SHRIMP SUPPLY CHAINS, COMMON PROPERTY AND POLLUTION MANAGEMENT AT TAM GIANG CAU HAI LAGOON, VIETNAM

A thesis

submitted in partial fulfilment

of the requirements for the Degree of

Doctor of Philosophy

at

Lincoln University

by

Truong Chi Hieu

Lincoln University

2012

DECLARATION

This work has not previously been submitted, either in whole or in part for a degree at this or any other university. To the best of my knowledge, the thesis is original and contains no materials previously published or written by any other persons except as acknowledged in the text.

Truong Chi Hieu

ACKNOWLEDGEMENTS

I firstly would like to thank NZAID for providing financial support for my study at Lincoln University. I acknowledge Lincoln University and staff of the Commerce Faculty for their friendly assistance. I am also thankful to Hue College of Economics for allowing me to study in New Zealand.

I am especially grateful to Professor Keith Woodford, my principal supervisor, who led me through the entire process of this thesis from the beginning to the completion with his leadership, insight, knowledge and special care. I may not have had the opportunity to study at Lincoln University and complete this thesis without his help. Whenever I turned to Professor Woodford asking for his help, he was always there with great insight and wisdom.

I am also very grateful to Associate Professor Mike Lyne, my associate supervisor who gave me many valuable comments on my writing. Associate Professor Mike Lyne has truly been a role model in my academic life and will always be so. I also may not have completed this thesis without his help.

I am indebted to my wife who had to sacrifice too much for my study and gave me endless encouragement. My little baby Gia Bao truly motivated me to get this thesis done. Last but not least, I should acknowledge my parents, my parents in law, my brothers and sisters, who had to take over some duties that should be mine during my study.

Abstract of a thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy

SHRIMP SUPPLY CHAINS, COMMON PROPERTY AND POLLUTION MANAGEMENT: A CASE STUDY OF TAM GIANG CAU HAI LAGOON

By

Truong Chi Hieu

Tam Giang Cau Hai (TGCH) Lagoon is the largest wetland system in Southeast Asia with an area of 21,467ha and a coastal length of 70km. Shrimp culture is one of the main livelihoods of local communities, which total about 300,000 inhabitants. The purpose of this study was to identify factors constraining the Lagoon's shrimp supply chain and to recommend ways of improving chain performance.

The TGCH shrimp industry was investigated within a supply chain framework. Given the lack of prior information about the structure of the chain and its performance, this investigation was exploratory, and used a qualitative methodology. The investigation showed that the TGCH shrimp supply chain was dysfunctional due to production losses linked to contaminants and associated disease conditions in the waters of the Lagoon.

There are several pollution sources including at least: (i) aquaculture production and other livelihood activities in the lagoon; (ii) agricultural production activities in upstream areas; and (iii) industrial production and urban dwellers in the lagoon catchment. Within the bounds of this thesis, it was decided to focus on the endogenous pollution from within the Lagoon, which was

considered the most important and complex of the pollution issues, while recognising that a comprehensive solution would also require consideration of exogenous sources.

An analysis of the pollution problem using theory relating to common pool resources attributed the pollution caused by shrimp culture to recent changes in property rights to lagoon resources. In particular, the lagoon bed had been privatised to shrimp farmers while the lagoon water remained an open-access resource.. Shrimp farmers are therefore able to internalise the benefits of shrimp culture while externalising their pollution costs. The consequent over-exploitation of the water is exacerbated by a lack of appropriate aquaculture zoning in the lagoon.

To solve the pollution problem, it is first necessary to open waterways adjacent to the privatised farms to help dissipate pollutants. Currently these waterways are partially blocked by net enclosures placed there by farmers without formal rights to this activity. However, removal of net enclosures is unlikely to be a sufficient remedy. Accordingly, a range of pollution abatement instruments including tradable shrimp output quotas, tradable shrimp input quotas, shrimp output taxes, shrimp input taxes, tradable pollution quotas and pollution taxes were assessed against normative criteria proposed by the environmental economics literature. First-order assessment criteria were environmental effectiveness and administrative feasibility. Second-order criteria were static efficiency, cost-efficiency, dynamic concerns, and political acceptability.

Although shrimps are considered to be the most profitable aquaculture option under optimal production conditions, farmers do have production substitution options using other aquaculture species. Accordingly, any quota systems (either input or output) would need to be designed to include all species, with either separate quotas for each species or composite quotas for species aggregates. The most promising of the quota systems is likely to be an individually transferable quota (ITQ) on the seed inputs for each species. This judgement is based on the limited number of seed suppliers which facilitates monitoring, and limited capacity within a

specific production system to replace seed with other inputs. However, this measure is challenged by administrative burdens. Recent literature in the field of community-based natural resource management suggests that these burdens could potentially be reduced by a co-management system.

Co-management has already been tested in four communes in TGCH Lagoon but only in association with the opening of waterways. Consequently, this study proposes a re-structured co-management in TGCH Lagoon that includes management of individually transferable seed quotas.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CIE: Centre of International Economics

FAO: Food and Agriculture Organisation

FAs: Fishery Associations

FSPS II: Fisheries Sector Program Support Phase II in Thua Thien Hue Province

GSO: General Statistical Office of Vietnam

HUAF: Hue University of Agriculture and Forestry

IMOLA: Integrated Management of Tam Giang Cau Hai Lagoon Activities Project

ITQs: Individually transferable quotas

MBI: Market-based instrument

NPS: Non-point source

OECD: Organisation for Economic Co-operation Development

PECAAF: Thua Thien Hue Provincial Extension Centre for Agriculture, Aquaculture and Forestry

PPC: Thua Thien Hue Provincial People's Committee

PPP: Polluter Pays Principle

PRA: Participatory Rural Appraisal

PS: Point source

SCM: Supply chain management

TGCH: Tam Giang Cau Hai

TTH: Thua Thien - Hue

VBARD: Vietnam Bank of Agriculture and Rural Development

WB: World Bank

CHAPTER 1

INTRODUCTION

1.1 Overview

The objective of this study is to investigate the Tam Giang Cau Hai (TGCH) shrimp supply chain in order to identify factors constraining the chain and to suggest ways of improving its performance. In the absence of previous studies and adequate information about the performance of the Lagoon's shrimp supply chain, it was decided to conduct the investigation in two phases starting with an exploratory study of dyadic relationships within the chain. The findings of this first stage were intended to inform the research questions to be addressed in the second stage of the study.

The first (exploratory) stage of the research was qualitative and drew on theories provided by supply chain and value chain literature. The findings showed clearly that improved shrimp supply chain outcomes were dependent on addressing the issue of pollution in the Lagoon. Pollution is an environmental risk that adversely affects production levels, resulting in contractual failures that undermine coordination between agents in the supply chain. In keeping with the problem-focused (rather than technique-focused) philosophy of the study, the second stage of the investigation analysed the pollution problem using theories drawn from

environmental economics and natural resource management. In so doing, this study integrates the usually distinct bodies of literature dealing with supply chain management, environmental economics and natural resource management.

This introductory chapter first presents information on the physical, biological and socio-economic characteristics of the lagoon. This is followed by brief descriptions of aquaculture in Vietnam and shrimp production in TGCH Lagoon. The research questions are then presented, followed by an overview of the research philosophy and methods used.

1.2 Introduction to TGCH Lagoon

1.2.1 Natural conditions

TGCH Lagoon is a tropical wetland system with an area of 21,467ha and a coastal length of 70km. The lagoon lies between latitudes 16014' - 16042'N and longitudes 107022 - 107057E (Figure 1.1). It is the largest lagoon in Southeast Asia (Huong & Berkes, 2011).

1.2.1.1 Climate

According to Thung (2007), the Tam Giang-Cau Hai Lagoon is at the southern end of the northern Vietnam monsoon region. The climate is also influenced by proximity to Truong Son Mountain. Annual rainfall averages 2,744mm/year and this is distributed unevenly with three months of dry season and nine months of rainy season. Peak rainfall occurs in October and November when floods often occur,

causing negative effects on aquaculture production. Annually, there are 0 to 4 storms with wind velocity from 20 - 40m/s. The entire area around the lagoon is prone to annual floods and low lying areas are particularly vulnerable. Storms and floods cause serious risks associated with the second crop of aquaculture from August to October. In November 1999 a catastrophic flood breached of the Lagoon barrier to the sea, resulting in loss of property and life of over 300 people. The annual average temperature is about 25-260C and the temperature is often 36-370C in the summer (May - August). Drought can occur from June to August.

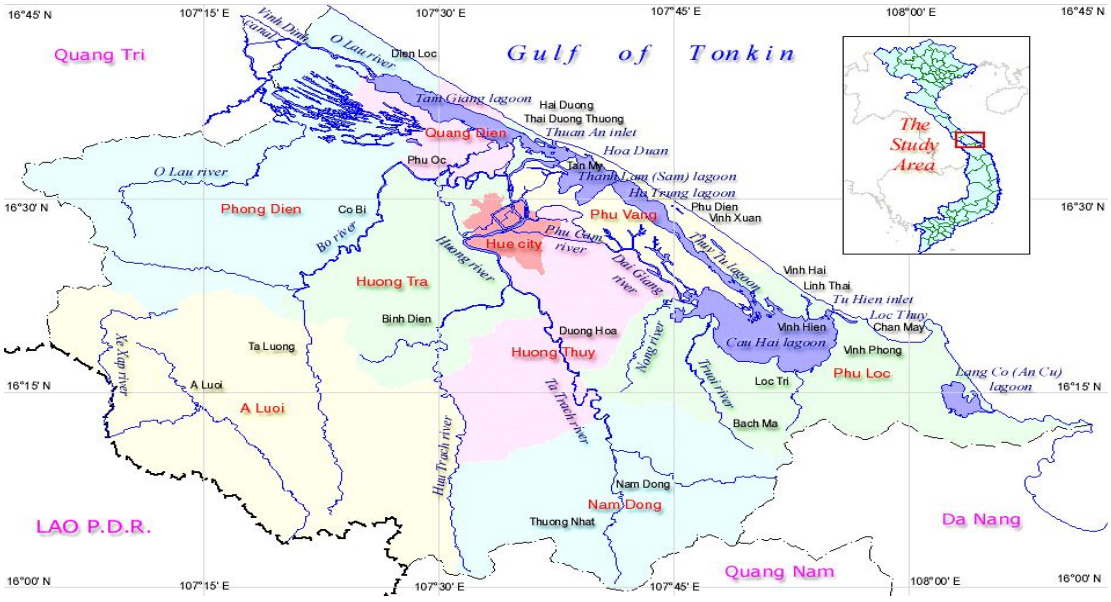


Figure 1.1. Location of TGCH Lagoon, adapted from ICZM (2003)

1.2.1.2 Hydrographic conditions

Thung (2007) states that the TGCH Lagoon system is affected by both river and marine hydrography. Four rivers converge at the Lagoon: O Lau, Huong (including three sub-streams Bo, Ta Trach, Huu Trach), Nong, and Truoi. During the

dry season, salt water may intrude up to 30km. There are two marine estuaries, Thuan An and Tu Hien. In Thuan An, the tidal fluctuation is 0.35m to 0.5m and at Tu Hien it is 0.55m to 1.0m. Waves in winter are 0.25m to 3m in height from the northeast. In summer they are 0.25m to 1m high and predominantly from the east.

1.2.1.3 Ecology

The TGCH Lagoon has been classified by the Ramsar Convention as a natural wetland brackish coastal lagoon (Thung, 2007). According to this author, there are six sub-ecosystems.

Estuarine sub-ecosystem: The Lagoon is directly affected by four river mouths which comprise the estuarine sub-ecosystem. This eco-system is characterised by nutrient enrichment, low salinity, submerged grasses and water fowl immigration.

Water grass sub-ecosystem: Water grass grows around the Lagoon and concentrates at depths of 0.5m to 1.5m, often growing into a blanket. The stock of water grass in the Lagoon is estimated at about 190,000 metric tons. The sub-ecosystem transforms organic and inorganic matters into available foods for other organisms. It also functions as a habitat of marine and fresh water migrant organisms and a source of fry (seed) for the whole Lagoon.

Soft bottom sub-ecosystem: This is from 2m to 9m in depth. Because of the depth and salinity (sometimes reaching 30%), water grass cannot grow. The soft

bottom is a place where small molluscs, crustaceans, echinoderm, and polychaeta all thrive. Hence, bottom fish are attracted to this area.

Tidal sub-ecosystem: This area is narrow, comprising sand flats and associated sand dunes lying between the Lagoon and the sea. This sub-ecosystem has less diversity than the other sub ecosystems but provides some protection from penetration of salinity into the lagoon.

Agricultural sub-ecosystem: These land areas are adjacent to the river mouths, and have been reclaimed for growing rice (approximately 120,000 tons per year) and other crops.

Mangrove sub-ecosystem: There is a small area of mangrove forest in the Lagoon, comprising Avicennia mariana, Rhizophora apiculata, and Bruguiera sexangula. This provides a habitat for waterfowl plus protection of the shoreline.

The water grass, soft bottom and estuarine sub-ecosystems represent the three main ecosystems of TGCH Lagoon (Thung, 2007).

TGCH Lagoon has rich biodiversity. It is estimated that there are about 1000 species including phytoplankton (287 species), fish (215 - 230 species), birds (73 species), zooplankton (72 species), benthos (193 species), seaweed (46 species), higher plants (31 species), and water grasses (18 species) (Thung, 2007). According to Thung (2007), the high biodiversity is linked to the variation in salinity between the dry and rainy seasons.

1.2.2 Socio–economic conditions of TGCH Lagoon

TGCH Lagoon is not an administrative unit and hence the Statistical Office in TTH Province does not collect socio-economic information specific to the Lagoon. In this sub-section, the major source of information is a baseline survey of the Integrated Management of Tam Giang Cau Hai Lagoon Activities Project (IMOLA) conducted in 2006.

There are about 300,000 inhabitants from 33 communes in 5 districts living in and around the Lagoon (IMOLA 2006). The incidence of poverty in these communities ranged from 55-70% in year 2000 (Phap, Mien & Thuan, 2002). This does not compare favourably with the national poverty rate in rural areas of 35.6% in that year (Phap et al., 2002).

Of the 300,000 inhabitants, it is estimated that 100,000 people engage in aquaculture and capture fisheries as their main livelihood activity, and the remaining 200,000 people participate in a range of related activities, including coastal agriculture and occasional or part-time aquaculture and capture fisheries (Tuyen, Armitage & Marschke, 2010). Complementary occupations include seasonal work, construction and trading. Households engaged in aquaculture as their main activity also undertake agriculture, livestock and capture fisheries. Farmers practicing agriculture as their main activity also raise livestock but undertake limited

aquaculture and capture fisheries. Fishermen are also involved in aquaculture and livestock but not in agriculture.

According to the IMOLA (2006) survey conducted in 23 of the 33 communes, over 90% of households have electricity and access to fresh water. The number of the poor either without houses or living in temporary houses decreased from 18,675 people in 2001 to 3,750 people in 2005.

In TGCH Lagoon, less than half (46.6%) of the population in 2005 had more than primary education and 2.6% of working age labourers were illiterate. Of the economically active population, 58.2% had never had skills training. Commune-level organisations associated with technical knowledge transfer and the provision of credit include the Farmer's Union, Women's Union, Youth Union and Veterans' Union.

1.3 Aquaculture development in Vietnam

In 1986, Vietnam conducted a substantial economic transformation, namely *Doi Moi*. The core economic principles were the provision of a legal and institutional framework for - and encouragement of - the private sector, the replacement of administrative controls with economic incentives, and the promotion of agriculture through de-collectivisation and land reform (CIE, 1998; Kumssa, 1997). In addition, the development of economic sub-sectors in which Vietnam held competitive advantage was emphasised. The Vietnamese central government's intention to

develop aquaculture to take advantage of its long coastline was recognised in several legal documents such as the Proceedings of the National Party Assembly in 1998, decision 224/QD-TTg of the Prime Minister in 1999, and Resolution 09/NQ-CP of the central government in 2000.

The development of sustainable commercial aquaculture became a priority of Vietnam. By 2003, 612,778ha of marine brackish water and 254,835ha of freshwater had been utilized for aquaculture, with shrimp culture occupying 580,464ha of the brackish area (Vietnam Ministry of Fisheries [MFI], 2008).

The value of aquaculture within total Vietnamese GDP increased from 2.1% in 1996 to 5.8% in 2005, whereas the contribution of capture fisheries to national GDP diminished from 5.0% to 4.0% in this period (General Statistical Office of Vietnam [GSO Vietnam], 2006). The export value of the fisheries sector increased from US$697 million in 1996 to US$2,650 million in 2005 (Nguyen, 2007). The total area of aquaculture in Vietnam increased at an annual compound rate of 13.8% and the total volume of production increased 33.2% per annum from 1999 to 2005 (GSO Vietnam, 2006). By 2006, aquaculture ranked as the third-most prominent economic sector after the oil and garment industries (GSO, 2006).

1.4 Shrimp production in TGCH Lagoon

In TTH province, there are two categories of aquaculture, including fresh water and brackish water aquaculture. All aquaculture in the TGCH Lagoon is of the

brackish type, and this TGCH aquaculture comprised about 70% of the total provincial aquaculture area in 2007 (TTH Statistical Office, 2008).

In TGCH Lagoon, shrimp culture is the most important type of aquaculture. There are two kinds of shrimps grown in the Lagoon. *Penaneus monodon*, the main one, was introduced in the early 1990s, and *Litopenaeus vanname*, the secondary one, was introduced in 2004.

In TGCH Lagoon, the area used for shrimp production increased from just 100ha in 1995 (Phap, 2002) to a peak of nearly 4000ha in 2004 (TTH Statistical Bureau, 2005). In 2002 the provincial TTH government set a target of 5,939ha by 2010 (Decision 3170/QD-UB). 1.5 Research questions and justification

1.5 Research questions and justification

1.5.1 Research questions

The following research questions were posed for the exploratory stage of this investigation:

1. What is the current situation of the supply chain for shrimp produced from the TGCH Lagoon?
2. What are the key constraints to improved chain performance?

The results of the exploratory study are presented in Chapter 3 of this thesis. They show clear evidence of systemic failure in the shrimp supply chain. This failure is attributed directly to declining and increasingly volatile yields caused by the

interrelated effects of water pollution and shrimp diseases. Further, this pollution reflects failure in current policies and institutions used to manage the shared water resources of TGCH Lagoon. Consequently, the second stage of this research relies largely on economic theory to understand the origins of the main water pollution problem affecting shrimp production in the Lagoon and to identify an effective policy response. The research questions for the second stage of the investigation were:

3. What are the alternative policy options for dealing with pollution that harms shrimp production in the TGCH Lagoon?
4. What is the most promising policy option to deal with this pollution?

1.5.2 Justification of the research

The justification of the research relates to the importance of shrimp culture to the economy of TTH Province, and to the inherent complexities and associated challenges of facilitating shrimp industry economic development while containing and then reducing environmental degradation. Although there have been several socio-economic studies of shrimp production in TGCH Lagoon, they have focused only on shrimp production at the farm level and none has provided a systematic view of shrimps as a resource-based agribusiness chain. In addition, although water pollution has been recognised as a serious livelihood problem to local communities

taking into account both economic and environmental objectives, there is no contemporary study investigating policy options for managing that pollution.

1.6 Research approach

1.6.1 Epistemology and ontology

Ontology and epistemology are regarded as a philosophical starting point for research, leading to the identification of appropriate methodologies and methods (Denzin & Lincoln, 2000). According to Davidson and Tolich (2003, p24), ontology can be defined as "reality" or an inventory of the kinds of thing that do, or can, exist in the world. Epistemology is considered as the philosophical theory of knowledge, or in other words, the branch of philosophy that deals with how we know what we know. In research, ontology and epistemology provide guidelines for the researcher in identifying the path along which the research is to be constructed and conducted (Sarantatos, 2005). Ontology and epistemology are starting points in research design as they determine the research approach (Figure 1.2)

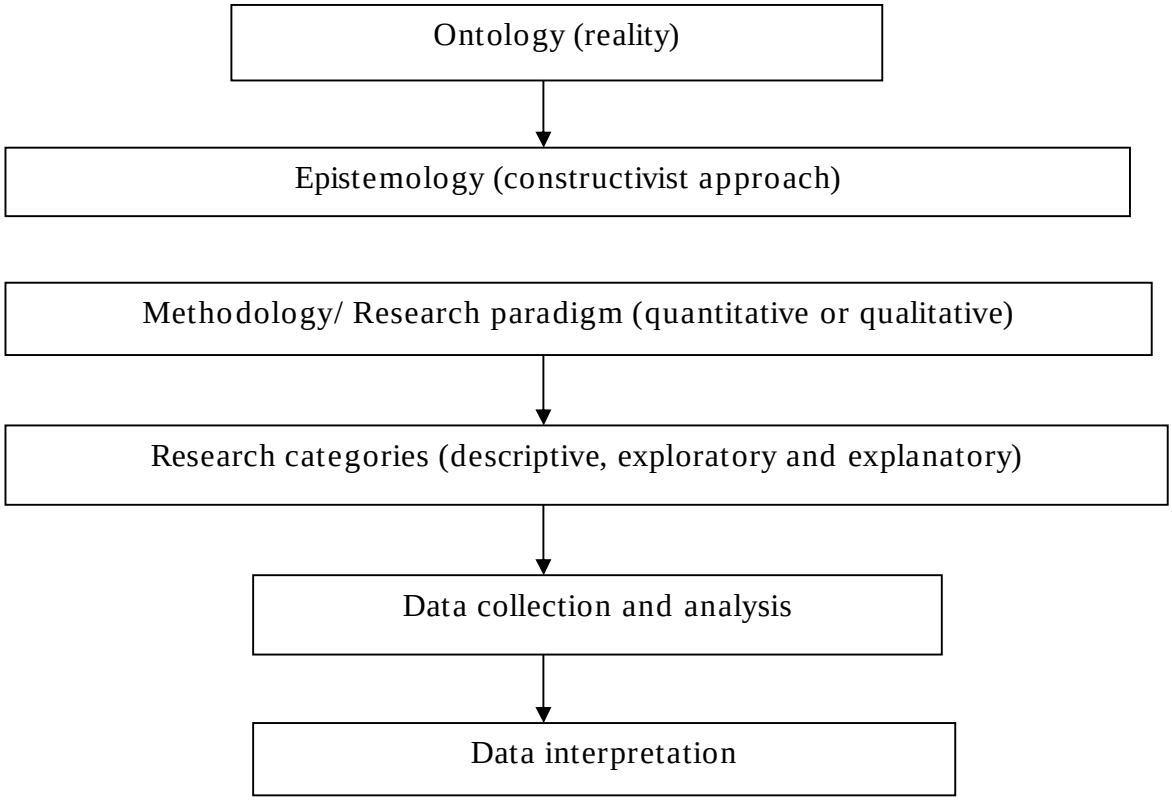


Figure 1.2. The research approach

In this research, the reality (*ontology*) is the performance of shrimp business. In this process, business players undertake complex functions based on incomplete knowledge in a dynamic environment. They make decisions to maximise their personal utility within a bounded rationality and scarce resources. The performance of each business actor is influenced both by internal factors, which refer to personality, skills, perceptions and preferences, and by external factors which refer to many relationships between the actor and the business environment (law, regulation, policies, natural conditions, etc.). In this sense, research findings cannot be a one-

size-fits-all explanation of reality, but only an "idiosyncratic search for temporary truth" (Burke, 1985 cited in Davidson & Tolich, 2003, p34). This is why the constructivist approach was applied in the epistemology of this research. The constructivist approach assumes that the reality is not directly knowable, individuals develop subjective meaning of their experiences – meanings directed toward certain objects or things (Lincoln & Guba, 1985; Schwandt, 2007). These meanings are varied and multiple, leading the researcher to look for the complexity of views rather than narrowing meanings into a few categories or ideas. As a consequence, the research is to rely as much as possible on the participants' views of the situation being studied

1.6.2 Research methodology

There are two kinds of research methodologies based on qualitative and quantitative inquiry paradigms. According to Patton (2002. p69), all debates about application of these alternative approaches focus on the "relative value of two different and competing inquiry paradigms:

- using quantitative and experimental methods to generate and test hypothetical-deductive generalisation, versus

- using qualitative and naturalistic approaches to inductively and holistically understand human experience and construct meanings in context-specific settings."

For different research purposes, each methodology has its own logic. In qualitative research, the inductive logic is employed to generate theory, whereas in

quantitative research, deductive logic is used to test theory. Accordingly, qualitative and quantitative research address different aspects of the same reality, and represent different intellectual frames of mind (Golicic *et al*., 2005).

In this study, a qualitative paradigm was employed to address the exploratory research questions seeking a better understanding of the TGCH shrimp supply chain and its performance. Case study was selected as the research strategy because it allows researchers to obtain holistic and meaningful characteristics of real-life events (Yin, 2003). The unit of analysis was defined as the shrimp industry based on production originating from the Lagoon. Primary data were gathered by interviewing industry participants, and some secondary data were located in government reports. Constructs used to guide the line of questioning and to analyse the data were drawn primarily from value chain and supply chain literature, especially the work of Mentzer *et al*. (2001), Collins *et al*. (2001) and Trkman and McCormack (2009), and from theories of industry development (Van de Ven & Garud, 1989). Methods used to conduct and analyse the case study are discussed more fully in Chapter 3. The findings of this exploratory research were consistent with secondary data showing the spread of shrimp diseases and declining area of shrimp production in TGCH Lagoon, and with theoretical arguments relating to changes in property rights to the Lagoon's resources.

A different research strategy was adopted to address the policy questions posed in the second stage of the study because farmers and other agents in the TGCH shrimp supply chain had little or no experience with policy instruments to control water pollution. For this reason, a normative, analytical research strategy drawing on economic theory and information provided by key informants was used to explain the origins of the main pollution problem affecting shrimp production in the Lagoon and to identify an appropriate policy response. The theory was drawn from literature dealing with environmental economics and natural resource management. The normative research strategy and its supporting literature are described more fully in Chapter 4.

1.7 Thesis structure

This thesis comprises of seven chapters. Chapter 2 reviews literature about agricultural supply chain management. Chapter 3 describes the case study used in the exploratory investigation of the shrimp supply chain in TGCH Lagoon, analyses the case study data, demonstrates a clear link between the chain's poor performance and water pollution created by the rapid expansion of intensive shrimp farming, and links these outcomes to recent changes in property rights to the Lagoon's bed and water. Chapter 4 applies Gordon's (1954) model of common property to analyse the main pollution problem affecting shrimp production in the Lagoon, and then draws on the environmental economics literature to construct a set of possible pollution

abatement instruments and normative criteria to assess these instruments. Chapter 5 applies the assessment criteria and identifies an appropriate pollution abatement instrument to promote sustainable shrimp production in the Lagoon. Chapter 6 considers the question of how best to implement the recommended pollution abatement instrument and explores the merits of co-management described in recent literature dealing with community-based natural resource management. Chapter 7 concludes the thesis with a summary of its main findings and recommendations for a sustainable shrimp supply chain at TGCH Lagoon.

CHAPTER 2

THEORIES OF SUPPLY CHAIN MANAGEMENT

2.1 Conceptualising an agricultural supply chain

Supply chain management is a topic that has attracted the interest of many researchers and practitioners because market competition is no longer between individual firms but between supply chains (Trkman *et al*., 2007; Li *et al*., 2005). Modi and Mabert (2007) argue that quality, costs and risks of a product or service are concerns not only of an individual firm but also of the network of firms that service it. Wathne and Heide (2004) contend that in order to understand performance of an individual firm, a larger network must be investigated.

