sustainability. Importantly, we need to examine the ways that governance initiatives will be beneficial for some people and detrimental for others (Nayak et al. 2015). Discussions with fishers suggest that TURFs and co-management will only be viewed as transformational if they lead to new outcomes for their livelihoods and ecosystem conditions, not merely changes to management

processes. We suggest that when scholars advocate for transformative change, they need to be aware of locally contested interests and acknowledge competing priorities for fisheries management and human wellbeing. As such, scholars must have greater recognition of the political framings of their research and take steps to acknowledge their positions. Since we are dealing with complex and contested SES we need to take some care not to overstate cases that are potentially transformative, versus those that are definitively transformative. In the Cau Hai lagoon, it is apparent that positive progress has been made with recent governance initiatives but it is unclear if there will be long-term institutional support and buy-in from fishers, and evidence to suggest that SES identity has been altered.

Normative aspects of the potential ongoing transformation require additional attention. How may different groups of fishers benefit or face new risks related to social-ecological changes? For whom might governance changes be beneficial? Now that we have an understanding of some of the competing interests and perspectives in the lagoon, we have a basis to further investigate these questions. As we have shown, although some actors claim that mobile fishers have gained status and a greater ability to fish with the new TURF arrangements, the mobile fishers' themselves feel that the TURFs are still not well suited for the ways that they fish. In other ways, fixed gear fishers have been casualties as well. During relocation of fish corrals in some communities, some households have been forced to either share nets with other households (thus reducing catch and income) or have been forced to abandon their corrals. As co-management partners work to tighten regulations on overfishing – with the broad vision of fishery sustainability – these groups of fishers will face further stresses. Until these issues are addressed and alternative livelihoods gain support, it is unlikely that the current pathway of development will stabilize.

Through engagement with subjective perceptions of change and their implications for livelihoods our research offers a useful entry point for understanding potential for, and consequences of, deliberate transformations in the Cau Hai lagoon.

Although we are able to recognize competing priorities for fisheries management and wellbeing, our conclusions do not fully address the role of power, politics, interests and worldviews in driving potential and real transformations. These are important dimensions that need to be addressed through further work in the Cau Hai lagoon and in the literature more broadly. There is also opportunity to deepen transformations analyses by considering the extent that resource users' perceptions can shape their experiences, and hence, SES interactions and feedbacks. We present our framework as a pragmatic means of analysing messy social and political aspects of emergent and deliberate transformations.

3.7 Conclusion

How can we empirically know if a social-ecological transformation has occurred? We framed our analysis around the notion of SES identity and drew on fishers' perspectives of social and ecological changes to tease out shifts in SES identity over time. Our findings show some promise for the use of local knowledge and the perceptions of resource user communities to understand feedbacks between environmental change, livelihoods and governance, and to characterize social-ecological transformations. In doing so, we place greater emphasis on implications for fishers' livelihoods and wellbeing, rather than seeking positivistic determinations about transformations. It is difficult to draw tidy conclusions about if and when a transformation is taking place, and any claims about transformations should consider the empirical foundations upon which such judgments are made.

We have found that adoption of social-ecological transformations terminology can be most useful when considering normative aspects of SES change. Individual fishers, even within the relatively small group we worked with, demonstrate substantial diversity in the ways that they have experienced and interpreted social-ecological changes. This diversity leads us to redirect our thinking away from whether social-ecological transformations are wholly 'good' or 'bad'. Instead, we need to consider the beneficial and harmful ways that transformations impact various actors. In the Cau Hai lagoon case, the establishment of the TURF system

and co-management has ameliorated some issues surrounding property rights but persistent problems of overfishing, pollution from non-fishing activities, poverty, and empowerment have yet to be resolved. By engaging with resilience thinking and building a community-oriented assessment of how the transformation has impacted people who are part of the SES we were able to open up questions about economic, political, cultural and environmental aspects of undesirable path dependencies and traps.

CHAPTER 4: Territorial use rights for fishers (TURF) implementation shaped by underlying characteristics of governance networks

Overview

Co-managed territorial use rights for fishers (TURFs) have shown promise for small-scale fisheries management. However, there is limited research into the associated governance network processes and structures that lead to their effective implementation. To investigate the underlying aspects of governance that position co-managed territorial use rights for success we combined social network analysis of 16 co-managed TURFs in the Cau Hai lagoon, Vietnam with in-depth interviews and focus groups. Our findings draw attention to several lessons to support successful implementation of co-managed TURFs: (1) the design of co-management agreements needs to attend to the association between spatial proximity of TURFs and actor proximity in networks; (2) as bundles of fisheries management responsibilities are decentralized through co-management, TURF leaders need capacity for collaboration with other local fisheries leaders; and (3) key actors can support collaboration by using their influential network positions to advocate for resources for TURF leaders. These findings highlight ways that TURFs – especially those clustered together within coastal marine ecosystems that are tightly connected – can function in complementary ways.

4.1 Introduction

Territorial use rights for fisheries (TURFs) have been introduced in coastal areas and lagoons to clarify access and management rights, mitigate conflicts, and reduce ecological impacts (Ruddle 1987; Gutiérrez et al. 2011; Marschke et al. 2012; Aburto et al. 2013). Many TURF initiatives also involve some form of co-management arrangement, where fisher organizations enter into agreements with government agencies and other stakeholders. As with other applications of co-management, bundles of territory-based rights for groups of fishers are linked to devolution of responsibilities for fisheries management (Berkes 2010; Cinner et al. 2012b).

Recent literature has emphasized that certain institutional arrangements – such as tenure duration and the nature of community involvement – influence TURF performance (Auriemma et al. 2014; Quynh et al. 2017). Important questions remain, though, about governance network processes and structures that lead to effective implementation of co-managed TURFs.

Establishment of TURFs in the Cau Hai lagoon, a coastal system in central Vietnam, involves a series of 16 co-management agreements signed by Fishing Associations (FAs) with local commune and district government agencies. The water surface is now divided geographically to correspond with areas used by communities around the lagoon, and then sub-divided within TURF zones to designate space for aquaculture, fixed gear fishing, mobile gear fishing, navigation, and habitat conservation. These arrangements were designed to address overcrowding and property rights issues (Tuyen et al. 2010; Boonstra and Nhung 2012; Marschke et al. 2012) and have shown some promise for reducing ecological impacts from intensive fishing (Armitage et al. 2011; Andrachuk and Armitage 2015). The Cau Hai lagoon case provides an interesting and relevant opportunity to examine network characteristics that influence implementation of spatial rights and management responsibilities. The formation of multiple TURFs in the Cau Hai lagoon created a network of actors – co-management signatories and other actors who informally play a role in co-management processes – who collectively influence small-scale fisheries and aquaculture.

Accordingly, in this paper we use social network analysis (SNA) in concert with in-depth interviews to empirically evaluate communication and interaction in this emerging network. We identify who is participating in co-management "on the ground" and the extent that they collaborate to resolve challenges for management of aquatic resources. For example, are some people or groups more important or influential than others? Or are there gaps in connectivity that may be inhibiting more effective implementation of TURFs? TURFs have significant potential to address tenure and space-related challenges facing small-scale fisheries (Auriemma

et al. 2014) but there is a need to identify what collaborative network attributes position a co-managed TURF to achieve ecological and social goals.

4.2 Co-managed TURFs From A Network Perspective

Despite the emerging popularity of TURFs, little is known about what aspects of governance networks – in terms of their structure and their function - position co-managed TURFs for longer-term success. For example, Singleton (2000) notes that co-management opens new processes and opportunities for constructive engagement and deliberation. Nonetheless, more recent research on multi-level relationships and governance networks still shows the need for better empirical understanding of social dimensions and network arrangements that are favourable for success of co-managed TURFs (Cinner et al. 2012a; Aburto et al. 2013; Auriemma et al. 2014; Rosas et al. 2014). In particular, we suggest that more attention needs to be given to how groups of actors are interconnected, and how networked relationships ultimately influence effective implementation of rights-based approaches.

Co-management occurs where community and government actors work towards shared goals for livelihoods and ecological conservation. The resulting networks of state and non-state actors are heterogeneous: governments contain multiple agencies at centralized and local levels; communities are composed of multiple groups with overlapping and sometimes competing interests; and there are actors including researchers, NGOs or business interests that are involved with various aspects of natural resource use and management (Carlsson and Berkes 2005; Lemos and Agrawal 2006; Kooiman et al. 2008). Network research approaches recognize that actors are embedded in systems of social relations and, in doing so, can attempt to explain – at least in part – the influence of patterns of relations on the success of co-management (Straton and Gerritsen 2005; Prell et al. 2009; Bodin et al. 2011; Ernoul and Wardell-Johnson 2013; Alexander et al. 2016).

Network analysis is particularly useful for empirical research on co-managed TURFs because it can help reveal information about which people regularly interact with each other, which people or groups are particularly well-connected (indicative of leadership or influence), which groups are marginalized within management, and linkages that are multi-level (Mandarano 2009; Vignola et al. 2013; Keskitalo et al. 2014). The relationships that are revealed reflect opportunities for and constraints to actors' agency and the ways that they are able to participate in co-management processes (Ernoul and Wardell-Johnson 2013). In addition to providing network-wide characteristics, networks research can also help bring attention to actors who have influential roles for bridging other actors or brokering knowledge exchange (Bodin and Prell 2011; Mills et al. 2014; Smythe et al. 2014). Here we address several aspects of a governance network in the Cau Hai lagoon to identify factors influencing implementation of co-managed TURFs: expression of fisheries management decentralization in the network; the relationship between spatial proximity and network connectedness; and the position and potential role of key actors in the network. We do this to support fisheries management by providing information on how to facilitate collaboration between actors who operate at different levels, design strategies to strengthen linkages between certain actors, and leverage important relationships.

4.3 Study Area

The brackish-water Cau Hai lagoon covers 9,800 hectares, encompassing much of the Phu Loc District and a small portion of the Phu Vang District. The lagoon has supported a multi-species capture fishery, although the size and distribution of species has shifted since the late 1980s as fixed fishing gear and aquaculture were introduced and their use increased in intensity (Tuyen et al. 2010; Andrachuk and Armitage 2015). Rates of poverty in communities around the lagoon are high, especially among fishing households (Hong and Thong 2000; Tuyen et al. 2010). Some of the livelihood issues that fishers have faced include conflicts over space use, social and economic marginalization of the poorest *sampan* households, dwindling fish catch rates due to overfishing, and inability to purchase nets with larger mesh to

comply with recent regulations (Brzeski and Newkirk 2002; DaCosta and Turner 2007; Armitage et al. 2011; Boonstra and Nhung 2012).

The current use of co-managed TURFs stems from efforts led by international donor-funded programs in the late 1990s to establish community-based natural resource management (Brzeski and Newkirk 2002). Changes to national and provincial land use and fisheries policies since 2003 have led to some decentralization of management and created opportunities to replace the historically open access regime with collective property rights arrangements. Developments of TURFs specifically commenced in 2005 and has been well documented (e.g. Tuyen et al. 2010; Armitage et al. 2011; Huong and Berkes 2011; Boonstra and Nhung 2012; Marschke et al. 2012; Andrachuk and Armitage 2015; Ho et al. 2015). Between 2005 and 2012 international NGOs and university researchers supported the formation and capacity building of FAs and facilitated the delineation of eight TURF zones (Figure 4.1). TURF zones were delineated by the Phu Loc District government in cooperation with the Integrated Management of Lagoon Activities (IMOLA) project based on predominant areas used by the local communes and town. Some of the zones were further subdivided based on geographic orientation and density of fishing activity (see Table 4.1 for breakdown of FAs).

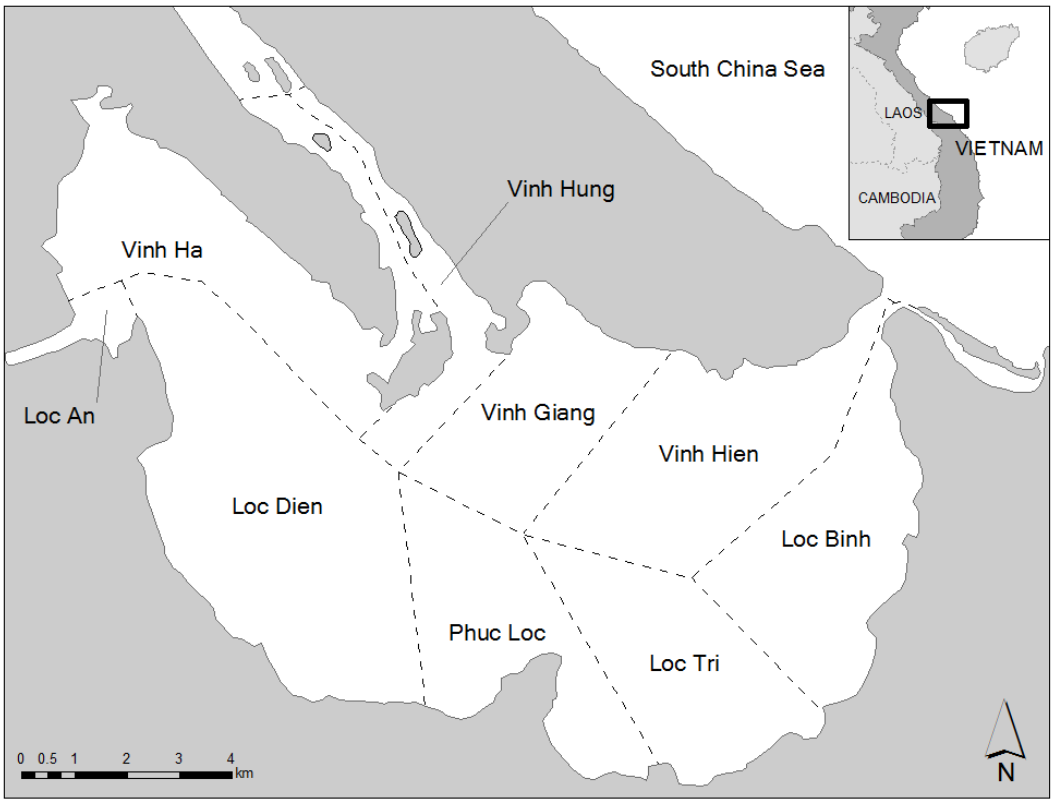

Figure 4.1: Cau Hai lagoon, central Vietnam. Fishing zones are shown with the names of corresponding commune/town (sub-divisions of fishing zones not shown).

Table 4.1: Fishing Associations in the Cau Hai lagoon.

District	Commune / Town	Fishing Association	Year co-management agreement signed
Phu Loc	Vinh Giang commune	Giang Xuan	2009
	Vinh Hung commune	Trung Hung	2012
	Loc Binh commune	Loc Binh 1	2010
		Loc Binh 2	2010
	Vinh Hien commune	Dam Pha Vinh Hien	2011
		Nuoi ca long Vinh Hien	2011
		NTTS Vinh Hien	2011
	Phu Loc town	Phu Loc	2010
	Loc Dien commune	Luong Chanh	2011
		Mieu Nha	2011
		Thach Son	2011
		Trung Luong	2011
	Loc Tri commune	Dong Hai	2010
		Le Thai Thien	2010
Phu Vang	Vinh Ha commune	Ha Trung 5	2013
		Ha Giang	2013

The TURFs are a legal mechanism that gives form to co-management by granting a suite of access rights to individual FAs and establishing commune and district government agencies as supporting stakeholders. The typical rights allocation agreements include a FA, their local Commune People's Committee, and agriculture and natural resources departments from the district government. In principle, the FAs are granted exclusive access to fishing zones and are expected, with support from co-signatories, to implement policies passed down from the centralized national and provincial governments. Ho et al. (2015) found that although power sharing was intended by government, fishers within the Cau Hai lagoon (and the broader Tam Giang lagoon complex) have had limited influence due to: (1) insufficient legitimacy of their power; and (2) a mismatch where commune and district level governments are co-management signatories but most relevant rules and regulations are directed by provincial and national governments. As such, there is a need for further examination of the co-managed TURFs in practice with the aim of improving implementation.

4.4 Methods

This research used a mixed methods design that combined network surveys, in-depth interviews, and focus groups (Hollstein 2014). Fieldwork involved multiple visits to the case site between 2012 and 2014, with most network data collected over five months from October 2012 to March 2013. Methods were devised to be inclusive of the entire network of agencies directly and indirectly involved in rights allocations and co-management in the Cau Hai lagoon. Participants in the research included leaders of FAs, commune government officials, representatives of relevant district and provincial government agencies, university researchers and NGOs. Network surveys (n = 68) and interviews (n = 73) were distributed across all communities in the Cau Hai lagoon and in Hue city with relevant government agencies, NGOs, and university researchers. Four focus groups (participants n = 45) took place in three focal communities (Vinh Giang commune, Loc Binh commune, and Phu Loc town)

4.4.1 Network Data Collection and Analysis

For the collection of network data, we used face-to-face surveys based on the question: *In the past year, who did you talk to most often about issues related to the following topics: (1) rights allocation process, (2) mobile fishing, (3) fixed gear fishing, (4) aquaculture.* Table 4.2 illustrates issues that research participants indicated as typical issues that they discuss with respect to each topic.

Table 4.2: Issues that network actors typically discuss with respect to each topic.

Topic	Example issues discussed between actors
Rights Allocation process	sources of financial support for FAs, meeting arrangements, role of stakeholder agencies
Mobile fishing	regulations for mesh size and number of gear per household, financial support for purchasing/modifying nets with larger mesh
Fixed gear fishing	regulation for relocating fish corrals, regulations for mesh size, financial support for corral rearrangements
Aquaculture	prospects for developing more aquaculture regulations, sources of breeding fish and feed, best practices for aquaculture

Since there was no previous network research in this case it was necessary for us to develop a list of actors and establish network boundaries that were inclusive of the full range of actors who influence co-management. We did not want to exclude actors who might be peripheral or did not occupy formal roles but who had important relationships with actors (potential sources of diversity and novelty). We adopted a combination of nominalist and snowball approaches to define the network population and boundaries (cf. Wasserman and Faust 1994; Prell 2012). Our initial criteria were to include any people in formal positions related to fisheries management in the Cau Hai lagoon (e.g., within Provincial and District government agencies and FAs) and who participated in advisory or support roles (e.g., researchers and NGOs). Due to the extensive list of agencies potentially involved we were not able to identify names of all relevant individuals *ex ante*. Consequently, we used free recall surveys to gather network data and when new individuals were identified multiple times they were added to the network list (Hanneman and Riddle 2005; Weiss et al. 2012). In order to limit potential issues with correctly identifying actors named in the surveys (cf. Borgatti et al. 2013) we took detailed notes of each

person's affiliations (e.g., community of residence, government department) and cross-referenced names on a cumulative master list.