In the food sub-sector, due to increasing demand for food, scientific farming has become widespread and has been instrumental in the change from small family-owned farms to larger, corporate farms. The modern farmer is an expert specialising in cultivation and animal breeding operations, thus transferring the functions of storing, processing and distribution of plants and animal products as well as the supply of input and production factors to organisations other than the farm. As a result, the traditional classification of activities into primary, secondary and tertiary sectors has given way to an analysis that focuses on the interlinked system of production, processing and commercialisation of farming originated products.

2.1.1 The supply chain and business system

There are several definitions of supply chain ranging from simple to complicated. Christopher (1992) defined a supply chain as a network of organisations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hand of final customers. La Londe and Masters (1994) considered a supply chain as a set of firms that pass materials forward. According to those authors, independent firms in the chain include raw material and component producers, product assemblers, wholesalers, and retail merchants. Lambert, Stock and Ellram (1998) emphasised collaboration among firms in their definition of a supply chain as an alignment of firms that bring products or services to market. Finally, supply chain is conceptualised as flows of products, services, finance and information from a source to a customer (Mentzer *et al.*, 2001, pp1-26) and it is a dynamic process (Jain, Wadhwa and Deshmukh, 2009).

This definition suggests that a supply chain includes not only the obvious agents like input suppliers, producers and distributors but also the firms that support these agents such as logistics companies, banks, market research firms and so on. Following this approach, Streeter, Sonka and Hudson (1991, p1465) define the agricultural supply chain as "*a chain of interrelated activities including genetics and seed stock firms, input suppliers, agricultural producers, merchandisers, processors, retailers and*

consumers supported by firms providing various services, financing, and research and development". Surprisingly, none of these definitions mentions the role of public organisations that might have supporting functions e.g. the provision of training, audit and information services to other actors in the chain.

The networking characteristic of a supply chain involves systematic relationships among its members. Webster (1992) argued that networks are characterised by complex and multifaceted organisational structures reflecting multiple strategic alliances. Webster (1992) also argued that the fundamental point in network organisation is the confederation in which key functions are oriented by a chain leader. Key functions in this context include developing and managing the alliances, coordinating financial resources and technology, defining and managing core competence and strategy, developing customer relationships, and managing information resources.

In order to investigate the performance of a supply chain, it is necessary to understand systematic relationships that exist not only among firms within the supply chain but also the external environment because supply chains do not operate in a vacuum. According to Van de Ven and Garud (1989), an industry consists of three sub-systems: instrumental, institutional and resource procurement. The instrumental sub-system includes firms involved in the production of goods with similar consumption attributes. The resource procurement sub-system of the

industry services the instrumental activities. The institutional sub-system is concerned with two main aspects: governance and legitimisation. It aims to establish a political and institutional environment favourable to the industry and the industry's right to use resources.

Table 2.1: An agribusiness system for shrimp product

Agribusiness sub-systems		
Institutional	**Instrumental**	**Resource procurement**
Governance structure Legitimation and support Policy, rules, regulations and standards	Input providers (seed, feed…) Shrimp farmers Intermediaries (wholesalers) Processors Retailers	Research and development Credit provider Infrastructure Extension network

Source: Adapted from Streeter *et al*. (1991) and Van de Ven and Garud (1989).

In this study, the subject is the supply chain for shrimp products in TGCH Lagoon. The concept of a business system, as developed by Van de Ven and Garud (1989) and Streeter *et al.* (1991) (Table 2.1) is used to examine the performance of shrimp supply chains in TGCH Lagoon.

2.1.2 Supply chain management

Supply chains exist in all distributional channels whether their relationships are managed or not (Mentzer *et al*., 2001, p1-26). However, whether the performance of supply chains is effective or not depends on how they are managed. The term

'supply chain management', was first used in 1982 to describe the range of activities coordinated by an organisation to procure and manage supplies (Oliver & Weber, 1982). This topic gained popularity among researchers and practitioners from the mid 1990s (Dunne, 2001) and supply chain management practices are now widely recognised in the food-business sector (Collins, Dunne & Murray, 2001). According to Mentzer (2001), supply chain management can be viewed as an operational term, a management process, and as a business philosophy.

Within the operational view, supply chain management was referred to as 'logistics' during the 1950s (Hugos, 2003). Logistics referred to the process in which products and services moved from a source to a destination. There was no clear demarcation between the terms 'logistics' and 'supply chain management' at that time (Lambert & Cooper, 2000). Today, logistics management is defined as "*that part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements*" (Council of Logistics Management cited in Vitasek, 2003, p74).

Cooper, Lambert and Pagh (1997) re-conceptualise the understanding of supply chain management from integrating logistics across the supply chain to the process of integrating and managing business across the supply chain. With regard to the management process, supply chain management can be defined as "*the*

systematic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purpose of improving the long-term performance of the individual companies and the supply chain as a whole" (Mentzer *et al.*, 2001). The management process across the supply chain involves customer relationship management, customer service management, demand management, order fulfilment, manufacturing management, procurement, and product development and commercialisation (Lambert & Cooper, 2000, p67). Simchi-Levi, D., Kaminsky and Simchi-Levi, E., (1999) define supply chain management as the integration of key business processes among a network of interdependent business actors in order to improve the flow of goods, services, and information from original suppliers to final customers, with the objectives of reducing system-wide costs while maintaining required service levels.

Lastly, the philosophical view of supply chain management emphasises relationships between actors in a supply chain (Ellram & Cooper, 1990; Greene, 1991; Cooper, Ellram, Gardner & Hanks, 1997). A business philosophy is an ideal or policy of a particular business actor (Backsdale & Darden, 1971; McNamara, 1972). From this perspective, a supply chain is considered an entity in which business actors have a unified ideal or policy in supplying products and services to the final consumer. The philosophy of supply chain management requires synchronisation and convergence between business players in terms of operational and strategic capabilities into a unified system (Ross, 1998). The unified system is to achieve

customer satisfaction. Hines (2004, p76) commented that "*Supply chain strategies require a total systems view of the linkages in the chain that work together efficiently to create customer satisfaction at the end point of delivery to the consumers*".

Supply chain management brings about many benefits to business actors, not only reducing operational costs but also creating customer value (Morash & Clinton, 1998; Normam & Ramirez, 2000; Wysocki, 2000; Dunne, 2001; Mentzer *et al*., 2001; Chopra & Meindl, 2004); improving competitiveness and profitability, and reducing time and cost (Schotzko & Hinson, 2000); enhancing organisational productivity and profitability (Gunasekaran & Chung, 2004); and improving cooperation among business actors within the supply chain by avoiding conflicts, improving logistics and coordination of production inventory, and achieving better flow of information (Hugos, 2003; Roekel, Kopichi, Broekmans & Boselie, 2002). With regard to the food supply chain, supply chain management is extremely important owing to the scattered distribution of producers, the perishability of agricultural products, and strong competition.

2.2 Factors contributing to the success of supply chain management

Increasing competition in the global market means that firms must not only be successful in their own operations but must also become embedded within a highly responsive supply chain (Su & Yang, 2010). Supply chain management plays a key role in establishing such supply chains. It is thus that supply chain management

is a growing area of interest amongst researchers and practitioners from varied disciplines (Arshinder, Kanda & Deshmukh, 2008).

Lambert and Cooper (2000, p69) worked out a conceptual framework of supply chain management as a combination of three elements including: the supply chain network structure, the supply chain business processes, and the supply chain management components. The supply chain network structure includes business actors and the links between these actors. Business processes refer to the activities that produce a specific output of value to the customer. The management components are the managerial variables by which the business processes are integrated and managed across the supply chain. Lambert and Cooper (2000, p81) argue that successful supply chain management requires integrating business processes with key members of the supply chain. Collins *et al*. (2001) identify the following six interlinked factors contributing to the success of a SCM:

- customer focus;
- creating and sharing value;
- getting the product right;
- having an effective information and communication strategy;
- ensuring effective logistics along the chain; and
- building effective relationships.

2.2.1 Customer focus

Market orientation is one component in the culture of a learning organisation (Slater & Narver, 1995) and satisfying customer needs is the central purpose of any business (Doyle, 1994). Customer needs are satisfied with customer value created by firms. Firms within a supply chain must all agree to prioritize customer service (Lambert *et al.*, 1998; La Londe & Master, 1994; Ross, 1998) because understanding the customer's situation and responding effectively to differing needs through supply chain management is a source of superior customer value creation (Juttner, Christopher & Baker, 2007.)

According to Kordupleski, Rust and Zahorik (1993) and Wood (2003), the first condition for customer focus is to address precisely customers' needs based on understanding customers' values and requirements. Because the nature of customers' needs is dynamic as a part of business uncertainty, business actors need to grasp those changes in customers' needs and revise their supply chain strategies timely and accordingly (Takeuchi & Quelch, 1983). More specifically, the reasons of firms' successes in their competition are worked out as: (i) to respond quickly to customers' demand with new ideas and technologies; (ii) to produce products that meet or exceed customers' requirements; and (iii) anticipate and respond to dynamic customers' needs (Stalk, Evans & Schulman, 1992). It is therefore, important for supply chain members to understand customers' needs in order to develop supply

chain management strategies and business plans to improve competitiveness of the whole supply chain. Consumers have not only demands on specific foods but also concerns about several related issues such as food safety, environmental and social responsibility, and animal welfare (Roekel *et al*., 2002, Pyke & Tang, 2010). Customer preferences are complicated and continuously evolving. Hence, business players in food supply chain need to pay much attention in understanding customers' needs and satisfying them.

In order to carry out customer focus effectively, building relationships with customers through improving customer service and customer care is a priority to business players (Stewart, 1994). The vehicles for creating good perceptions of customers on products/services are to improve products/services quality and customer services (Carlson, Gilmore and Maclaran, 1998). Improved quality of products/services and improved customer services are necessary conditions for business players to get high price and loyalty of customers as they are important factor for satisfying customers in long-term.

2.2.2 Creating and sharing value

Generally, value is defined as "a quantitative measure of utility" (Clark, 1981, p459). Regarding the performance of individual business, value is defined as "*the amount buyers are willing to pay for what a firm provides them*" (Porter, 1985, p38). With a view on the whole business chain, Cox (1999) considered a value chain in terms of

the revenue flow of any product and service from the end consumer. It means that a value chain is another side of a supply chain. Or in other words, adding value along the chain is an inherent characteristic of a supply chain.

With the view of value chain, business actors at any stage in a chain can add value to the products/services through the functions they carry out (Collins *et al*., 2002; Webster, 2001). In a food supply chain, there are many kinds of adding value activities including cleaning and cooling, packaging, processing, distributing, cooking, combining, churning, culturing, grinding, hulling, extracting, drying, smoking, labelling, or packaging (Richard & Wechsler, 1996). These value adding activities can account for 85% of the final retail cost in the food sub-sector (Webster, 2001).

For business players in the food sub-sector, there are two kinds of strategies of adding value, namely captured-value and created-value (Born & Bachmann, 2006). The difference between these two strategies relies on the way that business players derive benefit from their value adding activities. The captured-value strategy argues that business players can get benefits through participating directly in producing food products, marketing to consumers, and joining producers' co-operatives for processing their products at scale. The created-value strategy emphasises the ability of business actors to get profits through unique or different characteristics of their products. According to this strategy, benefits can be realised through organic

certification, a brand image, identification with a specific geographic region and/or producer, identity preservation, and ethical or environmental stewardship.

Each strategy has its own strengths and weaknesses. The captured-value strategy is a conventional way so the risk associated with investment might be low. However, competition in commodity markets is often high. Moreover, the latent risk when customers' preferences turn to other products should be considered. Conversely, the created-value strategy exposes business players to higher risks because they do a new thing compared with other ones, meanwhile business players might get higher profits and little competition. In the food sub-sector, practical considerations of business players according to this strategy are about food safety, labelling and other regulations, as well as coping with liability issues and insurance (Born & Bachmann, 2006). Finally, there are many benefits and costs associated with value adding activities. Therefore, the decision of business players on whether to take adding value activities or not depends on the estimated costs and benefits of these activities.

2.2.3 Getting the product right

Sub-section 2.2.1 argues that understanding customers' values and requirements is the key factor for success of a supply chain. To satisfy customers' needs, the follow-up thing is to provide right products/services. So what are right

products/services? The answer for this question must be based on how the customers' need is perceived by business players.

In general, customers' needs can be categorised in two following groups: individual satisfaction and societal benefits (Hudson, 1990). Individual satisfaction is achieved thanks to characteristics of products/services that satisfy private needs of customers. Those attributes of products/services might be convenience, variety, stable prices, product quality, and nutrition and food safety. Meanwhile, societal benefits are derived from satisfying customers' concerns about societal issues. Those issues might be human welfare, environmental security, food safety, economic stability, investment opportunities and ethical business conduct.

Customer needs evolve continuously and become more and more complicated. Individual business players as well as the whole supply chain need to be able to adapt accordingly to those changes. Collins *et al*. (2001) pointed out that to be capable of adapting to change, business players need to understand (i) what their products/services are, and how those products/services are transformed, (ii) what value is added along the supply chain, (iii) the market specification of the products/services, and (iv) the customers' specifications. It's the reason why the quality management system becomes necessary within individual firms as well as the whole supply chain in order to provide the right products/services, (Collins *et al*., 2001).

Individual and societal benefits are clear in the food sub-sector. For identifying right products, several standards relate to food safety and responsible production. Those standards include Good Agricultural Practice (GAP), Total Quality Management (TQM), and Hazard Analysis and Critical Control Points (HACCP) (Roekel *et al*., 2002). The cost of meeting those standards is significant to small producers in developing countries. When many firms enter to the market and they set up quality criteria in a disorderly manner, it might undermine brand name of the domestic industry. In order to solve this problem, small producers often build up horizontal coordination. The horizontal coordination is helpful to maintain industry criteria for establishing or keeping reputation of the domestic industry in global market.

2.2.4 Having an effective information and communication strategy

According to Porter and Millar (1985, p152) every organisational activity includes both physical and information components. The physical task is to produce product and the information task is to capture, process and exchange information to support the production. Regarding customer orientation in business, the timely response of firms to customers' needs is obviously an important factor and those responses cannot be done without effective information sharing among business players (Mason-Jones & Towill, 1997). Several authors stress the significance of mutual information exchanged among members in a supply chain (Ellram & Cooper,

1990; Cooper, Ellram, Gardner & Hanks, 1997; Cooper *et al.*, 1997; Zhao, Xie & Zhang, 2002; Zhou & Benton, 2007).

One important aspect of information and communication strategy within a supply chain is the quality of exchanged information. Petersen (1999) argues that information quality is measured by the degree to which the information exchanged between organisations meets the needs of the organisations. Several researchers have identified important characteristics of information quality. These characteristics are content, accuracy, recency, and frequency according to Neumman and Segev (1979); accuracy, frequency, credibility, and availability of forecast according to McCormack (1998); and currency, accuracy, and completeness according to Petersen (1999).

There is a wide range of information that can be exposed to other members in a supply chain including inventory levels, market predictions, sale promotion strategies, and marketing strategies (Global Logistics Research Team, 1995). Moreover, Shepherd (1997) argued that business actors should exchange both current and historical information because current information is for meeting the immediate requirements of producers and marketers and historical information is for their long-term planning.

The benefits of mutual sharing information are clear, especially to planning and monitoring efforts of business players. Uncertainty is an inherent attribute to any

business and it imposes high transaction costs on business players and hinders their performance in satisfying customers' needs. Specifically, Shepherd (1997) stated that lack of information or misleading information regarding consumer requirements might bring about problems in the provision of infrastructure, transport, handling facilities, and marketing management, as well as the necessary planning to put these in place. In the presence of uncertainty, mutual sharing of information among supply chain members helps to reduce uncertainties and, as a consequence, reduces transaction costs and enhances business performance (Shepherd, 1997; Schotzko & Hinson, 2000; Zhao *et al.*, 2002).

Despite those benefits, it is not easy to achieve effective information sharing among chain members as business actors tend to withhold information to take advantages of information asymmetry (Akerlof, 1970; Stiglitz, 1975; Schotzko & Hinson, 2000; Collins *et al.*, 2001; Sahay, 2003). This is why the involvement of the public sector in providing impartial and accurate market information is often considered necessary (Shepherd, 1997).

2.2.5 Ensuring effective logistics along the chain

One important function of supply chain management is to provide logistics management effectively (Zuckerman, 2002). The purpose of logistics management is for effective and efficient movement and storage of products along the chain from production to final consumers (Fisher, 1997; Ross, 1998; Collins *et al.*, 2002; Chopra &

Meindl, 2004). Logistics management has a significant role in the success of a supply chain because good logistics management brings about many benefits that are not only from satisfaction of customers' needs but also reduction of transaction costs (Collins *et al*., 2002).

Logistics management consists of many activities as Coyle, Bardi and Langley (2003) pointed out. These activities include forecasting, order management, production and inventory planning, procurement, warehousing, material handling and packaging, and transport. Furthermore, paralleling with the movement of products along the supply chain, logistics management must be integrated with exchanging information flow along the chain (Hugos, 2003). According to Cooper *et al.* (1997), a successful supply chain needs an integrated process from sourcing, manufacturing and distributing along the chain.

In the food sub-sector, business is characterised by the perishable nature of most products, dynamic consumer preferences, seasonality and the gap between time of planning production and time of supply. Therefore, the role of logistics management in the food sub-sector is even more significant than in other sectors (Schotzko & Hinson, 2000). In developing economies that lack modern facilities and good infrastructure, providing high quality and safe food products to final consumers can pose real challenges to logistics managers (Roekel *et al*., 2002). Given such poor logistical conditions, supply chain management in general, and the

function of mutual information sharing in particular, must be enhanced to reduce uncertainties and risks associated with business.

2.2.6 Building effective relationships

Supply chain management is essentially made up of a set of partnerships. Partnership is defined as the bond connecting supply chain members (Dunne, 2001) or as the collaborative long-term relationship between a buyer and a seller (Gunasekaran, 2004). Both of these definitions of partnership recognise interdependence and cooperation among business actors in a supply chain. It has been shown that dependence, commitment, trust, and communication are related to the economic success of buyer–seller relations and inter-firm cooperation (Hoffman & Mehra, 2000; Kingshott, 2006). Several authors emphasise that an effective supply chain management needs to build, maintain, and enhance long-term relationships (Cooper *et al*., 1997; Lambert & Cooper, 2000; Stanko *et al*., 2007).

A business agent may coordinate both horizontally and vertically when building effective relationships with other agents. Coordination can be defined as effort or measures designed to make players within a market system act in a common or complementary way or toward a common goal (Poulton *et al*., 2004). Vertical coordination refers to contractual arrangements between firms at different stages of the supply chain. The intensity of vertical coordination achieved by these arrangements varies between the two extremes of spot market exchange (no

coordination) and vertical integration into a single firm (Swimnen, 2005). Horizontal coordination refers to contractual arrangements between firms at the same stage of the supply chain.

There are several drivers that encourage business agents to coordinate vertically. Williamson (1971) attributes vertical coordination largely to the hold-up problem. This problem arises when value-adding requires investment in highly specific assets, and returns from this investment are uncertain owing to bounded rationality and opportunism. Since the asset has little value in other uses, firms in the supply chain could extract quasi-rents from the investor by threatening to withhold their products or services. Under these conditions, the parties have an incentive to establish relationships that will reduce the investor's risk and so facilitate value-adding to their mutual benefit. Williamson (1971) concludes that the advantages of integration are not that technological (flow process) economies are unavailable to non-coordinated firms, but rather that vertical coordination harmonizes interests and makes decision-making more efficient.

Poulton and Lyne (2009) identify the key drivers of horizontal coordination as size economies, finance and bargaining power. Small farmers, for example, may pool their produce in order to reduce unit processing, marketing, compliance and transaction costs, to share the costs of lumpy assets, and to negotiate and enforce favourable contractual terms. If the farmers surrender decision-making power to a

centralised management team as in a marketing cooperative, the outcome is referred to as horizontal integration, analogous to vertical integration.

Partnerships among supply chain members are therefore viewed as critical for both short and long-term performance of the chain, especially when business players are small and lack market power, logistical facilities and access to an impartial legal system. As Morgan and Hunt (1999) contend, many small firms find that entering partnerships is a good way to increase their joint competitiveness.

Despite these benefits, it is not easy for business player to establish, maintain and develop partnerships owing to divergent views and lack of trust among supply chain members (Lambert & Cooper, 2000; Roekel *et al.*, 2002); incomplete information about when and with whom to establish partnerships; attempting to implement partnerships that are over-reliant on technology (Barrat, 2004); and culture-related reasons (Spekman & Carraway, 2006). Partnership in the whole supply chain is even more difficult than dyadic partnership as it requires high levels of understanding beyond the firms directly involved (Barrat, 2004); open communication; high levels of trust (Roekel *et al.*, 2002; Schotzko & Hinson, 2000); interdependence (Roekel *et al.*, 2002); and the development of mutual benefits among supply chain collaborators (Roekel *et al.*, 2002; Aghazadeh, 2004); common vision of future benefit, and common norm and value (Spekman & Carraway, 2006). Several authors stress that building partnerships is not only the key factor but also is

the most difficult element in successful supply chain management (Barrat, 2004; Aghazadeh, 2004; Collins *et al*., 2002; Schotzko & Hinson, 2000).

2.3 Uncertainty as a threat to the supply chain

The performance of a supply chain is affected by uncertainty. Uncertainty is defined as a situation in which there is not enough information (Rowe, 1977), knowledge or understanding to enable decision makers to identify all possible outcomes (Ritchie & Marshall, 1993), and their consequences or likelihood of occurrence (MacCrimmon & Wehrung, 1986). Coordination in a supply chain implies dependency among firms. As a consequence, individual firms are exposed to risks facing other firms (Hallikas *et al*., 2004).

There is a strong and negative relationship between the level of uncertainty and performance of a supply chain. Uncertainty might lead to inferior customer services, excess inventory, waste, excess business capacity, and - as a result - higher cost of supply and less customer value (Fisher, Hammond, Obermeyer & Raman, 1994; McGuffog & Wadsley, 1999, Kleindorfer *et al*., 2003).

To describe the general nature of uncertainty faced by a firm, Koopmans (1957, pp162-163) made a distinction between primary uncertainty, which is state-contingent, and secondary uncertainty which arises “from lack of communication that is from one decision maker having no way of finding out the concurrent decision and plans made by another”. Williamson (1996, p60) emphasised the role of

behavioural uncertainty, which arises from opportunism - for example strategic nondisclosure, disguise, or distortion of information. Davis (1993) grouped supply chain uncertainties according to their sources; supplier uncertainty relates to on-time performance, average lateness and degree of consistency; manufacturing uncertainty to process performance, machine breakdown, etc; and customer or demand uncertainty to failure in forecasting, side-selling, etc. Tang (2006) refers to external uncertainties in customer demand, supply and costs as operational uncertainties and distinguishes these from disruptions caused by natural and man-made disasters. Ritchie and Brindley (2007) categorised the turbulence caused by a combination of environment and industry characteristics as strategic risk.

Trkman and McCormack (2009) proposed the constructs of endogenous and exogenous risk. Endogenous risk arises inside the supply chain and can lead to changing relationships between the focal firm and suppliers, the most notable kinds are market and technology turbulence. Exogenous risk arises outside the supply chain. This construct can be further divided into continuous risks (e.g. changes in the rate of inflation) and discrete risks (e.g. natural disaster, disease and war). Trkman and McCormack (2009) argued that endogenous risk could be addressed by a proper and proactive relationship with a supplier (e.g. enhancing information and risk sharing). Exogenous risk is generally much more difficult to manage as it is characterised by unplanned and unanticipated events.

Uncertainty has been generally viewed as a driver of vertical coordination between firms (Anderson & Coughlan, 1987; Stern & El-Ansary, 1992). However, Williamson (1996) emphasises the role of behavioural risk rather than exogenous risk. Trkman and McCormack (2009) argue that uncertainty does not necessarily encourage coordination. On the contrary, very high levels of systemic risk (i.e. risk affecting some agents creates risk for other agents in the chain) or covariant yield risk (i.e. risk that simultaneously affect the vast majority of producers) will tend to inhibit vertical coordination as there is little point in buyers contracting with suppliers who cannot deliver the agreed quantities and quality. This situation is particularly relevant to TGCH Lagoon where yields on small shrimp farms are affected by the same environmental conditions.

CHAPTER 3

PERFORMANCE OF THE TGCH SHRIMP SUPPLY CHAIN

3.1 Introduction and methods

This chapter reports the results of an exploratory investigation of the supply chain for shrimps produced in the TGCH Lagoon. The supply chain was investigated within a qualitative and case study framework owing to the exploratory nature of the investigation and lack of prior information about the structure of the chain and its performance. The selected methodology is relevant to this study. Patton (2002, p69) argued that qualitative and naturalistic approaches are advantageous to inductively and holistically understand human experience, and to construct meanings in context-specific settings. According to Yin (2003, pp1-9), the distinctive advantage of the case study approach is to allow researchers to identify holistic and meaningful characteristics of real-life events, such as individual life cycles, organisational and managerial processes, and industrial development. Eisenhardt (1989) contended that theory building from case studies is particular appropriate when little is known about a phenomenon. This fits well within the frame of this study, given the lack of prior knowledge relating to the supply chain.

Business agents involved in the TGCH Lagoon shrimp supply chain were purposively selected for interviews about the shrimp supply chain and its evolution.

Given that the aim was to elicit information free of any predetermined perspective, data were gathered in semi-structured interviews using open-ended questions, with the content shaped by what the respondents told the researcher (Opie, 2003, p241).

Various units of analysis have been proposed to study organisation economics (Williamson, 1996, p234). These units of analysis include decision premise (Simon, 1957, ppxxx-xxxii), ownership (Demsetz, 1967; Alchian & Demsetz 1973), industry (Bain, 1956; Scherer, 1970), individuals (Jensen, 1983), and transactions (Commons, 1934). According to Commons (1934, p4), transactions contain the three principles of conflict, order and mutuality. Commons' three principles prefigured governance as the means by which to infuse order, to mitigate conflict and to realise mutual benefit. To study supply chain performance, the chain governance is the core issue. Several authors used dyadic transactions to investigate chain governance (Key & Runsten, 1999; Gereffi, Humphrey & Sturgeon, 2005; Beugelsdijk, Koen & Noorderhaven, 2009). In this study, dyadic transactions were treated as embedded units of analysis within the TGCH shrimp supply chain. Transactions are studied from different perspectives including transaction costs (Coase, 1937, Williamson, 1985), resource dependency (Pfeffer & Salancik, 1978) and contract theory (Macneil, 1978).

The interviewed parties included farmers, shrimp collectors, and a processing and exporting enterprise (Table 3.1). Appendix 3.1 presents detailed information about the parties interviewed.

Table 3.1: Respondent interviewed and criteria for their selection

Supply chain agents	Number of respondents	Criteria for selection
Farmers	10	Reflecting different levels of production scale: - Medium and large scale production : 8 farmers (3 farmers having semi-intensive culture, 4 farmers having improve-extensive culture) - Small scale production: 3 farmers (1 farmer having improved-extensive culture, 2 farmers having extensive culture)
Wholesalers	9	Reflecting different business capacity - Large wholesalers: 5 respondents - Small independent wholesalers[1]: 2 respondents - Small agents of large wholesalers[2]: 2 respondents
Processing-exporting company	1	
Retailers	3	Reflecting diversified domestic demand in different markets

Due to the existence of numerous small-scale shrimp farmers in TGCH Lagoon, a large collecting network has been established. Small wholesalers procure shrimps from farmers and sell to larger wholesalers both inside and outside TTH Province, and to retailers including hawkers in open-air markets, restaurants and hotels. From wholesalers, shrimps are sold to a number of processing-exporting

[1] Independent wholesalers are small middlemen who buy shrimp from farmers and sell to large scale wholesalers and/or retailers.
[2] Small agents of large wholesalers are small middlemen who buy shrimp from farmers and sell to their wholesalers only.

enterprises. However, only one of these processing- exporting enterprises is located within TTH Province.