The network we present in this paper includes 90 actors from 39 organizations and government departments, from a total of 68 people who completed the survey (76% response rate). We applied several criteria to determine which actors named in the surveys would be included within our analyses: all actors had to be actively involved in management or collaborations within one year, have a connection to the Cau Hai lagoon (e.g., some FA leaders in other lagoons were named by provincial government officials), and be listed in the surveys multiple times. These criteria eliminated 180 names from the total list of actors who were identified in the surveys. Survey responses were first combined into spreadsheet matrices then network calculations were carried out using Ucinet software (Borgatti et al. 2002). Our analyses are based on individuals, rather than organizations, since network theory was developed with respect to social relations that form between actors (cf. Vance-Borland and Holley 2011). Visualizations of network maps were generated with NetDraw software, using the spring embedding function to lay out actors with stronger connections closer to each other.

Cross-group analysis was used to investigate the ways that predefined groups in the network interact. To simplify the number of organizations – and to better reflect our interest in types of roles that actors play in co-management – we categorized organizations into seven groups: FAs, commune government, district government, provincial government, NGOs, university researchers, and Provincial FA. The cross-group interactions function in Ucinet used a blockmodel to calculate the tendency for actors to have relationships within their own group or with actors from other groups. Densities of ties were reported for each pair of groups, including within-group ties.

Ucinet's Gould and Fernandez's brokerage function was used to look at the ways that groups are connected by individual actors. Gould and Fernandez (1989)

propose five types of brokerage based on (1) sets of three actors (triads) where one actor is the "go-between" that connects the other two, (2) the direction of ties between the actors, and (3) the group membership of each actor. Ucinet found every instance where an actor lies on a directed path between two other actors. We used a 'weighted' approach for calculating brokerage since our main interest was to reveal how groups work together (Hanneman and Riddle 2005). For the weighted calculations, if actor A was the only broker between actors X and Y, actor A would get full credit; whereas if another actor B was also a broker between X and Y, actors A and B would each receive half credit. The output was a simple count of the number of times each actor played each broker role.

We used two analyses to identify key actors and further investigate what roles they play in the network. First we identified actors who play important brokering roles according to Gould and Fernandez brokerage analysis. Second we analysed the potential for actors to play bridging roles by looking at the combination of betweenness centrality and density of ego networks (c.f. Prell 2012). An actor with high betweenness centrality lies on the path between many other pairs of actors who are otherwise disconnected, however, we are not able to know if information actually flows along those pathways. Additionally identifying actors with low ego network density helps determine if an actor also has potential to broker connections across structural holes – that is, connect otherwise disconnected actors (Prell 2012).

With respect to validity, the concern with SNA is the extent that the data collected reflects the network that is being measured (Prell 2012). The intent here was to investigate relationships among actors who are directly or indirectly involved with co-management. One way of ensuring that all relevant actors were captured within the analysis was to use free name-recall instead of allowing participants to select from a predefined list. Predefined lists of actors (rosters) can artificially limit respondents' choices (Wasserman and Faust 1994; Prell 2012). Another way of ensuring validity was to ask a general question ("who do you talk to?") that emphasized communication between individuals. This approach was preferable

over asking a series of more complicated questions that relied on reciprocal ties (Prell 2012).

4.4.2 Interviews and Focus Groups

In-depth interviews gathered perspectives on the perceived purpose of the FAs and TURFs, roles for stakeholders, and improvements and challenges faced under the new governance arrangements. Interviews typically included one or two individuals and were semi-structured to allow interviewees to make connections between topics of relevance for them. All interviewees also completed the network surveys (interviews, n = 73). Interviews were coded and analysed using (1) open coding to identify emergent themes and (2) predefined themes to aid interpretation of SNA results. Focus groups were also instrumental in interpreting SNA results. Each focus group involved approximately 10 individuals from FAs, with approximately equal representation of fishers involved in fixed gear fishing, mobile gear fishing, and aquaculture. These focus groups were developed as a venue for sharing preliminary SNA results with FAs and gathering additional information to verify and explain results.

4.5 Results and Analysis

Results are presented here in several parts. We first map and characterize the network from general SNA outputs. In subsequent sections we combine SNA and in-depth interviews to report on issues that help and hinder success of the Cau Hai lagoon TURFs. These issues are organized around themes of horizontal and vertical orientation of the network with respect to decentralization (section 4.1), spatial and network proximity (section 4.2), and the role of key actors (section 4.3).

The Cau Hai lagoon co-management network is illustrated in Figure 4.2. The pre-defined types of organizations are colour-coded in the network map. Analyses showed that of all the possible ties in the network only eight percent are present (Table 4.3). To understand if low density is a concern for network connectivity, we interpret this finding alongside other factors (Sandstrom and Rova 2010; Prell

2012). Actors in the Cau Hai network are relatively 'close' to each other since the longest distance between any two actors is six ties and average number of ties separating any two actors is 2.6 (Table 4.3). Closeness in combination with high centralization (52 percent) shows potential for information to flow quickly through the network. Thus, in terms of overall connectivity, the low density is somewhat offset by relatively short path lengths and high centralization.

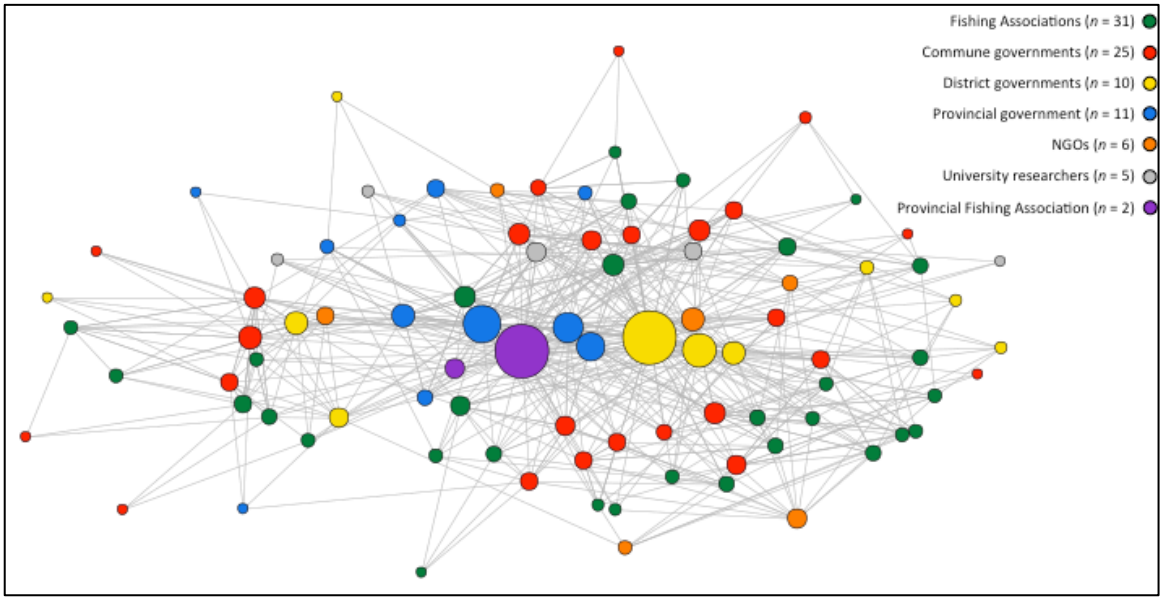

Figure 4.2: Network map of Cau Hai lagoon fisheries management actors. Node size represents the number of ties for each actor. Ties are undirected and indicate one or both actors reported communication.

Table 4.3: Network descriptive measures.

Descriptive Variables	
Total number of actors *Total size of network*	90
Total number of ties *Number of relationships identified by actors*	621
Density *Observed number of ties vs all possible ties* *(1 = all ties present, 0 = no ties present)*	0.08
Average degree *Average number of ties for all actors*	7
Centralization *The network's tendency to center around an actor or set of actors* *(1 = highly centralized, 0 = all actors have same centrality)*	0.52
Diameter *Longest pathways between any two actors*	6
Average path length *Average number of ties between any two actors*	2.6

Although high centralization can be beneficial for efficient information flow, centralization in this network is clustered around only a handful of actors. These key actors are discussed in more detail in section 4.3 but are visually evident as the largest nodes in Figure 4.2. We found that these actors were connected to each other but, according to clique analyses in Ucinet (Girvan-Newman clustering analysis), they do not form their own tightly connected subgroup. There are several implications of asymmetrical centralization for the network. First, although there is potential for a few highly connected actors to exert influence over flow of information in the network, there is limited evidence of a subgroup working in concert to influence information flow. Second, 'potential' for efficient information flow should not be interpreted as a certainty that actors actually do pass along information efficiently or equally. Third, most individuals have very little influence over how information flows in the network. It is evident that there is limited open communication between actors across the network.

4.5.1 Decentralization of Fisheries Management: Horizontal and Vertical Orientation

With co-management we should expect to see strong relationships between signatory groups – in this case, FAs, commune governments, and district government. SNA results for cross-group interactions (Table 4.4) in the Cau Hai lagoon show that FAs are only well connected to district government officials. On the other hand, all three levels of government are relatively well connected to each other. It is noteworthy that the densities of all government-government relationships are higher than the overall network density of eight percent (Table 4.3).

Table 4.4: Cross-group interactions. Values are the density of ties that actors in one group have with actors in another group (0.0 = no ties, 1.0 = all actors in one group have ties to all actors in another group).

Pairs of Organizations by Type		Density of Ties
Fishing Associations	Commune Government	0.11
Fishing Associations	District Government	0.20
Fishing Associations	Provincial Government	0.08
Commune Government	District Government	0.19
Commune Government	Provincial Government	0.20
District Government	Provincial Government	0.24

The strong connections of the provincial government are, in part, a reflection of Vietnam's centralized political system and top-down orientation of policy development. The process for policy development for fisheries and aquaculture starts with the Thua Thien-Hue Provincial government – through the Department of Agriculture and Rural Development – who establish laws and policies such as Decision No. 4260/2005 that formalizes the ability of FAs to receive rights allocations. The province also provides funding to improve programs and training for local government. The Phu Loc District government develops implementation plans that follow provincial policies. At this level, the Department of Agriculture and Rural Development and the Department of Natural Resources and Environment play main roles. Commune governments and FAs are responsible for direct application of those plans. Following the allocation of TURFs, each Commune is responsible for

directing all activities within their TURF territory (Figure 4.1) through shared rights with FAs. As part of the rights allocation process for TURFs, FAs also establish bylaws as long as they are consistent within broader policy structures.

As expressed in interviews, the top-down orientation of fisheries policy clearly surfaced as a tendency for government officials to espouse expert-driven policies and plans as appropriate for resolving fisheries issues. One provincial government official described how fisheries laws and policies are based on the opinions of fishers with respect to the outcomes of research and pilot projects from universities and NGOs. In contrast, FA leaders explained that district and commune government officials will present management plans to FA members to inform them of the purpose of the policies and to gather their opinions. In practice, though, FA members often feel that governments only make minor adjustments to plans, rather than include fisher opinions in the design of management plans. This tendency was also apparent during our second round of focus groups when participants expressed appreciation that the research team had listened to them and recorded details of their perspectives. Evidently, there is a validation in being heard and a need for adequate consultation that is lacking for many fishers.

While policy orientation is clearly top-down oriented, governance of fisheries is more than an expression of top-down power. The roles of different organizations and actors are layered and complicated. Our interviews with officials from the Department of Agriculture and Rural Development (Phu Loc District) revealed how the political system can undermine their department's ability to exert influence over actual fisheries and aquaculture compliance. In one instance the Department of Agriculture and Rural Development had ordered a household using illegal aquaculture practices to empty their pond. The local Commune People's Committee not only overruled this decision, they ordered the district government to pay for the household's lost investment. This consequently has made the Department of Agriculture and Rural Development hesitant to levy such penalties again.

In many ways the co-managed TURFs are seen as a means of improving compliance with fisheries and aquaculture regulations. FA leaders discussed how, prior to rights allocations for TURFs and realignment of fixed fishing gear in the lagoon, fishers did not follow regulations. One FA leader described how before the FA formation there were many fishers who simply weren't aware of fisheries laws – and hence did not know there were policies and plans to follow. Gaining rights of exclusion and rights to protect their own fishing area has been viewed as a positive step for giving fishers some sense of authority and reason for following the district government plans.

4.5.2 Spatial and Networked Proximity

We examined whether the spatial adjacency of FAs in the lagoon conveyed institutional closeness in the network. Cross-group analysis showed that density of FA-FA relationships was 0.04 and Commune-Commune relationships was 0.06. These densities are quite low relative to overall network density of 0.08 and the densities of other group-group relationships in Table 4.4. The low FA-FA tie densities signifies that FA leaders are not communicating with other FAs; note that this is not a reflection of interactions between fishers, who do have strong social bonds. Low Commune-Commune tie densities are not surprising since Commune governments typically deal with management of aquatic resources only within their own community.

In light of the biophysical interconnectivity and proximity between FAs, these findings are important because the lack of FA-FA horizontal connections clearly undermines the potential for successful TURFs. When it comes to enforcement of fisheries regulations, FA leaders repeatedly described how they felt unable to stop illegal activities such as electrofishing. Fishers using illegal gear often have faster boats and are difficult to chase. Once they leave an FA's zone, a patrol team doesn't have authority for enforcement in other zones. FA leaders often know where illegal fishers come from (in some cases they are members of other FAs) but it has been very difficult to punish them. There are no strategies in place for better FA-FA coordination and communication strategies to notify other patrol teams in adjacent

zones. The main communication of FAs with each other has been at large occasional meetings organized by the Provincial FA, rather than regular communication to address specific challenges.

We explored why FA leaders are not better connected in the network or more able to work with each other for management of aquatic resources. A central issue that emerged is design of the co-management agreements for the TURFs. The structure of co-management agreements is based only on vertical relationships. Through review of the agreements for rights allocations to FAs, it is apparent that co-management agreements were set up as relationships between individual FAs with their respective Commune government and the Phu Loc District government. Thus, there are 16 co-management arrangements that are essentially operating independently from one another (with a few anecdotal exceptions). In the process of establishing these agreements there was no apparent effort put into establishing horizontal relationships between FAs. For instance, there are three FAs in Loc Tri that each co-ordinate with the Loc Tri Commune government but they do not work with each other or FAs in adjacent communities. As a result of this institutional design, there is a lack of awareness among FA leaders of the benefits of working together. This is problematic for coordination across the lagoon.

In interviews with commune, district and provincial government officials, there was genuine interest in helping fishers be more involved in management of aquatic resources and in improving livelihoods. However, there were differences in the ways that they talked about these issues compared to FA leaders. Government interviewees emphasized their expectations for improving compliance and efficiency of monitoring and enforcing policies. FA leaders expressed hope that they would receive more support from their commune and district government partners. When asked specifically about the purpose of FAs and TURFs, FA leaders tended to list rights for exclusion, reduced conflicts, education of the importance of conservation, participation in relocation of fixed fishing gear, and monitoring and enforcement. Some government interviewees mentioned the same purposes but

they tended to place more emphasis on FAs as a bridge between fishers and government, with FAs and TURFs as means to improve compliance with fisheries policies and plans.

4.5.2.1 Capacity Differences Across the Network

In addition to institutional design, another issue for FAs involves capacity constraints. The implication of fragmented and minimal communication between FAs is that rights and responsibilities have been decentralized through TURF arrangements, but there has not been corresponding decentralization of capacity for management. Capacity issues notably arise as a lack of resources for FA leaders. Without funds for salary, FA leaders don't have time for all of their duties because they need to continue fishing or aquaculture activities full time. FA leaders are primarily fishers and need to spend their time focused on their livelihoods for income. Some FA leaders have found their position too stressful and lacking personal benefits and are already seeking to resign their role.

Lack of funding also means that they aren't able to purchase gas for patrol teams and aren't able to communicate more regularly (e.g., annual meetings) and quickly with their own FA members and with other FA leaders. In many cases there is also insufficient cooperation from Commune governments to support enforcement efforts, leaving FAs without authority to penalize illegal fishing activity and aquaculture practices. Current laws do not allow FAs to arrest fishers using illegal practices or seize boats and gear. They must cooperate with local Commune authorities to patrol fishing activities.

Fishers who participated in focus groups that reviewed our preliminary SNA findings compared their situation to government officials who are more tightly connected in the network. They observed that government officials, especially at the provincial level, have more time and ability to communicate with each other because they work in Hue city together and have more opportunities for face-to-face interactions. These discrepancies help explain how there are challenges in

coordination in the network at the community level. Without resources and capacity for communication, the FA and commune governments are highly vulnerable to continued fragmentation.

4.5.2.2 Potential for Horizontal Brokerage

We also examined potential sources of brokerage between FAs to determine if there are intermediaries who may mitigate some of these coordination issues. Table 4.5 summarizes the results of the Gould and Fernandez brokerage analysis. Outputs of the analysis were for individual actors and we summed the counts within each group to emphasize the overall flow between groups. Coordinator and consultant brokerage are most relevant for looking at ways of linking FAs since those types of brokerage link actors from the same group. The lack of coordinator brokerage confirms that FA actors are not playing intermediaries within their own groups (e.g., an active FA leader connecting multiple other FA leaders).

Table 4.5: Gould and Fernandez brokerage analysis. The top of the table summarizes the types of brokerage and the bottom portion shows the number of times actors within each group took on those roles.