Farmers, wholesalers, and retailers were purposively selected to represent different business scales of respondents. It was consistent with the strategy of information-oriented selection developed by Flyvbjerg (2006) to maximise the utility of information from small and single cases. The vice-director of the Provincial Extension Centre recommended certain farmers and two large scale wholesalers for interview. These large-scale wholesalers and interviewed farmers helped the author to identify other wholesalers and retailers.

Interviews were conducted in April and May 2009. For farmers, interviews took place on their farms. All other interviews were conducted at the respondents' places of business. Some of interviews were recorded if the respondents gave consent for this to occur. Notes were taken if the respondents did not give consent for the interview to be recorded.

Human ethics approval was given by the supervisor under delegated authority relating to situations where all questions are of a non-personal nature, and relating to matters within the professional competence of the interviewees.

In order to investigate the current situation of the supply chain for shrimp produced from the TGCH Lagoon, common guiding interview themes were applied in interviews with all actors in the supply chains (Appendix 3.2):

- The development process of their businesses (how they started their businesses, how their businesses evolved and the reasons);
- Their current functions in the shrimp supply chain (what function they performed, advantages and disadvantages of performing those functions);
- The current situation of their business (availability of production factors, cost of production, revenue);
- Accessibility to inputs (what inputs they need, where and how they buy inputs, how the price is established, how payment is made, how quality is maintained);
- Relationships with input providers (the form of contracts, how often they are in contact with input providers, what and how information is exchanged between them and input providers, how they share risks, how they settle conflicts);
- Accessibility to customers (what products they sell, where and how they sell products, how the price is established, how the payment is made, how quality is maintained); and
- Relationships with buyers (the form of contracts, how often they are in contact with buyers, what and how information is exchanged between them and buyers, how they share risks, how they settle conflicts).

The development of these common guiding themes relied on an assumption that the current situation of the shrimp supply chain was an evolutionary outcome of business relationships. The evolutionary processes can be categorised into two groups, namely competition and cooperation. The theoretical basis to examine competition behaviour included the strategic-based approach (Porter, 1980) and resource-based approach (Pfeffer & Salancik, 1978). Cooperation behaviour was examined using supply chain management theories (Mentzer *et al*, 2001, Collins *et al*, 2001).

The interviews undertaken in this field study relied on the memories of the actors. Interviewees had clear recollection about the major events that happened to their businesses, but were less clear about the details. The author took notes on changes of business behaviours of all interviewed actors. The changes of business behaviours informed the current situation of the supply chain. The current situation of shrimp supply chain was compared with principles of a successful supply chain (see Chapter 2) to find out failures in the shrimp supply chain. Furthermore, these failures were pooled together to find out their fundamental cause. In interview, insights on the fundamental problem of shrimp supply chain failures emerged obviously and consistently.

In addition, key informant interviews were conducted with representatives of government organisations (Appendix 3.3). These informants provided insights about

aspects of shrimp production and marketing under their management, including information about policies and views on the institutional sub-system and also triangulated opinions of business players about the development of the shrimp supply chain in TGCH Lagoon. A checklist was made for each key informant reflecting issues raised in earlier interviews with supply chain agents and focusing on how their organisation provide help to shrimp business.

In order to increase reliability of the research, related reports and documents issued by government organisations, NGOs, and research publications from academic institutions were collected. These materials were used to build up preliminary knowledge on the research issues before conducting interviews and to triangulate information gained through interviews.

3.2 Performance of the shrimp supply chain in TGCH Lagoon

3.2.1 An overview of the shrimp business system in TGCH Lagoon

The performance of the shrimp supply chain in TGCH Lagoon is viewed within the framework of a broad business system which contains interacting sub-systems. These sub-systems include the instrumental (i.e. shrimp supply chain actors), procurement and institutional sub-systems. The business process along the supply chain is supported by both institutional and resource procurement sub-systems (Van de Ven & Garud, 1989).

The most important support from the resource procurement sub-system is the provision of credit and the dissemination of technical knowledge. According to Tinh (2005) and Hoa (2010), the incidence of shrimp farmers in TGCH Lagoon who have borrowed money to finance their production was 65% and 78% respectively. Interviewed farmers pointed out high investment in shrimp culture (especially initial investment in pond building) as the reason that most of them had to borrow money. The most important credit source for shrimp farmers was the Vietnam Bank of Agriculture and Rural Development (VBARD) in TTH Province. Interviewed farmers claimed that many shrimp farmers used their Red Book (i.e. certificate of private property rights) as collateral to access this formal credit before 2004. Due to losses of shrimp crop since 2004 which resulted in high rate of loan default, an increasing number of farmers had resorted to informal sources of credit.

Dissemination of knowledge was carried out through a system of state-run and subsidised extension services from provincial to communal level. However, according to PECAAF (2008a), the technical support for aquaculture of this extension system did not meet the actual needs of farmers in term of both quantity (i.e. number of extension workers) and quality of provided services.

The institutional sub-system provided indirect support to the supply chain through governance and legitimisation (Van de Ven & Garud, 1989). In the case of shrimp business in TGCH Lagoon, the sub-sector was dominated by government

agencies. Before 2008, the Department of Fisheries (DFI) had been responsible for governance of shrimp culture in the lagoon. In 2008, this department was merged with the Department of Agriculture and Rural Development (DARD). At the time of data collection in 2009, government sub-agencies within DARD with responsibilities for aquaculture included the Office of Aquaculture, the Office of Rural Development and Quality Management for Agricultural Products, the Office of Veterinary Services, and the Office of Extension Services. Among these, the Office of Aquaculture leads the design of development policy for the whole sub-sector (Decision 1964/QD-UBND in 2008 of TTH PCP). The Office of Rural Development and Quality Management for Agricultural Products was newly established and its operations were still limited (Van[3],pers. comm, 2009)

The support from the institutional sub-system was mainly focused on the shrimp culture sub-sector. Issues related to marketing, such as shrimp product quality management and facilitating coordination between supply chains agents were not being addressed by government agencies. Although government agencies have issued regulations about hygiene conditions and safety of products to regulate business in the food sub-sector, the managerial responsibility was shared among various state agencies, and the implementation of those regulations in domestic markets was very weak.

[3] Mr. Van is the Head of Office of Rural Development and Quality Management for Agricultural products, Department of Agriculture and Rural Development in TTH Province.

The policy for shrimp culture in the TGCH Lagoon differed before and after 2004. Before 2004, the main focus of the institutional sub-system was to promote shrimp production as much as possible. Decision 773/QD-TTg of the Prime Minister in 1994 was an important policy milestone in government support for inland and coastal aquaculture. It emphasised mobilisation of domestic and overseas investment, and 'reclaiming' of inland and coastal lowland areas for aquaculture. The support for shrimp production was furthered in the Decision 251/QD-TTg of the Prime Minister in 1998 which identified fisheries as a key economic sector. Following decisions made by the central government, TTH Provincial People's Committee (PPC) set up an objective in 2002 as part of Decision 3170/QD-UB to expand the shrimp area in TGCH Lagoon from 2,733 ha in 2002 to 5,939 ha in 2005. Consequently, TTH PPC encouraged the issuing of Red Book property rights to farmers who constructed shrimp ponds in the Lagoon and urged the VBARD to finance shrimp farmers. This strong support from government facilitated the rapid expansion of shrimp area in TGCH Lagoon. However, shrimp farmers suffered significant losses to aquatic diseases after 2004. Therefore, the main orientation of policy post-2004 was to reduce marginal shrimp areas and to strengthen management over shrimp culture. This orientation was evident with Decision 3014/QD-UBND in 2005 about management over centralised shrimp culture areas in TTH province and its updated version – Decision 31/QD-UBND in 2011.

3.2.2 Description of business relationships between chain actors

The consumption of shrimps produced in TGCH Lagoon was diversified with various final markets. Business actors and the flows of shrimp product are illustrated in Figure 3.1.

The following classes of transaction help to describe business relationships between agents in the shrimp supply chain, there are the following notable groups of transactions: (i) farmers with input suppliers, (ii) farmers with shrimp collectors and (iii) shrimp collectors with downstream actors. Feed and seed are the most important inputs for shrimp culture according to interviewed farmers. Therefore, relationships between farmers and seed and feed suppliers were investigated as representative of the relationship between farmers and input providers in general. However, wholesalers provide functions as both shrimp buyers and feed sellers, and they even provide credit to farmers in some cases. The interacting influences among different roles of wholesalers make the relationship between these business actors and farmers more complicated than the relationship between farmers and seed suppliers which can be considered as spot market. Therefore, different roles of wholesalers (including providing feed to farmers) are examined simultaneously in the second group.

3.2.2.1 Seed suppliers and farmers

There were two sources of seed supply for farmers including hatcheries located inside TTH Province and neighbouring provinces. The number of hatcheries inside TTH Province and their production capacity increased significantly between 2001 and 2003 but fell sharply after 2004 (Table 3.2). There were a number of reasons for the growth and decline of shrimp seed production in the province. In the early 2000s, shrimp culture reached its highest levels in TGCH Lagoon, and increased the derived demand for shrimp seeds.

Table 3.2: Shrimp seed production in TTH province, 2002-2008

Year	Number of seed stations	Number of seeds produced inside TTH province (mil)	Estimated quantity of seed demanded (mil)	Estimated provincial production/ demand (%)
2001	11	80	320	25
2002	24	200	350	57
2003	41	250	400	63
2004	39	215	460	47
2005	27	117	350	33
2006	21	85	320	27
2007	18	60	300	20
2008	13	N/A	N/A	N/A

Source: PECAAF (2008b).

However, demand for shrimp seed decreased sharply after 2004 as farmers quit the industry or reduced their shrimp production scale to avoid risks caused by diseases. Farmers reduced their shrimp production scale by applying lower shrimp stocking density and/or developing polyculture with shrimp and other brackish

products instead of shrimp monoculture. Among interviewed farmers, seven farmers who had large and medium production scales applied lower stocking density. For instance, the stocking density of interviewed farmers who had semi-insentive culture reduced from about 17-18 seeds/m^2 to 12-13 seeds/m^2. This figure of improved-extensive culture reduced from 13-14 seeds/m^2 to 10-11 seeds/m^2. Five of these seven farmers applied polyculture of shrimp and other brackish products including tilapia and crab. Tilapia and crabs were considered as more resistant to diseases accordingly to interviewees' statements. All of the ten interviewed farmers also mentioned that a lot of other farmers in their communes also reduced their shrimp production scale and applied polyculture with other products. Three interviewed farmers who had relatively small-scale production did not change their stocking density and form of culture. Of these three small farmers, two farmers undertook agriculture as their main livelihood so they did not pay much attention on shrimp culture. The remaining farmer did not experience any serious problems happening to his shrimp production.

Table 3.3 shows that, during the period 2004 to 2008, disease outbreaks affecting more than one-third of the Lagoon's production area occurred in 2004 and 2007. These outbreaks affected large numbers of shrimp farmers simultaneously. Therefore, the risk caused by shrimp diseases is not idiosyncratic but co-variant. Moreover, the yield losses affected agents at all stages of the local shrimp supply

chain as it reduced both the quantity and quality of products supplied. Hence this risk is also systemic.

Table 3.3: Shrimp diseases during the period 2002–2008

Year	Shrimp production (ha)	Area infected with disease (ha)	Share of production area infected (%)	Type of disease		
				White-spot (ha)	MBV (ha)	Others (ha)
2002	3197.00	171.36	5.36	28.00	64.00	79.36
2003	3622.00	122.06	3.37	45.00	26.00	51.06
2004	3998.00	1383.31	34.60	1126.00	125.00	132.31
2005	3464.00	581.61	16.79	350.00	145.00	86.61
2006	3024.00	170.25	5.63	138.04	3.80	28.41
2007	3053.00	1084.43	35.52	890.63	2.50	191.30
2008	2733.00	146.22	5.35	118.96		27.26

Source: FSPS II, (2008).

Furthermore, TTH Province is not favourable for shrimp seed production because of its relatively low temperature. Consequently, many hatcheries in TTH Province closed leaving farmers more reliant on outside sources of shrimp seed.

Farmers often organised themselves into groups of 5-7 buyers and dealt directly with seed suppliers in neighbouring provinces. All purchases were settled immediately with cash payment.

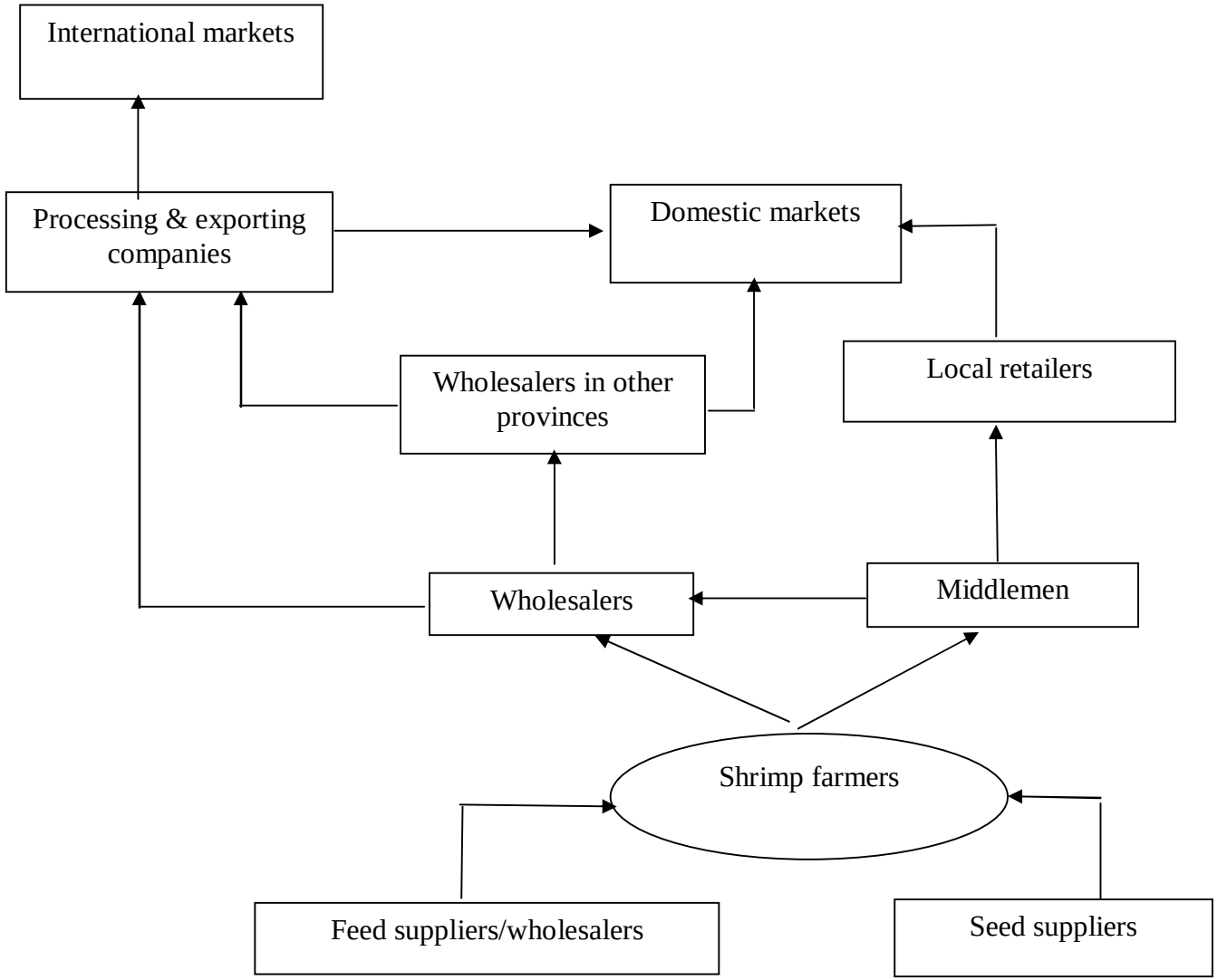


Figure 3.1. The shrimp supply chain in TGCH Lagoon

The two problems farmers faced in accessing shrimp seeds were the unreliable seed quality and the high transaction cost associated with buying seed from remote hatcheries. According to interviewed farmers, some farmers (especially those with extensive shrimp culture) used seed that is contaminated with bacteria. If raised in a polluted environment, those bacteria can cause widespread diseases. Moreover, several reports released by state agencies highlight the poor quality of shrimp seed (TTH Department of Fishery (DFI), 2007; TTH PECAAF, 2008b). According to these reports, there were two common diseases present in seed samples, namely white-spot (a disease that kills shrimps within a few days) and MBV (a disease that stunts growth resulting in undersized shrimps).

The seed market was affected by the weakness in quality management. Before purchase, farmers should check the ability of shrimp seeds to swim upstream; their sizes; and the quarantine certificate certifying that the seed batch is disease free. Of these three checks, the quarantine certificate ought to be the most conclusive because the other two are less accurate indicators of disease. Quarantine certificates are issued by the Office of Rural Development and Quality Management for Agricultural Products. However, according to interviewed farmers the reliability of quarantine certificates was questionable as disease remained a serious problem even though they bought certified seed. There is no third-party accreditation of quarantine certificate.

3.2.2.2 Relationship between farmers and wholesalers

There was a big network of wholesalers in the Lagoon. Large-scale wholesalers are key nodes in the collecting network as they implemented several functions including not only buying products but also supplying inputs (industrial feeds, medicines), and providing credit in some cases. Consequently, this sub-section focuses in the main on the relationship between farmers and large wholesalers.

In the past, farmers often bought industrial feed for their entire crop. There were three forms of purchasing feeds:

- Purchase by cash: farmers paid the full purchase price in full at the time of purchase. In this case, the transaction between farmers and wholesalers could be considered an impersonal spot market transaction.

- Purchase on credit: Farmers were allowed to pay for feed after their shrimp harvest. Due to the deferred payment, farmers had to pay a higher price for feed. For instance: if farmers paid cash at the time of transaction the price of feed would be 236,000 VND/10 kg in 2009, while if they paid after harvest, the price would be 250,000 – 260,000 VND/10 kg.

- Interlinked transaction: In this case, the feed was purchased on credit supplied by the wholesalers but farmers verbally agreed his or her shrimp crop being supplied to the wholesaler at a price below the market price of the time at harvest.

According to interviewed farmers, the majority of farmers preferred the last two ways of purchase because they seldom have efficient liquidity to pay cash up front. These trust-based relationships between farmers and wholesalers have been built up since the boom in shrimp farming since the early 1990s. In fact, there were a number of credit sources in rural areas of TTH Province including state-run banks, private banks, NGOs and money lenders (e.g. wholesalers). However, interviewed farmers stated that most of them had mortgaged their shrimp pond Red Books (Certificates of Title) to banks for loans that were not repaid. They could not repay loans to banks on time because of the serious yield loss since 2004. This situation was common to shrimp farmers in TGCH Lagoon. For instance, nearly two-thirds of shrimp farmers in Quang An commune and one half of shrimp farmers in Vinh Hung commune had loan default with banks according to statements of interviewed farmers in these two communes. With those loan defaults, farmers could not borrow more money from banks for their production. It is the reason why yield loss after 2004 obliged more farmers to seek credit-linked transactions.

Even though these trust-based relationships between farmers and wholesalers evolved over time, there were some serious threats to them. Interviewed farmers argued that wholesalers, especially small scale wholesalers could lower the price of shrimp products and they could not have predictable and stable contracts from large scale wholesalers at the beginning of their crop. Three of the interviewed farmers in

Vinh Hung and Loc Binh communes contended that "there seem to be a verbal agreement among small scale wholesalers" to reduce their shrimp price at the end of their crop. Meanwhile, wholesalers complained that more and more farmers did not meet their payment obligation in the case of payment on credit, and engaged in side-selling in the case of interlinked transactions. A wholesaler in Vinh Hung commune - said "*My hundreds of millions of VND were appropriated by shrimp farmers, in which the highest number is 20 millions and the lowest number is 3 millions. The business has become more and more difficult*".

Interviewed farmers contended that loan default was limited to farmers whose yield losses were so serious that they did not have enough income to meet their loan obligations. Interviewed farmers argued that side-selling occurred because middlemen and wholesalers did not offer them predictable and stable consumption contracts. On the other hand, interviewed wholesalers stated that they could not offer such contracts to farmers because farmers were no longer able to supply a stable amount of quality shrimp products.

Since 2004, the yield loss of farmers' production led to significant changes in the business situation of wholesalers. According to statements of small scale wholesalers, they responded to unstable shrimp supply by reducing their business scale, looking for other products, strengthening relationships with other wholesalers to buy shrimp product with a good price, and even quitting the industry. A small

scale wholesaler in Thuan An township said that "*the amount of shrimp that I bought in this crop is only equal to a half of the early 2000s*". Most of the small scale wholesalers had other income-earning activities in addition to shrimp collecting. As a result, they did not have much incentive to maintain good relationships with farmers when yield losses happened.

However, large scale wholesalers often had relatively different responses to farmers' yield loss. According to statements of interviewed large scale wholesalers, all of them had started their business before 2000. Business investments included stores, transportation vehicles, and freezing facilities.. These investments could be the reason why none of them quit the industry as some small-scale wholesalers did. In order to respond to yield loss, they exerted much effort in different ways according to interviewed wholesalers' statements. They reduced their business scale at some point and looked for other products. However, most of them tried to strengthen their relationships with farmers who had good source of supply, especially by providing credit to farmers, even although loan defaults still happened.

Despite loan default and side-selling problems, wholesalers still wanted to maintain their trust-based relationships with farmers. The owner of a large company in Hue city, who had been unable to recover loans totalling over 1,000 million VND, said that "*The amount of appropriated capital is really high, but we have to stand it. Farmers had to deal with too many difficulties in recent years, and we share these difficulties*

with them because we want to keep good relationships with farmers for a long time". The owner of a company in Phu Thuong commune said that "*My shrimp business could be profitable in this year and could be bad in the next year, however it would be still better than quitting the industry and doing nothing*".

Both wholesaler and farmer respondents contended that the greatest difficulty that farmers confronted was the spread of diseases in TGCH Lagoon after 2004. Widespread diseases came as an external threat rather than opportunistic behaviour of farmers, so wholesalers were willing to share some of the risks.

However, loan default would gradually undermine the capital capacity of wholesalers and side-selling would exacerbate supply uncertainty. This prevented wholesalers from making predictable contracts with downstream business actors. Consequently, these problems would undermine trust-based relationship among farmers and wholesalers, and would harm both wholesalers and farmers in the long-term unless the fundamental cause of widespread disease was solved.

Quality management in transactions between farmers and shrimp collectors (both middlemen and wholesalers) was poor. The popular indicator of quality was the size of shrimp. No recognised standard of food safety and responsible production was applied. There was no value adding activity in the supply chain from farm-gate to wholesalers except some simple handling activities (e.g. transporting, cleaning and classifying products). The logistic conditions were also poor. Small scale

wholesalers often used cool boxes and ice to preserve shrimp products in transportation to wholesalers or retailers. Most wholesalers also did not have cold storage, and had to transport shrimp products to processing and exporting enterprises quickly.

3.2.2.3 The relationship between wholesalers and downstream chain actors

Processor-exporters often play an important role in a supply chain because they have more resources (e.g. finance, knowledge, market information, etc.). According to key informants, in the early 2000s, there were three processor-exporters in TTH Province (Song Huong Joint Stock Company, Thai Binh Duong Ltd Company, and Song Phu Ltd Company). All of them mainly relied on shrimp supply of TGCH Lagoon. Their main markets included China, ASEAN, US, Japan and European countries. In 2005, the biggest company – Song Huong Joint Stock Company – faced a lot of difficulties as US and European agencies found anti-biotic residue in their shrimp products. This firm went bankrupt in 2007. Thai Binh Duong Ltd Company no longer relied on source of shrimp produced in TGCH Lagoon as the shrimp supply did not meet its quality and quantity requirements. Thus, in TTH Province only Song Phu Company bought shrimp produced in TGCH Lagoon and it exported mainly to China . There were also some firms located in other provinces buying shrimp products from TGCH and according to interviewed large-scale wholesalers, these firms also exported most of their products to China.

In the TGCH Lagoon, shrimp supply chain co-ordination between processors–exporters and upstream business actors was not strong. No wholesalers had predictable and stable contracts from these firms. Rather, processor-exporters often informed wholesalers as to the price, quantity and quality of shrimp that they needed 3-7 days prior to the transaction, with adverse consequences for the coordination with farmers. It was the common situation of all interviewed large-scale wholesalers. A wholesaler in Thuan An township said that "*Some processors–exporters who have bought shrimps produced in TGCH Lagoon now rely on sources of shrimp supply in Quang Tri and Quang Binh Provinces. For remaining ones, I rarely have contracts with them at the beginning of shrimp crop as I do not know how many tonnes of shrimps that I can supply to these firms"*. It implies that some processors–exporters responded to yield loss of shrimp culture in TGCH Lagoon by looking for other sources of shrimp supply. Therefore, it can be firstly concluded that information sharing between wholesalers and processors–exporters was not effective. Furthermore, the limited contacts between wholesalers and processor–exporters could be explained as the supply of shrimp produced in TGCH Lagoon was unstable combined with processor–exporters having other sources of supply.

Second, the quality management between processor-exporters and wholesalers was poor, as with farmers and shrimp collectors. They relied only on shrimp size to assess quality and no recognised quality standards (e.g. TCM, HACCP) were applied. All large-scale wholesalers remembered that some contracts of

processing–exporting firms in TTH Province with US and European companies were cancelled due to antibiotic residues in shrimp products in 2004 - 2005. However, they still had no awareness of recognised quality standards as no processor–exporters required them to be applied in the following years. According to most interviewed wholesalers, they thought that China markets would not require recognised quality standards so it would not be necessary to apply these standards.

Apart from processors and exporters, retailers purchased a significant proportion of shrimp produced in TGCH Lagoon according to interviewed farmers and middlemen. Relationships between middlemen and retailers were much less standardised than those among wholesalers and processor-exporters because the volumes transacted were much smaller. Middlemen and retailers have limited capacity and could not lead effective chain coordination.