	Coordinator *All actors in same group*	**Gatekeeper** *External actor approaches broker to reach actor within their group*	**Representative** *Broker represents actor from own group*	**Consultant** *External broker connects two actors from the same group*	**Liaison** *All actors in different groups*	**Total**
Fishing Associations	3	28	47	30	105	213
Commune Governments	3	32	34	62	185	316
District Governments	3	101	23	238	520	886
Provincial Government	10	48	37	37	166	298
NGOs	0	0	0	0	2	2
University Researchers	1	4	3	0	18	26
Provincial Fishing Association	0	0	5	41	370	416

The Phu Loc District government plays a very strong role in consultant brokerage. Of the district government's 238 instances of consultant brokerage (Table 4.5), 127 instances link FA to FA; commune to commune linkages account for another 101 instances. Clearly the district government plays an important broker role here,

although any information sharing between FAs or commune governments through this means is indirect and inefficient. Also noteworthy is that although there are 10 actors in the district government group in this network, only two of these actors are responsible for most of this brokerage as will be further explored in section 4.5.3.

4.5.3 Key Actor Positions and Opportunities

Our findings show that several key actors stand out in the network and have the potential to improve TURF implementation. We first identify who these actors are and then discuss roles they are, and could be, playing. Among actors with low ego network density (i.e., less than 25 percent of all possible ties within their ego network were present) two actors stood out with very high betweenness centrality (from the District government and Provincial FA) and two more were moderately high (from the District government and Provincial government). These are strategically important actors since they hold potential to be intermediaries to resolve conflicts, help build trust, introduce actors to each other, or otherwise show their commitment to facilitating governance processes.

Those four actors were also prominent in other node-level centrality measures, including number of ties and closeness centrality. Closeness centrality is a measure of the shortest path between an actor and all other actors. An actor who has more closeness centrality (lower numbers) is 'closer' to all other actors in the network. Table 4.6 summarizes the various scores discussed in this section. Other actors also scored moderately well in some of these indicators but (1) these four actors were consistently at the top of all measures, and (2) actors 7 and 23 clearly stood out from all others. The key actors we highlight here can be instrumental for the flow (or lack thereof) of information in the network and may be strategically important as entry points for interventions. Drawing again on the Gould and Fernandez brokerage analysis, actors 23, 7, and 24 account for 55 percent of all instances of brokerage (28, 17, and 9 percent respectively). Comparatively, there are 33 actors in the network who play no brokerage role at all. This signifies the relative importance of the few actors who are prominent brokers.

Table 4.6: Summary indicators for key actors in the Cau Hai lagoon network. Bottom half shows brokerages scores.

	Network Average	**Actor 23** District Government	**Actor 7** Provincial Fishing Association	**Actor 24** District Government	**Actor 1** Provincial Government
InDegree	*7*	53	50	17	33
Closeness Centrality	*355*	237	238	274	259
Betweeness	*51*	802	1,055	198	266
EgoNetwork Density	*47*	17	17	23	25
Brokerage (Number of instances)					
Liaison	*15*	354	359	108	37
Consultant	*5*	164	37	69	6
Representative	*2*	12	5	6	12
Gatekeeper	*2*	78	0	0	27
Coordinator	*0*	2	0	0	9

We are able to look at the ways that the key actors specifically facilitate the connections between groups. Actor 23 (Phu Loc District government) has a very strong role in linking groups and facilitating information flow between otherwise disconnected actors and groups. He communicates with all groups in the network – unsurprising given that 53 of the 89 other actors reported communication with him – but a lot of his brokerage particularly involves FA, commune governments, and the Provincial government. He does a moderate amount of all types of brokerage, but notably at the community level he facilitates 77 FA-FA connections, 77 Commune-Commune connections, and 172 FA-Commune connections. As confirmed through interviews, this actor has an important formal job that involves interacting with other actors, but he is also a person who is highly trusted.

Actors 24, 7, and 1 have contrasting roles. Actor 24 (Phu Loc District government) is active at the community level, facilitating 47 FA-FA connections, 22 Commune-Commune connections and 62 FA-Commune connections. While this is much less than actor 23 it is still the second strongest among all actors. Actors 23 and 24 are virtually the only people in the network who facilitate community-level horizontal connections. Although actor 7 (Provincial FA) is the provincial representative for FAs, he doesn't facilitate any connections between FAs. Instead, he facilitates

vertical connections to advocate on behalf of fishers to higher levels of government, as well as communicating policy and program information from governments to FAs. Interviews with provincial government officials revealed that they view actor 7 as a legitimate channel for communicating information to and from FAs. This is a useful pattern in many ways since this individual is seen as trustworthy and is well connected in the network. However, interviews with FA leaders rarely mentioned actor 7 as having a critical role in supporting them. This individual spent his career working for the government, not as a fisher. While he represents FAs at the provincial level and works in their interests, he does not have the social background of fishers. These diverging views indicate that the flow of information through actor 7 may not be happening to the extent expected by government actors, and not to the satisfaction of FAs. Actor 1 is not a strong broker like the other key actors. Much of his centrality comes from his position high in the Provincial government, meaning that he is an influential authority figure.

Taken as a whole, the horizontal and vertical linkages facilitated by key actors are promising for the future of the network. TURF implementation may be improved by drawing on the strengths of these actors as starting points for interventions. For instance, identifying key actors can help to build collaborative capacity and leverage resources for FAs if those key actors advocate these needs at the provincial level. However, there are limitations to what these actors can accomplish. Brokering is not an adequate replacement for direct FA-FA relationships. What the key actors can do is help to build relationships and advocate for the benefits of FAs working in more coordinated ways (during the formation of TURFs international NGOs played this type of role but they are not present in the lagoon long-term). Such efforts would help tighten connections in the network (especially horizontally at the local level) and have potential to improve implementation of TURFs.

4.6 Discussion

The results presented here suggest that some special considerations are needed for co-managed TURFs in coastal areas. We begin this section with practical insights

that emerged about ways that fishers can be more involved in co-management and TURFs in the Cau Hai lagoon and then offer general governance lessons.

4.6.1 Network Lessons for the Cau Hai Lagoon

The Cau Hai lagoon fisheries governance network is characterized by centralization around government actors and low density of relationships. Although allocation of fishing rights for FAs was intended as an alternative to top-down orientation of management, our network analysis reveals how the institutional arrangements are still very much vertically oriented. The vertical integration is, in part, due to the concentration of relationships among government officials. FA leaders are mostly connected to that inner core through relationships with key actors in the District government and Provincial FA. This pattern is effective with respect to the flow of information from the Provincial government down to the local FAs. However, the scarcity of local level horizontal connections (i.e., FA-FA) means there is no coordination between FAs, which is problematic for enforcement against illegal fishing activity. There are essentially TURF-based sub-units for management, instead of coordinated management across the lagoon. These realities are a reflection of capacity and time limitations, and also due to inattention to the importance of horizontal relationships during the allocation of fisher rights for FAs.

Another characteristic of the network is the presence of a few key actors who play important roles for bridging horizontal and vertical connections. These individuals have potential to facilitate or constrain flow of information or resources. Whether these actors use this power consciously is another question, but their structural network position indicates that they can exert influence on implementation of co-management. In terms of network weaving and enhancing network performance, these key actors represent high potential to build important relationships and leverage resources.

In addition to structural characteristics of this network, contextualizing these findings in historical management of the lagoon shows that prior to FAs and TURFs

there was effectively no formal management of aquatic resources. Customary management practices were in place but those had become ineffective in recent years due to population growth, new technology, resource use intensification, and property rights issues (Tuyen et al. 2010; Boonstra and Nhung 2012; Andrachuk and Armtiage 2015). Thus, the existence of the co-management network to the extent that we currently see can be viewed as an encouraging development.

Some practical insights for governance and TURFs follow from our analysis of the Cau Hai lagoon network. Any efforts to increase management capacity should focus on collaborative capacity (c.f. Owens 2014) and building awareness of the benefits of FAs working with each other and how they can help each other. This would entail putting resources into fostering more relationships between FA leaders, as well as strengthening relationships between FA leaders and Commune governments. The establishment of more relationships can help increase network density and bring more community-level actors into the core of the network, required to sustain TURFs over the longer-term and in the face of additional pressures. With respect to formation of new fisheries policies and laws, greater consultation with FAs and multi-level linkages would aid the provincial and district governments in devising policies that are seen as beneficial by fishers. Interventions of this kind are likely to have broadest reach if they involve two of the key actors we identified (actors 7 and 23) because they are the most connected and they play important brokerage roles linking organizations.

4.6.2 Governance Considerations for Co-managed TURFs

TURFs are an intriguing management instrument in coastal areas where property rights are particularly messy and challenging. According to a recent review from Quynh et al. (2017), there is a need for more research on contextual conditions and design features that affect TURF performance. We have found that additional consideration needs to be given to characteristics of governance networks, over and above the allocation of spatial property rights. If co-managed TURFs are to catalyse significant change, they need to be designed and implemented with consideration of

the ways that fishers, government officials, and other actors are able to work collaboratively.

Our findings bring attention to several lessons that can support implementation of co-managed TURFs. First, design of co-management agreements needs to attend to the association between spatial proximity of TURFs and actor proximity in networks. In the physical context of the Cau Hai lagoon TURF zones are clustered immediately against each other. In cases with similar contexts (e.g. Gallardo et al. 2011) – whether neighbouring zones are TURFs or under other management regimes – design of co-management agreements needs to facilitate and encourage horizontal interaction across management boundaries. Most aquatic species of interest in the lagoon are mobile and co-managed TURFs need to address this unique type of transboundary issue. These considerations are, of course, in addition to partnerships and collaboration between fisher groups with government agencies (vertical relationships). Vertical partnerships are important for legitimacy and authority (Alexander et al. 2015), however, adjacent TURFs also need channels of collaboration for monitoring and enforcement. Designing co-management agreements to include FA-FA relationships would link actors with similar socio-political status to address shared challenges and foster shared learning.

Second, there is a need to ensure collaborative capacity across governance networks. We make a distinction between decentralization of authority and decentralization of capacity. In the Cau Hai lagoon rights allocation agreements transferred a bundle of rights and responsibilities to FAs but they were not necessarily accompanied with sufficient means for FAs to fulfill their responsibilities. Responsibility for monitoring and enforcement of fisheries policies was intended to take shape through partnerships between FAs and commune governments. As many of the commune governments have failed to fully cooperate and support FAs, there have been clear lapses in the ability of FAs to function. As we have explored elsewhere (Chapter 5), FA leaders are not aware that regular communication with commune governments can help them understand challenges

faced by fishers and FAs. With more resources in place to ensure that all co-management signing partners have commitment and ability to fulfill their responsibilities, TURFs would have a stronger chance for success.

Third, a networks approach offers ways of identifying key people who can play unique roles in supporting co-managed TURFs. As we have discussed above, certain key actors are able to leverage resources (e.g., advocate for funding from higher levels of government) that can be used at the local level. Given their own connections within a network, key actors are also often in positions to build relationships between other actors (Crona and Bodin 2006; Vance-Borland and Holley 2011). In light of the need for horizontal relationships in co-managed TURFs, key actors may be particularly instrumental in building those direct relationships (for instance in the Cau Hai case, that would mean relationships between FA leaders).

4.7 Conclusion

TURFs have shown promise as a model for management of coastal small-scale fisheries, especially when implemented with co-management (Guttierrez et al. 2011; Auriemma et al. 2014). TURFs help address overlapping spatial property rights, which is common in coastal zones due to mobile species and high population density. In spite of successes with this model, there is a need for more empirical research that unpacks the specific biophysical and governance contexts that influence success of co-managed TURFs (Quynh et al. 2017). We examined a network of co-managed TURFs in the Cau Hai lagoon, Vietnam to learn more about the relationships between groups of actors and how those relationships (or lack thereof) support or hinder FAs in their efforts to improve fishing conditions and livelihoods of fishers.

The Cau Hai lagoon governance network would benefit from (1) amended co-management agreements that address horizontal connections, (2) additional support for FAs from Commune governments and other local organizations, (3)

increased financial support for FA leaders to build capacity for management responsibilities as well as their ability to collaborate with each other, and (4) efforts to build relationships among FA leaders in neighbouring communities. Working through these steps can be greatly aided by key actors in the district government and Provincial FA who can help to leverage necessary resources and establish connections between actors.

More broadly, our findings point to several governance lessons for TURFs where multiple groups receive allocation of property rights in adjacent or overlapping areas. The network perspective reveals that TURF zones must function in complementary ways, rather than as isolated silos. Co-management agreements need to match spatial proximity of TURFs with actor proximity within networks. As bundles of fisheries management responsibilities are decentralized through co-management, TURF leaders need capacity for collaboration. There can be opportunities for key actors to support collaboration and use their influential network positions to advocate for such resources. These insights will not address all limitations of TURFs but they represent a set of entry points for further understanding underlying governance contexts that influence TURF success.

CHAPTER 5: **Building blocks on the pathway to social-ecological transformations**

Overview

This study introduces *building blocks* as an approach to assess deliberative transformations in linked systems of people and nature. In doing so, we address a knowledge gap about the governance processes that support transformative change, with a particular focus on small-scale fisheries facing ecological decline. Recent introduction of co-managed territorial use rights for small-scale fishers in the Cau Hai lagoon, Vietnam has shown promise for alleviating ecological impacts from overfishing and reduced conflicts among fishers. We use this setting to inductively identify building blocks in two case study sites, and highlight the lessons for replicating successes in similar small-scale coastal fisheries. The investigation revealed five building blocks that were instrumental to success in the two case study communities: fisher approval of ecological conservation, co-operation among fishers, support from local government, secure funding, and effective leadership. These findings demonstrate site-level specificity of what governance attributes are already contributing to more durable and transformative change, and how these attributes can be augmented in other communities in the Cau Hai lagoon. Key lessons for governance of transformations are that (1) building blocks do not need to be identical from case to case, and (2) further consideration needs to be given to how building blocks may nest or fit together. Our research contributes to a relatively new body of literature on deliberative transformations and offers guidance on a way to support and enhance transformations of small-scale fisheries.

5.1 Introduction

This paper examines what it means to support and enhance processes of social-ecological transformations for coastal small-scale fisheries (SSF). In particular, we are interested in examining how to proactively address persistent challenges facing SSF. These challenges include social inequality and poverty, unclear tenure and property rights, overcapacity, and lack of comprehensive policies that address the

wellbeing needs of small-scale fishers (O'Brien 2012; Pomeroy 2012; Cinner and McClanahan 2015; Nayak and Berkes 2014; Jentoft and Chuenpagdee 2015; Saunders et al. 2016). The concept of deliberative social-ecological transformations implies the creation of fundamentally different pathways through which societies make decisions about, and interact with, fishery resources.

To facilitate transformations in small-scale fishery contexts, there is an imperative to improve our understanding of, and learn how to shape, transformative processes *ex ante* (see Moore et al. 2014; Olsson et al. 2014; Patterson et al. 2017). For example, as part of their framework to analyze deliberative transformations, Moore et al. (2014) cite the importance of adopting innovations that are successful in experimental stages (uptake and replication). This involves learning about what is working in particular places and contexts and "scaling out" to similar contexts. However, further context-specific guidance is needed on how such scaling out can be achieved, particularly in places where there have been successful fisheries governance innovations.

In this paper, we introduce *building blocks for transformations* as a heuristic to study opportunities for building on early successes in small-scale fisheries. Identifying and learning about what is already working *in situ* can be valuable for replicating conditions that have led to early signs of transformations. We apply this approach in Vietnam where a governance transformation in a small-scale fishery is thought to be underway (Armitage et al. 2011; Andrachuk and Armitage 2015). We examine early site-specific or localized successes to identify building blocks that may be replicated across the system more broadly.

Transformations research is limited in its ability to only perceive and confirm the occurrence of social-ecological transformations in hindsight (Carpenter et al. 2005). This research brings a novel approach to the transformations literature by highlighting how it may be possible to focus on small successes as forward-looking research, instead of relying solely on historical cases or focusing on barriers and

constraints (Patterson et al. 2017). In doing so, we aim to understand what occurs along transformation pathways by focusing on the aspects of governance in small-scale fisheries that can be maintained and replicated.

We bring together two bodies of literature to define core attributes of building blocks for social-ecological transformation, and to develop the criteria upon which to assess their potential: (1) an emerging body of literature on governance transformations in small-scale fisheries, and (2) literature on processes of, and supporting conditions for, transformations. Our inductive assessment proceeds from a description of the transition to collective property rights and co-management in the Cau Hai lagoon, Vietnam and in-depth consideration of what is working in two sub-cases. Synthesis of case-specific building blocks is followed by consideration of what strategies and aspects may be replicated for other communities. The lessons from this research will be of interest for replicating successes within the Cau Hai lagoon and for other SSF undergoing transformative governance changes (and further supports insights from Armitage et al. 2017).

5.2 Literature Review And Conceptual Framework

5.2.1 Governance Transformations in Small-scale Fisheries

SSF research has considered both unintentional and deliberative transformations. Unintentional transformations – sometimes framed as regime shifts – are typically viewed in relation to drivers of change (e.g., impacts of climate change and technological innovations) and the ways that they shift community wellbeing, power, and property rights (e.g., Bennessaiah and Sengupta 2014; Bush and Marschke 2014; Nayak and Berkes 2014).

Deliberative transformations in SSF are often framed around transitions to co-management or other collaborative and ecosystem-based management arrangements. Cinner et al. (2012) use several transitions concepts (drivers of change, institutional arrangements, institutional fit, actor interactions, and adaptive management) to assess movement towards decentralization for co-management in

Kenya, Tanzania, and Madagascar. Gelcich et al. (2010) point to the importance of ecological crisis and political turmoil for opening a critical window of opportunity in a Chilean fishery, but that a governance transformation was seeded by a novel application of marine tenure rights for artisanal fishers. Chuenpagdee and Jentoft (2007) demonstrate that the combination of actors who initiate co-management (i.e., government, local entrepreneurs, donor agencies, researchers, or environmental groups) can influence the effectiveness of implementation. The role of social networks has also been studied in various contexts and has helped illuminate the ways that social capital and interpersonal relationships influence outcomes of governance transformations, such as enforcement and fisher participation (e.g., Crona and Bodin 2010; Alexander et al. 2015).

Taken together, SSF literature emphasizes the importance of site-level understanding of particular places and contexts that influence social and ecological systems (Allison and Ellis 2001; Pomeroy 2012; Hauzer et al. 2013; Weeratunge et al. 2014; Fabinyi et al. 2015). The SSF literature also shows how governance transformations require appropriate legal settings, leadership, social pressures, multi-actor and multi-level relationships, and taking advantage of windows of opportunity with innovative problem solving (see also Nasuchon and Charles 2010; Benessaiah and Sengupta 2014; Blythe 2014; Cinner and McClanahan 2015; Frey and Berkes 2014). However, there remains an opportunity in this literature to better identify points of departure with which to 'scale out' successful experiences.

5.2.2 Transformations Processes

We align our thinking with Moore et al. (2014), in that the outcomes of transformations are shaped by both the agency of actors and underlying social and biophysical conditions. Path dependence and feedbacks tend to reinforce existing structures and dimensions of politics, power imbalances, and contested values among actors (Avelino and Rotmans 2009; Heinmiller 2009; Pelling et al. 2015; Nayak et al. 2016). Actors may not 'control' transformations but they do nudge towards their goals by resisting undesirable path dependencies or working to

establish new norms and patterns of development (Moore et al. 2014). Hence, there is a need for bottom-up and top-down perspectives on how to foster meaningful and lasting changes.

Olsson and colleagues (e.g. 2004, 2006) view transformations in terms of sequential phases: building towards, and preparing for, systems change; capitalizing on windows of opportunity; navigating messy transitions; and building resilience of new regimes. Within this area of research, social capital and social networks, multi-level interactions, institutional flexibility, experimentation and learning, and leadership have been identified among key factors for progressing through the phases of transformation (Hahn et al. 2006; Olsson et al. 2008; Rijke et al. 2013; Moore et al. 2014). A related line of research focuses on social innovation and the agency of key actors in leveraging and triggering changes in broader social-ecological systems (Westley et al. 2011, 2013). Social or technological innovations can be important to address power imbalances, challenging norms, or creating disruptions and new opportunities (Olsson et al. 2006; Westley et al. 2011; Leach et al. 2012). We situate building blocks as part of a process of navigating the transition and building the new regime (see Olsson et al. 2004, 2010), where clear signals of potential transformation are in place at the local level but outcomes are still uncertain.

The transformation literature is useful for understanding high-level and long-term processes, but is more limited when seeking to devise practical site-level strategies to support and enhance potentially transformative initiatives. Accordingly, a number of researchers have turned their attention to assessing enabling and supporting conditions for transformations. Feola (2015) argues that since transformations are multi-faceted and complex, it is helpful to have a variety of frameworks that address different aspects of transformations. Some research has questioned what combination of socio-economic and biophysical changes constitutes social-ecological transformations (e.g., Ferguson et al. 2013; Moore et al. 2014; Andrachuk and Armitage 2015; Patterson et al. 2017), while other

scholarship has focused specifically on governance conditions that are conducive to transformations (e.g., Leach et al. 2012; Burch et al. 2014; Pereira et al. 2015). Pereira et al. (2015) identify a set of principles for 'safe operating space' that are seen as necessary for transformations to sustainability. Those principles are emancipation and empowerment, ensuring reflexivity, knowledge co-creation, transformative learning, and nurturing innovations (Pereira et al. 2015). These conditions are consistent with much of the literature. However, they are too general for informing local-level actions in a SSF context.

The motivation for introducing building blocks in this paper is to address the challenge of supporting and enabling transformations in progress in SSF. We do this by empirically identifying local successes within communities in the Cau Hai lagoon, Vietnam, and analyzing opportunities to replicate those successes for other communities in the lagoon. We inductively identify building blocks that are relevant for this specific context.

5.2.3 Building Blocks for Social-Ecological Transformations

The metaphor of building blocks emphasizes the value of contextual specificity and empirical understanding of what has led to small, early successes for SSF transformations. We offer several guiding attributes, based on our review of SSF and transformations literature, that help scope what building blocks may look like. First, building blocks are local and relevant for particular places and times. Spatial and temporal boundaries are important due to variability in social, economic, political and ecological systems. Emphasis is given to bottom-up perspectives, although recognition must be given to changes that can be top-down. A transformation need not have the same building blocks from place to place. Building blocks indicate how success was achieved in one place that may be useful in other similar contexts. Second, consideration should be given to a wide array of institutions, roles for key people, types of networks, technological or social innovations, management arrangements, knowledge, or values and perspectives (emphasized as different shapes in Figure 5.1).

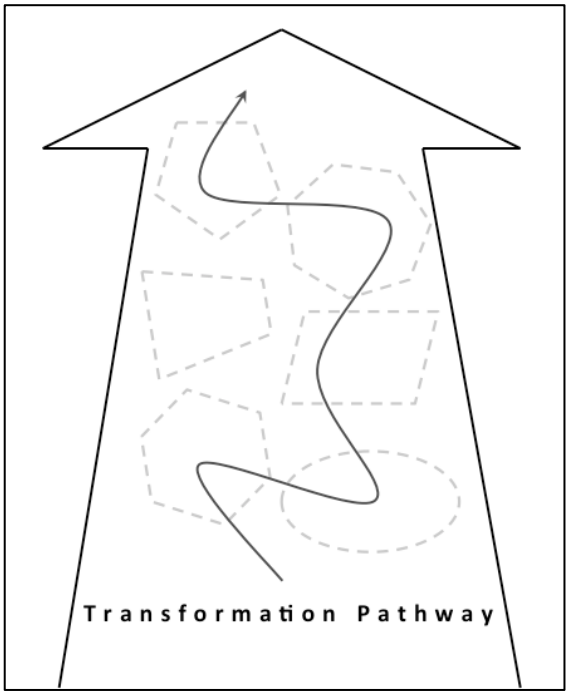

Figure 5.1: Building blocks along a transformation pathway. This graphic representation emphasizes that it is more important to think about how building blocks may fit together, rather than assuming a linear pathway. Several blocks together begin to build a pathway.

Third, building blocks are not static or linear. Building blocks are part of how transformation pathways are achieved, reflecting a normative vision of where people want to go. There is not a first step or specified sequence of actions, and what is needed may shift over time. Fourth, we envision building blocks as features that have been seeded as part of a new regime. We shift the focus away from barriers and constraints. Resistance against traps and lock-ins of an old regime are critically important but do not tell us how to move forward. Building blocks may feature empowerment, poverty reduction, and other pro-equity reforms as a new regime is taking shape. Lags and barriers are common for social-ecological change due to path dependence. Building blocks, as a tool for intervention, are useful for moving beyond lags that may have stalled transformations.

We use the building blocks metaphor to help think about the local level and how communities are participating in – and driving – transformative changes. Building

blocks are distinguished from other frameworks for, and conceptualizations of, transformations (Feola 2015) by the emphasis on local level, empirical research that specifically targets means of supporting deliberative transformations in progress. Existing transformation conceptualizations and frameworks do not always emphasize site-level guidance and policy development. Investigating a case that is *potentially* transformative and in-progress (Armitage et al. 2011; Andrachuk and Armitage 2015) offers a unique opportunity to learn how it may become *actually* transformative. The value added from building blocks is thinking about how they nest or fit together. One block is insufficient, but several together start to build strength for a transformation, allowing for an assessment of the niche conditions and processes that can be replicated in similar contexts.

5.3 Methods

5.3.1 Study Site

The Cau Hai lagoon supports a multi-species capture fishery and low intensity aquaculture through a diversity of habitats and a range of marine and brackish water conditions. The lagoon has had well documented challenges related to overfishing due to technological intensification, growing population of fishers, water stagnation related to density of fishing enclosures, and pollution from aquaculture and terrestrial runoff (e.g., Brzeski and Newkirk 2002; Marconi et al. 2010; Andrachuk and Armitage 2015). There have also been wellbeing issues stemming from poverty, lack of livelihood alternatives, unclear property rights, and historical exclusion of fishers from management institutions (e.g., DaCosta and Turner 2007; Tuyen et al. 2010; Boonstra and Nhung 2011).

Examination of livelihood and ecological challenges facing the Cau Hai lagoon through the lens of property rights led to the recognition that customary fishery practices had relied on open access to common pool resources, and that modern technology, introduction of aquaculture, and increasing population density undermined the relevance of those customary practices (Tuyen et al. 2010; Huong and Berkes 2011). In response, a model for territorial use rights for fisheries

(TURFs) was developed that was based on the formation of fishing associations (FAs), which could enter into co-management agreements with local government agencies and receive allocations of collective property rights and responsibilities (Armitage et al. 2011; Marschke et al. 2012). Ostensibly, the intents of these arrangements are to (1) provide a mechanism for implementing and enforcing national and provincial fisheries laws, (2) set up institutions to enable fisher participation and some autonomy over monitoring and enforcement of fisheries laws and regulations, and (3) improve livelihoods for fishers.

The Phu Loc District government, which encompasses most of the lagoon, has moved forward with TURF allocations for all FAs in their district. As of 2014 the lagoon was demarcated into 16 fishing zones (Figure 5.2 map shows demarcation according to communes; several zones have been further subdivided). The FAs receive bundles of exclusive rights for fishing and aquaculture and are responsible, through co-management with commune governments, for monitoring and enforcement of fisheries policies. Allocation of TURF rights to FAs followed a numbers of steps that are outlined in Table 5.1, including the signing of co-management agreements with local government agencies. One of the requirements for FAs gaining TURF rights is to develop a fisheries management plan. These management plans set out goals for reducing gear, which was mandated by provincial laws. The management plans also give FA members opportunity to contribute to the development of bylaws.

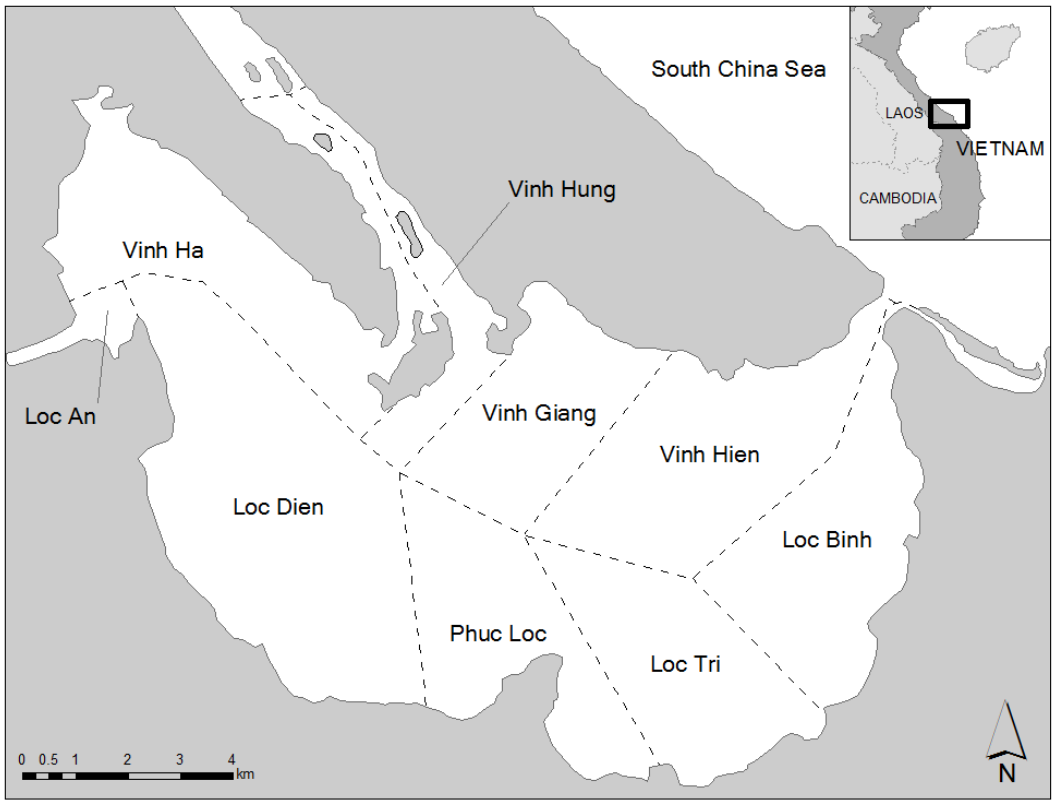

Figure 5.2: Study sites in the Cau Hai lagoon, Vietnam. Focal study sites were Vinh Giang commune (Giang Xuan FA) and Loc Binh commune (Loc Binh I FA).

Table 5.1: Steps and guidelines for the establishment of co-management and allocation of collective property rights in the Cau Hai lagoon.

Steps	Guidelines
1. Formation of Fishing Associations (FAs)	FAs form for respective lagoon territory. Membership must represent all types of gear users within the territory. Selection of chair, vice-chair and sub-committees.
2. Promote benefits of conservation	University researchers, NGOs and government agents lead workshops to educate fishers on importance of fisheries conservation.
3. Assess status of lagoon resources	Gather data on gear types in use and management practices within territory.
4. Capacity building for FAs and establishing by-laws	Training for FA leadership team. Development of management plan for territory and agreement on bylaws to regulate fishing activities. Determine criteria for access and use of resources and procedures for conflict resolution.
5. Plans for zoning within territory	Map and plan for rezoning within territory for different gear use (fixed gear, mobile gear, and aquaculture), protection areas, and navigation waterways. Demarcation of zones in lagoon.
6. Formation of co-management	Formalization of partnerships for co-management. Signatories typically include FA, Commune government, Phu Loc District government.
7. Application for rights allocation	Application for rights allocation to FA can proceed once criteria are met for appropriate FA membership, formation of leadership team, and development of management plan. Applications are typically prepared on behalf of FAs by NGOs or university researchers who support the process.
8. Co-management implementation	Re-arrangement of aquaculture activities and fixed fishing gear (fish corrals). Ongoing monitoring of fishing activities and enforcement of laws and bylaws.

Andrachuk and Armitage (2015) use the concept of system identity to characterize past and current social-ecological transformations in the Cau Hai lagoon. Drawing on the perspective of fishers to understand social and ecological changes, this research confirmed earlier reporting that ecological conditions have stabilized and affirmed that a shift towards a new system identity may be underway as a result of the new governance arrangements (see also Tuyen et al. 2010; Armitage et al. 2011). On the other hand, Andrachuk and Armitage (2015) also found that (1) minor improvements in fish catches have come at the cost of increased marginalization of some fishers, and (2) only a few of the FAs have been able to implement their management plans while most FAs are struggling to function.

Ho et al. (2016) also discuss how the establishment of co-managed TURFs was donor-driven, which has led to limited 'ownership' among some government co-

management partners. Ho et al. (2015) analyse power sharing between government and FAs and the ability of fishers to exercise power in fisheries management. They found that although power sharing was intended in the design of co-management, in practice fishers are prevented from exercising powers due to lack of legal support and conflicting policies at higher levels of government (Ho et al. 2015). Boonstra and Hanh (2015) also highlight that many maladaptive and destructive practices, particularly for aquaculture, persist in the lagoon and contribute to a social-ecological trap.

Taken together, this body of research has contributed to a better understanding of the interconnected issues facing the lagoon. More work is needed to identify pathways forward through adjustments to policies, redesigning interventions for improving livelihood, and building fisheries and aquaculture practices that are ecologically sustainable. Much of the forward-looking research on the lagoon has been aimed at policy and more general adjustments to SSF management. For instance, Armitage and Marschke (2013) suggest a series of policy responses: a more integrated approach to coastal systems, fishing and aquaculture; clarification of the security of fishers' access rights to aquatic resources; and creating better conditions for multi-actor collaboration and learning. Andrachuk et al. (Chapter 4) advocate for better collaboration specifically between FA leaders, including resources devoted to supporting this collaboration. These assessments offer useful insights, but additional tangible and practical measures are also required to further actualize the gains being made.

The Cau Hai lagoon presents a site where (a) governance and technological innovations are already in place and (b) there is already evidence of success for some FAs. We work from the assumption that overcoming barriers to implementation of new SSF management – and hence supporting the transformation – does not require additional social or technological innovations at this point. In consultation with Vietnamese research partners and local government, two communities were selected that are perceived to be functioning in terms of their

ability to implement fisheries management plans: Vinh Giang commune (Giang Xuan FA) and Loc Binh commune (Loc Binh I FA). 'Success' is used here to indicate that these FAs have been able to implement their fisheries management plans, engage members and hold regular meetings, collect membership fees, and consistently monitor and enforce regulations. While acknowledging that we did not develop an objective measure of success, we use the term as a relative comparison of these two FAs to the other 14 FAs in the Cau Hai lagoon that have been unable to function adequately or implement their management plans. Our findings contrast the factors that have enabled the Giang Xuan and Loc Binh I FAs to function, thus supporting a nascent social-ecological transformation (Armitage et al. 2011). This approach is intended to draw attention to the specific conditions that have been conducive to implementing co-management and clarifying property rights. As these FAs have been successful with implementing management strategies, there should be lessons of relevance for the other FAs. Scaling out these lessons among all FAs is needed given the interconnectivity of the lagoon social-ecological system.

5.3.2 Data Collection & Analysis

Data were collected with the aim of facilitating a cross-case comparison within the Cau Hai lagoon. Preliminary literature review and document analysis was carried out in order to review the context for efforts to implement co-management and collective property rights in the Cau Hai lagoon. A series of interviews were conducted with leaders of FAs in each of the case communities and with government agents in Communes, District government, and Provincial government (n = 16). The interviews followed a semi-structured script and attention was given primarily to the perceived purpose of co-management and TURFs, challenges faced by FAs, and improvements observed for livelihoods and the lagoon environment. Focus groups with fishers were also held in each case community (total participants, n = 18). The focus groups solicited discussion about what aspects of the new management arrangements fishers felt are working, what new challenges they are facing, and their suggestions for management improvements. Two additional sets of interviews were conducted to follow up on specific issues. One set of interviews with key

individuals (n = 4) was held in order to gather more information about conditions that contributed to FA success. A set of interviews with fishing households (n = 31) was used to solicit more local perspectives on the operation of the two successful FAs. Participant observation was also used to learn more about day-to-day fishing and aquaculture activities and the management issues facing FAs (e.g., conversations with fishers in their communities and taking boat tours with fishers).