3.2.3 Fundamental problems in the shrimp supply chain

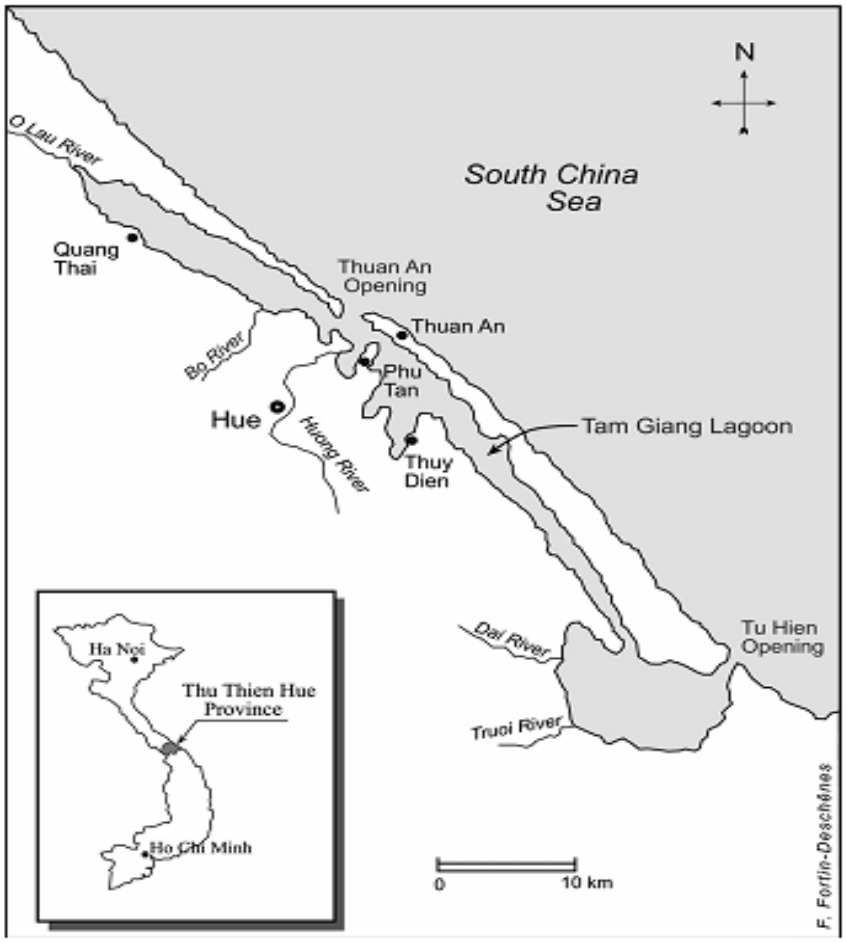
It can be concluded that the TGCH shrimp supply chain was not performing well. In particular, the evidence showed that the chain lacked customer focus and effective systems to share information and control product quality. However, it is important to ask why the supply chain was not performing well when less than a decade earlier it supplied substantial quantities of quality shrimp via long-term relational contracts between farmers and wholesalers that linked credit and feed supply to the purchase of the farmer's crop.

The local shrimp industry changed dramatically after the outbreak of widespread and persistent disease in 2004 (Table 3.3) that reduced both quantity and quality of shrimp product throughout the Lagoon. The resulting yield risk made it impossible to fulfil supply contracts all along the shrimp supply chain. In short, relational contracts were damaged by environmental uncertainty as heightened yield risk undermined efforts to coordinate value-adding activities, rendering the supply chain ineffective.

According to Subasinghe, Bontad Reantaso and McGladdery (2001), pathogens and the environment play an important role in the spread of shrimp diseases. Water pollution is the fundamental problem as it leaves all producers vulnerable to diseases even if their shrimp seed is disease free. Heightened pollution of TGCH Lagoon since 2004 has been identified as a serious threat to local livelihood by state agencies, researchers and the farmers interviewed in this study. State agencies (TTH PPC, 2005 & 2007; TTH Department of Science and Technology (DoST), 2005; TTH DFI, 2007; TTH PECAAF, 2008b) acknowledged the pollution threat to local communities - including shrimp farmers - as early as 2005. Hop *et al*. (2008) and Thung (2007) conducted experiments that showed some alarming indicators of deteriorating water quality in TGCH Lagoon between 1998 and 2004. These indicators included: diminishing levels of diffused oxygen (i.e. an increase of organic pollution), especially in places close to crowded shrimp farming areas; greater

nutrient loads entering the lagoon and less absorptive capacity of the natural environment - conditions conducive to eutrophication; higher levels of total coliform density; and higher levels of organochlorine pesticides in the sediment.

There are at least three sources of pollution in TGCH Lagoon (Hop *et al.*, 2005; Nga, 2006), including: (i) aquaculture production and other livelihood activities in the lagoon; (ii) agricultural production activities in upstream areas; and (iii) industrial production and urban dwellers in the lagoon catchment (Figure 3.2). There is no study to date quantifying the respective contribution of each of these sources of pollution. However, aquaculture - and shrimp culture in particular – has been clearly linked by Tuyen (2002) and Huong and Berkes (2011) to the Lagoon's environmental deterioration. According to these researchers, the dense distribution of ponds and net-enclosures impeded water exchange, restricted the dispersion and development of aquatic plants and accelerated sediment deposition. Intensive production methods (e.g. supplementary feeding and use of medicines) adopted by farmers aggravated the problem (Binh, 2005; Linh, 2005).



Source: Adapted from Cartographic Publishing House (2002).

Figure 3.2. Catchment of TGCH Lagoon

Some authors blame the pollution on uncontrolled privatisation of the Lagoon that facilitated the 'boom' in shrimp production (Tuyen, 2002; Huong & Berkes, 2011). To examine this argument it is useful to trace recent institutional changes in the Lagoon. Before 1975, there were two kinds of lagoon use, namely *Dai Nghe* (fixed-gear fishing) and *Tieu Nghe* (mobile fish catching). Fishing was regulated by village authorities, implying that lagoon water within their areas of jurisdiction was a common property resource. However, village authorities also auctioned off exclusive

use rights to fixed-gear fishers (Tuyen, 2002) and these rights could be transferred between generations. By 1975, much of the peripheral lagoon bed had been *de facto* privatised even though natural resources were statutorily owned by the state. Between 1975 and 1986, fishing cooperatives replaced village authorities as the administrators of use rights to catch fish in lagoons (Huong & Berkes, 2011). After 1986, *Doi Moi* policy reforms shifted production decisions and property rights to households, starting with use rights but extending to temporary transfer rights in 1993 and to permanent transfer rights in 2003 (Huong & Berkes, 2011).

This brief description of institutional change is both naive and misleading. It is naive because it does not define what was being privatised, and misleading because it creates the impression that institutional change was driven exogenously by the state. It was the lagoon bed that was privatised, and not the water above it. The exclusive rights enjoyed by fixed-gear fishers related to a specific part of the lagoon bed on which nets and bamboo fences were erected. The water above the lagoon bed washed through the nets and fences much like the air above a privately-owned farm. From a fisher's perspective, the water was a common property resource because rules governing the extraction of fish were policed and enforced (at least during the time that fishing was regulated by village authorities). However, this situation changed when the water gained a new use – shrimp production.

In 1985, the government introduced *Penaeus monodon* (the giant tiger shrimp) that could be sold on lucrative export markets. However, households were denied the right to practice shrimp aquaculture. This privilege was granted only to state-owned enterprises, but these enterprises were poorly managed (Quyen[4], Pers.Com, 2009). In 1993, the state relented and issued Decree 64/CP which allowed households to exercise exclusive rights to the lagoon bed (in certain parts of the Lagoon) in order to practice aquaculture. Demand for secure property rights was strong because export prices for giant tiger shrimps were increasing (FAO, undated) and farmers wanted to protect their investment in shrimp enclosures (Phap *et al.*, 2002, p30). The Provincial People's Committee responded by issuing Red Book property rights to fixed-gear fishers located near the shoreline who converted their net and fence enclosures into earthen-walled ponds for shrimp production (Huong & Berkes, 2011). Shrimp farmers operating in deeper water further from the shore privatised the lagoon bed by erecting fine-mesh nets. Many of these farmers were allowed to formalise their *de facto* exclusive rights to the lagoon bed by taking up five-year and one-year permits issued by district and commune authorities respectively (Huong & Berkes, 2011). The permits sanctioned exclusive operational rights within the enclosed area.

[4] Mr. Quyen is the Coordinator of Fisheries Sector Program Support (2nd Stage) in TTH Province, Department of Agriculture and Rural Development in TTH Province.

This process of institutional change is consistent with the Evolutionary Theory of Land Rights (Demsetz, 1967) or Coasian 'transaction cost' model of institutional change which, in the context of property rights to land, contends that secure tenure and low transaction costs emerge in response to population growth and new technology (Feder & Noronha, 1987). The generic explanation starts with land becoming relatively scarce owing to population pressure and better prospects for commercial farming. This is expected to induce a change towards private land rights because farmers have an incentive to invest but are unable to internalise the benefits of their effort unless they can exclude other users (Ault & Rutman, 1979). While the Coasian model has been criticised for ignoring problems of collective action that may prevent farmers from launching an effective lobby (Olson, 1965), political resistance (Thomson & Lyne, 1993) and path dependency (Bardhan, 1989) these potential barriers to institutional change were obviously not limiting in *Doi Moi* Vietnam.

Regardless of what drove privatisation in TGCH Lagoon, it is important to remember that it related only to the lagoon bed. To emphasise this point, it is useful to distinguish between shrimp farmers who constructed earthen-walled ponds in the shallows of the Lagoon (lower earth ponds) and those operating in deeper water who erected net enclosures to contain their shrimps. When considering net enclosures, it is clear that the water passing through the nets is not a private resource (characterised by exclusive property rights) but rather a common pool

resource (characterised by inclusive property rights). Moreover, the use of water to grow shrimps was not governed by the common property rules that regulated the extraction of fish. Like the air above a factory, the lagoon water became an open access resource to farmers producing shrimps in net enclosures. The same argument can be applied to pond farmers if they are able to discharge polluted water into the lagoon. In theory, regulations preventing the discharge of polluted water from shrimp ponds would internalise the cost of pollution to these farmers, encouraging them to adopt cleaner production methods. In practice, it is not cost-effective to police such regulations given the existence of thousands of small and inaccessible ponds.

The privatisation of TGCH Lagoon for shrimp production was not well regulated. Zoning was not implemented and natural waterways were blocked by earthen walls and fine-mesh nets (Tuyen *et al.*, 2010). Pond farmers were not required to construct treatment ponds where polluted water could be cleaned before it was released into the lagoon. Not only did the area used to produce shrimps increase rapidly but farmers also adopted intensive production methods (Huong & Berkes, 2011). The evolving mix of private and open access property rights would have encouraged shrimp farmers to intensify their production methods as they were able to internalise the benefits of their investment while externalising the cost of their water pollution. In addition, the Red Books issued to many owners

improved their ability to finance investments in shrimp farming because formal lenders accepted these certificates as collateral for loans (Tinh, 2005; Hoa, 2010). Together, the expansion and intensification of shrimp production elevated the concentration of contaminants (excess feed, shrimp waste and chemicals) over a larger part of the lagoon. In the absence of zoning to keep natural waterways open, it was inevitable that water quality would deteriorate.

Provincial policy-makers responded to the problem of blocked waterways long before the disease problem emerged. Their response was motivated by concerns about sustainable use of lagoon resources and a burgeoning social problem (Tuyen *et al.*, 2010). *De facto* privatisation of the lagoon bed reduced both access to, and the area of, open water for fishing. Mobile-gear fishers, who lacked the resources needed to privatise the lagoon bed, were thus further marginalised. In 2001, the provincial government adopted a proposal to phase out all net enclosures by 2010. Implementation of this policy stalled in the face of resistance from the owners of net enclosures and it took a threat of force to clear just some nets from designated waterways (Tuyen *et al.*, 2010). No compensation was offered for net enclosures that were expropriated as the owners did not have Red Book property rights.

Failure of this 'top down' intervention encouraged the provincial government to support a strategy of co-management initiated by an interdisciplinary research

team based at Hue University. In essence, this strategy involves compromises negotiated between government authorities at the local and district level and Fishery Associations representing multiple user groups at the village or sub-village level (Tuyen *et al.*, 2010). The first priority is to encourage the owners of net enclosures to reduce the size of their enclosures in order to create gaps between them. These gaps will give mobile-gear fishers better access to open fishing water and are also expected to benefit shrimp farmers by reducing disease through improved water flow. Even so, the pilot project described by Tuyen *et al.* (2010) has confronted many challenges and progress has been patchy and slow.

Opening the waterways is a necessary step in promoting a sustainable shrimp industry at TGCH Lagoon, and compensation would no doubt expedite this process. Some might argue that compensation should be offered to help achieve the provincial government's 2001 policy proposal to remove all net enclosures. However, the Lagoon's own history emphasises the critical relationship between shrimp farming and private property rights to the lagoon bed. Removing these rights would be disastrous for the shrimp industry and local livelihoods. Apart from zoning to clear the Lagoon's waterways, policies to promote sustainable shrimp production should focus on pollution abatement instruments that induce farmers to adopt cleaner production methods. Such instruments could be market based, regulatory or involve institutional innovation to manage lagoon water as a common property

resource in shrimp production. These instruments are discussed and evaluated in the context of Tam Giang Lagoon in the chapters which follow.

3.3 Concluding remarks

The initial investigations reported in this chapter were undertaken from a supply-chain perspective and were guided by supply chain theory. These initial investigations were set up within an exploratory framework, and it was envisaged that this would be followed by a second stage of in–depth investigations drawing on these same supply chain theories. However, there was a clear emergent insight from the first stage investigations that the over-riding issue was supply chain failure arising from a production decline that was itself a consequence of shrimp disease, which in turn was a consequence of pollution within the Lagoon. These pollution issues were apparently linked to issues of intensification combined with privatisation of the Lagoon bed but with open access to the water of the Lagoon (Figure 3.3). Accordingly, it was decided that the second stage of the investigations should turn away from the supply chain framework to investigate the prime cause of failure.

At this point the thesis therefore turns to a different analytical framework which draws on the principles of resource economics and property rights. Subsequently, consideration is also given to co-management principles as an implementation strategy.

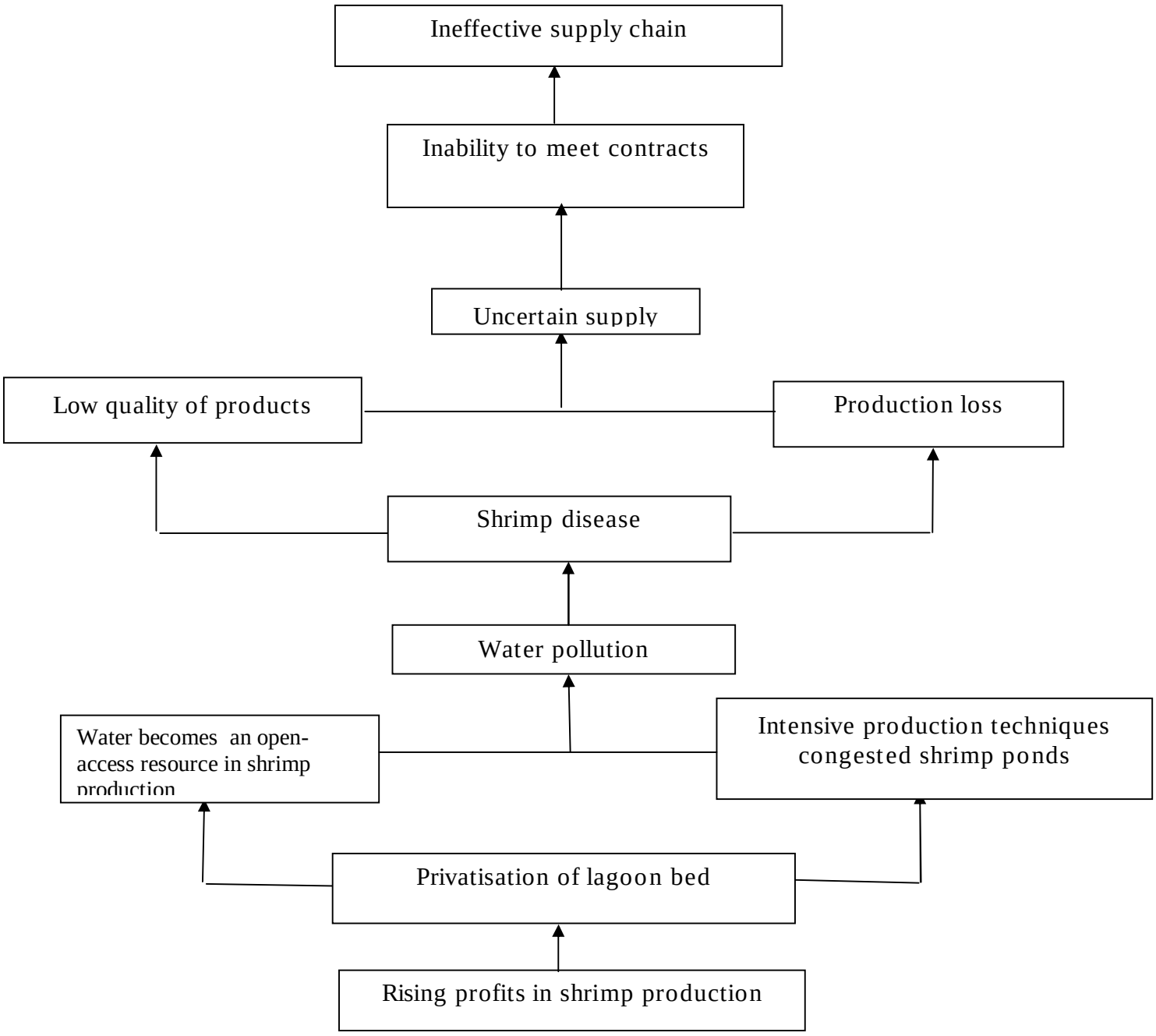


Figure 3.3. Weakening of the shrimp supply chain in TGCH Lagoon

CHAPTER 4

THEORIES OF POLLUTION MANAGEMENT

4.1 Introduction and methods

The exploratory research reported in Chapter 3 provided clear evidence of an endogenous pollution problem in the TGCH shrimp supply chain. This result was consistent with secondary data showing the spread of shrimp diseases and declining area of shrimp production in TGCH Lagoon, and with theoretical arguments relating to changes in property rights to the Lagoon's resources. Chapter 4 marks the beginning of the second stage of this study. It applies Gordon's (1954) model of common property to explain why the mix of private rights to the lagoon bed and open access to the lagoon water encouraged shrimp farmers to adopt intensive production methods that proved to be unsustainable, and then draws on the environmental economics literature to construct a set of possible pollution abatement instruments and normative criteria to assess these instruments. This represents a first step in addressing the policy related research questions listed in Chapter 1.

There is a shift from the positive, case study research strategy employed in the first stage of the study to a normative, analytical research strategy in the second stage. This change in research strategy was necessary because farmers and other

agents in the TGCH shrimp supply chain had little or no experience with policy instruments to control water pollution. Relevant environmental economics literature was reviewed to identify a set of pollution abatement instruments that could be applied to shrimp farmers in the TGCH Lagoon, and to synthesise a set of normative criteria against which these instruments could be tested in order to recommend an appropriate policy instrument. These analyses also drew on e-mail correspondence with key informants from the TTH Provincial People's Committee, Department of Planning and Investment, and the Department of Agriculture and Rural Development. These officials provided useful information about current policy instruments, their achievements and challenges. Chapter 5 applies the assessment criteria developed in Chapter 4, and Chapter 6 considers ways of implementing the recommended policy instrument. This discussion is informed by a review of recent literature dealing with co-management of common property resources.

Chapter 4 comprises of four sections. Section 4.2 describes approaches in pollution management and presents a taxonomy of pollution control measures in the context of TGCH Lagoon. Section 4.3 examines difficulties in applying pollution controls, especially in the context of developing countries. The final section proposes a set of normative criteria to assess pollution abatement instruments that could be applied to shrimp farmers (and other fixed-gear aquaculturists) operating in the TGCH Lagoon.

4.2 Review of environmental policies for managing pollution

4.2.1 Approaches in pollution management

Pollution is an economic externality. According to Huppes and Simonis (2009, p259) externalities occur when the total social costs of an action differ from the private costs for the persons (or organisations) deciding on that action, and the difference between social costs and private costs spill over to others. A negative externality exists when the total social cost outweighs the private costs and conversely, a positive externality occurs when the total social benefit is higher than the private benefits.

There are two approaches to remedy externalities, namely the Pigouvian (Pigou, 1932) and Coasian (Coase, 1960) approaches. The Pigouvian approach focuses on the role of the state through intervening in existing markets (e.g. through imposition of physical regulations or taxes). The Coasian approach emphasises the creation of new markets to exchange property rights (e.g. tradable pollution permits). Accordingly, these two approaches involve state and market mechanisms in different ways and with different emphases.

According to the Pigouvian approach, the state should take an active role in dealing with negative externalities like pollution. State interventions may take the form of taxation or subsidies, direct ownership, participation in investment and provision of goods and services, or administrative and regulatory controls (Adams *et*

al., 2003; Hallett, 1979; Whitehead, 1983). On the other hand, Coase's Theorem states that externalities can be internalised by creating new property rights and that the initial assignment of property rights does not make any difference to efficiency because a Pareto-optimal allocation will emerge through exchanging property rights among parties when they have secure property rights and transactions are frictionless. However, the initial assignment of rights does affect the distribution of income (i.e. it affects equity). Furthermore, Coase (1960) argues that when governments intervene to deal with externalities, corrective measures are associated with other changes which might be more harmful than the original deficiency.

However, transactions are not frictionless and high transaction costs could constrain or even prevent the exchange of property rights (Furubotn & Ritchter, 2000). Institutions like formal laws and informal customs are important determinants of incentives and transaction costs (Benham & Benham, 1997; Coase, 1937, 1960, 1992; North, 1993; Matthews, 1996; Eggertsson, 1997; Dawkins, 2000) which, in turn, affect exchange and production (Shirley, 2006, p611). Institutions are created not only by state bureaucracies but also by private parties (e.g. private firms). However, many scholars emphasise the role of the state in creating and protecting property rights (Matthews, 1986; Przeworski, 1997; Deininger & Binswanger, 1999; Dawkins, 2000; Deininger, 2003); and providing a legal system that facilitates market exchanges in those rights (Deininger, 2003; Deininger & Binswanger, 1999).

Some state interventions constrain the Coasian approach by attenuating property rights. Cheung, (1974) and Lai (1997, 2002) argue that attenuation erodes the exclusivity of private property rights by limiting freedom either in the derivation of income from the use of resources, or in the transfer of these interests. According to Furubotn and Richter (1991, pp1-32) attenuation can be considered as shrinkage of economic options and reduction in asset value. In addition, state intervention might lead to monopoly of ownership, management and control over resources (Adams, Disberry, Hutchinson & Munjoma, 2001, 2002) thereby preventing private parties from acquiring property rights for their development needs, distorting price signals (Munro-Fause, 1999), and encouraging perverse incentive/rent–seeking behaviour (De Alessi, 1980; Moe, 1984, Dawkins, 2000).

The Pigouvian and Coasian approaches suggest different ways of managing externalities in general, and pollution in particular. With the Pigouvian approach, government can take the role of regulator by providing regulations, manipulating incentives and/or intervening directly. With the Coasian approach, government should focus on assigning rights, adjudicating conflicts and facilitating negotiation among private parties (Richards, 2000). Nevertheless, a common point shared by these approaches involves the change of property rights.

Generally, there are two types of change in property rights; these are voluntary exchanges of rights between individuals in a given structure, and change in

the structure of property rights. Voluntary exchanges of rights re-allocate the property rights within a given structure of property rights. The second type of change includes the creation of new rights, the abrogation of or limitation on existing rights and changes from common to private and *vice versa* (Quiggin, 1988). Such changes translate into environmental polices.

4.2.2 Taxonomy of pollution control policies in the context of shrimp culture in TGCH Lagoon

Taxonomy is a classification of knowledge. It is used for organising a body of knowledge from several sources. Environmental management is the process of articulating the different social agents that interact within a certain space, with the purpose of guaranteeing the adaptation of the means for exploiting environmental resources (natural, economic and socio-cultural) to the specificity of the environment. Environmental management aims to enhance environmental sustainability or the management of environmental resources in such a way that their qualities are maintained according to societal norms and standards (Goodland, 1995). Environmental policy instruments are necessary to co-ordinate efforts amongst social agents including public and private organisations and individuals. According to Huppes and Simonis (2009, p254), "*Environmental policy instruments are structured activities aimed at changing other activities in society to achieve environmental goals in a particular time schedule*". There are several ways to establish a taxonomy of

environmental policy instruments according to how organisations and individuals in the society are co-ordinated to achieve environmental objectives.

Vedung (1998) proposes three basic categories of policy instruments including legal instruments (i.e. direct regulations), economic incentives, and informative instruments. Legal instruments reflect the direct intervention of the state and they do not provide discretion to polluters. Economic policy instruments aim at altering the benefits and/or the costs of polluters. These policy instruments give discretion to polluters to choose their own optimal action based on altered benefits and costs of actions. Policy instruments in this category include subsidies, taxes and fees, and tradable permits. Third, informative instruments alter the priorities of polluters. Through altered priorities, polluters could have voluntary actions that contribute to a better environmental condition.

The World Bank (1997) groups environmental policy instruments into the following three categories: regulations using current markets (e.g. taxes and subsidies), creation of new markets, and engagement of the public (informative instruments are the main tools in this category). The World Bank (WB) puts emphasis on the role of the state in creating a market to exchange property rights. This category includes not only tradable permits (referring to voluntary exchange of property rights) but also the creation of new property rights and changes to existing property rights. These changes can bring about improved conditions of

environmental management (e.g. when privatisation internalises a negative externality).

The OECD (2007) provides a synthesis of environmental policy instruments applied by European countries that yields a classification similar to that produced by the World Bank (1997). The report (OECD, 2007) emphasises the importance of using a mix of instruments to address a specific environmental problem because these problems are often multifaceted. For example, the location and timing of pollution may be no less important than the volume of pollution.. In addition, certain instruments can be mutually reinforcing. For instance, a labelling scheme may enhance the responsiveness of firms and households to an environmental tax, and the tax may help to draw attention to the labelling scheme.

The success of informative measures relies on a credible enforcement threat, together with a monitoring program by a respected and independent third party, and peer sanction for under-performance (Alberini & Segerson, 2002; Krarup, 2001; Lyon & Maxwell, 2002; Walton, 2000; Welch & Hibiki, 2002; Potoski & Prakash, 2004). Hence, informative instruments should be considered complementary to regulations rather than as an alternative (Lyon & Maxwell, 2002).

Shrimp farming in TGCH Lagoon produces excessive emissions because the lagoon water is an open access resource and farmers can therefore externalise the costs of their own pollution.. The absence of effective zoning exacerbates this

problem because blocked waterways diminish the carrying capacity of the lagoon (Sub-section 3.2.3). Pollution control policies need to be designed to solve both the blocked waterways and over-exploitation problem.

4.2.2.1 Policy options for reducing emission from shrimp enclosures

Over-exploitation of the lagoon water can largely be explained using the production function approach proposed by Gordon (1954) in analysis of open access fisheries. Figure 4.1 measures output (in value terms) on the vertical axis and shrimp seed input on the horizontal axis. The cost of adding one unit of input is P_s. If a single farmer has exclusive use of the lagoon water and is a rational profit maximiser, he or she will keep adding shrimp seed to the lagoon water until its marginal value product (MVP_s) equals P_s. In this 'private property' case, the equilibrium stocking rate occurs at level Q_1 and the farmer earns rent equal to VNP_s. If this farmer's property right to the lagoon water is secure and he or she is unable to externalise the cost of pollution by discharging contaminated lagoon water into the sea, the equilibrium stocking rate will not exceed the maximum sustainable stocking rate (Q_3) even if Ps=0.