Analysis followed a three-stage approach. First, we examined what it means for a FA to be successful following allocation of territorial use rights. Given strong capacity limitations in most FAs, this came down to whether FA members paid their fees and if FAs are able to fulfill their duties for monitoring and enforcement. Evaluation of the case sites confirmed that research participants do believe the two FAs to be successful (see also Andrachuk and Armitage 2015). The second stage of analysis used a form of narrative categorization of interviews and focus groups that retained contextualization of data (c.f. Maxwell 2012). The findings in sections 5.4.2 and 5.4.3 are the outcomes of this categorization and identification of factors that have been most important for FA success within each case. Third we used a display-based technique (matrix) for comparing similarities and differences across the two main cases and interpreting common themes for FA success (c.f. Miles and Huberman 1994; Maxwell 2012). This cross-case comparison was the basis for identifying the building blocks and deriving lessons for what could be done to replicate successes for other FAs in the Cau Hai lagoon.

5.4 Findings

We begin our findings with an examination of successes and limitations of new SSF management arrangements. The two highly functional FAs in the Cau Hai lagoon are then reviewed in-depth to identify the key factors that led to their success. Our intent has not been to identify identical building blocks in each case. Rather, we have sought to surface the unique keys to successes for each FA to date. These key factors then form the basis of our synthesized building blocks for transformation pathways.

5.4.1 Experiences with Co-management and Collective Property Rights in the Cau Hai Lagoon

Our interviews and focus groups revealed that there have been mixed signals from fishers and government about the implementation of TURFs. On one hand, fishers in all focus groups stated their preference for strengthening the ability of FAs to monitor activities in the lagoon and enforce policies. This was a demonstration of strong belief that the FA and TURF model can work. Fishers in the Cau Hai lagoon are aware of the need for conservation and reduced fishing effort, but they are not able to envision a path to greater sustainability in a way that does not compromise their livelihoods and wellbeing. On the other hand, beyond some education workshops and re-arrangement of fishing activity zones in the lagoon, there has been minimal implementation and enforcement of new policies. Water quality has improved to some degree and the rate of fish catch decline has slowed but there is a clear lag or stall in the SES transformation (Armitage et al. 2011; Andrachuk and Armitage 2015; Boonstra and Hanh 2015; Ho et al. 2016).

The capacity for FAs to undertake responsibility for their management functions has been a recurrent issue in SSF literature (e.g., Jentoft and Sandersen 1996). As we noted earlier, however, in the Cau Hai lagoon success relates as much to partnerships and collaboration as to management capacity. Before we discuss what has led to 'success' for two Cau Hai lagoon FAs (section 3.2 and 3.3) we first highlight some apparent limitations that they face. Donor-led establishment of FAs and co-management was often cited by FA leaders as valuable because NGO projects provided short-term access to funding and training. In some cases, project funding was used to purchase computers, boats, or other infrastructure. However, in most instances when projects ended, the management systems that were put in place collapsed. In several communities fishers won't pay FA membership fees because they still see too much illegal fishing taking place and they don't trust their FA leadership team. In addition to insufficient funding, FAs typically lack legal authority for enforcement against illegal fishing. District and commune governments were

often cited as important organizations because FAs rely on them for any form of funding and support for fisheries patrols (monitoring lagoon activities).

Commune government officials and FA members are in agreement that Provincial and District government policies to increase mesh size of nets are needed. However, implementation is hindered because many fishing households are poor and even if they could afford new nets, there are few companies who produce nets with larger mesh. Limitations were also revealed in relation to training offered to fishers. During discussions with local university researchers it was disclosed that when they give training presentations to fishers, they often do not consult with fishers about what they already know or how to present the information in a useful way. Fishers sometimes attend training sessions only because they receive money for participating. Fishers will often try new fishing and aquaculture techniques that they learn in these workshops (for instance, specific combinations of species to raise together for polyculture aquaculture) but if they do not see direct benefits or improvements they will not stay committed.

How have some FAs been able to overcome these limitations? In the following sections we explore two successful cases.

5.4.2 Case 1: Vinh Giang

The Giang Xuan FA in Vinh Giang commune was established in 2008 and it received allocation of territorial use rights in 2009. The water area of the lagoon is 997 hectares, of which 35 hectares have been set aside for habitat protection (in 2010). 125 households are FA members. In total 102 households participate in aquaculture, although many of these households also participate in fixed and mobile gear fishing. In terms of fishing effort, FA members use 56 fish corrals (fixed gear) and an estimated 5,700 lu nets (mobile gear).

Part of Vinh Giang's reputation as a successful case is due to its participation in a pilot project led by Vietnamese researchers at the Hue University of Agriculture and

Forestry (HUAF) in partnership with Canadian researchers through the International Development Research Centre (IDRC) funding. This project tested the efficacy of FAs as an entity for co-managing TURFs and established the steps for rights allocations in Table 5.1. Positive reception in Vinh Giang led the district and provincial governments to create policies based on this model for other FAs to follow. Another important project was the Integrated Management of Lagoon Activities (IMOLA) project that worked across the entire Tam Giang – Cau Hai lagoon. The UN Food and Agricultural Organization (FAO)-funded IMOLA initiative had a key role in the zoning of TURFs and planning for rearrangement of fixed gear in the lagoon. According to our research, the projects did improve the capacity of the Giang Xuan FA leaders and the willingness of fishers to follow new fishing and aquaculture policies. For instance, FA leaders noted infrastructure capacity through the purchase of a computer and management capacity through training for how the leadership team can work together. However, it is important to acknowledge that feasibility studies led to the selection of Vinh Giang for inclusion in those projects, meaning that there was underlying predisposition to cooperation in this commune.

We have identified four key factors that appear to have led to this FA's success (Table 5.2). The first was the election of an effective FA leadership team. The Giang Xuan FA chose people who have good communication and organizational skills, and also people who are able and willing to work well together. The leadership team has sub-group leaders to represent each group of fishers – mobile gear fishers, fixed gear fishers, and aquaculture producers. These leaders meet regularly and share the experiences of their groups with each other. For instance, during seasons that are difficult for households who own fish corrals, the whole leadership team is made aware of specific challenges they are facing. Perhaps more importantly, according to our interviews with the FA chair, in the early stages of establishing TURF rights all of the FA leaders worked together to communicate with the commune government in order to foster good relationships. Interviews with commune officials reciprocated the importance of FA leaders – in particular the FA chair – for building positive relationships and trust.

Table 5.2: Cau Hai lagoon building blocks and evidence for the building blocks in each sub-case.

Building Blocks	Giang Xuan FA	Loc Binh I FA
Awareness of the value of ecological conservation	• Workshops from university researchers and international projects • Willingness of fishers to reduce gear and follow new policies	n/a
Co-operation among fishers	n/a	• Solidarity and trust among fishers • Cooperation with neighbouring FAs to create bylaws for habitat protection area
Support from local government	• FA chairman communicates regularly with commune government, leads to better understanding of fisheries issues • Vice-chair of FA is from police force	• Support from several key sympathetic individuals within commune government
Secure funding for the FA	• Membership fees collected from fishers • Salary for FA leader through employment with commune government	• Micro loan and credit system set up by fishers • Membership fees collected from fishers • Support from international projects to purchase a computer and boat
Good leadership within the FA	• Team of leaders willing to work together; meet regularly to discuss issues for different fishing gear users • Chairman has good communication and organization skills	n/a

The second key factor is support and cooperation from the commune government. There are several facets that contributed to sustained support. The FA chair regularly shares information with the commune government about FA activities. This has helped build understanding about fisheries issues and mutual trust. Additionally, the FA's vice chair is from the police, which helps the police force understand fisheries and aquaculture livelihoods and the importance of patrol teams for monitoring and enforcement. Commune government support means that there is good coordination and communication among all relevant local agencies for activities ranging from patrols to conflict resolution to consultation about creation of bylaws. For instance, one interviewee in government also explained how there is

now accountability since there are people who are directly responsible for different aspects of fisheries management.

The third key factor is awareness among fishers about the importance of ecological conservation. The HUAF team initially helped fishers understand that protecting and conserving aquatic resources is in their interest for securing their livelihoods. In fact, several interviewees from the FA felt that this education was the most important contribution of external projects. Interviews with fishing households in Vinh Giang were unique in the ways that interviewees openly talked about the importance of reducing the number of nets used by households (especially Chinese lu bottom nets) and the benefits of increasing mesh size of fixed and mobile gear nets. Government interviewees also explained that prior to formation of the FA, Vinh Giang had many households who participated in (illegal) electric fishing. Government previously had no way to prevent or control use of this illegal activity. The combination of effective enforcement through coordinated efforts and buy-in from fishers on the need to reduce impacts on the lagoon thus led to a substantial decrease in electric fishing gear use (see also Andrachuk and Armitage 2015).

Awareness about the importance of ecological conservation also led to fishers' willingness to set aside 35 hectares for habitat protection and to participate in rearrangements of fixed gear. As discussed elsewhere (e.g., Marconi et al. 2010; Tuyen et al. 2010), the density of fish corrals in the lagoon through the early 2000s caused water stagnation and algae blooms. Reduction and rearrangement of corrals in all FA zones in the lagoon have improved water flow and quality, as well as providing open waterways for navigation and reduced conflicts by establishing clear areas for fixed and mobile gear fishing.

The fourth key factor was funding to support the FA. Funding has meant that leaders are able to have some salary to compensate for their time and that the patrol team is able to pay for boats and fuel. Funding in Vinh Giang came initially from the externally-funded projects and government but continued funds come from

members paying fees and from seaweed harvesting in the protection area. Considering that many other FAs around the Cau Hai lagoon report that members refuse to pay fees, fisher participation in Giang Xuan FA (i.e., pay fees, attend meetings, follow bylaws) is an indication of trust. Access to funds has also helped the FA play a role in creating alternative livelihoods for FA members. Alternative livelihoods – tailored to each household based on their skills, wealth, and whether they have access rights to an area in the lagoon – have included new, less destructive gear for fishing or training and infrastructure for new forms of aquaculture.

With good leadership, positive relationships with local government, awareness of conservation, and funding the FA has been able to reduce conflicts between fishers using different gear, reduce use of destructive fishing, regularly patrol the lagoon to enforce policies, and develop local rules (e.g., FA members get to vote to accept new bylaws; some other FAs do not do this). Furthermore, as one government official commented, the Giang Xuan FA is effective as a bridge between fishermen and government authorities.

5.4.3 Case 2: Loc Binh

Loc Binh commune has three FAs. We focus here on Loc Binh I FA. Of the other two FAs, one is concerned entirely with aquaculture and the other is smaller and not as well established. Loc Binh I FA was founded informally in 2003 when an entrepreneurial individual set up a micro-loan program. This individual is now the FA leader and has widespread trust and respect in this community and beyond. The FA received allocation of territorial use rights in 2010 and established a 40 hectare protection area in 2011. The water area for this FA's zone is 987 hectares. There are 100 FA members, of which 25 households participate in aquaculture (similar to Vinh Giang, some households participate in both fishing and aquaculture). Fishing effort in this FA includes 52 fish corrals and an estimated 6,000 lu nets.

We have identified three key factors that have contributed to Loc Binh I FA's success (Table 5.2). First was funding to support FA activity. Primary among all factors for Loc Binh is a micro-loan program that was set up by fishers. In spite of not having financial training, the current FA leader was instrumental in the idea of fishers pooling their money in 2003 as a way to share and help each other through difficult years. In recent years, when difficult decisions had to be made to reduce the number of fixed fishing gear (corrals) to meet district government plans, FA leaders came to understand that some households would no longer be able to practice this type of fishing. The FA leaders worked with those households and discussed alternative livelihoods. Government provided some funding to those families but the FA was also able to support them through microfinance loans to purchase new nets or other equipment. In an example that was discussed during a focus group, one man purchased a rototiller so that he could rent out his services to aquaculture pond owners while they were cleaning their ponds. The ability of FA members to access loans has been critical for building trust in the FA chairman and trust that their livelihoods will be supported. Interviews with Loc Binh commune officials – in addition to widespread acknowledgements from other communes – echoed the primacy and importance of the loan and credit system set up by the Loc Binh fishers. Additional financial support for Loc Binh I FA has also come through IMOLA and Fishery Livelihoods Project (FLP) projects that provided workshops to teach fishers about the importance of ecological conservation, support the establishment of a habitat protection area, and purchase a computer and boat for monitoring the lagoon.

The second key factor for Loc Binh was support from the commune government. In contrast to Vinh Giang, support from the local government appears to come from only a few influential people. The tone and content of interviews with those officials reflected an understanding of fisheries issues and their support has been demonstrated through development of fisheries management plans and cooperation with FA for enforcing fisheries policies. While emphasizing the importance of participation from all co-management partners, there was evidence that the

commune government's confidence and trust in the FA chairman is seen as very important for success of the FA.

Solidarity among fishers was the third key factor identified in Loc Binh. FA members are a close-knit community, in large part due to the sharing and trust discussed in relation to financial loans. During interviews with fishing households, there was an emphasis on personal relationships that help deal with livelihood challenges. Interviewees explained how they share information about skills (e.g., teaching each other about new aquaculture techniques), exchange observations about environmental conditions in the lagoon with neighbours who use the same gear, and receive help from family and neighbours to repair damaged gear. FA leaders have also worked closely with all fishers to understand problems faced by different gear users and to find solutions. For example, they work with contacts at the local fish market to find out prices for fish and then share this information with FA members so that they are aware of fair prices. Another way that fisher solidarity plays out is cooperation of the FA with neighbouring FAs. This has included working with a neighbouring FA to agree on bylaws for the habitat protection area, and coordinating patrols of the lagoon for enforcement against illegal fishing activities.

The outcome of secure funding, support from the commune government, and fisher solidarity has been similar to Vinh Giang. The Loc Binh I FA has been able to significantly reduce illegal fishing and overall fishing effort, carry out regular patrols of their lagoon zone, and support alternative livelihoods for members. The combination of solidarity and trust with an improved appreciation of the importance of conservation also made it easier to gain agreement on policies such as setting aside the protection area. Conflicts within this community were never as problematic as seen in other parts of the lagoon, although focus group participants did indicate that they now have few conflicts with fishers from outside of their community.

5.5 Discussion

There is a need for practical strategies and grounded initiatives to foster ongoing transformation processes in SSF. We identified the need for an approach that was fine-grained for the local level and dealt with the potential to support a transformation that appears to be in progress. Through our earlier research (Tuyen et al. 2010; Armitage et al. 2011; Andrachuk and Armitage 2015) we saw signs of promise in the Cau Hai lagoon but that there appeared to be a stall or lag following some initial promise. We advance the notion of building blocks as a way of thinking about and assessing supporting conditions for local-level transformations.

Facilitating deliberative social-ecological transformations for SSF implies the ability of actors to take actions that shift social and biophysical systems in new directions (Moore et al. 2014). Transformations and SSF literature have already indicated that social capital, appropriate legal settings, learning, and leadership are among factors that can contribute to such shifts (e.g., Olsson et al. 2008; Rijke et al. 2013; Benessaiah and Sengupta 2014; Cinner and McClanahan 2015). Nonetheless, there is a disconnect in finding ways to understand and shape those shifts in deliberative and proactive ways (Patterson et al. 2017). Our discussion below aims to demonstrate some of the site-specific, forward-looking lessons that can emerge in useful ways to address these needs for SSF. Addressing persistent challenges for SSF requires grounded, bottom-up insights and building upon site-specific successes to facilitate continued and broader change.

5.5.1 Synthesis of Site-specific Building Blocks

Our findings have explored what is working in two FAs in the Cau Hai lagoon in order to understand why those FAs have been successful. We synthesized site-specific building blocks by distilling factors that contributed to the FAs' success (Table 5.2). Leadership and funding were identified as two of the building blocks, however, we leave open the possibility for alternative and additional interpretations of building blocks. For instance, trust appears to be closely related to both leadership and funding. We interpreted the latter two as building blocks because

they more directly capture the content of interviewee responses. Additionally, the other FAs in the Cau Hai lagoon will likely each require a unique combination of building blocks. As noted in our basic attributes of building blocks, they are not to be thought of as static or linear. The approach of identifying context-specific factors is the prime interest. It is likely that other FAs may require other building blocks that were not observed in Giang Xuan or Loc Binh I FAs (for example, bridging organizations, collective visioning, or poverty alleviation).

Figure 5.3 is a graphic representation of five building blocks that emerged from the two cases: awareness of the value of ecological conservation, co-operation among fishers, support from local government, secure funding for the FA, and good leadership within the FA. We do not suggest that all five building blocks are required for success (or that these are the only potential building blocks) – only that they provide insights and lessons for improving implementation of TURFs for SSF and, thus, improving ecological conditions and livelihoods in the Cau Hai lagoon. It is noteworthy that although these building blocks were empirically identified from the ground up, they echo longstanding findings in literature on co-management and SSF (e.g. Pinkerton 1989; Baland and Platteau 1996).

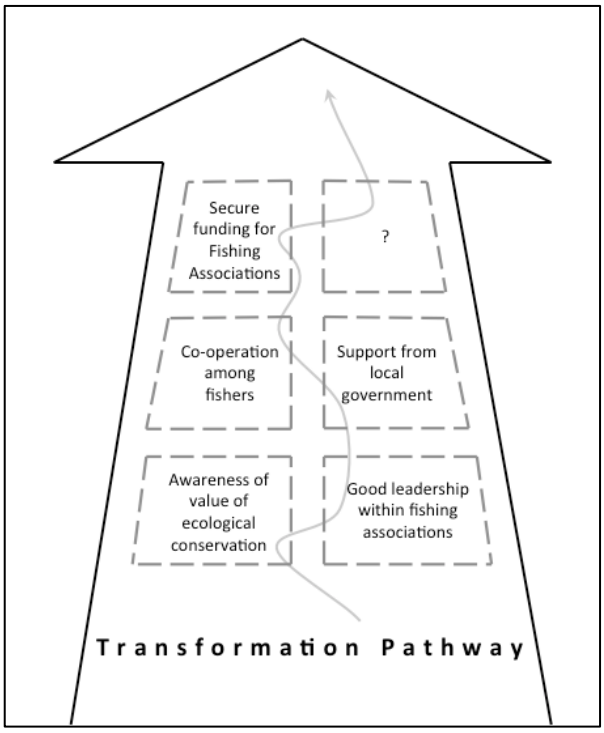

Figure 5.3: Building blocks for social-ecological transformation in the Cau Hai lagoon. Dotted blocks suggest supporting conditions for transformation; the non-linear pathway is a reminder that building blocks will not be the same for all Fishing Associations.

Deliberative transformations are complex and require many interconnected variables working together. Catalysts for the transformation also require acknowledgement. Innovations that helped set the Cau Hai lagoon transformation in motion (Westley et al. 2011; Moore et al. 2014) were the introduction of FAs and co-managed TURFs. FAs replaced earlier attempts to create fisher cooperatives that were more politically oriented. The FAs have been adopted much more favourably by fishers because they reflect the organization of customary fisheries management. TURFs were introduced to deal with property rights issues that developed as a result of technological advances and growing population pressures. The legal and policy settings originated from the central government and opened the door for decentralized SSF management and co-management with FAs (see also Tuyen et al. 2010; Armitage et al. 2011). Our aim here is not to describe all factors that initiated the transformation, but to recognize and demonstrate how the factors build on each other and open opportunities for further interventions.

Each of the building blocks came about in different ways for each individual FA. Secure funding for both FAs was aided by the former presence of internationally-funded projects and both FAs collect membership fees. The main factor for Loc Binh I was their micro-loan system. Giang Xuan, on the other hand, greatly benefits from the FA chair receiving salary from his participation in the commune government. Another building block that demonstrates differences in the ways that they took shape in each FA is support from local government. For Loc Binh I, that support comes from a few key individuals. Giang Xuan benefits greatly from strong communication by the FA chair that results in a better understanding of fishing issues for the commune government. These examples illustrate how supporting conditions for transformations can have different pathways. Our interpretation is that the building blocks have a presence in both FAs but they are emphasized in different ways due to the ways that various factors are perceived to be important.

Up to this point we have focused attention only on FAs. While we maintain that the five building blocks identified here were inductively identified, it is noteworthy that they are dominantly 'social' and related to governance as opposed to 'ecological'. This outcome was not due to the design or intent. We suspect that with ecological conditions being similar within and across the Cau Hai lagoon, emphasis from research participants was placed on social and governance factors. In the following section, we consider what building blocks can reveal about potential to build transformation pathways.

5.5.2 Lessons for a Transformation in Progress

The building blocks metaphor can be useful as a heuristic tool for reflection and learning. Several important lessons for Cau Hai lagoon FAs follow from identification of building blocks. Specifically, these lessons indicate options for ways to enhance the success of other FAs – thus opening pathways for continuing the social-ecological transformation.

Improving implementation of co-managed TURFs should not focus only on FAs. The onus needs to be placed on all co-management partners (i.e., commune and district governments) to be involved and committed to enforcing fisheries policies. There is a need for strong communication between FAs and commune government. Giang Xuan has shown the ideal standard, where the FA leader is both willing and has the opportunity to regularly share fishing experiences with government. The mutual understanding and trust developed through this communication has led to commune financial and physical support for activities such as lagoon monitoring and enforcement against illegal fishing practices. The co-management arrangements require both authority and resources for implementation. As noted earlier, these types of lessons are not novel in the co-management literature. However, the transformations literature lacks these types of site-specific lessons. The co-management context adds a focus on governance processes and structures that can be instrumental to support a social-ecological transformation.

Among the steps for establishing co-management (Table 5.1), it is not clear how step four (building capacity for FAs) was carried out in the case study FAs or other FAs. It is possible that Giang Xuan and Loc Binh I FA were fortunate to have good leadership and financial stability already in place and the need for further capacity building was not essential. If that it is the case, it should have been imperative to add an additional step to develop a financial plan for each FA to ensure that they have financial stability. Furthermore, more consideration needs to be given to how FA leaders are selected and trained. FAs members are fishers from poor communities who have had no training in SSF management or administration. A common attribute of leaders in the case FAs was their ability to gain trust and build relationships with both fishers and government.

The ability to navigate trade-offs is also critical for FAs. As fishers are required to reduce their number of gear – or remove all fixed gear for some households – transition plans and support for alternative livelihoods are needed. Fishers report fewer conflicts following re-arrangement of fixed gear nets, but fishers who were

already economically and politically marginalized are also more restricted in the fishing activities they can pursue (see also Andrachuk and Armitage 2015). Loc Binh I FA was able to work with members to create alternative livelihoods thanks to their micro loan system and the commitment of FA leaders to meet members' needs. FA support came in the form of loans to purchase new nets, equipment, or training. In contrast, other FAs forced some households to share fish corrals because they had no way to financially support alternative livelihoods

The network of fishers and government officials needs to be able to work together to overcome remaining social and ecological challenges facing the lagoon. These challenges include, strong policy to reduce impacts from aquaculture, programs to divert household wastes from being dumped in the lagoon, better enforcement against destructive fishing practices, and further reducing fishing effort by increasing mesh size of nets and decreasing the total number of nets used (Armitage and Marschke 2013; Andrachuk and Armitage 2015; Ho et al. 2015). Outcomes of such actions remain uncertain, especially whether they will fulfill the social-ecological transformation, but these multi-faceted challenges can only be addressed through collaboration.

We argue that the five building blocks identified in this paper have high potential to contribute to improved implementation of co-managed TURFs for other Cau Hai lagoon FAs. As literature on social-ecological transformations has shown (e.g., Leach et al. 2012; Moore et al. 2014), such empirical evidence of conditions that are conducive to success can lead to replication. For instance, as the process of establishing co-managed TURFs was donor driven it undermined the participation of local government (Ho et al. 2016). The way that Giang Xuan FA was able to overcome this challenge was through continued and meaningful communication from the FA leader to government officials. This is a direct and practical lesson that can be shared with other FA leaders. Another lesson is that FAs – most likely with NGO, government, or researcher support – need to develop models of long-term funding. In Loc Binh I that model was based on fisher-controlled loans. It is

noteworthy that if these types of lessons were applied in other FAs, there would be need for continued experimentation and learning (Olsson et al. 2008). That is, these building blocks do not offer guarantees for success – they offer useful starting points for further experimentation and learning that is essential for supporting a long-term transformation.

5.5.3 Replicating Successes, Contributing to Multi-level Transformations

We make two interrelated arguments in this paper with respect to governance of deliberative transformations. First, we need transformative change to proactively meet the wellbeing needs of people while eliminating ecologically unsustainable practices. However, we do not yet know enough about governance processes that support such transformations. Second, support for transformations requires continually building on successes. This does not preclude efforts to remove path dependencies and barriers to change, but focusing on what does work *in situ* can be more proactive and forward-looking. Further, we do not put forward building blocks as a clear and straight-forward way to navigate transformations. As processes that are complex and contested (Andrachuk and Armitage 2015), social-ecological transformations require pragmatic approaches that are grounded in empirical insights.

We cannot know with certainty if the building blocks that we have identified, if applied in other Cau Hai lagoon FAs, would generate the desired transformation outcomes. We do, however, have good reason to suspect that the lessons from the building blocks are likely to be transferrable to other FAs in the lagoon – due to the similarities within this SSF context – and improve implementation of co-managed TURFs. Commonalities across communities and FAs include dependence on the same resource base, the lagoon as an interconnected ecosystem, use of the same technologies for exploiting aquatic resources, similar levels of wealth, and immersion in the same political and legal settings. As we have noted earlier, the building blocks need not look identical for each FA. The building blocks are a reflection of what has been seen to work in two FAs and are likely to yield positive

outcomes if they had been replicated during establishment of other FAs and co-management agreements.

The Cau Hai lagoon case points to issues of power and questions about the relevance of who initiates a transformation. The model for co-managed TURFs came from local researchers who are intricately familiar with the lagoon (Tuyen et al. 2010; Marschke et al. 2012) and largely supported by international NGOs (Ho et al. 2016). The extent that these actors are 'insiders' or 'outsiders' was not addressed through this research, and important questions remain about the relevance of different actors initiating and navigating the transformation. With respect to building blocks, important questions remain about the relevance of researcher-led insights, who can and should be involved in identifying and replicating building blocks, and who stands to benefit from this type of process.

The notion of building blocks is not intended for scaling vertically. What they do reflect is a bottom-up perspective that can complement higher level, international efforts. Multi-level and multi-faceted approaches have been advocated but few approaches have been proposed for achieving these ends (Patterson et al. 2017; Armitage et al. 2017). Building blocks offer a metaphor and a heuristic that fills an important gap for governance. This idea of in situ, local-scale replication is novel in the transformations literature, where most work is at the global level. For SSF, this type of tool can be particularly useful because discussions around transformations are rarely about scaling up. The need for SSF is to find ways to support and build on very local, specific successes.

5.6 Conclusion

This paper introduced *building blocks* as an approach to assess local, fine-grained deliberative transformations, and to consider how to build transformative pathways. Complex social-ecological transformations – whether deliberative or emergent – require multiple building blocks. The intent is to seek out *in situ* the factors that can be built upon and replicated. We argue that such efforts to seek out

supporting conditions are critical for research and action on deliberative transformations. This approach may be particularly useful for SSF because of the emphasis placed on local conditions and context-dependence.

We inductively analysed potential building blocks in the Cau Hai lagoon and assessed broadly applicable lessons. The small successes seen among two FAs in the lagoon contribute to a larger social-ecological transformation, but they need to be more than incremental or piecemeal. We offer some analysis of what has been working in those cases and hope that our efforts can help guide future research and development projects in the Cau Hai lagoon. This research contributes to the growing body of literature on governance of deliberative transformations in SSF, and offers researchers a practical way to consider supporting conditions for such transformations.

CHAPTER 6: **Conclusion**

Research outcomes in this dissertation are presented as a collection of individual, interconnected manuscripts, yet together they offer a cohesive narrative about governance and transformation in the context of small-scale fisheries in Vietnam. This final chapter synthesizes the findings with respect to the overall aim and objectives of my research. Contributions to academic knowledge are discussed and recommendations are offered for policy and practice. Lastly, I outline several ideas for future research.

6.1 Summary of Objectives and Main Findings

The central aim of this dissertation is to further understand how coastal fishing communities can catalyze or engage in programs to improve livelihoods and ecological sustainability. The research pursues three main objectives: (1) refine a framework for conceptualizing and assessing social-ecological transformations at the community level; (2) empirically characterize social-ecological changes and transformations in the Cau Hai lagoon and their implications for fishers' livelihoods; and (3) assess opportunities within small-scale fisheries governance arrangements for enabling and supporting transformations. Objectives one and two are addressed in the first manuscript (Chapter 3) through a combination of literature synthesis and empirical work. Objective three is addressed in the second and third manuscripts (Chapters 4 and 5) though empirical analysis of a governance network and building blocks for supporting transformations, respectively. The flow between manuscripts, reflecting the research objectives, is depicted in Figure 6.1. The aim and main findings of each manuscript are reviewed below.

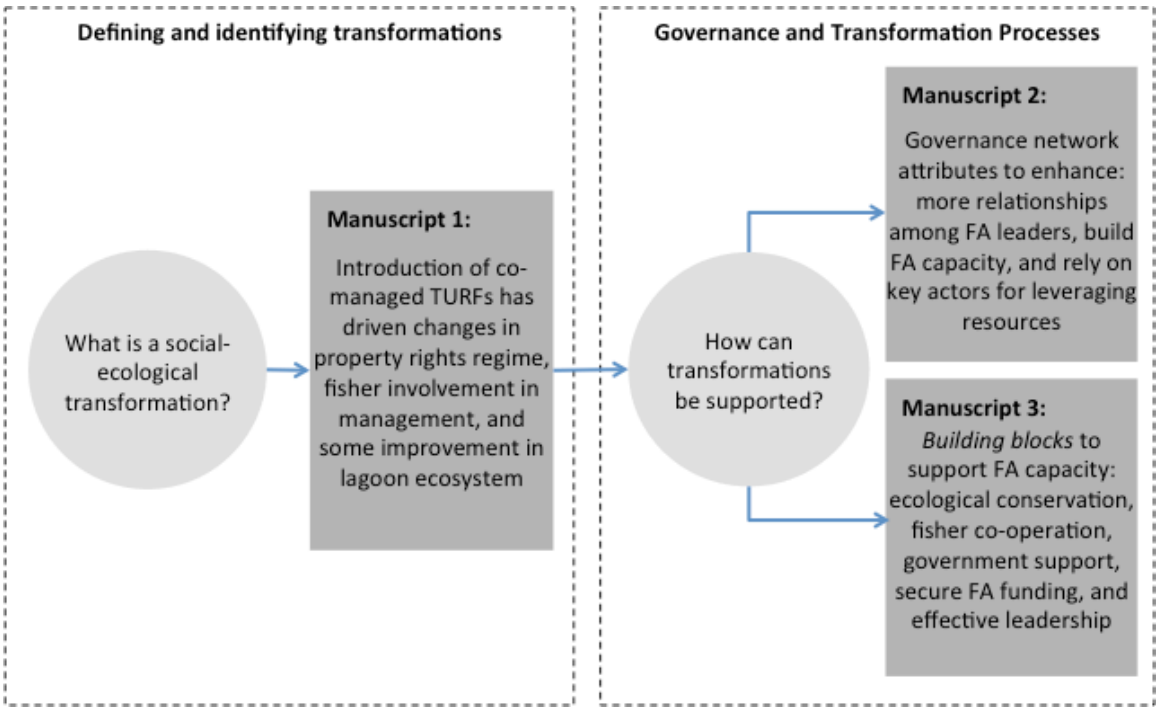

Figure 6.1: Relationship between three manuscripts in this dissertation. Left side box addresses objectives 1 and 2 (gap related to defining and identifying transformations). Right side box addresses objective 3 (gap related to supporting transformations).

My research is premised on an understanding that evaluation of social-ecological transformations is a normative practice. There are multiple ways of framing transformations – cognitively, physically, and temporally – that influence how an observer may make determinations about whether a transformation is taking place or not (Blaikie 1989; Batterbury et al. 1997; Waltner-Toews et al. 2003; O'Brien and Wolf 2010). The findings of the first manuscript (Chapter 3) directly address this conceptual challenge. The outcomes of the first manuscript set the stage for the remaining two manuscripts (Chapters 4 and 5), which address more applied issues related to supporting a deliberative transformation that is thought to be underway.

The first manuscript (Chapter 3) draws heavily on resilience thinking literature to define a framework and approach for assessing social-ecological transformations (Cumming et al. 2005; Folke et al. 2010; Robinson and Berkes 2010). Specifically, the analysis is framed around the notion of SES identity that is teased out through fishers' perspectives on shifts in social and ecological systems over time. Findings

show that greater emphasis on implications for fishers' livelihoods and wellbeing may be more pertinent in understanding transformations than seeking positivistic determinations about transformations (e.g., evaluate implications of crossing thresholds rather than pinpointing when critical thresholds were crossed). There is value in considering the beneficial and harmful ways that transformations impact various actors. With those considerations in mind, there were three findings specifically related to a social-ecological transformation in the Cau Hai lagoon: (1) the introduction of co-managed TURFs has been instrumental in driving the social-ecological transformation that is underway; (2) there are diverse ways that fishers experience and are affected by social-ecological change; and (3) outcomes of the new governance arrangements have been mixed – there are some benefits in terms of fisheries yields but poverty and inequality persist. It is important to be fully aware of locally contested interests and acknowledge competing priorities for fisheries management and human wellbeing. These findings set up the importance of the following two manuscripts that investigate how to improve implementation of co-managed TURFs and support a broadly beneficial social-ecological transformation.

The second manuscript (Chapter 4) investigates the relationships between groups of actors and how those relationships (or lack thereof) support or hinder FAs in their efforts to improve fishing conditions and livelihoods of fishers. The research assesses the governance network surrounding 16 co-managed TURFs in the Cau Hai lagoon. The findings point to three governance lessons for contexts where TURF rights are allocated to multiple neighbouring groups of fishers. First, it is critical for TURF zones to function in complementary ways, rather than as isolated silos, so that governance connectivity reflects ecological connectivity. Second, co-management agreements need to be designed with horizontal relationships in mind so that spatial proximity of TURF zones is matched with actor proximity within networks. Due to the mobility of aquatic resources it is critical for TURF managers to communicate across management boundaries. Network proximity here means that managers directly communicate with each other, and are not connected only

through higher levels of government. Third, as fisheries management responsibilities are decentralized through co-management, TURF leaders need capacity for collaboration. Related to the previous finding, it is critical that TURF leaders are aware of the importance of collaboration and have access to resources to work together. These insights underscored the very pragmatic need to build capacity for FA leaders to communicate with each other and with government counterparts.

As my research unfolded, I heard repeatedly from government agents, university researchers, and FA leaders that a few FAs have been particularly successful in terms of their ability to function according to new co-management agreements. This common impression plus the outcomes of the first two manuscripts were the impetus for the final manuscript. The third manuscript (Chapter 5) introduces *building blocks* as an approach to assess deliberative governance transformations. Two FAs were assessed in detail to inductively identify five building blocks that were instrumental to their success in implementing fisheries management plans: fisher approval of ecological conservation, co-operation among fishers, support from local government, secure FA funding, and effective leadership. These findings support three outcomes from this manuscript related to supporting social-ecological transformations. First, demonstration of site-level specificity of what governance attributes are already contributing to more durable and transformative change in the Cau Hai lagoon. Second, the set of attributes may be replicated in other communities around the lagoon. Third, a means of learning how to move the social-ecological transformations in the Cau Hai lagoon forward. Additionally, the notion of *building blocks* offers a novel research approach that can be used elsewhere to support deliberative transformations that are in progress.

In light of the central interest of this dissertation – how communities can become more engaged in transformative change – the first manuscript establishes an understanding of the types and extent of social-ecological change taking place in the Cau Hai lagoon. This was an important starting point for my research because it

clarified fishers' impressions of how co-managed TURFs have altered the path of development for fishery conditions and their livelihoods. As Figure 6.1 illustrates, the second and third manuscripts then follow up by investigating specific entry points for helping communities become more engaged in governance initiatives that are driving social-ecological change. Those entry points have led to specific recommendations for improving collaboration across the governance network and adopting best practices for FAs, respectively (recommendations in section 6.2.2).

6.2 Contributions

In this section I discuss how findings from the three manuscripts – individually and collectively – have academic and applied contributions.