On the other hand, when many farmers share the lagoon water without restriction (even though they do not share the lagoon bed), the equilibrium stocking rate will increase to level Q_2 because each farmer - acting independently to maximise his or her individual profit - will keep adding shrimps until their average value

product (AVP_s) equals P_s. A consequence of this rational behaviour is that all rents are dissipated. As demonstrated by Gordon (1954), the open access equilibrium could exceed the maximum sustainable stocking rate depending on the price of P_s and the characteristics of the externalities. Although, this 'tragedy of the commons' is not a necessary outcome of open access as argued by Hardin (1968), there is strong evidence as presented in Chapter 3 that this situation is occurring in the TGCH Lagoon. Despite these negative outcomes, farmers sharing the lagoon water under conditions of open access have no economic incentive to reduce their own stocking rates as the rents generated by input reduction would accrue to other farmers.

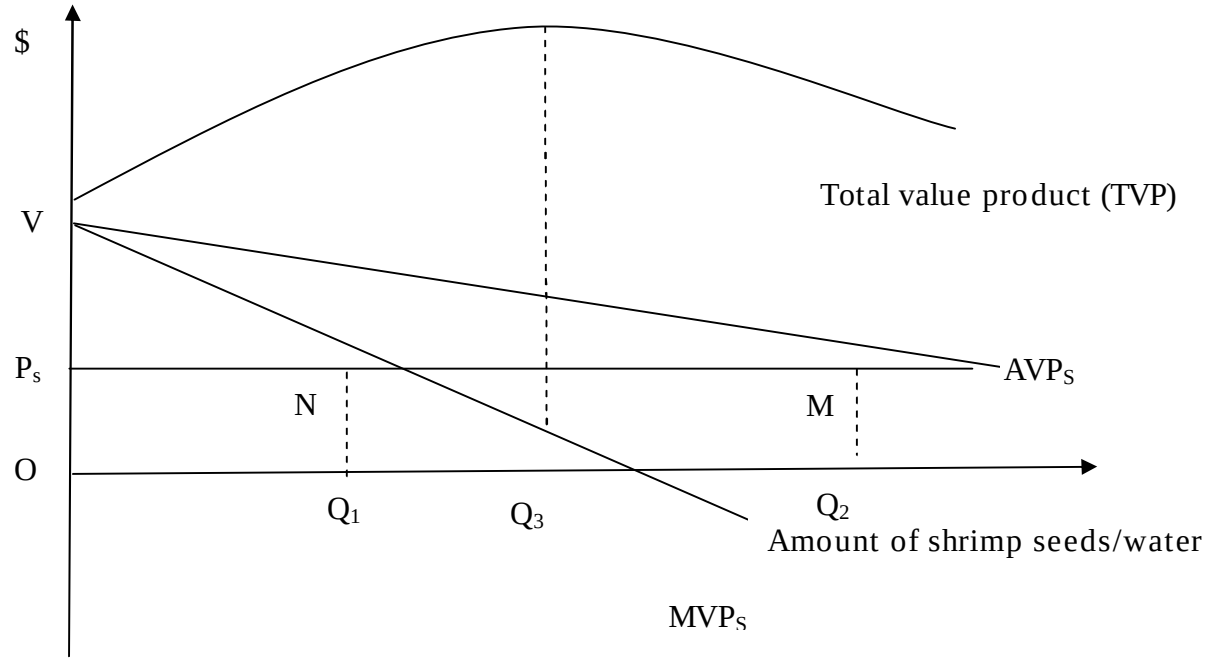


Figure 4.1. Shrimp stocking rates for private and open access lagoon water

Source: Adapted from Gordon (1954).

In order to reduce over exploitation of TGCH Lagoon, policy-makers can adopt physical regulations, market-based measures, or alter property rights. Physical regulations refer to instruments that dictate a physical limit on the amount of shrimp produced (output quotas), the amounts of inputs used (input quotas) or on the amount of pollution discharged (pollution permits). Market-based measures refer to instruments like input taxes (to increase the marginal cost of raising more shrimps), output taxes, pollution taxes, tradable output or input quotas, and tradable pollution permits. Changing the property rights regime refers to either privatisation or 'unitisation' of the open access common pool resource. Unitisation implies a shift from open to common property where rates of exploitation are governed by rules established and enforced by or with user groups. The alternative of privatisation of TGCH lagoon water to individuals (in contrast to the existing privatisation of the lagoon bed) is not considered to be practical owing to natural movement of water in the lagoon. In addition, privatising the lagoon water to individual shrimp farmers will not eliminate its over-exploitation if farmers are still able to externalise the cost of pollution by discharging contaminated water into public waterways.

Quotas on shrimp products and inputs for shrimp production can take the forms of non-transferable (physical regulations) and transferable quotas (market-based instruments). The environmental outcomes of these quotas are the same as they both dictate limits on production. They also entail similar challenges in

monitoring and enforcing. However, transferable quotas are expected to result in better allocative efficiency over time as they impose an opportunity cost on less effective farmers who stand to earn more by selling or leasing their quotas to more effective farmers. To better realise these allocative efficiency advantages, input and output quotas should be detached from the right of access to lagoon water or the lagoon bed. The range of pollution control instruments considered for shrimp farmers in TGCH Lagoon and assessed in Chapter 5 therefore excludes quotas that are non-transferable or which are attached to other resources. It implies that these optional policy instruments for shrimp culture are all market-based measures.

There is a difference between the taxonomic categories of market-based instruments and unitisation. Market-based instruments are designed to operate within a particular property right regime. Unitisation, on the other hand, represents a shift to a new property right regime. Regulations and market based instruments recommended for users of open access resources will differ from those recommended for users of private property because the institutional rules associated with each of these property right regimes create different incentives and problems (Slangen, Loucks & Slangen, 2008, p318). For this reason, market-based pollution control instruments considered for farmers who have private access to the TGCH Lagoon bed and open access to the lagoon water are assessed in Chapter 5, whereas unitisation is assessed in Chapter 6.

4.2.2.2 Policy options for opening waterways

Opening waterways in TGCH Lagoon will entail some expropriation of shrimp farms. According to Tuyen *et al.* (2010), TTH provincial government established an objective of phasing out all net enclosures in the Lagoon by 2010. At first, the government adopted a top-down approach in some communes (Tuyen *et al.*, 2010). Commune and village leaders informed farmers of the provincial government's decision and demarcated waterways according to guidelines set by the district government. Shrimp farmers were then instructed to remove any parts of their net-enclosures within the demarcated waterways. This approach failed in the face of firm resistance from the owners of net enclosures.

Recognising the high political risk of the top-down approach, the provincial government agreed to support an experiment in co-management in which some control over shared lagoon resources would be devolved to local Fishery Associations in certain parts of TGCH Lagoon (Tuyen *et al.* 2010). These user groups were given legal status in the national Fisheries Law of 2003. According to Tuyen *et al.* (2010), the experiment was initiated in 2004 with a workshop that included researchers based at Hue University of Agriculture and Forestry (HUAF), district leaders, relevant departments of district government and commune leaders to explore collaborative ways of opening waterways. In 2005, a Provincial Decision (No. 4260/2005) formalised the role of Fishery Associations in local management of

community lagoon resources. (Tuyen *et al.*, 2010). The HUAF research team had been working towards common property solutions to this problem with Lagoon users in the Sam Choun area since 1996, well before their efforts were given official support. By 2009, after more than a decade of participatory action research, only modest progress had been made with the realignment of farm boundaries to open the waterways (Tuyen *et al.*, 2010).

Persistent resistance to opening waterways is to be expected when farmers with officially recognised rights to the lagoon bed are not compensated for property expropriated in the public interest. To date, the government has not offered compensation for expropriated net-enclosures even where the owners were previously granted permits by commune authorities. Compensation has been offered only to pond farmers in possession of Red Book property rights, and the amount of compensation offered has been well below market prices paid for ponds (TTH PPC, 2011). A more generous compensation policy would no doubt help to expedite agreements on waterways, a process that is widely viewed as necessary to restore and maintain the productive capacity of TGCG Lagoon. However, opening the waterways is unlikely to be sufficient if farmers continue to overexploit the lagoon water. While strongly supporting collaborative efforts to open the waterways and a more generous approach to compensation, the balance of this thesis focuses on policy options to reduce emissions from shrimp ponds. These include unitisation and

market-based instruments like transferable quotas for inputs, outputs and pollution rights, and taxes on inputs, outputs and emissions. Chapter 5 assesses the suitability of each of these market-based instruments for TGCH Lagoon, and Chapter 6 considers an extension of the unitisation or co-management approach recently adopted by the provincial government.

4.3 Problems of pollution control policies

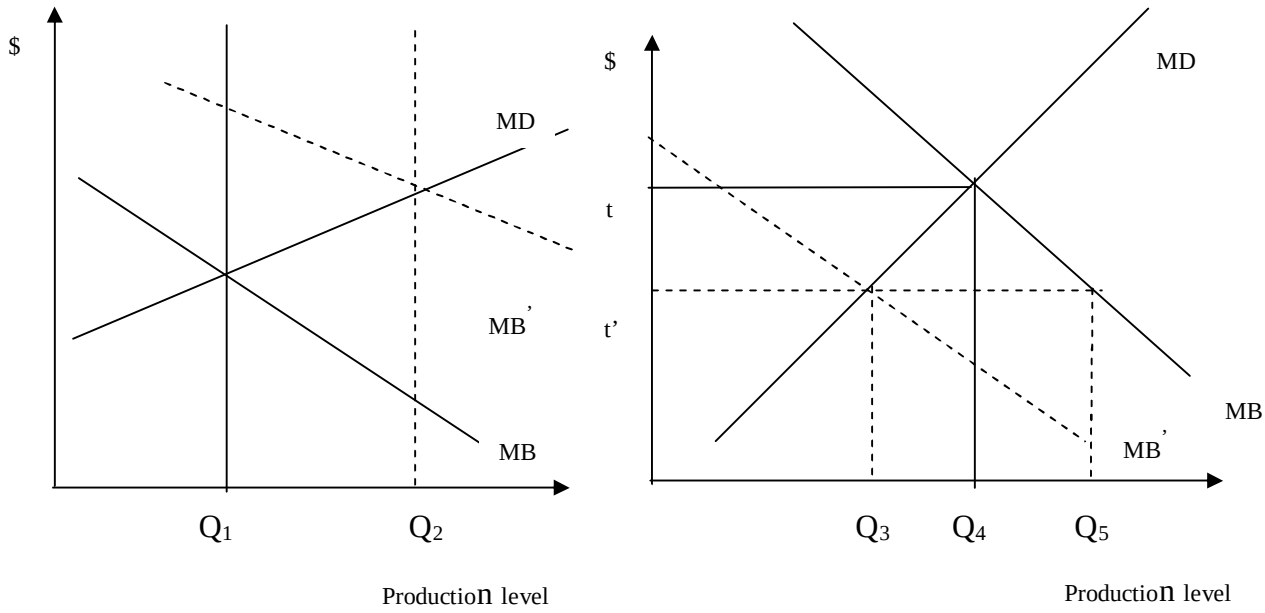
Pollution is a global problem despite the best efforts of many governments. This situation implies shortcomings in pollution control measures. The literature points out two types of problems in applying environmental policy instruments. These problems include inherent shortcomings of environmental policy instruments and difficulties in applying those instruments in developing countries.

4.3.1 Inherent problems of environmental policy instruments

The role of policy-makers is to design policies so as to confront polluters with the costs of their action in order to increase social benefits (O'Shea, 2002). The first order condition states that the optimal level of emission for society is identified by equality between the marginal benefit of an extra unit of emission and the marginal damage of that unit. However, pollution control policies seldom achieve this optimal level in the real world because they are associated with several shortcomings (especially policies dealing with non-point source pollution (NPS).

The analysis of inherent problems in pollution control policies starts with instruments to address point source (PS) pollution which are usually much simpler than instruments to address NPS pollution. In order to achieve the first order condition, it must be assumed that policy-makers have complete knowledge about the polluter's marginal benefit function and its damage function to design optimal policy. However, this assumption is not realistic in practice. First, firms are likely to withhold information about their benefit functions to evade pollution control policies. As O'Shea (2002) argued, if the government introduces quantitative-based measures, firms tend to overstate their benefit functions (Figure 4.2a), and conversely, if price-based measures are applied, firms tend to understate their benefit functions (Figure 4.2b). Second, estimation of the damage function is hardly precise because the environment is a non-market good. Consequently, pollution policies tend to ignore the notion of an optimal level of emission and instead follow a more pragmatic approach which is based on an acceptable standard of pollution (O'Shea, 2002). Policy-makers can adjust their policy instruments in a trial–and–error fashion (e.g. adjust the pollution tax rate) so as to prevent pollution from exceeding the acceptable standard. The trial–and–error process in adjusting pollution polices requires a precondition that policy-makers can monitor the activities of individual polluters together with (as a minimum) the total emissions of polluters in aggregate

who are subject to the instrument, and hence the contribution to the ambient environment.



(4.2a) - quantitative-based measure (4.2b) – price-based measure

Figure 4.2. Polluters' behaviours responding to environmental policy instruments.

Source: Adapted from O'Shea (2002).

Notes:
- MD is marginal damage function of polluters.
- MB is marginal benefit function of polluters.
- MB' is overstated marginal benefit function of polluters in (a) and understated marginal benefit function of polluters in (b).
- t and t' are respectively the right tax rate and the tax rate applied when polluters understate their marginal benefit function.

In the case of NPS, the nature of the problem is much more complicated due to the fundamental difference between PS and NPS pollution. According to Xepapadeas (1999), NPS pollution is distinguished from PS pollution by difficulties in recognising sources, size, distinctive characteristics of sources, and time lags

between causes and effects of emissions. Moreover, stochastic elements are added to the pollution dispersion process by weather condition (e.g. wind, flood, etc). As a result, identifying individual NPS pollution sources and measuring their contribution to ambient pollution become impossible in practice. In short, there is a large information gap between regulators and polluters in the case of NPS pollution.

The pollution caused by shrimp farming in TGCH Lagoon is a typical NPS pollution because there are thousands of small shrimp farmers. Accordingly, it is likely to be prohibitively costly to monitor pollution discharged from individual shrimp ponds.

Braden and Segerson (1993) separate this information gap into two components.

- Problems of monitoring and measurement: these problems refer to inability to directly monitor individual emissions or to infer them from observable inputs or from the ambient concentration of the pollutant.

- Natural variability component: this refers to weather conditions and technology variability which results in stochastic pollution processes.

The information gap between regulators and polluters gives rise to free-rider problems and as a consequence, increases difficulties in managing NPS pollution. The relationship between regulators and polluters can be considered as a typical

principal–agent problem[5]. In this relationship, polluters can free-ride[6] taking advantage of the information asymmetry about their real emissions. In the presence of such market failure, standard instruments of environmental policy such as Pigouvian taxes, tradable permits and emission standards do not create pertinent incentives to individual polluters. The information asymmetry causes a prohibitively high transaction costs for regulators and polluters to get complete information.

4.3.2 Difficulties in applying pollution control policies in developing countries

Pollution happens in both developing and developed countries. However, developing countries face more difficulties in managing pollution. Rietbergen-McCracken and Abaza (2000) argue that developing countries have more severe environmental degradation while they also have a greater reliance on environmental resources for economic development. In addition, developing countries often have a weak institutional base and limited capacity to implement environmental policy (Rietbergen-McCracken & Abaza, 2000; Blackman & Harrington, 2000).

In the context of developing countries and countries in transition (CITs), pollution control policies are polarising into two distinct points of view (Kathuria, 2006). The first favours the use of market-based instruments (MBIs). The reason for supporting MBIs is that they link economic rationality with environmental outcomes

[5] A situation where one economic actor, called the principal, can set the rules under which another economic actor, called the agent, operates. To maximise his utility, the agent chooses an action independently of the principal that nevertheless affects the principal's utility; the agent's utility function is different from that of the principal (Pushkarskaya, 2003)

[6] Free-ride refers to the situation in which 'free-riders' consume more than their fair share of a resource, or shoulder less than a fair share of the cost of its production. (Corner & Sandler., 1986)

because market instruments rely on profit generated to produce environmental protection (Anderson & Leal, 2001; Kosobud & Zimmerman, 1997; Stavins, 2003). Relying on the link between economic rationality and environmental outcomes, MBIs are able to bring about a 'win-win' situation for the treasury (raising revenue for the society), the environment (encouraging polluters to change their behaviours and/or using revenue raised to compensate environmental loss), and the economy (creating incentives for applying new pollution control technologies) (Baumol & Oates, 1988; Rietbergen-McCracken & Abaza, 2000, pp6-7). However, the application of market approaches in developing countries is criticised for many reasons. Bell (2003) argues that the four factors necessary for MBIs to succeed - namely transparency, accurate monitoring, realistic incentive to trade, and trust - are seldom present in developing countries. In similar vein, Blackman and Harrington (2000) stress that financial, institutional and political constraints make environmental policies much more problematic in developing countries than in industrialised countries.

The second point of view argues that policy instruments should be based on the existing institutional capabilities of countries and political support (Cole & Grossman, 1999; Anderson, 2001; Soderholm, 2001; Bell, 2003). Direct regulations often get political support more easily than other instrument groups (O'Shea, 2002) because they explicitly give an assurance that pollution will not exceed a certain level. However, direct regulations (including both technology and performance

standards) are criticised as inflexible policies that create a disincentive for firms to invent, innovate and diffuse new technologies and ways of doing things (Jaffe, Newell & Starvins, 2003).

In light of the second viewpoint, some authors suggest a hybrid mechanism in which there are some roles for government and others for markets (Donahue & Nye, 2002). Anderson and Leal (2001) focus on assigning property rights instead of using MBIs. On the other hand, Hahn, Olmstead & Starvins, (2003) suggest using market incentives such as fees, taxes, and subsidies to achieve goals that are set politically.

The debate on which instruments should be used to tackle environmental problems, in general or in specific cases, has been very active (Fisher *et al*., 1996; Keohane, Revesz & Stavins, 1998; Mickwitz, 2003; OECD, 2007). Appropriate criteria are important in assessing pollution control policy instruments.

4.4 Normative criteria to assess pollution control policy instruments

4.4.1 Literature review

An evaluation of environmental policy instruments includes either *ex-ante* or *ex-post* analysis and each has its own assessment criteria. *Ex-post* analysis requires experiments of policy instruments and information on their outcomes. Such information is not available for TGCH Lagoon. Consequently, this study focuses on a normative, *ex-ante* analysis. The selection of normative criteria to assess environmental policy instruments ex ante is constrained by the principle of

sustainable development. According to the Brundtland Commission (1987), sustainable development is defined as development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. This definition contains two key concepts, including;

- the concept of 'needs', in particular the essential needs of the world's poor;
- the idea of limitations imposed by the state of technology and social organisation on the environment's ability to meet present and future needs.

Choosing an appropriate policy instrument requires reconciling among conflicting issues. Richards (2000) made a summary of assessment indicators used by other researchers and environmental organisations including Majone (1976), Bohm and Russell (1985), U.S Department of Energy (1989), Project 88–Round II (1991), Office of Technical Assessment (OTA) of U.S Congress (1995), and Hoel (1996) (Annex 3.1). All of these studies include criteria of static efficiency, cost-efficiency, political feasibility and administration burden. The criteria of environmental effectiveness and dynamic concern (i.e. incentives to develop new abatement technology and adaptability of policy instrument to changing conditions) were also adopted in most of these studies.

The above assessment criteria are also highly consistent with Revesz & Stavins (2007) who devise relevant questions for choosing environmental policy instrument, including:

- will the policy instrument achieve the stated goal or standard;

- will it do so at the lowest possible cost, including both private-sector compliance and public-sector monitoring and enforcement;

- will the instrument be flexible in the face of changes in tastes and technology;

- will the instrument provide dynamic incentives for research, development, and adoption of better pollution abatement technologies;

- will the implementation of the policy instrument result in an equitable distribution of the benefits and costs of environmental protection;

- will the policy be politically feasible in terms of enactment and implementation;

The first question refers to the criterion of environmental effectiveness. The second question refers to both criteria of administrative feasibility and cost-efficiency. The third and fourth questions refer to criteria of dynamic concerns. The fifth and sixth questions refer to criteria of political feasibility.

Richards (2000) suggests that the ideal environmental policy instrument is one that minimises costs for society given the pollution abatement requirements and prevailing legal and political constraints. Costs for society include production costs, public finance impact, and transaction costs. Production cost refers to the actual capital, training, operation, maintenance, and management costs of producing emissions abatement or other environmental service. They are direct costs of controlling pollution. Public finance impact refers to the cost imposed on the system

of public finance related to an instrument's revenue-raising requirements. Transaction costs include measurement costs and governance costs. Measurement costs refer to the resources dedicated to implementing, monitoring and evaluating the policy instrument. Governance costs are the costs of establishing and maintaining mechanisms to resolve conflict and adapt to changes.

4.4.2 Proposed assessment criteria for pollution control policy instruments in the context of TGCH Lagoon

The foregoing literature review suggests that an environmental policy instrument should be assessed with many aspects. Accordingly, the assessment involves a set of criteria. Even though all criteria are important in theory, they should not be treated equally in practice as regulators must have different priorities in designing instruments. All assessment criteria of an environmental policy can be categorised into the first-order groups referring to the impact of the instrument on ambient environment and the second-order group referring to implications of environmental improvement on cost-benefit function of the society.

With regard to the first-order group, assessment criteria for pollution control policy instruments include environmental effectiveness of the instrument and its administrative feasibility. The environmental effectiveness of the instrument refers to the level of action forcing or rigidity that it imposes on polluters. Administrative feasibility refers to the extent to which the instrument to be practical, not incurring

excessive monetary or informational costs for its implementation and operation. The administrative feasibility depends on the costs of instrument incurred by regulatory agencies. The costs of an instrument include the cost of measurement (resources for implementing, monitoring and enforcing work) and cost of governance (resources for establishing and maintaining mechanisms to resolve conflict and adapt to changes). The governance cost is strongly dependent on the effectiveness of monitoring and enforcing.

With regard to the second-order group, an instrument can result in different implications for the cost-benefit function of the society. These implications are assessed with criteria including static efficiency, cost-efficiency, dynamic concerns, and political acceptability

Static efficiency refers to the optimal production level of polluters. An environmental instrument achieves static efficiency when it equates marginal abatement costs with marginal damages of pollution. It implies that regulators need to have complete information about marginal damages of pollution.

Cost-efficiency refers to the extent to which the instrument achieves the designed environmental goal at the least cost. This criterion will be satisfied if abatement costs among polluters who have the same marginal damages are equalised. It implies that regulators need to know the difference in marginal

damages of polluters. Accordingly, cost-efficiency can be considered as the necessary condition of static efficiency.

Dynamic concern refers to the changes in a number of dynamic relationships. First, it involves response of farmers to the policy instrument (e.g. applying cleaner production technology, reducing production scale). Second, it involves response of farmers to changes in preferences, incomes, availability of production factors and technology in the business environment (e.g. substituting inputs). The responses of farmers both to the instrument and the business environment depend on how the instrument creates incentives and discretion for farmers. Third, it involves the adaptability of the environmental instrument to changes in the ecological environment (e.g. more pollution) and the socioeconomic environment (e.g. input and output prices).

Political acceptability should be considered from both government and community perspectives. From the community perspective, the political acceptability of an environmental instrument is influenced by the political risks, and the ethical views of society in relation to the instrument. The political risk is influenced by effects of the environmental instrument on the size and distribution of costs and benefits of polluters, and the political influence of losers in particular. The ethical view of society on the instrument is affected by the compatibility of the instrument with the Polluter

Pays Principle7. Given the government structure in Vietnam, it is possibly for government to over-ride community concerns, albeit with subsequent enforcement challenges.

7 The Polluter Pays Principle requires those responsible for producing pollution to pay for damage done to the natural environment.

CHAPTER 5

ASSESSMENT OF MARKET-BASED POLICY OPTIONS FOR REDUCING EMISSION FROM AQUACULTURE FARMS IN TGCH LAGOON

This chapter applies the criteria developed in Chapter 4 to assess transferable quotas for – and taxes on – outputs, inputs and pollution as suitable instruments to reduce emissions from aquaculture farms in TGCH Lagoon. This analysis assumes that the property right regime is unchanged and that these instruments are imposed by regulators on farmers who have private access to the lagoon bed and open access to the lagoon water. Chapter 6 considers a role for co-management of common property lagoon water.

5.1 Transferable output quotas

Environmental effectiveness

The level of action forcing of transferable shrimp output quotas in the context of TGCH Lagoon is threatened by the substitutability of brackish aquaculture species. In fact, shrimps can and have been substituted with other brackish aquaculture species in the lagoon. The over-exploitation problem applies to all aquaculture production because the lagoon water is an open access resource and farmers can freely discharge polluted water from their farms. Consequently, a quota restricting only shrimp production would not be rigid. It is therefore necessary to consider and assess transferable quotas for all aquaculture products in the lagoon.

Marginal damage to the ambient environment will differ between species. Therefore, it is necessary to design distinct and non-convertible quotas for each aquaculture product. Alternatively, if quotas were convertible between species then the conversion ratios would need to be set according to the relative pollution associated with a unit of each species. The implication is that farmers would have to buy and sell quotas in order to alter their production mix. Such quotas, usually referred to as 'individual transferable quotas' or ITQs, have been applied to deep water fisheries in New Zealand with reasonable success (Costello, Gaines & Lynham, 2008)

The environmental effectiveness of output ITQs depends on whether or not the allowed quantity of each product can be sustained by the Lagoon. It follows that output ITQs may have to be adjusted frequently to accommodate increasing understanding of the Lagoon's ecology. In a laboratory environment, a sustainable level of output can be achieved through an iterative process where regulators buy and sell quotas (or adjust quota levels) to individual farmers. However, this task is much more complicated in the context of TGCH Lagoon where sustainable levels of production also vary across the lagoon.

Output ITQs would not be environmentally effective if they were applied 'across the board' because the Lagoon's capacity varies from one location to the next depending on local ecological and biological conditions. Consequently, output ITQs

would have to be location specific, providing for different average rates of exploitation by farmers in each location, and trading of quotas between locations would have to be prohibited. Administratively, this would require zoning of the lagoon into areas of similar marginal damage and the operation of decentralised quota markets.

Administrative feasibility

The measurement cost of transferable output quotas is mainly influenced by the cost of information (i.e. cost of collecting information about sustainable and actual production rates in different parts of the lagoon), the cost of establishing and maintaining quota markets, and monitoring costs. The first two kinds of cost depend largely on how output ITQs are implemented.

First, regulators can initially allocate transferable output quotas to individual farmers by direct auction or by grandfathering. Grandfathering implies that farmers are allocated sufficient quota to produce at levels proportionally lower than their levels before the introduction of quotas. This implies that regulators must incur a substantial information cost to establish each farmer's recent level of production. With direct auction, regulators offer the allowable ITQs to farmers who must bid for them. This reduces the regulator's information cost but raises the issue of political feasibility (discussed later as a 'political risk').

Second, the cost of establishing quota markets depends largely on the type of market and level of decentralisation. Quota markets can be managed by regulators or left unmanaged. In the latter (laissez faire) case, the regulator does not facilitate quota transactions. Conversely, in a managed market, the regulator acts as an intermediary, providing information and enforcing contracts. While this is expected to reduce private transaction costs and to promote allocative efficiency, it imposes an additional cost on government. In the case of TGCH Lagoon, quota markets would require some management in order to prevent trades between quota zones. The more decentralised are these zones, the higher will be the cost of managing quota markets.

Apart form the information cost associated with grandfathering and managing quota markets, regulators also face technical information costs associated with zoning. These costs, and the cost of setting quota levels, would be ongoing due to changes in production technologies that impact on pollution, and increasing knowledge as to ecological sustainability limits.