6.2.1 Academic Contributions

Contributions from this research are relevant for the bodies of literature reviewed in Chapter 1, including social-ecological transformations, environmental governance, governance networks, and small-scale fisheries governance. These bodies of literature have significant overlap in terms of the physical contexts they draw on and the key concepts that are cited (in left column of Table 6.1). Three main contributions were identified in Chapter 1: (1) extension of the use of community perceptions as a method for defining social-ecological system identity and emphasis on how people are affected by processes of change; (2) use of a networks perspective to evaluate the implementation of TURFs and learn about ways to support long-term transformation processes through improved collaboration and coordination; and (3) introduction of *building blocks* as a tool for assessing context-specific conditions that be replicated in other similar locations in order to achieve more system-wide success.

To elaborate on the relevance of these three major contributions, Table 6.1 outlines key findings from this research with respect to each body of literature, and points to some lessons for transformations research. Also detailed in Chapter 1 are two main gaps that I sought to address through my research, namely: (1) how to know if a

transformation is occurring and how to empirically characterize a transformation, and (2) how to support transformations in progress. Contributions from this dissertation are discussed here mainly with respect to those gaps.

Table 6.1: Overview of bodies of literature that informed this dissertation and key insights for transformations research.

Bodies of Literature	Relevant Findings: Cau Hai Lagoon	Insights for Transformations Research
Social-ecological Transformations ➢ *resilience thinking, social-ecological systems, fundamental change, path dependency, drivers of change, thresholds, agency*	Chapter 3: Fishers provided in-depth understanding of long-term change in SES and implications of different *system identities.* Chapter 3: Introduction of co-managed TURFs was a driver of SES transformation; other drivers included technological changes, collapse of old property rights regime.	Use of *system identity* and fisher perceptions can provide useful *in situ* understanding of social-ecological transformations. View of linked SES helps unpack tensions between change and stability that are critical for communities. Empirical case shows how fishers need livelihood stability in short term but also collectively make long-term adjustments for sustainability.
Environmental Governance (For Dealing With Change) ➢ *collaboration, multi-level linkages, actor groups (state, communities, non-profit sector), norms, power*	Chapter 3: Evidence that there are diverse ways that fishers experience and are affected by social-ecological transformation. Chapter 3: Early outcomes from co-managed TURFs include some benefits (improved catch size) but persistent challenges of poverty and inequality remain. Chapter 5: *Building blocks* offer site-level lessons on what is needed for TURFs to function successfully.	Empirical case showing how social-ecological transformations have unequal outcomes. Advocacy for deliberative transformations need to be tempered with sensitivity to impacts on different groups. *Building blocks* support learning for transformations. Specific building blocks (i.e. five building blocks in ch. 5) are not readily transferrable to other contexts but the approach of identifying such building blocks is applicable for other fisheries and communities.
Governance Networks ➢ *social relationships, social structures, collaboration, actors embedded in social groups*	Chapter 4: It is detrimental that leaders of adjacent TURF zones are not directly connected within the governance network. Not able to coordinate monitoring and enforcement. Chapter 4: A few key actors communicate heavily and are trusted. These individuals can leverage resources and facilitate new communication patterns.	Collaboration and coordination among many actors is required for influencing transformations. Analyses of governance networks can help target specific groups and connections to weave together. Networks research can assist with understanding where strong relationships exist and how to mobilize knowledge and resources to support

		implementation of governance initiatives.
Small-scale Fisheries Governance ➢ *co-management, coastal communities, fisher engagement, devolution, tenure, territorial use rights, spatial-based management*	Chapter 4: Devolution requires building capacity for fishing associations for communication and coordination. Chapter 5: There are isolated cases where FA leaders and government do have communication and trust, leading to information flow and understanding. Effective implementation of co-managed TURFs guided by fisher approval of ecological conservation, co-operation among fishers, support from local government, secure FA funding, and good leadership.	Devolution of fisheries management requires co-ordination of many actors from government, fishing communities, and other supporting agencies. Devolution of responsibilities is ineffective if fisher institutions do not have capacity to fulfill their responsibilities. Empirical evidence and reminders that (1) trust takes time to develop, (2) buy in from all relevant actors is critical, and (3) good leadership and funding are critical foundations for capacity.

The first gap is that much uncertainty remains about how to know if a transformation is occurring and how to empirically characterize a transformation (Ferguson et al. 2013; Moore et al. 2014; Patterson et al. 2017; Fazey et al. 2017). One contribution from this dissertation is a methodological approach for defining transformations using community perceptions of social-ecological system identity (Chapter 3; Table 6.1). Social-ecological transformations are complicated processes driven by many factors (Weber and Khademian 2008; Moore et al. 2014). Drawing on fisher perspectives and user participatory tools (in focus groups) offers a pragmatic way to assess transformations that is sensitive to local norms and interests. Moreover, Chapter 3 offers a novel case study to a limited set of papers that empirically characterize social-ecological transformations (e.g., Olsson et al. 2006, 2008; Gelcich et al. 2010; Enfors 2013; Benessaiah and Sengupta 2014).

This research also points to some reasons for caution with overt optimism about the outcomes of efforts for transformations. As the results of Chapter 3 show, transformations are unlikely to be wholly beneficial for communities (Table 6.1). Some groups and individuals will benefit more than others. Thus, transformations scholars need to consider who will benefit from transformations, how they will

benefit, and the durability of those benefits. Transformations are complex and outcomes of SES change are often unpredictable (Folke et al. 2010; Moore et al. 2014). I argue that it may be less important to draw neat conclusions (i.e. that a transformation did or did not happen), than to examine potential outcomes of transformations. The risk is that a community may simply shift from one undesirable pathway to another undesirable pathway (Cinner 2011; Steneck et al. 2011; Boonstra and Hanh 2015). It is critical to question the motivation and benefits of transformations and evaluate how SES change can help meet diverse needs.

One person's adaptation is another person's transformation (O'Brien and Wolf 2010; O'Brien 2012). This dependence on perceptions and scale confounds our ability to study and understand social-ecological transformations (Huong 2010). As Chapter 3 demonstrates, by engaging directly with perceptions of people within a system, we can begin to understand lived experiences, potential of transformations transpiring, and relevance of transformations *in situ* (Table 6.1).

The second gap is that little is known about how to support transformations in progress (Moore et al. 2014; Olsson et al. 2014; Pereira et al. 2015; Patterson et al. 2017). Much work is needed to link transformation theories to approaches for actualizing transformations. Chapter 5 offers a novel approach to see beyond obstacles and traps, and instead focus on fine-grained instances of success. The notion of *building blocks* for transformations is introduced as a bottom-up way of assessing how successes can be replicated across similar communities (Table 6.1). This approach and empirical documentation of *building blocks* adds to the collection of recent efforts to focus on the aspirational and positive aspects of deliberative transformations (c.f. Leach et al. 2012; O'Brien 2012; Bennett et al. 2016; Abson et al. 2017; Armitage et al. 2017).

A governance lens – especially aspects of governance for dealing with change – was beneficial for evaluating how to support transformations (Folke et al. 2005; Lebel et al. 2006; Armitage 2008; Duit and Galaz 2008; Plummer et al. 2013). Chapter 4

specifically addresses ways of improving collaboration for fisheries management by evaluating the network of FAs, government representatives, and other non-government actors in the Cau Hai lagoon. An important governance lesson from this research is that TURFs that are spatially proximate need local-level, horizontal connections between TURF leaders (FA leaders in this case) and local government actors (Table 6.1). Transformations require fundamental changes in governance (Olsson et al. 2004; Gelcich et al. 2010; Patterson et al. 2017). Without coordinated and effective changes across the entire Cau Hai lagoon, the potential transformation has been stalled.

Another important lesson for governance comes from Chapter 5 and the ways that *building blocks* can support learning and reflection (Table 6.1). Transformations are long-term processes that can require strategic interventions to support positive outcomes (Westley et al. 2011; Pereira et al. 2005; Abson et al. 2017). Implementation of co-managed TURFs can be improved by looking at FAs that have shown ability to engage fishers and implement fisheries policies, thus supporting system-wide change and transformation. While these insights are not altogether novel, they do re-emphasize and confirm that governance for transformations requires collaboration and learning (c.f. Park et al. 2012; Pahl-Wostl et al. 2013; Pereira et al. 2015; Patterson et al. 2017).

Finally, this research also compels reflection on the five transformations themes that were reviewed in section 1.2.1 and Table 1.1: *fundamental change*, *path dependence*, *drivers of change*, *thresholds*, and *actor agency.* Collectively, these themes were useful for informing empirical research by opening questions about the essence of social-ecological transformations and what it really means to be transformative. Equally important is that they fell short of addressing all aspects of transformations. As the Cau Hai lagoon case revealed, *power, politics,* and *finances* all critically influence the progression of transformations. Insights related to issues of *power* – while not fully addressed here with an explicit framework – did arise through the identification of important questions that transformations research

must grapple with: Who initiates transformations? Does it matter if actors who initiate a transformation are 'inside' or 'outside' the community? Who are the 'winners' and 'losers' as a result of transformative change? Importantly, a contribution of this research is that it highlights the need for further assessment of discursive power (Li 2006), decentralization of power (Raik et al. 2008; Ho et al. 2015), and the ways that politics and power are intertwined and influence equality in transformation outcomes (Manuel-Navarrete and Pelling 2015; Nayak et al. 2016). Future studies would benefit from these types of research that engage with issues and questions of power and how power influences transformation processes and outcomes. *Scale* is another important theme to consider because it highly influences framing and the ways that various drivers of change are conceived and treated. To some extent, all of these issues arose within this dissertation but often indirectly.

6.2.2 Recommendations for Policy and Practice

Applied contributions are discussed here as recommendations specifically related to fisheries governance in the Cau Hai lagoon. These recommendations are targeted for government agencies (commune, district, and provincial) and FAs. I hope that the results of this research will assist these groups to understand how to implement TURFs more effectively, and consequently, help to further improve ecosystem conditions and livelihoods. While these recommendations are most directly relevant for the Cau Hai lagoon, they may also be useful across the Tam Giang – Cau Hai lagoon and other contexts exploring TURFs.

The first set of recommendations emerge from Chapter 4 and the research on governance networks. The Cau Hai lagoon governance network would improve with (1) amended co-management agreements that promote local-level connections between FAs, (2) additional support for FAs from Commune governments and other local organizations, (3) increased financial support for FA leaders to build capacity for management responsibilities as well as their ability to collaborate with each other, and (4) workshops and other activities aimed at building relationships among

FA leaders in neighbouring communities. Any efforts to implement these recommendations can be aided by leaders in the Phu Loc district government and Provincial FA who can help to leverage necessary resources and establish connections between actors.

A second set of recommendations emerges from Chapter 5 and the research on *building blocks*. The idea of *building blocks* was to identify very specific, locally-relevant lessons. In the Cau Hai lagoon, Giang Xuan and Loc Binh I FAs were assessed to learn what has enabled them to implement fisheries management plans. This was particularly salient because most other FAs have struggled to function after receiving TURF allocations. The lessons were that each FA should put more effort toward: (1) fisher support for ecological conservation, (2) co-operation among fishers, (3) financial and logistical support from commune governments for monitoring and enforcement, (4) securing funding for leader salaries and monitoring activities, and (5) selecting and training effective leaders. Other FAs will have some of these building blocks in place but can improve their functioning – and consequently improve conditions across the entire lagoon – by paying attention to all five lessons.

Another audience for recommendations that flow from this research include HUAF researchers and other scholars pursuing work in the Cau Hai lagoon. Much of the action-oriented work by Dr. Tuyen and colleagues at HUAF (e.g., Tuyen 2002; Tuyen et al. 2006) focuses on property rights and community-based natural resource management. The manuscripts in this dissertation supplement earlier transformation work in the Tam Giang – Cau Hai lagoon by Tuyen et al. (2010), Huong and Berkes (2011), and Armitage et al. (2011). The transformations lens is useful for maintaining a holistic perspective on social and ecological changes, long-term trends, and considering the implications of co-managed TURFs. This new way of thinking about challenges for fisheries sustainability and fisher livelihoods in the Cau Hai offers new perspectives on ways forward for supporting FAs. As described

in the following section, this dissertation has also opened new questions for research.

6.3 Ideas for Future Research

This research suggests some ways forward related to co-managed TURFs in the Cau Hai lagoon. There remain some persistent issues that are beyond the scope of the recommendations for policy and practice above. Overall fishing effort – in terms of number of nets used in the lagoon – remains a difficult problem. *Lu* nets in particular are overabundant. These nets are used by all groups of fishers (mobile gear, fixed gear, and aquaculture), have fine mesh, and it is difficult to enforce limits because of the way that they are deployed below the water surface. Bylaws have been established to limit the number of *lu* nets per household and increase mesh size but many households cannot afford to (1) reduce their daily catch and lose needed income and (2) purchase new nets that have larger mesh. Research that investigates innovative ways of resolving these predicaments has potential to make very tangible impacts.

Discharge of pollution into the lagoon is another important issue that was not addressed in this dissertation. In addition to agricultural runoff from the surrounding watershed and water pumped out of aquaculture ponds, household waste is discharged directly into the lagoon in many communities. Efforts have been underway to divert household waste but lack of funding has limited the speed of progress. Fishers noted that this was an important area for concern because of the impacts on aquatic resources during focus groups that verified research results (discussed in part in Chapter 3). There is a need for technical research to determine locally appropriate means of diverting household waste and disposing of it in an environmentally sensitive way.

Poverty among fishing households was highlighted from the onset of my research. Many of the challenges described in this dissertation are connected with poverty of fishers. The TURFs are intended to improve fishing conditions and, consequently,

improve the economic position of fishers. However, these governance arrangements can only be part of the way forward. Tourism has begun to develop in the area and holds some promise as an alternative livelihood industry, but fishers also expressed concerns that they will be pushed out of their livelihoods while highly trained individuals from urban areas take tourism jobs. Clearly, there is a need for research to address broader social and economic issues in communities around the lagoon, especially research that seeks to identify potential job markets that can be developed in the area to support fishers (and former fishers).

Given the long-term perspective of transformations in this dissertation, it would be valuable to see future follow-up studies on the progress of implementation of co-managed TURFs. Such research can help to identify new challenges that emerge and continue to support a positive transformation to a sustainable fishery. If local network connections (i.e., relationships between FA leaders) improve, what consequences arise for monitoring and enforcement? What other conditions contribute to long-term success or shortcomings? In addition to changes over time, different analytical lenses are likely to reveal new and different insights. Another interesting avenue may be comparative research with other parts of the Tam Giang – Cau Hai lagoon that can help identify best practices that have been employed in other areas.

There are several potential avenues for research on social-ecological transformations that follow from this dissertation. More testing and refinement of the use of system identity to assess and characterize transformations is needed. What distinguished my research was the focus on fisher perceptions and the use of participatory tools to identify thresholds between system identities – rather than determinations about thresholds for key variables in earlier studies (e.g., Cumming et al. 2005; Robinson and Berkes 2010; Huong and Berkes 2011; Blythe 2014). This is a promising approach for assessing transformations from the perspective of people within a system. Another avenue for further transformations research is to test and refine the use of *building blocks* to support deliberative transformations.

This approach confronts the difficulty of working with past and future tenses in transformations research. *Building blocks* offer a way of thinking about specific places and contexts to tailor interventions and governance adaptations. More research on this tool – and other similar tools – can be useful for actualizing transformations.

One final area for additional research relates to governance networks. Chapter 4 identifies some conditions and aspects of social relations that are important for implementation of co-managed TURFs. The research is part of ongoing efforts to evaluate how the structure of social relationships influence environmental governance (e.g., Bodin and Prell 2011; Henry and Vollan 2014; Alexander et al. 2016). As this is a broad field of study, continued research will be needed in diverse cases to further our understanding of governance networks, particularly those centered around co-managed TURFs. With specific reference to the Cau Hai lagoon, my research only touched on the leaders within the governance network but did not attempt to specifically assess social relationships among fishers – within and between communities. Further investigation of such relationships will surely reveal additional useful insights for improving co-management. Since SNA only offers a snapshot in time, more research on the Cau Hai governance network and how it is evolving would be beneficial for understanding how it can be improved over time.

6.4 Closing Remarks and Reflections

During one of my field visits to Vietnam, I had a conversation with Christophe Béné (at the time with the Institute of Development Studies, UK) and he challenged me to reflect on whether I could swap another word in place of transformation. Does 'transformation' connote something meaningfully different than 'change' or 'adaptation'? On one level this is a question about semantics and academic discourses, but it also forces consideration of what a focus on transformations adds to research about coastal fishing communities. To answer the first part of the question – very briefly – the term transformation implies radical or fundamental changes. Some discussion of the academic traditions that draw on these terms has

been included in this dissertation but these closing paragraphs are not the place to further unpack the ways that change, adaptation, and transformation are used. These terms will continue to be interpreted and used in multiple ways by scholars in overlapping fields such as resilience, climate change adaptation, and international development.

The aspect of the question about research on transformation of coastal fishing communities brings my research into broader contexts. It has enabled consideration of development pathways and whether governance changes (introduction of co-managed TURFs in the Cau Hai lagoon) have brought about meaningful change for fisher livelihoods, engagement of fishers in management, and improved ecosystem conditions. In my view, if governance institutions change but there are not tangible differences for fisheries and livelihoods, there is no real difference in a system's development pathway (system identity). This is the essential value that a transformations lens added: it forced a spatially and temporally holistic assessment of what type of change really has occurred in the lagoon and what type of changes may still be possible. Recognizing limitations in the Cau Hai lagoon case helped open new questions about what could be done, how practical interventions could be devised, to spur further changes for fisheries and human wellbeing. The focus on transformations helped me retain the emphasis on deeper, fundamental changes to both social and ecological systems, as opposed to smaller incremental changes in social or ecological systems.

Designing governance arrangements that fit with ecosystem dynamics requires an understanding of the scale, intensity and trajectory of ongoing SES changes. This dissertation emphasizes how the knowledge and perspectives of local resource users can be drawn upon to better understand SES change – and the desirability of SES change. Researchers need to distance themselves from claims that collaborative and adaptive forms of governance (in this case, co-managed TURFs) are wholly beneficial. I hope that this research provides more food for thought on how to evaluate the ongoing outcomes of such governance changes.

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Appendix A: Publications related to work in this dissertation.