Third, the monitoring cost of this instrument is high. Monitoring could be applied to physical production on farms or to receipts issued at the point of sale. The former method is very time consuming because it is difficult to observe quantities produced in a pond or net enclosure. Monitoring sale receipts is much easier but potentially less effective because farmers have an incentive to behave

opportunistically and to sell products without receipts. Although quota holders may voluntarily assist regulators with monitoring (to protect their investment in quotas), the wide range of product buyers (Section 3.2.21) would still make it difficult for regulators and quota holders to prevent non-compliance. Consequently, output ITQs will also be burdened with high governance costs.

Cost-efficiency and static efficiency

Output ITQs would be cost-efficient if the marginal abatement costs of polluters whose emissions cause the same marginal damage are equated. Initially, the marginal abatement cost of farmers depends on how quotas are allocated. In the case of grandfathering, initial abatement costs are represented by the opportunity cost of reduced production. In the case of auction, the marginal abatement cost includes both this opportunity cost and the direct cost of buying output quotas. In the long-term, the marginal abatement costs of transferable quotas will reflect both opportunity and direct costs regardless of how the quotas were initially allocated. Therefore, even if zoning equalises the marginal damage of farmers within a quota zone, it would not be possible to administer output ITQs that equate exactly the marginal abatement cost of these farmers because they are likely to face different transaction costs when purchasing quota. Unit transaction costs may well differ between farmers depending on the scale of their production and on personal attributes like the ability to assemble and process information. Although well-

administered output ITQs could achieve reasonable cost-efficiency, this would not imply the same for static efficiency because it would not be practical to measure the marginal damage of farmers.

Dynamic concerns

Transferable output ITQs impose an opportunity cost on less efficient farmers and therefore create an incentive for these farmers to sell or lease their quotas to more efficient farmers. The improvement of allocative efficiency is influenced by the type of quota markets established and their level of decentralisation. In case of laissez faire markets, smaller farmers could face prohibitively high unit transaction costs that prevent some efficiency-improving trades. Managed markets could reduce private transaction costs (adding to the gains in allocative efficiency) but only at the expense of higher information costs. Decentralisation of quota markets would also help to reduce private transaction costs but, again, there is a trade-off because allocative efficiency is compromised when ITQs cannot be transacted between quota zones (in order to preserve their environmental effectiveness). Under these conditions, the gains in allocative efficiency will be constrained by the total amount of quota issued for each different product in the quota zone.

While output ITQ's will allow individual farmers to respond to changes in their business environment (e.g. new technology and changes in relative prices) by buying and selling quotas, the extent of their responses will depend on the ability of

regulators to make appropriate adjustments in the product mix allowed in each quota zone. Regulators can adjust output ITQs by buying or selling quotas in the market or by making proportional adjustments to the level of output allowed by each quota. The revision of quota levels would need to be considered frequently because regulators do not have perfect information at the beginning and ecological conditions and technology are dynamic. Consequently, this policy instrument offers reasonable flexibility to regulators and gives farmers reasonable discretion in their production choices. However, it does not create an incentive for farmers to adopt cleaner production technology.

Political acceptability

The political risk of output ITQs depends on how they affect the size and distribution of costs and benefits, and the political influence of losers in particular. If quotas are initially allocated through auction, farmers who are poorest in terms of liquidity will suffer the largest cuts in production and will benefit least from environmental improvement. Political risk could be high if these disaffected farmers have significant influence, even if other stakeholders (like mobile-gear fishers) stand to gain. This appears to be the case when viewed against the staunch resistance to government's 'top-down' attempt to open waterways in TGCH Lagoon (Tuyen *et al.*, 2010). This risk could be reduced by grandfathering the ITQs as the costs and benefits of environmental improvement would then be shared by farmers in

proportion to their recent levels of output. However, even if ITQs are grandfathered, the fact that they are transferable opens the door to involuntary distress sales that leave some of the poorest farmers worse off. Ethically, transferable output ITQs can be defended on the grounds that the 'polluter pays' regardless of whether they are auctioned or grandfathered as all farmers bear the opportunity cost of reduced production. Political risk associated with output ITQs is therefore unlikely to originate from outside the farmer group.

5.2 Assessment of transferable input quotas

Environmental effectiveness

First of all, the level of action forcing of transferable shrimp input quotas in TGCH Lagoon is threatened by the substitutability among aquaculture products (sub-section 5.1). Accordingly, as with output ITQs, input ITQs would need to be extended to all aquaculture species in the lagoon. In addition, input quotas would need to either be non transferable between species, or else transferability would occur using ratios that estimate the relative pollution associated with the level of production that is associated with use of a unit of input when applied to each species.

Given these issues, the input ITQ analysis in this thesis focuses on seeds rather than feed, This is because, unlike with feed, the specific seed requirements for

each species are non substitutable between species, and also there are only limited options for changing the technology mix to compensate for low seed numbers.

The level of action forcing of seed ITQs depends on whether the designed allowable amounts of seed for aquaculture species in TGCH Lagoon are set at levels that are consistent with ecological sustainability. As with output ITQs, trading of quotas between ecological zones would need to be prohibited. This would require zoning of the lagoon into areas of similar marginal damage and the operation of decentralised quota markets.

Administrative feasibility

Similarly to output ITQs, the costs of seed ITQs include information costs, the costs of establishing quota markets, and monitoring costs. The information costs depend on the chosen method for initial allocation of quotas, the type of quota markets, and the level of decentralisation. The technical information costs associated with zoning would be ongoing due to production technology innovations and increasing knowledge of ecological sustainability limits.

A significant distinction between seed ITQs and other ITQs (either input or output) is the relative ease of monitoring for seed ITQs. This is because farmers no longer rely on seeds collected from wild sources (PECAAF, 2008), and there are only a small number of potential suppliers of commercial seeds. Accordingly, the seed suppliers can be considered as “check points” in the monitoring system. However,

there would still be considerable governance costs to prevent opportunistic strategies by farmers who might attempt to find non-accredited seed providers.

Cost-efficiency and static efficiency

As with output ITQs, well-administered output ITQs could achieve reasonable cost-efficiency but would have low static efficiency. The low static efficiency occurs because it would not be practical to measure the marginal damage of farmers.

Dynamic concerns

Both output and seed ITQs impose opportunity costs on farmers who use their quotas inefficiently, and there is a market incentive for these less efficient farmers to sell their quotas to farmers who are more efficient. However, allocative efficiency also depends on the type of quota markets and the level of decentralisation, given that quotas would not be transferable between zones. As with output ITQs, there is no incentive for farmers to apply cleaner technologies.

There is a subtle difference between seed ITQs and output ITQs in regard to the farmers' responding to changes in the business environment. In case of output ITQs, farmers have complete discretion to minimise their production cost through applying the most appropriate input mix. In case of seed ITQs, the farmers' ability to minimise production cost is partially limited due to the biological relationship between amount of used seed and other inputs.

Political acceptability

Seed and output ITQs have similar political acceptability implications. If seed ITQs are allocated through auction, then poor farmers will suffer the largest production reduction and obtain the least benefits from environmental improvement. Grandfathering of seed ITQs would reduce the political risk. In the long-term, the concentration of quotas amongst a limited number of farmers who are more efficient (regardless how seed ITQs being allocated) skews the income distribution among farmers and subsequently may cause some adverse effects on equity.

5.3 Assessment of transferable pollution permits

Environmental effectiveness

In the context of TGCH Lagoon, transferable pollution permits have the highest level of action forcing in comparison with output and seed ITQs as this measure pertinently manages pollution discharged from aquaculture enclosures. To be effective, these transferable pollution permits would need to be extended to all aquaculture products in the lagoon.

Administrative feasibility

Transferable pollution permits are administratively non feasible. This is because of the prohibitive cost of monitoring the non-point-source pollution from some thousands of small aquaculturalists who are transferring water between their ponds and the broader lagoon. Given this infeasibility of monitoring, which is a first-

order criterion, it is not necessary to assess transferable pollution permits with other criteria.

5.4 Assessment of output taxes

Environmental effectiveness

First of all, due to the substitutability among aquaculture products, output taxes should be applied not only to shrimp culture but also other aquaculture activities in TGCH Lagoon. The level of action forcing of output taxes depends on whether the tax rates are high enough to make farmers reduce their production scale to the desired level. In a theoretical environment, the optimal tax rate would be achieved after an iterative process. However, it is much more difficult in the context of TGCH Lagoon where farmers are operating in a diverse bio-physical environment and face different production functions. Whereas output quotas have a direct impact on production, output taxes depend for their effectiveness on a set of unknown farmer response functions. Administratively, regulators would need to implement zoning of aquaculture production into areas of similar marginal damage as in the case of transferable output and seed quotas, and to tailor tax rates accordingly.

In the long run taxes should have the same level of action forcing compared with quota-based measures. However, taxes are likely to require more iterations to achieve this level of action forcing.

Administrative feasibility

The measurement cost of output taxes is mainly determined by the information cost (i.e. cost of collecting information about sustainable production level in TGCH Lagoon), the monitoring cost and the cost of collecting the tax payments. Compared with grandfathering output and seed ITQs, the initial information cost of output taxes is lower as regulators do not have to collect information about production of individual farmers prior to implementation of the tax. However, the technical information costs associated with zoning of output taxes is ongoing and the same as for output ITQs and seed ITQs. Meanwhile, the monitoring cost of output taxes is relatively higher than quota-based instruments as it would be more difficult to prove non-compliance of farmers when there is no physical restriction. Further, the cost of collecting tax payments is likely to be higher than the cost of establishing quota markets as farmers have many opportunities for non compliance.

Cost-efficiency and static efficiency

In regard to cost-efficiency, the marginal abatement cost of farmers is represented by the tax rate. Assuming that the zoning of aquaculture is well-administered, the differential tax rates would be tailored to the distinctive conditions of each aquaculture zone and would result in higher cost-efficiency compared with output ITQs and seed ITQs. This is because farmers would not have transaction costs

associated with buying and selling quotas to adjust their scale of production. However, due to the infeasibility of estimating marginal damages of individual aquaculture farms, output taxes bring about low static efficiency, as do output ITQs and input ITQs.

Dynamic concerns

Unlike output and input ITQs, output taxes do not provide a direct market incentive for less efficient farmers to sell their aquaculture rights to more efficient farmers; nor do they create an incentive for farmers to apply cleaner technology.

Compared to both output and input ITQs, output taxes provide farmers with more flexibility to respond to exogenous changes in the business environment. This includes changing the input mix, changing the output mix of aquaculture species, and changing the scale of production. All of these could occur without transaction costs.

In regard to modifying the instrument in response to new information as to ecological sustainability limits, output taxes might be less effective, at least initially, than either output or input ITQs. This is because of the new information requirements relating to farmer response functions to the adjusted tax. Tax rates would also need to be adjusted periodically to account for inflation.

Political acceptability

The political risk of output taxes would be high because of opposition to the tax. There is a relevant issue as to whether all of the tax would be borne by producers or whether some of this would be transferred to consumers through an increase in the price of the aquaculture products. The share of the tax passed on to consumers would be determined by the price elasticity of demand for aquaculture products relative to the price elasticity of supply. However, since these output taxes would be applied only to aquaculture products from the TGCH Lagoon, the price elasticity of demand is likely to be very high because buyers can substitute TGCH aquaculture products with other products produced elsewhere in Vietnam. This implies that farmers in TGCH Lagoon rather than consumers would pay almost all of the tax. As well as paying the tax itself, farm income would be reduced through impact of the tax on production decisions. The overall cost to farmers would be higher than other options so far discussed, but the tax would provide revenue to government.

5.5 Assessment of input taxes

Environmental effectiveness

The level of action forcing of shrimp input taxes depends on all aquaculture species being included. In addition, the taxes need to be set at a level such that farmers do modify their production decisions. Although in theory the appropriate tax rate equals the marginal damage rate, in practice there would be major challenges in

determining the correct figure. The appropriate tax rates would have to be individually set for each zone in the lagoon.

Administrative feasibility

The measurement cost of aquaculture seed taxes mainly includes information cost (i.e. cost of collecting information about ongoing sustainable aquaculture scale in the lagoon), the monitoring cost and the cost of collecting tax payments. In the case of a tax on seed inputs, the costs could be minimised by requiring the sellers of the seed to collect the tax, thereby minimising the number of collection points. Administrative effectiveness would depend on farmers being required to keep their tax receipts provided by the sellers of seed.

Cost-efficiency and static efficiency

Aquaculture seed taxes have similar implications for cost-efficiency and static efficiency as do output taxes. Well-administered zoning of aquaculture is the precondition for these measures to achieve high cost-efficiency. Their cost-efficiencies would be potentially higher than transferable output and seed ITQs as farmers would not have transaction costs associated with buying and selling quotas. Similarly to other measures, the infeasibility of estimating marginal damages of individual aquaculture farms would result in low static efficiency of seed taxes.

Dynamic concerns

As with output taxes, seed taxes have marked weaknesses for dealing with dynamic issues. First, seed taxes do not facilitate the improvement of allocative

efficiency through the transfer of production from less efficient to more efficient farmers. Second, they do not create an incentive for farmers to apply cleaner technology. Given that they are an indirect instrument, there are also likely to be ongoing adjustments required as the business environment changes, to ensure that the production response is consistent with ecological sustainability requirements. However, as with output taxes, it is possible for farmers to change the scale of production and the species production mix without incurring transaction costs.

Political acceptability

Both seed taxes and output taxes have high political risk due to the burden that they impose on farmers and the ongoing need for adjustment of the taxes. Farmers' opposition is likely higher in the case of seed taxes as farmers have to pay tax before their production cycle and this tax payment would create some negative effects on farmers who often have low liquidity. Political risks of both seed taxes and output taxes are potentially higher than both grandfathering output and seed ITQs.

5.6 Assessment of a pollution tax

A pollution tax has the same fundamental problems of administrative infeasibility as is the situation for transferable pollution quotas. These problems arise from the non point source characteristics of the pollution and the difficulty in measuring specific pollution levels from individual farms. Accordingly, pollution taxes are excluded from further consideration as possible policy instruments.

5.7 Synthesis and concluding remarks

The purpose of this final section is to draw on the preceding analyses within this chapter to determine a preferred policy instrument. Accordingly, the instruments are now given qualitative grading for each criterion (Table 5.1) consistent with these previous analyses.

It is apparent from this synthesis that all of the considered instruments have potential to address the level of pollution, but only one, being that of seed input quotas, has high administrative feasibility. This superior administrative feasibility derives directly from the supply chain characteristics of seed being supplied by only a limited number of suppliers. In addition, there is already a need for monitoring at this point of the supply chain to minimise disease transfer. Given that administrative feasibility is a key first order condition, seed ITQs therefore become the preferred instrument.

Despite seed ITQs being the preferred instrument, there are considerable challenges to implementation. First there is the need for technical assessments to be made to create the lagoon zones within which quotas would be transferable. These zones would need to be determined primarily on ecological factors, but also taking into account administrative communities (such as communes and districts). Second, there are technical assessments required as to the aggregate quotas for each zone. If substitution between the various species is to be permitted, then the appropriate

quota substitution ratios must be determined. Third, there are judgments required as to the basis for the initial allocations. If these are to be grandfathered based on a proportion of existing production, then there are considerable information requirements as to the current production of each farmer. Fourth, administrative structures need to be created so that quotas can be traded. Fifth, there will be significant governance requirements to control opportunistic behaviours of farmers who try to obtain seed from non approved sources.

All of the above challenges are more likely to be successfully dealt with if there is co-management between government and the user groups in each zone of the lagoon. This issue of co-management is considered in Chapter 6.

Table 5.1: Synthesis of policy instrument assessments

Instruments / Criteria	Output quotas	Seed quotas	Pollution quotas	Output taxes	Seed taxes	Pollution taxes
Environmental effectiveness	**HIGH**	**HIGH**	**VERY HIGH**	**HIGH**	**HIGH**	**VERY HIGH**
Administrative feasibility	**LOW**	**HIGH**	**VERY LOW**	**LOW**	**LOW**	**VERY LOW**
- Measurement cost	HIGH	LOW	VERY HIGH	HIGH	HIGH	VERY HIGH
- Governance cost	HIGH	HIGH	VERY HIGH	HIGH	HIGH	VERY HIGH
Cost-efficiency	**MODERATE**	**MODERATE**		**HIGH**	**HIGH**	
Static efficiency	**LOW**	**LOW**		**LOW**	**LOW**	
Dynamic concerns	**VERY HIGH**	**HIGH**		**LOW**	**LOW**$^{-}$	
- Response of farmers to the instrument	HIGH	HIGH		LOW	LOW	
- Response of farmers to business environment	HIGH	LOW		HIGH	LOW	
- Adaptability of the instrument	HIGH	HIGH		LOW	LOW	
Political acceptability	**HIGH**	**HIGH**		**LOW**	**LOW**	
- Political risk	LOW	LOW		HIGH	HIGH	

CHAPTER 6

CO-MANAGEMENT TO REDUCE EMISSIONS ON AQUACULTURE FARMS IN TGCH LAGOON

Chapter 4, Section 4.2.2.2, noted that the Provincial Government had given its support to a co-management experiment in which some control over shared lagoon resources was devolved to local user groups in certain parts of TGCH Lagoon. These user groups or 'Fishery Associations' were given legal recognition in 2005 and are therefore entitled to receive and administer fishing rights on behalf of the users (Tuyen *et al*., 2010). Although the co-management approach supported by Provincial Government since 2004 accommodates a shift from open access to common property lagoon water, the experiment has focused on negotiations with user groups to devise and implement their own ways of opening waterways (Tuyen *et al*., 2010). As noted in Chapter 4, this is a necessary step toward restoring and maintaining the productive capacity of the Lagoon but not necessarily a sufficient condition as it does not address the problem of high emissions caused by farmers over-exploiting lagoon water. This chapter draws on the findings presented in Chapter 5 to propose an extension of the co-management strategy initiated in TGCH Lagoon that is aimed at reducing emission levels on aquaculture farms.

Chapter 6 comprises three sections. The first section reviews co-management as an appropriate strategy to manage common pool resources used by aquaculture farmers in the context of TGCH Lagoon. The second section describes recent efforts to introduce a co-management strategy in parts of the Lagoon and the final section proposes an extension of this experimental work that draws on the analysis conducted in Chapter 5.

6.1 Co-management as the appropriate form of common property management in TGCH Lagoon

Resource management refers to decisions governing actions taken to use and conserve natural resources. According to Ostrom (2002), these decisions determine:

- who is allowed to appropriate resource units;
- the timing, quantity, location, and technology of appropriation;
- who is obliged to contribute resources to provide or maintain the resource system itself;
- how appropriation and obligation activities are to be monitored and enforced;
- how conflicts over appropriation and obligation activities are to resolved; and
- how the rules affecting the above will be changed over time with changes in the performance of the resource system and the strategies of participants.

The last point emphasises the need for an adaptive management model (i.e. learning-by-doing) to deal with uncertainty and complexity. This is particularly

important in the case of TGCH Lagoon owing to its dynamic environmental, technological and market conditions.

Kooiman (2003) recognises three models of governance: hierarchical governance characterised by state intervention, self-governance, and co-governance consisting of collaboration and interplay among different actors for managing common pool resources. Co-governance by public–private–civil society partnerships has emerged as a way of dealing with the shortcomings of self-governance and of single agency, top-down management (Kooiman, 2003).

The analysis presented in Chapter 5 suggests that grandfathering decentralised seed ITQs holds promise as an effective instrument to control water pollution generated by aquaculture farms in TGCH Lagoon. However, this strategy poses significant challenges to the state in terms of administrative feasibility, including high costs of monitoring and sanctioning opportunistic behaviour, gathering technical information, and managing decentralised quota markets. Some of these costs could potentially be reduced by empowering community-based organisations to take ownership of, and responsibility for, well-defined areas of lagoon water

Meinzen-Dick (2009, p328) argues that collective action by the users of a common pool water resource is necessary to reduce the administrative burden of natural resource management because users have the best knowledge of the

resource and its use, and a strong incentive to maintain the resource over time. She also argues that it is necessary to devolve rights and control to user groups (like Fishery Associations) in order to realise these knowledge and incentive advantages (Meinzen-Dick, 2009, p325).

Collective action is, of course, not cost free. The costs incurred by members of a user group in managing a common property may be prohibitively high when:

- the resource is large and its boundaries poorly defined (Ostrom, 1990 & 1992; Bardhan, 1993),
- the resource is not homogeneous (Ostrom, 1990),
- members of the group are not homogenous with respect to their interest in the resource (Olson, 1971; Naidu, 2005). This is more likely when the group is large (Ostrom, 1990 & 1992; Bromley, 1992; Bardhan, 1993; Nugent, 1993 White & Runge, 1995),
- and members of the group do not live close to the resource (Wade, 1988; Ostrom, 1990).

Clearly, the costs of collective action in TGCH Lagoon would be prohibitively high if all aquaculture farmers were grouped into a single user group as this would result in a large resource and high levels of resource and membership heterogeneity. Under these circumstances it would be virtually impossible for members of the user group to reach agreement on rules governing individual use of the resource, to

police these rules and to sanction rule-breakers. Instead, rights and control would have to be devolved to a number of user groups, each with members reasonably homogeneous in their use of the resource, and each responsible for its local, well-defined and reasonably homogeneous part of the Lagoon. This coincides well with the notion of Fishery Associations, which - according to Tuyen *et al*. (2010) - operate at the village or sub-village level and comprise of members who share similar aquatic resource exploitation practices.

While promoting the likelihood of collective action, the decentralisation of user groups confronts the problem that lagoon water is mobile and its movement cannot be constrained by boundaries on its surface, no matter how well they are defined. This reality will encourage continued over-exploitation of the lagoon water if user groups are able to externalise the cost of their pollution to other users without sanction. Meinzen-Dick (2009, p328) argues that government has a cost advantage at this aggregate level in providing scientific information about sustainable exploitation rates and resolving conflicts between user groups. She concludes that an adaptive form of co-management is most appropriate for common pool resources that are highly variable over space and time. This is certainly true of TGCH Lagoon.

6.2 Current co-management strategy in TGCH Lagoon

Section 4.2.2.2 of Chapter 4 describes the provincial government's failed attempt to open channels in TGCH Lagoon by instructing farmers to remove net-enclosures from demarcated waterways. Confronted with firm resistance from the owners of net enclosures, this top-down approach was abandoned in the early 2000's in favour of co-management, a collaborative strategy in which some control over shared lagoon resources would be devolved to local Fishery Associations. In 2004 the provincial government initiated an experiment in co-management involving the different tiers of government, lagoon users and researchers based at Hue University of Agriculture and Forestry (HUAF). The HUAF research team had been working with users in the Sam Chuon area of TGCH Lagoon since 1996 in an attempt to resolve conflicts over access to lagoon resources.

A participatory action learning approach was adopted to negotiate informed agreements with Fishery Associations. According to Tuyen *et al*. (2010), the approach aimed to: (i) build a shared understanding among user groups and stakeholders with regards to current lagoon resource use, livelihood problems, priorities, and appropriate management approaches; (ii) introduce a more participatory approach to lagoon resource governance and to resolve conflicts; (iii) strengthen community organisations and to create conditions for co-management; (iv) facilitate learning between stakeholders (i.e., village, commune, district and province) and develop a

consensus for co-management as an appropriate approach; and (v) identify methods to support the 'scaling up' of the approach more generally (Tuyen *et al*., 2010). In order to address the livelihood conflict between mobile gear fishers on the one hand and fixed gear fishers and farmers on the other, negotiations focused on the problem of opening waterways between net-enclosures to improve access to the Lagoon's common fishing grounds.

The co-management strategy was given impetus in 2005 by Provincial Decision No. 4260 which provided for the allocation of access and use rights to Fishery Associations (FAs). As noted in the previous section, FAs operate at different administrative levels, starting at the village or sub-village level to ensure that members share similar aquatic resource exploitation practices (for example, farmers using net enclosures). The strategy views co-management as the sharing of power and responsibility for decision making between FAs and the state, with the state allocating access and use rights to FAs rather than to individual households (Tuyen *et al*., 2010). Each FA is expected to develop a formal constitution (bylaw) outlining membership and operating procedures, and to play a role in planning and managing aquatic resources.

Tuyen *et al*. (2010) believe that the co-management experiment has produced some promising results: local government has benefited from participatory learning; local visions and strategies for resource use have shifted from top-down and short-

term to participatory, long-term and integrated with the ecosystem; awareness and capacity for participatory planning and management have been strengthened; and users are better organised to respond to problems. They also acknowledge significant challenges: FAs do not yet have the capacity to make and enforce their own management decisions, or to finance their operations; technically it is difficult to allocate rights to FAs small enough to avoid heterogeneity in user interests; and FAs evolve at different rates with different and perhaps conflicting purposes. Despite these challenges, three of the four experimental communes in the Sam Chuon area of TGCH Lagoon had made some progress towards opening their waterways by 2006.

Although modest, these achievements are not trivial as they emphasise the potential for successful co-management. As suggested in Section 4.2.2.2, co-management leading to an acceptable level of compensation for property lost to waterways would no doubt help to expedite this necessary process. However, opening the waterways is not a sufficient condition to restore and maintain ambient water quality while farmers are able to externalise the costs of over-exploitation. For this reason, co-management must also address the problem of high emissions on aquaculture farms in TGCH Lagoon. The analysis in Chapter 5 suggests that grandfathering decentralised seed ITQs holds promise in this regard but faces serious challenges in respect of administrative burdens. Section 6.3 argues that these

challenges could be mitigated by encouraging FAs to adopt seed ITQs as a co-management strategy.

6.3 Towards adaptive co-management in TGCH Lagoon

As noted in Chapter 5, grandfathering decentralised seed ITQs would burden the state with high costs of monitoring and sanctioning opportunistic behaviour, gathering technical information, and managing decentralised quota markets. Section 6.1 suggests that adequately empowered FAs could be instrumental in reducing some of these costs. First, the cost of monitoring farmer compliance is expected to decline because members of FAs have an incentive to police the actions of other members, and rule-breakers would find it difficult to conceal their opportunistic behaviour from their neighbours.

Second, FAs could limit their members' opportunistic behaviour in reporting their actual production levels when governmental agencies collect this information to initially allocate seed ITQs. This is because it is in the interest of all members of a FA that their fellow members do not over report their initial production, as over-reporting reduces the grandfathered quotas of other members. Third, the availability of detailed information about the production situation of FA members would make FAs able to collect information on quota supply and demand more easily than governmental agencies. Accordingly, FAs could reduce the cost of managing decentralised quota markets.

Given the availability of detailed knowledge and the strong incentive to maintain the resource, FAs also have advantages for the enforcement of sanctions compared with formal courts that are often geographically distant from local farmers. FAs also have the potential to work out sanctions with relatively lower cost and to use group pressure to prevent farmers from violating their allocated quotas.

Paralleling with the advantages, FAs face a challenge in collecting technical information about the sustainable production level in different parts of the lagoon by themselves., In comparison, governmental agencies would have more advantages in collecting such information as they have better technical capacity. Besides, FAs have limited power to impose sanctions on other groups who pollute the water resource. Accordingly, the involvement of governmental agencies in setting zonal quotas, providing technical assistance, and resolving conflicts among FAs, would be essential for successful co-management in TGCH Lagoon.

Considering all of these arguments, it is recommended that decentralised seed ITQs should be implemented in conjunction with adaptive co-management between FAs and government. However, it is also recognised that this does not provide a complete solution to the sustainability issue. Accordingly, the decentralised input ITQs would need to be combined with efforts to opening the waterways, and linked to other measures to regulate emissions from agricultural lands and urban communities external to the lagoon (the investigation of which lies outside the

bounds of this thesis). It is also noted that further policies may be necessary, also potentially implemented from within a co-management framework, to encourage cleaner technologies.

CHAPTER 7

SUMMARY AND CONCLUSIONS

7.1 Introduction

The purpose of this study was to investigate the TGCH shrimp supply chain in order to identify factors constraining the chain and to suggest ways of improving its performance Owing to a lack of adequate prior information, it was decided to conduct the investigation in two phases starting with an exploratory study of dyadic relationships within the chain. The findings of this first stage were intended to inform the research questions to be addressed in the second stage of the study. The exploratory research was qualitative and employed a case study research strategy. Semi-structured, open-ended interviews were conducted with supply chain participants in April and May 2009. The respondents were purposively selected to span a wide range of dyadic transactions. Constructs used to guide the line of questioning and to analyse the data were drawn primarily from value chain and supply chain literature, especially the work of Mentzer *et al*. (2001), Collins *et al*. (2001) and Trkman and McCormack (2009), and from theories of industry development (Van de Ven & Garud, 1989).

The exploratory research showed clearly that improved shrimp supply chain outcomes were dependent on addressing the issue of pollution in the Lagoon.. Technical information indicated that although there were multiple sources of

contamination, the key source was the endogenous pollution generated by the shrimp industry itself. This finding informed a second set of research questions seeking appropriate pollution control instruments, institutions and policy recommendations to strengthen the Lagoon's shrimp supply chain. The second stage of this study employed a normative, analytical research strategy informed by economic theory and some key informants to explain why recent changes in property rights to lagoon resources had encouraged shrimp farmers to adopt overly intensive production methods, and to construct a set of possible pollution abatement instruments and criteria to assess these instruments in order to recommend an appropriate policy instrument. The theory applied in this second stage of the study was drawn primarily from literature in the fields of environmental economics and natural resource management.

7.2 Research questions and answers

Research question 1: What is the current situation of the supply chain for shrimp produced from the TGCH Lagoon?

The TGCH shrimp supply chain was not performing well, with problems at each transaction point. From the input suppliers to farmers, transactions involving seed - a key input - were affected by poor quality management. From farmers to wholesalers, many loan defaults were occurring, and the trust-based relationship between farmers and wholesalers was undermined. Farmers blamed the loan defaults on serious yield losses. From wholesalers to processor-exporters, there was

inadequate information sharing and poor quality management. Processor-exporters often informed wholesalers of the price, quantity and quality of shrimp that they needed only 3-7 days prior to the transaction, with adverse consequences for coordination with farmers. They relied only on shrimp size to assess quality and no recognised quality standards (e.g. TCM, HACCP) were applied. Finally, the evidence showed that the shrimp supply chain faced to a lot of contractual failures among business actors.

Research question 2: What are the key constraints to improved chain performance?

The local shrimp industry changed dramatically after the outbreak of widespread and persistent disease in 2004, which reduced both quantity and quality of shrimp product throughout the Lagoon. The resulting yield risk made it impossible to fulfil supply contracts all along the shrimp supply chain. In short, relational contracts were damaged by environmental uncertainty as heightened yield risk undermined efforts to coordinate value-adding activities, rendering the supply chain ineffective.

The spread of shrimp diseases in TGCH Lagoon was attributed to water pollution. Although there are multiple sources of pollution in the Lagoon, intensive aquaculture - and shrimp culture in particular - is regarded as the main cause of pollution harming the shrimp industry. Intensive production methods were facilitated by the privatisation of the Lagoon bed as farmers were able to fully internalise the

benefits of their investment in aquaculture. However, in the absence of well-defined property rights to the Lagoon's water, shrimp farmers over-intensified as they were also able to externalise the costs of their water pollution. In addition, the process of privatisation was not well regulated as zoning was not implemented and natural waterways were blocked by earthen walls and fine-mesh nets. This aggravated the pollution problem as the blockages prevent natural dissipation of contaminants.

Research question 3: What are the alternative policy options for dealing with pollution that harms shrimp production in the TGCH Lagoon?

TTH government attempted to open blocked waterways by forcibly removing fine-mesh nets and, more recently, through a pilot project involving co-management in which some control over resources was devolved to local Fishery Associations in certain parts of the Lagoon. However, compensation has been an obstacle as the Government has offered compensation only to pond farmers in possession of Red Book property rights, and the amount of compensation offered has been well below market prices paid for ponds. A more generous compensation policy may help to expedite the opening of waterways. Even so, opening the waterways is unlikely to be sufficient given the incentive that farmers have to over intensify their production.

For this reason, the study focused on policy options to reduce emissions from shrimp ponds. The range of policy options investigated included regulations (non-transferable inputs and output quotas) and market-based measures (transferable input quotas, transferable output quotas, transferable pollution permits, inputs and

output taxes, and pollution taxes). In addition, co-management was investigated, whereby there would be a shift from open to common property, with rates of exploitation governed by rules established and enforced by or with user groups.

Non-transferable input and output quotas were subsequently excluded as options as their monitoring and enforcement challenges are no different from those confronting transferable input and output quotas, yet they have lower allocative efficiency. Direct pollution quotas and taxes were also excluded owing to insurmountable monitoring and enforcement problems.

Privatisation of TGCH Lagoon water (in contrast to the lagoon bed) is not considered to be practical given the nature of the flows of water between aquaculture enclosures and the greater lagoon. However, unitisation - whereby local management zones would be created within the lagoon- was considered to be a realistic possibility. Unitisation and an associated co-management regime were viewed as enabling institutional arrangements, whereas quotas and taxes were treated as policy instruments. Owing to the presence of substitute aquaculture products and species, the assessment of policy instruments was extended to encompass all aquaculture products and species in TGCH Lagoon.

Research question 4: What is the most promising policy option to result in sustainable aquaculture production in TGCH Lagoon?

Policy options were assessed accordingly to a set of normative criteria including environmental effectiveness, administrative feasibility, cost-efficiency,

dynamic concerns, and political acceptability. Of these criteria, environmental effectiveness and administrative feasibility were considered to be first-order and the others second order.

Input transferable quotas (ITQs) for seed are considered the most promising instrument. This potential derives from the supply chain characteristics, as there are only a limited number of seed suppliers and there is already a need (irrespective of ITQs) for quality management procedures to be applied at the level of the supplier-farmer dyad. There is also limited scope for substituting other inputs for seed. In comparison, monitoring and enforcement of output quotas is considered administratively more difficult, given the multiple selling options. Relative to taxes, ITQs are considered to be preferable in that action-forcing is direct and not dependent on uncertain farmer responses. Further, opposition within the communities is likely to be less strong for quotas than for taxes.

Tradability of ITQs would be limited to intra-zone and not inter-zone within the Lagoon. For ethical and political reasons, the initial quotas would be grandfathered to producers in proportion to their existing production levels.

Seed ITQs are more likely to be effective if undertaken in association with a co-management regime based on communities of similar fishing practices and within zones where the ecological conditions are homogeneous. The Government would retain an important role within the co-management regime, given the needs for

ongoing ecological information and associated expertise, and the need for facilitating, monitoring, adjusting and, where necessary, enforcing the trading regime.

One of the weaknesses of seed ITQs is that they do not provide incentives for farmers to use cleaner technologies. This is also a weakness of all of the other instruments considered in this thesis except for direct pollution taxes, which were eliminated on the grounds of being administratively impractical. However, unitisation within a co-management regime would provide potential for operating rules to include specific pollution-reducing technologies.

7.3 Contribution to knowledge

Much of the supply chain literature views a supply chain as a flow of products, services, finance and information from a source to a customer. Some authors (e.g. Van de Ven & Garud, 1989) take a somewhat broader view that includes not only the instrumental sub-system (i.e. flow of products) but also the procurement and institutional sub-systems. Although this broader view embraces more fully the implications of institutional change and risks in procurement, the supply chain literature pays little attention to these very important aspects of chains for products grown by farmers using shared natural resources. This represents a serious gap in the literature as these chains often support large numbers of poor households and involve valuable environmental resources.

The ‘biological chain’ investigated in this study highlights an important concept that helps to integrate the rather distinct bodies of literature relating to supply chains on the one hand and environmental economics and natural resource management on the other. This concept relates to the distinction between behavioural risk and environmental risk, a distinction made by Williamson (1985, 1996) and more recently by Trkman and McCormack (2009). In general, the supply chain literature accepts the view that increasing uncertainty tends to drive relational contracting and hence tighter coordination of the chain. However, Williamson’s (1985) argument linking relational contracting to uncertainty dealt specifically with behavioural risk (i.e. opportunism). Trkman and McCormack (2009) recognise the distinction between behavioural and environmental risk and contend that an increasing level of environmental risk (as opposed to behavioural risk) will undermine chain coordination. The findings of the exploratory research conducted in this study confirm these views. Long standing relational contracts that once characterised the TGCH shrimp supply chain collapsed in the face of increasing yield volatility.

Studies of biological supply chains, especially those heavily reliant on common pool resources, need to distinguish clearly between behavioural and environmental risk, and therefore need to embrace a broad view of the chain from the outset. Useful recommendations to improve the performance of a particular chain may well require knowledge beyond the usual bounds of supply chain

management, including knowledge of property rights, social demographics, cultural norms, ecological systems, production technology and policy instruments.

7.4 Limitations of the study

The qualitative methodology used to studying the TGCH shrimp supply chain has its own strengths and weaknesses. Its strength comes from its suitability for exploratory analyses based on research questions but no prior hypotheses. In this study, it was this philosophy that allowed emergence of key insights relating to pollution as the underlying driver of supply chain problems. The weakness of the qualitative approach relates to inevitable subjectivity, with the researcher being part of the research instrument. Further, the purposive nature of the sampling can lead to questions as to the representativeness of the findings.

Pollution in the TGGH Lagoon has both exogenous and endogenous sources. Within the bounds of this thesis the focus has been on endogenous pollution from within the aquaculture industries. It is recognised that a comprehensive solution to the problems of the lagoon requires consideration to be given to both exogenous and endogenous sources. The findings of this study are based on published evidence plus fieldwork conducted within the bounds of the PhD. Given the complexity and heterogeneity of conditions within the lagoon, validation of the current situation in the lagoon would need to occur before implementation of the recommended strategies.

7.5 Further research

This study would have benefited from better information about the different sources of pollution impacting TGCH Lagoon and the shrimp producing areas in particular. The feasibility of enforcing seed ITQs across all species needs to be investigated. In addition, quantitative estimates of the costs and benefits of seed ITQs are needed. Similar studies should also be conducted for the major exogenous sources of pollution. At the same time, the Government should be promoting research into cleaner production technologies for aquaculture.

LIST OF REFERENCES

Adams, D., Disberry, A., Hutchison, N., Munjoma, T. (2001). Ownership constraints to brown field redevelopment. Environment and Planning A, 33, 453-477.

Adams, D., Disberry, A., Hutchison, N., Munjoma, T. (2002). Land policy and urban renaissance: The impact of ownership constraints in four British cities. Planning Theory and Practice, 3(2), 195-217.

Adams, D., Allmendinger, P., Dunse, N., Tiesdell, S., Townsend, J., Turok, I. & White, M. (2003). Assessing the impact of planning, housing, transport and regeneration policies on land pricing. New Horizons Research Programme: Universities of Aberdeen and Glasgow. Retrieved from http://www.communities.gov.uk/documents/corporate/pdf/142754.pdf

Aghazadeh S-M. A. (2004). Improving logistics operations across the food industry supply chain. International Journal of Contemporary Hospitality Management, 16(4/5), 263-270.

Akerlof, G. (1970). The Market for 'Lemons': Quality uncertainty and the market mechanism. Quarterly Journal of Economics (The MIT Press), 84(3), 488-500.

Alberini, A., Segerson, K. (2002). Assessing voluntary programs to improve environmental quality. Environmental and Resource Economics, 22(1-2), 157-184.

Alchian, A., Demsetz, H. (1973). The property rights paradigm. Journal of Economic History, 33(1), 16-27.

Anderson, T. L., Leal, D.R. (2001). Free Market Environmentalism. New York: Palgrave.

Anderson., E., Coughlan, A.T. (1987). International market entry and expansion via independent or integrated channels of distribution. Journal of Marketing, 51(January), 71-82.

Arshinder, K., A., Deshmulk, S.G. (2008). Supply chain coordination: Perspectives, empirical studies and research directions. International Journal of Production Economics, (115), 316-335.

Ault, D. E., Rutman, G.L. (1979). The Development of individual rights to property in tribal Africa. Journal of Law and Economics, 22, 163-182.

Backsdale, H. C., Darden, B. (1971). Marketer's attitude toward the marketing concept. Journal of Marketing, 35(October), 29-36.

Bain, J. (1956). Barriers to New Competition. Cambridge, MA: Harvard University Press.

Bardhan, P. (1989). The Economics of Agrarian Institutions. Oxford: Clarendon Press.

Bardhan, P. (1993). Analytics of the institutions of informal cooperation in rural development. World Development, 21, 633-639.

Barrat, M. (2004). Understanding the meaning of collaboration in the supply chain. Supply Chain Management: An International Journal, 9(1), 30-42.

Baumol, W. J., Oates, W.E. (1988). The Theory of Environmental Policy (2nd ed). New York: Cambridge University Press.

Bell, R. G. (2003). Choosing environmental policy instruments in the real world. Paper presented at the OECD Global Forum on Sustainable Development: Emission Trading. Retrieved from http://www.oecd.org/dataoecd/11/9/2957706.pdf

Benham, A., Benham, L. (1997). Property rights in transition economies: A commentary on what economists know. In Nelson, J.M., Tilley, C., Walker, L. (Eds.), Transforming Post-communist Political Economies. Washington, DC: National Academy Press. Retrieved from http://www.nap.edu/html/transform/sec-1.htm

Bennett, S., Nguyen, T.L. (1996). Water quality management in Vietnam. Paper presented at the Reaching the Unreached - Challenges for 21st Century, 22nd Water Engineering & Development Centre (WEDC) Conference, New Dehli, 31-33.

Beugelsdijk, S., Koen, C., Noorderhaven, N. (2009). A dyadic approach to the impact of differences in organizational culture on relationship performance. Industrial Marketing Management, 38, 312-323.

Binh, T.X. (2005). Development of aquaculture with poverty and environmnetal issues in Tam Giang Cau Hai Lagoon. In Nam, D. (Ed.), Proceedings of the National Conference on Thua Thien Hue Lagoon. Department of Science and Technology, Thua Thien Hue Province, Hue, Vietnam.

Blackman, A., Harrington, W. (2000). The use of economic incentives in developing countries: lessons from international experience with industrial air pollution. Journal of Environment and Development, 9(1), 5-44.

Bohm, P., Russel, C.S. (1985). Comparative analysis of alternative policy instruments. In A. V. Kneese, Sweeney, J.L., (Ed.), Handbook of Natural Resource and Energy Economics(Vol. 1, pp. 395-460). Amsterdam: North-Holland.

Born, H., Bachmann, J. (2006). Adding value to farm products: An overview. Fayetteville, Arkansas: ATTRA-National Sustainable Agriculture Information Service. Retrieved from http://www.sdhdidaho.org/eh/pdf/valueadded.pdf

Braden, J., Segerson, K. (1993). Information problem in teh design of non-point source pollution policy. In C. Russell, Shogren, J (Ed.), Theory, Modelling and Experience in the Management of Non-Point Source Pollution. Dordrecht: Kluwer Academic Publishers.

Bromley, D. (Ed.). (1992). Making the Commons Work. Theory, Practice and Policy. San Francisco: ICS Press.

Carlson, D., Gilmore, A., Maclaran, P. (1998). Customer or profit focus: an alternative approach. Journal of Marketing Practice: Applied Marketing Science, 4(1), 26-39.

Cheung, S.N.S. (1974). A theory of price control. Journal of Law and Economics, 17(1), 53-71.

Chopra, S., Meindl, P. (2004). Supply Chain Management: Strategy, Planning and Operation (2nd ed). Upper Saddle River, New Jersey: Prentice Hall.

Christopher, M.L. (1992). Logistic and Supply Chain Management. London: Pitman Publishing.

CIE. (1998). Vietnam's trade policies 1998. Canberra and Sydney: Centre of International Economics.

Clark, J. B. (2003). The Philosophy of Value. In C. R. McCann Jr (Ed.), The Elgar Dictionary of Economic Quotations. Chentelham, UK: Edward Elgar Publishing.

Clifford, S. R., Philip, T.P. (1999). Practical considerations and comparison of instrumental of environmental policy. In Van der Bergh, J. (Ed.), Handbook of Environmental and Resources Economics (pp307-329). Cheltenham: Edward Elgar Publishing Ltd.

Coase, R. H. (1937). The nature of the firm. Economica, 4(3), 386-405.

Coase, R. H. (1960). The problem of social cost. Journal of Law and Economics, 3, 1-44.

Coase, R. H. (1992). The institutional structure of production. The American Economic Review, 82(4), 713-719.

Cole, D., Grossman, P. (1999). When is command and control efficient? Institutions, technology, and the comparative efficiency of alternative regulatory regimes for environmental protection. Wisconsin Law Review, 5, 887.

Collins, R., Dunne, T., Murray, G. (2001). Forming and managing supply chains in agribusiness: Learning from others (CD-ROM). Canberra: Department of Agriculture, Forestry, and Fisheries.

Commons, J. R. (1934). Institutional Economics. Madison: University of Wisconsin Press.

Cooper, M.C., Ellram, L.M., Garner, J.T., Hanks, A.M. (1997). Meshing multiple alliances. Journal of Business Logistics, 18(1), 67-89.

Cooper, M. C., Lambert, D.M., Pagh, J.D. (1997). Supply chain management: more than a new name for logistics. International Journal of Logistic Management, 8(1), 1-14.

Corner, R., Sandler, T. (1986). The Theory of Externalities, Public Goods and Club Goods. New York: Cambridge University Press.

Costello, C., Gaines, S.D., Lynham, J. (2008). Can catch shares prevent fisheries collapse? Science, (321), 1678-1681.

Cox, A. (1999). Power, value and supply chain management. Supply Chain Mangement, 4(4), 167-175.

Coyle, J.J., Bardi, E.J., Langley, C.J.Jr. (2003). The Management of Business Logistics: A Supply Chain Perspective (7th ed). Canada: Thomson Learning.

Davis, T. (1993). Effective supply chain management. Sloan Management Review, 34(4), 35-46.

Davison, C., Tolich, M. (2003). Social Research in New Zealand: Many Paths to Understanding (2nd ed.). Auckland, New Zealand: Pearson Education New Zealand.

Dawkins, C.J. (2000). Transaction costs and the land use planning process. Journal of Planning Literature, 14(4), 507-518.

De Alessi, L. (1980). The economics of property rights: A review of the evidence. Research in Law and Economics, 145, 561-577.

Deininger, K., Binswanger, H. (1999). The evolution of the World Bank's land policy: Principle, experience and future challenges. The World Bank Research Observer, 14(2), 247-276.

Deininger, K. (2003). Land policies for growth and poverty reduction: A World Bank policy research report. Washington, DC: World Bank and Oxford University Press.

Demsetz, H. (1967). Toward a theory of poperty rights. American Economic Review, 57(May), 347-359.

Denzin, N.K., Lincoln, Y.S. (2000). Handbook of Qualitative Research (2nd). Thousand Oaks: Sage Publication.

Donahue, J.D. (2002). Market-based governance and the architecture of accountability. In J. D. Donahue, Nye, Jr., J.S (Eds.), Market-Based Governance: Supply Side, Demand Side, Upside, and Downside (pp1-25). Washington, DC: Brookings Institution Press.

Doyle, P. (1994). Marketing Management and Strategy. London: Prentice-Hall.

Dunne, A. J. (2001). Supply chain management; Fad, panacea or opportunity. School of Natural and Rural System Management, 8, 1-40.

Eggertsson, T. (1997). Rethinking the theory of economic policy: Some implications of the new institutionalism. In J.M. Nelson, Tilley, C., Walker, L (Eds.), Transforming Post-Communist Political Economies. Washington, DC: National Academy Press.

Ellram, L. M., Cooper, M.C. (1990). Supply chain management: Partnerships, and the shipper - third party relationship International Journal of Logistic Management, 1(2), 1-10.

FAO. (undated). Cultured aquatic species information programme: *Penaeus Monodon*. Food and Agriculture Organisation Fisheries and Aqauculture Department, Rome. Retrieved 16 march, 2012, from http://www.fao.org/fishery/culturedspecies/Penaeus_monodon/en

Feder, G., Noronha, R. (1987). Land Rights Systems and Agricultural Development in Sub-Saharan Africa. Washington, D.C.: World Bank.

Fishel, B., Barrett, S., Bohm, P., Kuroda, M., Mubazi, J., Shah, A., Stavins, R. (1996). Policy instruments to combat climate change. In J.P. Bruce, Lee, H., Haites, E.F (Eds.), Climate Change 1995: Economic and Social Dimensions of Climate Change (pp397-439). New York: Cambridge University Press.

Fisher, M., Hammond, J., Obermeyer, W., Raman, A. (1994). Making supply meet demand in an uncertain world. Harvard Business Review, 72(3)

Fisher, M. C. (1997). What is the right supply chain for your product. Harvard Business Review, 75(2), 105-116.

FSPS II (2008). Assessment of aquatic diseases in Thua Thien Hue Province during the period 2002-2008. A report of the Management Board of the Fisheries Sector Programme Support Phase II. Hue, Vietnam.

Furubotn, E.G., Richter, R. (1991). The new institutional economics: An assessment. In E.G. Furubotn, Richter, R (Eds.), The New institutional Economics: A Collection of Articles from the Journal of Institutional and Theoretical Economics (pp1-32). Tubingen, Germany: Mohr.

Furubotn, E.G., Richter, R. (2000). Institutions and Economic Theory: The Contribution of the New Institutional Economics. Ann Arbor, MI: The University of Michigan Press.

General Statistical Office of Vietnam. (2006). Statistical Yearbook. Hanoi: Statistical Publishing House.

Gereffi, G., Humphrey, J., Sturgeon, T. (2005). The governance of global value chains. Review of International Political Economy 12(1), 78-104.

Golicic, S.L., Davis, D.F., McCarthy, T.M. (2005). A balanced approach to research in supply chain management. In Kotzab, H,,Westhaus, M. (Eds.), Research Methodologies in Supply Chain Management (pp267-282). New York: Physica-Verlag.

Goodland, R. (1995). The concept of environmental sustainability. Annual Review of Ecology and Systematics, 26, 1-24.

Gordon, H.S. (1954). The economic theory of a common property resource: The fishery. Journal of Political Economy, 62, 124-142.

Gowdy, J.M. (2004). The revolution in welfare economics and its implications for environmental valuation and policy. Journal of Land Economics, 80, 239–257.

Green, A.H. (1991). Supply chain of customer satisfaction. Production and inventory Management reviews and APICS News 11(4), 24-25.

Gunasekaran, A., Chung, W.W.C. (2004). Special issue on supply chain management for the 21st century organizational competitiveness. International Journal of Production Economics, 87(3), 209-212.

Hahn, R.W., Olmstead, S. M., Stavins, R. N. (2003). Environmental regulation in the 1990s: a retrospective analysis. The Harvard Environmental Law Review, 27(2003), 377-416.

Hallett, G. (1979). Urban Land Economics: Principles and Policy. London and Bastingstoke, UK: Mcmillan Press.

Hallikas, J., Karvonen, I., Pulkikinen, U., Virolainen, V., Touminen, M. 2004). Risk management processes in supplier networks. International Journal of Production Economics, 90(1), 47-58.

Hansen, J.M., Phan, D.H. (2005). Integrated water resource management in Vietnam: Present status and future challenges. In Biswas, A.K., Varis, O., Tortajada, C (Eds.), Integrated Water Resource Management in Vietnam in South and Southeast Asia (pp219-249). New Dehli: Oxford University Press.

Hardin, G. (1968). The tragedy of the commons. Science, 162, 1243-1248.

Hines, T. (2004). Supply Chain Strategies: Customer-driven and Customer Focused. Oxford: Butterworth-Heinemann.

Hoa, P.V. (2010). Commercialisation of aquaculture in Tam Giang Cau Hai Lagoon. Hue: Hue College of Economics.

Hoffman, J.M., Mehra, S. (2000). Efficient customer response as a supply chain strategy for grocery business. International Journal of Service Industry Management, 11(4), 365-373.

Hole, M. (1996). Climate change 1995: Economic and Social Dimensions of Climate Change. New York: Cambridge University Press.

Hop, N.V., Long, H.T., Phong, N.H., To, T.C. (2005). Quality of water resource in Tam Giang Cau Hai Lagoon. In Nam, D. (Ed.), Proceedings of the National Conference on Thua Thien Hue lagoon (pp306-323). Department of Science and Technology, Thua Thien Hue Province, Hue, Vietnam.

Hop, N.V., Tung, T.Q., Long, H.T, Phong, N.H., Marconi, M., Tuan, L.C., Hue, N.V., To, T.C, Bang, T.H. (2008). Assessment of water and sediment quality of TGCH Lagoon 2006 - 2007. Hue: Integrated management of lagoon activities project.

Hudson, M.A. (1990). Toward a framework for examining agribusiness competitiveness. Agribusiness, 6(3), 181-189.

Hugos, M. H. (2003). Essentials of supply chain management. Hoboken, New Jersey: John Wiley.

Huong, T., Berkes, F. (2011). Diversity of resource use and property rights in Tam Giang Lagoon, Vietnam. International Journal of the Commons, 5(1), 130-146.

Huppos, G., Simonis, U.E. (2009). Environmentalpolicy instruments. In J. J. Boersema, Reijnders, L (Ed.), Principles of environmental sciences (pp. 239-280): Springer Science + Business Media B.V.

IMOLA. (2006). Socio-economic baseline survey data of Hue Lagoon. Hue: A report prepared for the Integrated Management of Lagoon Activities (IMOLA) Project. Hue, Vietnam.

Jaffe, A. B., Newell, R.G., Stavins, R.N. (2003). Technological change and the environment. In K. G. Maler, Vincent, J.R (Ed.), Handbook of Environmental Economics (Vol. 1, pp. 461–516). Amsterdam: Elsevier.

Jain, V., Wadhwa, S., Deshmulk, S.G. (2009). Select supplier-related issues in modeling a dynamic supply chain: Potential, challenges and direction for future research. International Journal of Production Research, 47(11), 3013-3039.

Jordan, A., Wurzel, R.K., Zito, A.R. (2003). 'New' instruments of environmental governance: patterns and pathways of change. Journal of Environmental Politics, 12, 3-24.

Juttner, U., Christopher, M., Baker, Susan (2007). Demand chain management-integrating marketing and supply chain management. Industrial Marketing Management, (36), 377-392.

Keohane, N. O., Revesz, R.L., Stavins, R.N. (1998). The positive political economy of instrurnent choice in environmental policy. In P. Portney, Schwab, R (Ed.), Environmental Economics and Public Policy. London: Edward Elgar.

Key, N., Runsten., D. (1999). Contract farming smallholders, and rural development in Latin America: The organisation of agroprocessing firms and the scale of outgrower production. World Development, 27(2), 381-401.

Kingshott, R. P. (2006). The impact of psychological contracts upon trust and commitment within supplier-buyer relationships: A social exchange view. Industrial Marketing Management, 35(6), 724-739.

Kleindorfer, P.R., J. Belke, M.R. Elliott, K. Lee, R. A. Lowe, H. Feldman. (2003). Accident epidemiology and the US chemical industry: Accident history and worst-case data from RMP. Risk Analysis 23(5), 865-881.