Citation	Publication status	Inclusion in dissertation?
Andrachuk, M. and Armitage, D. 2015. Understanding social-ecological change and transformation through community perceptions of system identity. *Ecology and Society* 20(4): 26.	Published 2015	Yes. Chapter 3.
Alexander, S.M., Andrachuk, M. and Armitage, D. 2016. Navigating governance networks for community-based conservation. *Frontiers in Ecology and the Environment* 14(3): 155-164.	Published 2016	No. Use of Cau Hai lagoon case study; reviews literature on governance networks for conservation and synthesizes 'waypoints' for understanding networks.
Nayak, P.K., Armitage, D. and Andrachuk, M. 2015. Power and politics of social-ecological regime shifts in the Chilika lagoon, India and Tam Giang lagoon, Vietnam. *Regional Environmental Change* 16(2): 325-339.	Published 2015	No. Use of Cau Hai lagoon case material with respect to historical power relationships.
Armitage, D., S. Alexander, M. Andrachuk, S. Berdej, T. Dyck, P.K. Nayak, J. Pittman and K. Rathwell. 2015. Emerging concepts in adaptive management. In C.R. Allen and A.S. Garmestani (eds.), Adaptive Management of Social-ecological Systems. Springer, Netherlands. pp.235-254.	Published 2015	No. Review of transformations literature.
Armitage, D., S. Alexander, M. Andrachuk, S. Berdej, S. Brown, P. Nayak, J. Pittman, and K. Rathwell. 2017. Communities, Multi-level Networks and Governance Transformations in the Coastal Commons. In, Armitage, D., A. Charles and F. Berkes (eds.), Governing The Coastal Commons: Communities, Resilience And Transformation. Routledge: Abingdon, UK. p. 231-251.	Published 2017	No. Use of Cau Hai lagoon case material with respect to multi-level knowledge sharing.
Andrachuk, M., D. Armitage, H.D. Hoang, N.V. Le. 2017. Territorial use rights for fishers (TURF) implementation shaped by underlying characteristics of governance networks. (submitted to *Global Environmental Change*).	Submitted 2017	Yes. Chapter 4.
Andrachuk, M., D. Armitage, H.D. Hoang, N.V. Le. 2017. Building blocks for social-ecological transformations: identifying and building on governance successes for small-scale fisheries. (submitted to *Ecology and Society*).	Submitted 2017	Yes. Chapter 5

Appendix B: Focus Group Protocols – Social-ecological Change

Preparation and materials*:*

- Poster paper, card paper, markers, pens, tape
- Snacks, water/tea
- Camera (to photograph visuals produced)

Notes for researcher(s):

1. Verbally present information about purpose of the research and consent for participation.

Statement of Purpose and Consent for Participation

Thank you for sharing your time with me. The purpose of this research is to understand how fishers in your community perceive (1) changes in the lagoon environment, (2) the rights allocations for Fishing Associations, and (3) the influence of those things on livelihoods. I am conducting this research as part of my doctoral studies at the University of Waterloo in Ontario, Canada.

This research has received ethics clearance as part of a project on marine social-ecological transformations supervised by Dr. Derek Armitage. Your participation is voluntary. You can choose to skip any of the questions and may withdraw your participation at any time. All of the information collected will be anonymous. If you agree, I will record your name but will only use it for keeping track of who has participated in my research. No names will be used in any reports or publications.

If you would like a copy of the results of this study upon its completion, you can contact me at the Department of Geography and Environmental Management, University of Waterloo, 200 University Avenue West, Waterloo, ON, N2L 3G1. Email: mandrach@uwaterloo.ca

Step 1:

- Record names of participants

Step 2:

- Identify and list system components
- Prompt participants to consider aspects of social, ecological, and government systems
- Record each system component on card paper; use words and simple pictures (e.g. "fish" and a symbol for fish)

Step 3:

- Identify and describe relationships between system components
- Place/tape cards on poster paper and draw linkages
- The main intent is to generate discussion about relationships between components

- e.g. prompt: "if _____ component was removed, how would that influence other components?"

Step 4:

- Sort/rank system component cards into most, somewhat, and least important
- The intent is to generate discussion and also to identify key system components

Step 5:

- Identify status of key system components (use only cards identified as 'most' and 'somewhat' important)
- On poster paper create a simple table with components on left side
- Each participant will use one of the following symbols for each component:
  - ✓ *(meets needs)*
  - – *(does not meet needs)*
  - ✗ *(in crisis)*
- Discuss why participants made certain choices
- e.g. prompt: "how do you know if conditions get to X?")

Step 6:

- Create timeline of major events in the lagoon
- On poster paper create a timeline, allowing participants to define important dates and events
- Add key system components down left side of poster paper
- Group deliberation to determine changes in system components following major events:
  - = *(about the same)*
  - ↑ *(increasing or getting better)*
  - ↓ *(decreasing or getting worse)*
  - *? (don't know)*

Step 7:

- Wrap up with discussion of three general questions:
  - What is going well in your livelihoods and in the lagoon?
  - What is not going well in your livelihoods and the lagoon?
  - What are some potential solutions to the challenges that you face?
- Group deliberation to determine responses; the questions are intended to flow from earlier topics and allow opportunity for new topics to emerge
- Deliberate each question individually and record responses on poster paper

Appendix C: Focus Group Protocols – Results Verification

Preparation and materials*:*

- Powerpoint slide deck with preliminary results
- Laptop and projector
- Poster paper, markers, tape
- Snacks, water/tea
- Camera (to photograph visuals produced)

Notes for interviewer:

1. Verbally present information about purpose of the research and consent for participation.
2. Focus group will proceed in three sections (1) phases of social-ecological change, (2) fisher opinions about co-management, and (3) communication networks. After brief presentation of each set of findings, allow time for questions and discussion.

Statement of Purpose and Consent for Participation

Thank you for sharing your time with me. As you may recall, the purpose of this research is to understand how fishers in your community perceive (1) changes in the lagoon environment, (2) the rights allocations for Fishers Associations, and (3) the influence of those things on livelihoods. Today I am sharing preliminary results and asking for your feedback.

This research has received ethics clearance as part of a project on marine social-ecological transformations supervised by Dr. Derek Armitage. Your participation is voluntary. You can choose to skip any of the questions and may withdraw your participation at any time. All of the information collected will be anonymous. If you agree, I will record your name but will only use it for keeping track of who has participated in my research. No names will be used in any reports or publications.

If you would like a copy of the results of this study upon its completion, you can contact me at the Department of Geography and Environmental Management, University of Waterloo, 200 University Avenue West, Waterloo, ON, N2L 3G1. Email: mandrach@uwaterloo.ca

Steps

- Present sections of preliminary results individually, with breakout discussion after each.
- Participants will be asked if they agree with the findings or if corrections need to be made.
- Participants will also be asked if they have more details to add to any of the findings.

Appendix D: Interview Protocols – Scoping Key Issues

Notes for researcher(s):

1. Verbally present information about purpose of the research and consent for participation.

Statement of Purpose and Consent for Participation

Thank you for sharing your time with me. The purpose of this research is to (1) identify boundaries of the Cau Hai lagoon, (2) gather information about main issues facing the lagoon and fisheries, (3) identify relevant stakeholders to include in the research, and (4) learn about other research that has taken place in the lagoon. I am conducting this research as part of my doctoral studies at the University of Waterloo in Ontario, Canada.

This research has received ethics clearance as part of a project on marine social-ecological transformations supervised by Dr. Derek Armitage. Your participation is voluntary. You can choose to skip any of the questions and may withdraw your participation at any time. All of the information collected will be anonymous. If you agree, I will record your name but will only use it for keeping track of who has participated in my research. No names will be used in any reports or publications.

If you would like a copy of the results of this study upon its completion, you can contact me at the Department of Geography and Environmental Management, University of Waterloo, 200 University Avenue West, Waterloo, ON, N2L 3G1. Email: mandrach@uwaterloo.ca

Questions:

1. How have you been involved with the Cau Hai lagoon (or Tam Giang more broadly)? What research have you led or participated in?

2. Briefly describe the Cau Hai lagoon (or Tam Giang more broadly) in your view. For example, what would you tell people about the lagoon during a conference presentation or lecture?

3. How is the lagoon different than it was in the past? (e.g. size, number, or type of fish; water quality)

4. What are the drivers of change that are influencing the Cau Hai lagoon? These can be environmental (e.g. climate change), government policies, economic, or other. Please be as specific as possible.
   - Please explain
   - What major events that have shaped the current ecological and livelihood conditions in the lagoon? (e.g. doi moi policy; introduction of aquaculture)

5. In spite of changes around the lagoon, what has stayed the same? This could be social, environmental, cultural, or other.

6. Are recent changes in the lagoon (e.g. decentralization and co-management) seen as positive developments for the lagoon ecosystem? As positive developments for livelihoods and wellbeing?

- Why?
- Who is benefitting most? (e.g. are some types of households benefitting more than others?

7. Please identify anyone else who you think I should contact in relation to this research.

Appendix E: Interview Protocols – Governance Processes

Notes for researcher(s):

1. Verbally present information about purpose of the research and consent for participation.
2. These interviews pair with surveys on Network Relationships; ask interview questions first, then end with surveys
3. The questions below are mainly intended to guide the discussion. The topics are most important; not all questions need to be asked.

Statement of Purpose and Consent for Participation

Thank you for sharing your time with me. The purpose of this research is to (1) gather data on the relationships among stakeholders involved with management of fishery resources in the Cau Hai lagoon, and (2) learn more about the processes of management and decision-making related to fishery resources and livelihoods. I am conducting this research as part of my doctoral studies at the University of Waterloo in Ontario, Canada.

This research has received ethics clearance as part of a project on marine social-ecological transformations supervised by Dr. Derek Armitage. Your participation is voluntary. You can choose to skip any of the questions and may withdraw your participation at any time. All of the information collected will be anonymous. If you agree, I will record your name and ask you for names of people you communicate with. This information will be used to analyze patterns of communication across fishers, government, and other actors. However, all names will be converted to anonymized numbers; no names will be used in any reports or publications.

If you would like a copy of the results of this study upon its completion, you can contact me at the Department of Geography and Environmental Management, University of Waterloo, 200 University Avenue West, Waterloo, ON, N2L 3G1. Email: mandrach@uwaterloo.ca

Questions:

1. Interviewee Background Information
   - What aspects of resource management are you involved with? What organizations are you a member of?
   - What role have you played in the formation of Fishing Associations? Negotiations for Rights Allocations? Or other management activities?

2. Organizations Involved in Resource Management
   - From your perspective, are you aware of any interactions among FAs within the Cau Hai lagoon? Are there any joint management efforts or sharing of resources for more effective management?
   - In your understanding, what is the purpose and aim of the local FAs in fishery resource management?
   - What is the role of the Provincial FA in fishery resource management?

- What is the role of the Commune People's Committee in fishery resource management?
- What is the role of the District People's Committee in fishery resource management?
- What is the role of the Provincial People's Committee in fishery resource management?
- What is the purpose of the Rights Allocations to FAs? Are FAs given a greater role in planning and management? Or is the Rights Allocation only intended to help with monitoring activities in their lagoon zone?

3. Processes of Decision-making and Planning
   - Can you describe some examples of how challenges in the lagoon have been addressed on the level of management? Who was involved in solving these challenges?
   - Have you noticed improvements in rule enforcement, environmental conditions, or livelihoods since the formation of the FA? Explain with examples
   - What role do advisory panels, researchers, or other experts play in providing information to your organization?
   - Describe what types of information and knowledge are used for developing plans? Who is consulted about problems in the lagoon and solutions for management? e.g. Is scientific knowledge used? Is fishers' knowledge used?

4. Relationships Among Organizations and Groups
   - With respect to the relationships between the organizations that we have been discussing, are there differences now compared to before FAs received Rights Allocations?
   - With respect to the process of management and decision-making related to lagoon resources, are there differences now compared to before FAs received Rights Allocations?
   - What is a typical interaction between you and FA leaders?
   - From your perspective, what is the level of information sharing and awareness between different FAs around the Cau Hai lagoon?

5. Key People and Organizations
   - Have any organizations, groups, or individuals been particularly helpful for building positive relationships among people involved with management of natural resources in the lagoon?
   - What types of support do FAs receive from government agencies?
   - What types of support do FAs receive from non-government agencies (e.g. university researchers or NGOs)?

Appendix F: Interview Protocols – Operation of Fishing Associations

[Full interview guide is provided here, however, only some of the data was used in this dissertation related to operation of Fishing Associations.]

Notes for researcher(s):

1. Verbally present information about purpose of the research and consent for participation.
2. Follow-up questions are of key importance because they provide the opportunity for more explanation and details about the interviewees' perspectives. Examples of follow-up (prompt) questions are:
    - How?
    - Why?
    - Please explain…
    - Provide examples…
    - Describe specific events…

Statement of Purpose and Consent for Participation

Thank you for sharing your time with me. The purpose of this research is to gather information about wellbeing and stresses related to fishing livelihoods. I am conducting this research as part of my doctoral studies at the University of Waterloo in Ontario, Canada.

This research has received ethics clearance as part of a project on marine social-ecological transformations supervised by Dr. Derek Armitage. Your participation is voluntary. You can choose to skip any of the questions and may withdraw your participation at any time. All of the information collected will be anonymous. If you agree, I will record your name but will only use it for keeping track of who has participated in my research. No names will be used in any reports or publications.

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Questions

1. Interviewee background
    - Life history
        - full name
        - age
        - number of household members
        - main livelihood activities (types of gear)
    - Do members of your household participate in other livelihood activities?

- Seasonal calendar: What activities are you involved with at different times of the year?
    - How do seasonal and yearly variability in the lagoon environment (e.g., water quality, abundance of shrimp/fish/crab/seaweed, temperature, precipitation) influence your ability to carry out your livelihood? Give specific examples or events. What do you do to get by during difficult times?

These questions have two purposes: 1. allow the interviewee to become more comfortable with speaking to the interviewers; 2. learn more about the specific activities that the interviewee is involved with (possibly draw out a seasonal calendar on paper).

2. Environmental change
- Over the long-term (10 to 20 years), what changes have you observed in the lagoon environment?
- How do these changes affect you?

Note that the previous questions focuses on short-term changes related to seasonal variations. This question considers long-term environmental changes such as decreasing number of fish/shrimp/crab, decrease in size or amount of catch, disappearance or appearance of species, changes in water temperature, changes in water quality, etc.

3. Livelihood change
- What are the things that influence your livelihood activities in the lagoon? [*e.g., how you fish; when you fish; when you choose to harvest aquaculture; where you fish; availability of certain species; space for your gear type; water quality*]
- Have you always used the same type of gear? Has this changed over time? Why did you change livelihood practices? [*be sure to ask for specific events that caused changes; specific years; why?*]
- Have there been any periods in your life when you stopped fishing? Why? What made you return to fishing?

I am interested to know if changes in people's livelihoods were cause by environmental or social factors (or both). Follow-up questions about "why?" are very important here.

4. Factors that influence wellbeing
- For you and people who have similar livelihoods as you, what are the factors that enable you to live well? [*e.g. activities you need to do; things you need to have; the type of person you need to be*]
- How would you describe someone in the community who is doing well? How would you describe someone who is not doing well? [*note: this question can be turned into a table with 2 columns for easy recording*]

It is important that the interviewees have flexibility to answer this question is many different ways. Responses should not be in reference to specific people; we are seeking to understand what they perceive to be desirable.

5. Challenges
- What are your greatest challenges? How have you dealt with these challenges?
- Have other people experienced similar challenges? How have other people dealt with these challenges?
- What are the factors that make it easier or more difficult to deal with these challenges?
- What are your main concerns for the future? For your household? For the community?

Note the difference between the first and last questions in this section. The first question relates to past and present challenges. The last question relates to the interviewees opinion about the future (and may include answers about employment for children, education, water quality, etc.)

6. Social capital
- What are the ways that relationships with other people influence your ability to carry out your livelihood? [*e.g., family, friends, fishers with same gear, fishers with different gear, FA leaders, government officials, fishers in other communes*]
- Why are these relationships important?
- Do these relationships help you address the challenges that you mentioned in the previous question?

7. Comparative wellbeing
- Do you see your own group [aquaculture households, fixed gear fishers, mobile gear fishers] as winners or losers after your Fishing Association received its rights allocation?
- When neighbouring Fishing Associations receive their rights allocations, do you see your own group [aquaculture households, fixed gear fishers, mobile gear fishers] as winners or losers?

Appendix G: Interview Protocols – Conditions for Fishing Associations Success

Notes for researcher(s):

1. Verbally present information about purpose of the research and consent for participation. Note that all participants are already familiar to the research team and have participated in earlier focus groups and/or interviews.
2. There are very few questions for this interview guide. The intent is to follow open-ended questions to generate some personal narratives.

Statement of Purpose and Consent for Participation

Thank you for sharing your time with me once again. The purpose of this research is to learn more about what conditions have led to the success of your Fishers Association. As you know, I am conducting this research as part of my doctoral studies at the University of Waterloo in Ontario, Canada.

This research has received ethics clearance as part of a project on marine social-ecological transformations supervised by Dr. Derek Armitage. Your participation is voluntary. You can choose to skip any of the questions and may withdraw your participation at any time. All of the information collected will be anonymous. If you agree, I will record your name but will only use it for keeping track of who has participated in my research. No names will be used in any reports or publications.

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Questions

1. Tell me about your role with the Fishing Association?

2. Tell me about the formation of the Fishing Association and allocation of fishers' rights

3. What role have NGO's played in those processes?

4. What role has government played in those processes?

5. What are the main aspects that make this a strong Fishing Association?

Appendix H: Surveys – Network Relationships

Preparation and materials*:*

- Printed copies of surveys, pens

Notes for researcher(s):

1. These surveys pair with interviews on Operation of Fishing Associations; ask interview questions first, then end with surveys.
2. If interviewees are able to read and write, they will fill out surveys on their own.

Survey part 1:
Influence network

Name of Interviewee: _____
Within the last year, who do you consider to have had the most influence on your opinions with respect to issues related to aquatic resources?

	Name & Organization	**Frequency of Contact:** (1) rarely, (2) sometimes, or (3) often.
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

<u>Survey part 2</u>:
Information exchange

Name of Interviewee: _____

Within the last year, who do you talk to most often about issues related to…

	1. Rights Allocation	2. Fishing Activities	3. Fish Corrals	4. Aquaculture
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				