Kooiman, J. (2003). Governing as Governance. London: Sage Publications.

Koopman, T.C. (1957). Three essays on the state of economic science. New York: McGraw-Hill.

Kordupleski, R.E., Rust, R.T., Zahorik, A.J. (1993). Why improving quality doesn't improve quality (or whatever happened to marketing). California Management Review, 35(3), 82-95.

Kosobud, R. F., Zimmerman, J.M. (1997). From journal articles to actual markets: the path taken. In R. F. Kosobud, Zimmerman, J.M (Ed.), Market-based approaches to environmental policy: Regulatory innovations to the fore (pp. 49-60). New York: Van Nostrand Reinhold.

Krarup, S. (2001). Can voluntary approaches be environmentally effective and economically efficient? In C. J. Higley, Le´ve¸que, F (Ed.), Environmental voluntary approaches: Research insights for policy-makers (pp. 52-64). Paris: Centre D'e´conomie Industrielle.

Kumssa, A. (1997). Economic reform policies and Vietnam's transition to a market-oriented economy. Regional Development Dialogue, 18(3), 72-81.

La Londe, B. J., Master, J.M. (1994). Emerging logistics strategies: Blueprint for the next century international. Journal of Physical Distribution and Logistic Management, 24(7), 35-47.

Lai, L. W. C. (1997). Property rights justification for planning and a theory of zoning Progress in Planning, 48, 161-246.

Lai, L. W. C. (2002). Planning and property rights in Hong Kong under constitutional capitalism. International Planning Studies, 7(3), 213-225.

Lambert, D. M., Stock, J.R., Ellram, L.M. (1998). Fundamental of logistic management. Boston, MA: Irwin/McGrw-Hill.

Lambert, D. M., Cooper, M.C. (2000). Issues in supply chain management. Industrial Marketing Management, 29(1), 65-83.

Lawrence, R. J. (2001). Special issue: property, rights, and fairness. Environment and Planning C: Government and Policy, 19, 633–728.

Li, S., Rao, S. et al,. (2005). Development and validation of a measurement instrument for studying supply chain management practices. Journal of Operations Management, 23(6), 618-641.

Lincoln, Y. S., & Guba, E. G. (1985). Naturalistic inquiry. Newbury Park, CA: Sage.

Linh, N.Q. (2005). Feeding and nutrition stategy to increase health and yield of aquaculture in Tam Giang Cau Hai Lagoon. In Nam, D. (Ed.), Proceedings of the National Conference on Thua Thien Hue lagoon (pp152-160). Department of Science and Technology, Thua Thien Hue Province, Hue, Vietnam.

Lyon, T.P., Maxwell, J.W. (2002). Voluntary approaches to environmental regulation. In Franzini, M., Nicita, A (Eds.), Economic Institutions and Environmental Policy (pp75-120). Aldershot, Hamsphire: Ashgate Publishing Company.

MacCrimmon, K.R., Wehrung, D.A. (1986). Taking Risks: The Management of Uncertainty. New York: Free Press.

Macneil, I. R. (1978). Contracts: adjustments of long-term economic relations under classical, neoclassical, and relational contract law. Northwestern University Law Review, 72, 854-906.

Majone, G. (1976). Choice among policy instruments for pollution control. Policy Analysis, 2(4), 589-612.

Mason-Jones, R., Towill, D.R. (1997). Information enrichment: designing the supply chain for competitive advantage. Supply Chain Management, 2(4), 137.

Matthews, R.C.O. (1986). The economics of institutions and the sources of growth. The Economic Journal, 96(384), 903-928.

McCarthy, J., Prudham, S. (2004). Special Issue: Neoliberal nature and the nature of neoliberalism. Geoforum, 35, 275-393.

McCormack, K. (1998). What supply chain management practices relate to superior performance? Boston, MA: DRK Research Team.

McGuffog, T., Wadsley, N. (1999). The general principle of value chain management. Supply Chain Management: An International Journal, 4(5), 218-225.

McNamara, C.P. (1972). The Present status of the marketing concept. Journal of Marketing, 36(January), 50-57.

Meinzen-Dick, R. (2009). Coordination in natural resource management. In Kirsten, J., Dorward, A.R., Poulton, C., Vink, N (Eds.), Institutional Economics Perspectives on African Agricultural Development (pp319-342). Washington, D.C: International Food Policy Research Institute.

Mentzer, J. T., De Wit., V., Keebler, K.S., Min, S., Nix, N.W., Smith, C.D. (2001). Defining supply chain management. Journal of Business Logistics, 22(2), 1-25.

Mentzer, J. T. (2001). Supply Chain Management. Thousand Oaks: Sage Publications.

Mickwitz P. 2003. A Framework for Evaluating Environmental Policy Instruments Context and Key Concepts, Evaluation, 9(4), 415-436.

Modi, S., Mabert, V. (2007). Supplier development: improving supplier performance through knowledge transfer. Journal of Operations Management, 25(1), 42-64.

Moe, T. (1984). The new economics of organisation. American Journal of Political Science, 28(4), 738-775.

Morash, E.A., Clinton, S.R. (1998). Supply chain integration: customer value through collaborative closeness versus operational excellence. Journal of Marketing Theory and Practice, 6(4), 104-120.

Munro-Faure, P. (1999). Sustainable development and land administration infrastructure reforms: The role of markets and land valuation systems—

Agenda for change? Paper presented at the UN-FIG conference on Land Tenure and Cadastral Infrastructures for Sustainable Development.

Naidu, S.C. (2005). Heterogeneity and common pool resources: collective management of forests in Himachal Pradesh India. Amherst, MA: University of Massachusetts. Retrieved from http://people.umass.edu/resec/workingpapers/documents/resecworkingpaper2005-8.pdf

Neumann, S., Segev, E. (1979). A case study of user evaluation of information characteristics for systems improvement. Information and Management, (2), 271-278.

Nga, P. H. (2006). Proposal of environmental monitoring indicators for Tam Giang–Cau Hai Lagoon, Thua Thien Hue Province, Vietnam. Paper presented at the Vietnam–Japan Estuary Workshop, August 22-24, 2006, Hanoi. Retrieved 17 April, 2012, from http://coastal.wru.edu.vn/papers/vjew-2006/vjew2006-pp118-127.pdf

Nguyen, V. T. (2007). Vietnam – working toward to produce safe and high-quality aquaculture foods. Nha Trang: Research Institute for Aquaculture No.2, Vietnam. Retrieved from http://www.agnet.org/library/bc/55005/

Norman, R., Ramirez, R. (2000). From value chain to constellation: designing interactive strategy. In Harvard business review on managing the value chain Boston: Harvard Business School Press.

North, D.C. (1993). Institutions and credible commitment. Journal of Institutional and Theoretical Economics, 149(1), 11-23.

Nugent, J. (1993). Between state, markets and households: A neo-institutional analysis of local organisations and institutions. World Development, 21, 623-632.

OECD. (2007) Instrument mixes for environmental policy. Organisation of Economic Cooperation and Development, Massachusetts, US: OECD Publishing.

Oliver, R.K., Webber, M.D. (1982). Supply-chain management: logistics catches up with strategy. In Christopher, M.G. (Ed.), Logistics, The Strategic Issue. London: Chapman & Hall.

Olson, M. (1965). The Logic of Collective Action: Public Goods and Theory of Groups. Cambridge, MA: Harvard University Press.

Opie, A. (2003). Unstructured interviewing. In Davidson, C., Tolich, M (Eds.), Social Research Science in New Zealand (pp240-250). Rosedale, North Shore: Pearson Education New Zealand.

O'Rouke, D. (1999). Community-driven regulation: The political economy of pollution in Vietnam. University of California, Berkeley, CA.

O'Shea, L. (2002). An economic approach to reducing water pollution: point and diffuse sources. The Science of the Total Environment, 282-283(2002), 49-63.

Ostrom, E. (1990). Governing the Commons: The Evolution of Institutions for Collective Action. Cambridge: Cambridge University Press.

Ostrom, E. (1992). Crafting Institutions for Self-governing Irrigation Systems. San Francisco: ICS Press.

Ostrom, E. (2002). Common-pool resources and institutions: toward a revised theory. In. Gardner, B., Rausser, G. (Ed.s), Handbook of Agricultural Economics (Vol. 2, pp1316-1339). Amsterdam: North Holland.

Panayoutou, T. (1994). Economic instruments for environment and sustainable development. Nairobi: United Nations Environment Programme. Retrieved from http://www.conservationfinance.org/guide/guide/images/40_panay.pdf

Patton, M. Q. (2002). Qualitative Research and Evaluation Methods (3rd ed). Thousand Oaks, CA: Sage Publications.

Paul, R., Teresa, F. (2003). Management of environment impacts of marine aquaculture in Europe. Journal of Aquaculture, 226, 139-163.

Pearce, D.W., Markandya, A., Barbier, E.B., (1989). Blueprint for a Green Economy. London: Earthscan Publications Limited

Petersen, K. (1999). The effect of information quality on supply chain performance: an inter-organizational information system perspective. Unpublished Thesis. Michigan State University, MI.

Pfeffer, J., Salancik, G. (1978). The External Control of Organisations. New York: Harper & Row.

Phap, T. T., Mien, L.V, Thuan, L.T.N. (2000). Sustainable development of aquaculture in TGCH Lagoon. In Brzeski, V.J, Veronika, J. & Newkirk, G.F. (Eds.), Lessons in Resource Management from the TGCH Lagoon (pp27-39). Halifax: Coastal Resource Research Network, Dalhousie University.

Pigou, A.C. (1932). The Economics of Welfare. London: Mcmillan.

Porter, M. E. (1985). Competitive Advantages: Creating and Sustaining Superior Performance. New York: The Free Press.

Porter, M. E., Millar, E. (1985). How information gives you competitive advantage. Harvard Business Review, 63(3), 149-160.

Potoski, M., Prakash, A. (2004). The regulation dilemma: cooperation and conflict in environmental governance. Public Administration Review 64(2), 152-163.

Poulton, C., Gibbon, P., Hanyani-Mlambo, B., Kydd, J., Nylandset L.M., Maro, W., Osario, A., Tschirley,D., Zulu, B. (2004). Competition and coordination in liberalized African cotton market systems. World Development, 32(3), 519-536.

Poulton, C., Lyne., MC. (2009). Coordination for market development. In Kirsten,J., Dorward, A.R., Poulton, C., Vink, N (Eds.), Institutional Economics Perspectives on African Agricultural Development (pp143-183). Washington DC: International Food Policy Research Institute..

Project 88 - Round II. (1991). A public policy study. Washington, D.C. Retrieved from http://www.hks.harvard.edu/fs/rstavins/Monographs_&_Reports/Project_88-2.pdf

Przeworski, A. (1997). The state in a market economy. In Nelson, J.M., Tilley, C., Walker, L (Eds.), Transforming Post-communist Political Economies. Washington, DC: National Academy Press.

Pushkarskaya, H. (2003). Nonpoint source water pollution control: incentives theory approach. The Ohio State University, Columbus, Ohio.

Pyke, D., Tang. C.S. (2010). How to mitigate product safety risk proactive? Process, challenges and opportunities. International Journal of Logistics Research and Application: A Leading Journal of Supply Chain Management (13), 243-256.

Quiggin, J. (1988). Private and common property rights in the economies of the environment. Journal of Economic Issues, 22, 1072-1087.

Quyen, P. (2009). The Coordinator of Fisheries Sector Program Support (2nd Stage) in TTH Province, Department of Agriculture and Rural Development in TTH Province

Revesz, R., Starvins, R.N. (2007). Environmental law. In Polinsky, A.M., Shavell, S (Eds.), Handbook of Law and Economics (Vol. 1, pp502-562): Elsevier B.V.

Richard, K., Wechsler, D.S. (1996). Making it on the farm: increasing sustainability through value-added processing and marketing. Elkin, Arkansas: Southern Sustainable Agriculture Working Group.

Richards, K. (2000). Framing environmental policy instrument choice. Duke Environmental Law & Policy Forum, X(Spring 2010), 222-285.

Rietbergen-McCracekn, J., Abaza, H. (Eds.). (2000). Economic Instruments for Environmental Management. London: Earthscan Publications Limited.

Ritchie, B., Marshall, D. (1993). Business Risk Management. London: Chapman & Hall.

Ritchie, B., Brindley, C. (2007). Supply chain risk management and performance: A guiding framework for future development. International Journal of Operations and Production Management, 27(3), 303-322.

Roekel, J.V., Kopichi, R., Broekmans, J.E., Boselie, D.M. (2002). Building agri-supply chains: issues and guidelines. In Giovanucci, D. (Ed.), A guide in Developing Agricultural Markets and Agro Enterprises. Washington, D.C: World Bank.

Ross, D.F. (1998). Competing through Supply Chain Management: Creating Market-winning Strategies through Supply Chain Partnerships. Dordrecht: Kluwer Academic.

Rowe, R.D. (1977). An Anatomy of Risk. Chichester, England: John Wiley & Sons Ltd.

Sahay, B. S. (2003). Supply chain collaboration: the key to value creation. Supply Chain Management: An International Journal, 52(2), 76-83.

Sarantakos, S. (2005). Social research (3rd ed). New York: Palgrave MacMillan.

Scherer, F. M. (1970). Industrial market structure and economic performance. Chicago: Rand McNally.

Schotzco, R. T., & Hinson, R.A. (2000). Supply chain management in perishables: a produce application. Journal of Food Distribution Research, 17-25.

Shadihul, I., Masaru, Tanaka. (2004). Impacts of pollution on coastal and marine ecosystems including coastal and marine fisheries and approach for management: a review and synthesis. Marine Pollution Bulletin, 48, 624-649

Shepherd, A. (1997). Market information services and their problems: food and agriculture organization of the united nations (FAO) DT/23-97.

Shirley, M. M. (2008). Institutions and development. In Menard, C., Shirley, M.M (Eds.), Handbook of New Institutional Economics (pp611-638). Berlin: Springer-Verlag.

Simchi-Levi, D., Kaminsky, P., Simchi-Levi, E. (1999). Designing and Managing Supply Chains. London: McGraw-Hill.

Simon, H. (1957). Administrative Behaviour (2nd ed). New York: Macmillan.

Slangen, L.H.G., Loucks, L.A., Slangen, A.H.L. (2008). Institutional Economics and Economic Organisation Theory. Wageningen: Wageningen Academic Publishers.

Slater, S. F., Narver, J.C. (1994). Does comparative environment moderate the market orientation-performance relationship. Journal of Marketing, 58(January), 46-55.

Smith Jr., F. L. (2000a). The market and nature. In Adler, J.H. (Ed.), Ecology, Liberty & Property: a Free Market Environmental Reader (pp25-38). Washington, DC: Competitive Enterprise Institute.

Smith Jr., F. L. (2000b). Markets and the environment: a critical reappraisal. In Adler, J.H. (Ed.), Ecology, Liberty & Property: a Free Market Environmental Reader (pp39-62). Washington, DC: Competitive Enterprise Institute.

Soderholm, P. (2001). Environmental policy in transition economics: will pollution charges work? Journal of Environment and Development, 10(4), 365-390.

Spekman, R. E., & Carraway, R. (2006). Making the transition to collaborative buyer–seller relationships: an emerging framework. Industrial Marketing Management, (35), 10-19.

Stalk, G., Evans, P., Schulman, L.E. (1992). Competing on capabilities: the new rules of corporate strategy Harvard Business Review, 70(2), 57-69.

Stanko, M.A., Bonner, J.M., Calantone R.J. (2007). Building commitment in buyer–seller relationships: A tie strength perspective. Industrial Marketing Management, 36(8), 1094-1103.

Stavins, R.N. (2003). Experience with market-based environmental policy instruments. In Maler, K.G., Vincent, J.R (Eds.), Handbook of Environmental Economics (Vol. 1, pp355–435). Amsterdam: Elsevier.

Stern, L. W., El-Ansary, AI. (1992). Marketing Channels. Englewood Cliffs, NJ: Prentice-Hall International.

Stewart, K. (1994). Customers exit: loyalties issues in retail banking. Irish Marketing Review, (7), 45-53.

Stiglitz, J.E. (1975). The theory of 'screening', education, and the distribution of income. American Economic Review, 65(3), 283-300.

Streeter, D. H., Sonka, S.T., Hudson, M.A. (1991). Information technology, coordination, and competitiveness in the food and agribusiness sector. American Journal of Agricultural Economics, 73(5), 1465-1471.

Su, Y., Yang, C. (2010). Why are enterprise resource planning systems indispensable to supply chain management? European Journal of Operational Research, (203), 81-94.

Subasinghe, R. R., Bontad-Reantaso, M.G., McGladdery, S.E. (2001). Aquaculture development, health and wealth. In Subasinghe, R.P., Bueno, P., Phillips, M.J., Hough, C., McGladdery, S.E., Arthur, J.R (Eds.), Aquaculture in the Next Millennium. Technical Proceedings of the Conference on Aquaculture in the Third Millennium (pp167 - 191). Rome: FAO.

Swinnen, J. F. M. (2005). When the market comes to you - Or Not. The dynamics of vertical co-ordination in agro-food chains in Europe and Central Asia. Washington, D.C: World Bank.

Schwandt, T. A. (2007). The Sage dictionary of qualitative inquiry (3rd ed.). Thousand Oaks, CA: Sage.

Tacon, A. G. J., Barg, U.C. (2001). Responsible aquaculture for the next millennium. Paper presented at the Seminar-Workshop on Responsible Aquaculture

Development in Southeast Asia organised by the SEAFDEC Aquaculture Department, Iloilo City, Philippines.

Takeuchi, H., Quelchi, J.A. (1983). Quality is more than making a good product. Harvard Business Review, 61(4), 139-145.

Tang, S.C. (2006). Perspectives in supply chain risk management. International Journal of Production Economics, (103), 451-488.

The Global Logistics Research Team at Michigan State University. (1995). World class logistics: the challenge of managing continuous changes. Oak Brook, IL: Council of Logistics Management.

Thomson, D.N., Lyne, M.C. (1993). Constraints to land rental in KwaZulu: analysing the transaction costs. Oxford Agrarian Studies, 21(2), 143-150.

Thung, D.C. (2007). Environment and resource in the TGCH Lagoon. Hue: integrated management of TGCH Lagoon Activities Project.

Tinh, B.D. (2005). Aquaculture production in Tam Giang Cau Hai Lagoon, Thua Thien Hue Province. Hue College of Economics, Hue, Vietnam.

Trkman, P., Stemberger, M., Jaklic, J., Groznik, A. (2007). Process approach to supply chain integration. Supply Chain Management: An International Journal, 12(1), 116-128.

Trkman, P., McCormack, K. (2009). Supply chain risk in turbulent environments - A conceptual model for managing supply chain network risk. International Journal of Production Economics, 119, 247-258.

TTH DFI. (2007). Review of aquaculture in Thua Thien - Hue Province from 2000 - 2006. Hue: Provincial Department of Fishery.

TTH DoST. (2005). Proceedings of the National Conference on TGCH Lagoon. Hue: Thua Thien - Hue Provincial Department of Science and Technology.

TTH PECAAF. (2008). Annual reviewing report on extension activities. Hue: Thua Thien Hue Provincial Extension Centre for Agriculture, Aquaculture and Forestry.

TTH PECAAF. (2008). Project on seeds for aquaculture in Thua Thien - Hue Province. Hue: Thua Thien Hue Provincial Extension Centre for Agriculture, Aquaculture and Forestry

TTH PPC. (2005). Summary of socio-economic development in Tam Giang - Cau Hai Lagoon from 2000 - 2005. Hue: Provincial People's Committee.

TTH PPC. (2007). Adjustment of socio-economic development planning for Tam Giang Cau Hai Lagoon from 2001 - 2010. Hue: Provincial People's Committee.

TTH PPC. (2011). Report on the land compensation in Thua Thien - Hue Province during 2005 - 2010. Hue: TTH Provincial People's Committee.

TTH Statistical Bureau. (2005, 2006, 2008, and 2009). Statistical Yearbook. Hue: Thua Thien Hue Publisher

Tuyen, T. V. (2002). Dynamics of property rights in the TGCH Lagoon. In Brzeski, V.J, Veronika, J. & Newkirk, G.F. (Eds.), Lessons in Resource Management from the TGCH Lagoon (pp39-52). Halifax: Coastal Resource Research Network, Dalhousie University.

Tuyen, T. V., Armitage, D., Marschke, M. (2010). Livelihoods and -co-management in the Tam Giang Lagoon, Vietnam. Ocean & Coastal Management, 53, 327-335.

U.S. Congress. (1995). Environmental policy tools: a user's guide. Retrieved. from http://www.princeton.edu/~ota/disk1/1995/9517/9517.PDF.

U.S. DEPARTMENT OF ENERGY. (1989). A compendium of options for government policy to encourage private sector responses to potential climate change. Washington, D.C: U.S. Department of Energy, (rep. no. doe/eh-0103).

Van de Ven, A. H., Garud, R. (1989). A framework for understanding the emergence of new industries. Research on Technological Innovation Management and Policy, 4, 195-225.

Van, N. D. (2009). The Head of Office of Rural Development and Quality Management for Agricultural products, Department of Agriculture and Rural Development in TTH Province

Vedung, E. (1998). Policy instruments: Typologies and theories. In M. L. Bemelmans-Videc, Rist, R.C., Vedung, E (Ed.), Carrots, sticks, and sermons: Policy instruments and their evaluation (pp. 21-58). New Brunswick, NJ: Transaction.

Vitasek, K. (2003). Supply chain visions, logistics terms and glossary. Bellevue, Washington: The Council of Logistics Management.

Wade, R. (1998). Village republics: Economic conditions for collective action in south India. New York: Cambridge University Press.

Walton, J. (2000). Should monitoring be compulsory within voluntary environmental agreements? Sustainable Development, 8(3), 146-154.

Wathne, K., Heide, J. (2004). Relationship governance in a supply chain network. Journal of Marketing, 68(1), 73-89.

Webster, J. (1992). The changing role of marketing in the corporation. Journal of Marketing, 56(October), 1-17.

Webster, K. (2001). The scope and structure of the food supply chain. In Sharples, L., Eastham, J. F., Ball, S. D (Eds.), Food Supply Chain Management: Issues for the Hospitality and Retail Sectors (pp37-54). Oxford, Boston: Butterworth-Heinemann.

Welch, E. W., Hibiki, A. (2002). Japanese voluntary environmental agreements: bargaining power and reciprocity as contributors to effectiveness. Policy Sciences, 35(4), 401-424.

White, T., Runge, C. (1995). The emergence and evolution of collective actions: Lessons from watershed management in Haiti. World Development, 23, 1683-1698.

Whitehead, C. M. E. (1983). The rationale for government intervention. In Dunkerley, H.B. (Ed.), Urban Land Policy: Issues and Opportunities. New York: World Bank Publication, Oxford University Press.

Williamson, O. E. (1971). The vertical integration of production: market failure considerations. American Economic Review, 61(May), 112-123.

Williamson, O. E. (1985). The Economic Institutions of Capitalism. New York: Free Press.

Williamson, O. E. (1996). Mechanisms of Governance. New York: Oxford University Press.

Wlliams, C. (1996). Combating marine pollution from land-based activities: Australian initiatives. Ocean and Coastal Management, 33(1-3), 87-112.

Woods, E. J. (2003). Supply chain management: understanding the concept and its implications in developing countries. In Johnson, G.I.,Hofman, P.G (Eds.), Agri-product Supply Chain Management in Developing Countries (pp18-26). Bali: Australia Centre for International Agriculture Research.

World Bank. (1997). Five years after Rio: innovation in environmental policy. Washington, D.C: World Bank.

Wysocki, A. F. (2000). Supply chain management: past and future. Journal of Food Distribution Research, (November), 53-55.

Xepapadeas, A. (1999). Non-point source pollution control. In Van der Bergh, J. (Ed.), Handbook of Environmental and Resource Economics (pp539-550). Cheltenham: Edward Elgar Publishing.

Yin, R. K. (2003). Case Study Research: Design and Methods (3rd ed). Newbury Park, CA: Sage Publications.

Zhao, X., Xie, J., Zhang, W.J. (2002). The impact of information sharing and ordering co-ordination on supply chain performance. Supply Chain Management : An International Journal, 7(1), 24-40.

Zhou, H., Benton Jr, W.C. (2007). Supply chain practice and information sharing. Journal of Operations Management, (25), 1348-1365.

Zuckerman, A. (2002). Supply Chain Management. Oxford: Capstone Publishing.

APPENDIX 3.1

LIST OF INTERVIEWED BUSINESS PLAYERS IN THE SHRIMP SUPPLY CHAIN

Business players	Name
Farmers	Mr. Nguyen Xuan Anh Mr. Le Van Ben Mr. Duong Hoa Mr. Tran Thuy Mr. Do Anh Dung Mr. Le Be Mr. Nguyen Thuat Mr. Nguyen Huynh Mr. Tran Van Bon Mr. Nguyen Dinh Ai
Middlemen	Mrs. Le Thi Tuyet Mr. Phan Van Chau Mrs. Le Thi Nghia Mrs. Hoang Thi Ai
Wholesales	Thanh Tin Ltd Company Thanh Dong Ltd Company Mr. Huynh Dien Mr. Nguyen Duc Tri Mrs. Tran Thi Thanh Van

Processing & exporting companies	Song Phu Ltd Company
Domestic retailers	Mrs. La Thi Hai Mrs. Hoang Mai Mrs. Tran Thi Chau

APPENDIX 3.2

INTERVIEW GUIDE: THE EVOLUTION OF SHRIMP BUSINESS IN TGCH LAGOON

- The development process of their businesses (how they started their businesses, how their businesses evolved and the reasons);
- Their current functions in the shrimp supply chain (what function they performed, advantages and disadvantages of performing those functions);
- The current situation of their business (availability of production factors, cost of production, revenue);
- Accessibility to inputs (what inputs they need, where and how they buy inputs, how the price is established, how payment is made, how quality is maintained);
- Relationships with input providers (the form of contracts, how often they are in contact with input providers, what and how information is exchanged between them and input providers, how they share risks, how they settle conflicts);
- Accessibility to customers (what products they sell, where and how they sell products, how the price is established, how the payment is made, how quality is maintained); and

- Relationships with buyers (the form of contracts, how often they are in contact with buyers, what and how information is exchanged between them and buyers, how they share risks, how they settle conflicts).

APPENDIX 3.3

LIST OF INTERVIEWED KEY INFORMANTS FROM THE INSTITUTIONAL SUB-SYSTEM

Name of key informants	Position	Name of organisations
Mr. Le Huu Toan	Vice director	TTH Provincial Extension Centre of Agriculture, Aquaculture and Forestry, Department of Agriculture and Rural Development in TTH Province
Mrs. Do Thu Hong	Vice director	Office of Aquaculture, Department of Agriculture and Rural Development in TTH Province
Mr. Pham Quyen	Coordinator	Fisheries Sector Program Support (2nd Stage) in TTH Province, Department of Agriculture and Rural Development in TTH Province
Mrs. Lien	Vice director	TTH Provincial Veterinary Services, Department of Agriculture and Rural Development in TTH Province
Mr. Van	Director	Office of Rural Development and Quality Management for Agricultural products, Department of Agriculture and Rural Development in TTH Province
Mr. Nguyen Quang Vinh Binh	Director	Office of Aquatic Resources Protection and Exploitation, Department of Agriculture and Rural Development in TTH Province.

Mr. Hoang Mai Lan	Vice-head	Office of Agriculture, Department of Planning and Investment in TTH Province
Mr. Nguyen Van Phuc	Officer	Provincial People's Committee in TTH Province